TEDS-M

TEDS-M Encyclopedia

A Guide to Teacher Education Context, Structure, and Quality Assurance in 17 Countries

Findings from the IEA Teacher Education and Development Study in Mathematics (TEDS-M)

Edited by John Schwille, Lawrence Ingvarson, and Richard Holdgreve-Resendez

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Michigan State University
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Foreword

The IEA Teacher Education and Development Study in Mathematics (TEDS-M) is the first large-scale international study of the preparation of primary and lower-secondary teachers. The study investigated the pedagogical and subject-specific knowledge that future primary and lower secondary school teachers acquire during their mathematics teacher education. It also examined variations in teacher education programs within and across countries. TEDS-M gathered data in 2008 from approximately 22,000 future teachers from 750 programs in about 500 teacher education institutions in 17 countries. Teaching staff within these programs (close to 5,000 mathematics and general pedagogy educators) were also surveyed.

The TEDS-M study was carried out by the International Association for the Evaluation of Educational Achievement (IEA), an independent, international cooperative of national research agencies. For over 50 years, the association has conducted large-scale comparative studies of educational achievement and reported on key aspects of education systems and processes.

TEDS-M identified striking differences across the participating countries in the knowledge that future teachers have of school mathematics and how to teach it. The study also showed that, in almost all countries, the majority of future teachers see mathematics as a process of enquiry that is best learned through active student involvement. This belief was held most widely by future teachers with relatively greater knowledge of mathematics content and pedagogy. They also believed that teachers can influence students' capacity to achieve in mathematics. These conclusions are just a few of those drawn from the results presented in the first TEDS-M report, which focused on data pertaining to the future teachers and was published in 2012.

This TEDS-M encyclopedia presents a broader context within which the data collected from future teachers and their educators can be understood and interpreted. Elements of this context include information about countries' distinctive political, historical, and cultural contexts that influence policy and practice in mathematics teacher education. It also describes the organization and characteristics of teacher education in the participating countries, the institutions that teach future teachers and their staff, the programs and required field experiences, and the quality-assurance arrangements.

The encyclopedia chapters show that despite some general commonalities, teacher education systems differ in many ways, particularly in terms of how they organize teacher education and in the characteristics of that provision. More specifically, these differences include the number and size as well as the nature of teacher education institutions (public versus private, universities versus self-standing colleges) and the types of teacher education programs they offer (built around grade span and/or teaching specialization). Differences in teacher selectivity and status also exist, with, for example, a shortage of candidates for this profession leading to a lowering of the standards governing admission and certification practices. The majority of future teacher educators in only some countries have doctoral degrees in the subjects they are teaching (in the case of TEDS-M, mathematics and/or mathematics pedagogy).

International studies such as TEDS-M would not be possible without the dedication, skill, cooperation, and support of a large number of individuals, institutions, and organizations from around the world. Referring to the list of acknowledgments on the next pages of this volume, I would like to thank all the people mentioned, especially those in the international study centers at Michigan State University in the United States and the Australian Council of Educational Research, the IEA Secretariat, and the Data Research and Processing Center, as well as the national teams headed by the national research coordinators in participating countries. This study also would not be possible without the participation of many future teachers, their educators, and policymakers within the participating countries. The education world benefits from their commitment.

Finally, I would like to thank the study's funders. A project of this size is not possible without considerable financial contribution. TEDS-M was supported by the US National Science Foundation, IEA, and the ministries of education and many other organizations in all participating countries.

Dr Hans Wagemaker
Executive Director, IEA

Acknowledgements

The success of any IEA study depends on mobilizing many different sources of support, influence, funding, and expertise in all parts of the world. TEDS-M is no exception. As a pioneering study, unlike any other crossnational study done before, it required even more willingness to deal with unknowns and to confront new challenges. We are therefore extremely grateful for the extraordinary support and work that has gone into this volume as well as the other international and national TEDS-M reports.

At the core of IEA studies are the national research coordinators (NRCs) of each participating country and their national centers. TEDS-M actively sought feedback and contributions from the NRCs on all aspects of the study. Through their participation and insights from the field, the NRCs worked to continually improve the study from beginning to end. The individuals coordinating this effort in the participating countries deserve special mention: Zuwaina Al-Maskari (Oman), Horst Biedermann (Switzerland), Sigrid Blömeke (Germany), Tamara Bokuchava (Georgia), Pierre Brochu (Canada), Beatrice Avalos Davidson (Chile), Precharn Dechsri (Thailand), Michał Federowicz (Poland), Evangeline Golla (Philippines), Pedro Gomes (Spain), Liv Grønmo (Norway), Feng-Jui Hsieh (Chinese Taipei), Mohd Mustamam Abd. Karim (Malaysia), Tuelo Martin Keitumetse (Botswana), Pi-Jen Lin (Chinese Taipei), Maia Miminoshvili (Georgia), Thabo Jeff Mzwinila (Botswana), Rajendran Nagappan (Malaysia), Ester Ogena (Philippines), Fritz Oser (Switzerland), Supatra Pativisan (Thailand), Luis Rico (Spain), William Schmidt (USA), Michał Sitek (Poland), and Khoon Yoong Wong (Singapore).

Of all the TEDS-M international reports, it is the *TEDS-M Encyclopedia* that is most centered on the contributions of the national teams. The country reports in this publication gave each of these teams the opportunity to discuss the features of their national teacher education system that they considered most important for the audiences of TEDS-M to know. The members of the national team who took responsibility for this work are listed as the authors of each chapter. The chapters are the culmination of a long process that began with preparation by the same authors of longer national reports in response to international guidelines.

The international TEDS-M team at Michigan State University (MSU) in the United States, the Australian Council for Educational Research, the IEA Data Processing and Research Center (DPC) in Hamburg, and the IEA Secretariat in Amsterdam shaped the overall TEDS-M survey and developed a framework, terminology, and design that ultimately had a strong effect on what went into these chapters. We will not mention all of these many people individually by name because they are specifically acknowledged in the other TEDS-M international reports and cited as the authors and editors of those reports.

However, a few collaborators do deserve individual recognition here for the encyclopedia. We would first like to thank our third editor Richard Holdgreve-Resendez, who, as an MSU doctoral student, went far beyond the call of duty during his work on early versions of the chapters and especially on the exhibits in each chapter.

Another special contribution that should not be overlooked is that of the international sampling team led by Jean Dumais of Statistics Canada, together with Sabine Meinck and Falk Brese of the IEA DPC. Their efforts to understand the complexities and distinctive features of teacher education in each country in order to develop a sampling frame

had, as a byproduct, the advantage of enabling the whole project to provide a much better understanding of the various systems described in this volume. They were also instrumental in raising and helping to solve problems of terminology and crossnational comparisons which, if left unresolved, would have been a source of confusion and misleading conclusions. In fact, the entire international team and the NRCs were involved at various points in making key distinctions, such as the controversial one between "program" and "program-type."

We are also grateful for the support of Maria Teresa Tatto, the overall director of TEDS-M, and Hans Wagemaker, the executive director of IEA, especially in regard to recognizing the value of the encyclopedia and the companion TEDS-M policy report, and then working in various ways to make sure these publications were completed even after TEDS-M ran short of resources.

In addition, we need to recognize the work of Ineze Berzina-Pitcher, the TEDS-M consortium coordinator at MSU, and administrative assistant Ann Pitchford, for all their thankless work in reminding everyone of the work to be done and in their painstaking attention to keeping track of everything submitted. Finally, Marlene Green of MSU did great work on the word processing and formatting of the many draft versions of this volume.

TEDS-M owes its existence to its funding agencies. Although each of the participating national centers had to raise its own funds to cover many of the costs of the study, and although the IEA organization itself invested heavily to get this study underway, TEDS-M could not have been completed without a very substantial grant to cover remaining international costs. This funding, awarded in 2005, came from the US National Science Foundation (NSF).[1] We are thankful to our program officer James Dietz for his dedication to this project and for his constant support, and to others at NSF for their interest in this new type of crossnational research: Janice Earle, Larry Suter, and Elizabeth Vanderputten.

Lastly, for sponsoring and supporting this unprecedented study, we would like to express our gratitude in the strongest terms to IEA, its former chairpersons Seamus Hagerty and Alejandro Tiana-Ferrer, and the members of the IEA Standing Committee and the General Assembly. We especially thank the IEA staff members who are critical to making the organization work: Hans Wagemaker, executive director; Barbara Malak-Minkiewicz, manager membership relations; and Juriaan Hartenberg, financial manager.

John Schwille and Lawrence Ingvarson
(on behalf of the TEDS-M team)

1 Tatto, M. T., Schwille, J., & Senk, S. First International Mathematics Teacher Education Study (TEDS-M) (NSF REC 0514431).

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2 Because of funding difficulties, the Russian Federation was unable to provide a report. The information on Russia in this volume contains only the overview prepared by the volume editors with the assistance of Galina Kovaleva.

INTRODUCTION

John Schwille and Lawrence Ingvarson

Preparation of this encyclopedia for the Teacher Education and Development Study in Mathematics (TEDS-M) enabled the TEDS-M national teams of researchers in the participating countries to provide the audiences of this study with a better understanding of the nature of teacher education for mathematics in those countries than was possible in the other TEDS-M international reports. The encyclopedia provides a resource that readers can draw from when analyzing the context-based similarities and differences that are important to keep in mind when interpreting and explaining the TEDS-M results. The encyclopedia thus strengthens the reporting of this first international assessment of teacher education, which focused on how the TEDS-M countries prepare teachers to teach mathematics in primary and lower-secondary schools, and studied the variation in the nature and impact of teacher education programs within and across countries.

Seventeen countries participated in TEDS-M: Botswana, Canada (four provinces), Chile, Chinese Taipei, Georgia, Germany, Malaysia, Norway, Oman (secondary teacher education), the Philippines, Poland, the Russian Federation, Singapore, Spain (primary teacher education), Switzerland (German-speaking cantons), Thailand, and the United States of America (public institutions, concurrent and consecutive routes only).

Data for the encyclopedia were drawn from one of the three major components of TEDS-M. The objective of this component (or substudy) was to examine the *policies* guiding the recruitment, selection, preparation, and certification of mathematics teachers. The questions framing this component were these:

- What are the policies that regulate and influence the design and delivery of mathematics teacher education for primary and lower-secondary school teachers?
- What institutions and programs have countries established at the national level to implement these policies?
- How do countries' distinctive political, historical, and cultural contexts influence policy and practice in mathematics teacher education?
- What are the policies in each country regarding standards for degrees, coverage of topics, certification practices, recruitment, selection, and preparation of future mathematics teachers?

These questions were addressed in individual country case study reports, the authors of which responded to guidelines issued by the TEDS-M international study center. In contrast, the questions in the other substudies were answered empirically through four large-scale surveys of the following nationally representative samples: teacher education institutions and programs, teacher educators, future primary school teachers being prepared to teach mathematics, and future lower-secondary teachers also preparing to teach mathematics (Tatto et al., 2012).

TEDS-M is unique in terms of being not only the first IEA study of higher education and IEA study of teacher education, but also the first crossnational study of teacher education designed to gather data from nationally representative probability samples, with that data pertaining to the knowledge outcomes of teacher education and the

possible determinants of these outcomes. It is furthermore the first crossnational study of teacher education to integrate a specific subject matter (mathematics) with generic issues in teacher education policy and practice on a nationally representative basis, and it is the first international assessment (employing national samples) of student learning in any field of higher education.

TEDS-M Organizational Framework

In TEDS-M, the structure and organization of teacher education is discussed in terms of key organizational characteristics, each of which was given a common definition in order to allow crossnational comparison. Definitions of these key terms follow.

Program, program-type, and program-group

In TEDS-M, *program* refers to a course of study leading to a teaching credential. *Program-type* refers to groups of programs that share similar purposes and structural features, such as the credential earned, the type of institution in which the program-type is offered, whether the program-type is offered concurrently or consecutively, the range of school grade levels for which teachers are prepared, the duration of the programs in the program-type, and the degree of subject-matter specialization for which future teachers are prepared.

Program-type thus refers to the distinctive organizational features that distinguish between the pathways that individuals traverse when studying to become qualified teachers. For example, in Poland, one of the program-types is a relatively new first-cycle Bachelor's degree designed to prepare teachers for integrated teaching in Grades 1 to 3. The opportunities to learn that this program-type holds for future teachers have certain attributes in common regardless of which university offers them. Some of these common features differ from the common features of other program-types in Poland, such as the ones that prepare mathematics specialists to teach in Grade 4 and above. In contrast, the word program in TEDS-M refers only to how a program-type has been implemented in one particular institution.

In short, the terms program and program-type are meant to clarify the everyday use of the term *program* in teacher education. This everyday usage is ambiguous because it can refer either to teacher education as organized in one particular institution or to closely related offerings at multiple institutions—a distinction that TEDS-M needed to clarify. Thus, in Chinese Taipei, whatever National Taiwan Normal University offers to qualify students studying to become secondary mathematics school teachers is a program whereas the program-type Secondary Mathematics Teacher Education consists of the common characteristics of all such programs throughout the country. Multiple programs of the same type in multiple institutions typically make up a program-type.[3]

For purposes of providing a more comparable and sufficiently large grouping of future teachers for analysis across countries (Tatto et al., 2012), TEDS-M further aggregated program-types into *program-groups*. However, because the term program-group was not needed for this encyclopedia, it is not used in it.

3 However, in a few countries, just one institution offers a program-type (e.g., the University of Botswana and the National Institute of Education in Singapore), in which case program and program-type are the same.

Concurrent and consecutive programs

One way in which program-types differ within and across TEDS-M countries rests on whether they are *concurrent* or *consecutive*. Concurrent program-types grant future teachers a single credential for studies in subject-matter content, pedagogy, and other courses in education; these components are all included in the same course of study during the first phase of postsecondary education. In contrast, consecutive program-types require completion of two phases of postsecondary education: first, an initial university degree, with specialization in the subject-matter to be taught, followed by a separate, second phase focused mostly on pedagogy and practicum and sanctioned by a second credential. Most program-types in TEDS-M are concurrent, but consecutive program-types exist and were surveyed in Georgia, Malaysia, Norway, Oman, Singapore, Thailand, and the United States.

School grade levels for which a program-type prepares teachers

Another obvious way to classify teacher education program-types is according to whether they prepare teachers for primary or secondary schools. However, with respect to TEDS-M, it quickly became apparent that the terms *primary* and *secondary* do not mean the same thing from country to country. Instead, the range of grades for which future teachers are prepared varies across countries, reflecting the structure of schooling. Grade spread is thus an important indicator of policy decisions (albeit shaped by tradition and history) about the extent to which the teacher workforce should be unified in its knowledge base and practice.

Subject-matter specialization in teacher education

Program-types can also be classified according to whether they prepare *generalist* teachers or *specialist* teachers of mathematics. Most TEDS-M countries prepare their primary-school teachers to be generalists, which means they teach most if not all the core subjects in the school curriculum.[4] However, some countries also prepare mathematics specialists to teach in grades as low as 1, 3, or 4 (depending on the country). Countries with specialists at primary level include Germany, Malaysia, Poland, Singapore, Thailand, and the United States. In lower-secondary schools, specialization is more the norm across countries, although in many cases, specialization means teaching not one but two main subjects, such as mathematics and science.

Program-type duration

Duration is another basis on which we can classify program-types. Most program-types preparing primary teachers in TEDS-M are four years long, but there is some variation across countries. Concurrent program-types commonly require four years. For consecutive program-types, the first phase typically lasts three or four years and the second phase one year. Duration of initial teacher education is of major concern to policymakers, with cost being the main reason for that concern. Longer program-types are ordinarily more expensive, both in terms of institutional costs and in terms of foregone income and other expenses borne directly by the student. The documents collected in TEDS-M show that in recent decades some countries have increased program-type duration while others have reduced it. In some cases (especially school-based rather than university-based program-types), these changes have tended toward

4 For purposes of precision, TEDS-M classifies future teachers as specialists if they are prepared primarily to teach one or two subjects and as generalists if they are prepared primarily to teach three or more subjects.

relatively short terms of formal training accompanied by longer periods of internship or probation. Comparable crossnational data on duration and outcomes could provide a basis for cost-effectiveness studies in teacher education.

Relative size of different program-types

Paying attention to the relative size of the program-types is essential to understanding the structure of teacher education in any particular country. Readers not keeping this consideration in mind might easily assume that some program-types must be bigger and less marginal than they actually are in meeting the demand for new teachers. The exhibits for each country in our (the editors) introductions at the beginning of each chapter show how the distribution of future teachers in the TEDS-M target population varies by program-type. For each country, the exhibit indicates which program-type or types produce the most graduates and which the least. In most countries, certain program-types are much larger than others and therefore have more impact on the composition of the teacher workforce.[5]

Chapter contents

Each of the country chapters in this encyclopedia begins with a one- to two-page overview, based on Chapter 3 of the international report (Tatto et al., 2012). In it, we discuss what we think readers most need to know about the characteristics and context of each teacher education system before they consider the findings of TEDS-M in more detail and depth. In addition to providing a narrative explanation, each of our overviews contains three graphs[6] designed to give an immediate visual image of the diversity of program-types within and between countries. The three organizational characteristics portrayed in these graphs are the grade span for which the program-types prepare teachers, the duration of each program-type (i.e., the total number of years of postsecondary education required to become fully qualified), and the size of the program-type in terms of number of future teachers (FTs) in the final year of their program (as estimated from the TEDS-M sample). The narrative summarizes the distinctive national context required for understanding these program-types and for interpreting the data discussed in other TEDS-M chapters and volumes. The narrative in each overview is organized under three headings: (1) institutions and governance, (2) program-types and credentials, and (3) curriculum content, assessment, and organization.

The main body of each encyclopedia chapter (i.e., the text following our overview) consists of a condensed and edited version of each national report. This content is organized in a way that is sufficiently parallel to allow for crossnational comparison and yet emphasizes what is most distinctive and important about each country, according to the members of the TEDS-M national teams who wrote these chapters.

5 This estimate of program-type enrollments in the last year of teacher education was based on the sum of weights from the achieved TEDS-M sample. These sums of weights are unbiased estimates of the actual total number of future teachers in the target population broken down by program-type. It is unlikely that these estimates could be derived from any source other than TEDS-M—even within a single country. This point is especially applicable to the preparation of teachers for lower-secondary school. TEDS-M was *not* searching for the total number of future teachers preparing to become lower-secondary teachers—a figure that might be more readily available. Instead, TEDS-M was interested in finding out how many future lower-secondary teachers were preparing for mathematics as either their only subject or as one of their two main teaching subjects. National educational statistics are not ordinarily maintained on number of future secondary teachers by subject-matter specialization.

6 Also taken from the international report (Tatto et al., 2012).

Each of these national reports constituted a response to guidelines prepared by the TEDS-M international team. We (Lawrence Ingvarson and John Schwille) took the lead in developing and implementing these guidelines, which provided an overall outline for the national reports and thereby indicated what the report authors should include under each heading. We asked that each report be submitted in three main parts: (1) context and organization of teacher education, (2) quality-assurance arrangements and program requirements, and (3) funding and reform of teacher education.

With respect to *context and organization*, we asked the NRCs to cover the historical, cultural, and social factors that have played a significant role in shaping the teacher education system in their country. We also asked them to focus on current policies and issues related to the teacher workforce and the teacher labor market, and to describe and discuss the structure and organization of the teacher education system.

In the next part of the national reports, we asked the NRCs to focus more specifically on *quality-assurance policies and program requirements*, as applied to entry into teacher education, the characteristics of the programs that offer teacher education, and the requirements for full entry to the teaching profession. We asked the NRCs to pay particular attention to curricula and field experience requirements.

The third part of the national report was devoted to analysis of the *financing of teacher education as well as current reform debates* in this field. On reviewing the reports, we decided to delete commentary on the costs and financing of teacher education from the reports because the participating countries had generally been unable to submit sufficient data on and analysis of these matters.

We also provided the authors of the country reports with other specific questions as well as additional guidance under all these headings. We furthermore called for clarity about the within-country differences between types of teacher education, between levels of schooling (elementary, lower-secondary, upper-secondary), between states or provinces in federal systems, and between public and private institutions.

The initial drafts of the national reports from the NRCs were generally 20 to 30 single-line-spaced pages. We reviewed these and began a detailed editing process, raising questions and making editorial suggestions as the basis for a second version. Throughout the editing process, one of us (Lawrence) took primary responsibility for the quality-assurance sections while John, with the assistance of Richard Holdgreve-Resendez, worked on the rest. John did the overall editing required to increase consistency of approach and expression throughout the volume.

We then reorganized the edited encyclopedia chapters into three main sections that reflected what we found to be the most important and consistently addressed aspects in the national reports. These were:

- *Context and conditions of the teaching career*, subdivided into historical roots and conditions at the time of the TEDS-M surveys;
- *The organization of teacher education*, subdivided into an introductory section followed by information on curriculum and field experience requirements, and staffing requirements; and
- *Quality-assurance arrangements*, subdivided into entry standards and selection methods, accreditation of teacher education institutions and programs, and requirements for entry into the teaching profession.

As might be expected in accounts of countries already known to differ from one another, the national reports had very different emphases, with each providing more depth in some sections than in others. Each report thus had little or nothing to say about topics its authors considered unimportant or irrelevant to the country in question, and so the country chapters presented in this encyclopedia logically also have little or nothing to say on these matters. What the encyclopedia does do is bring together a considerable amount of information and insight into teacher education in the TEDS-M countries that would otherwise not be readily available in a single volume.

Reference

Tatto, M. T., Schwille, J., Senk, S. L., Ingvarson, L., Rowley, G., Peck, R., Bankov, K., Rodriguez, M., & Reckase, M. (2012). *Policy, practice, and readiness to teach primary and secondary mathematics in 17 countries: Findings from the IEA Teacher Education and Development Study in Mathematics (TEDS-M)*. Amsterdam, the Netherlands: International Association for the Evaluation of Educational Achievement (IEA).

Authors and Editors of the TEDS-M National Reports and Encyclopedia Country Chapters

Authors

The entries under each country are presented according to the order in which the authors are listed at the beginning of their country chapter.

BOTSWANA

Kgomotso Gertrude Garegae is associate professor of mathematics education and holds a Ph.D. from the University of Manitoba, Canada. She has been a teacher educator at the University of Botswana since 1991, before which she taught in secondary schools for seven years. Her doctoral dissertation was on teachers' beliefs and how they are communicated to students. Garegae has published on teacher education and classroom practices, and reviews for both national and international journals of education, especially on topics relating to mathematics education. Her research interests include teacher beliefs, ICT, ethnomathematics, and contemporary issues in mathematics education.

Thabo Jeff Mzwinila holds a Bachelor's degree in mathematics and a Master's degree in mathematics education from the University of Botswana and Swaziland and the University of Botswana respectively. His experience with teacher education dates back to 1998 when he joined Molepolole College of Education as a lecturer in the Department of Mathematics. In 2000, he was promoted to the position of senior lecturer. Before joining the college, he taught mathematics in various secondary schools in Botswana for several years as well as at Taung College of Education in South Africa for four years. Mzwinila is also cofounder of the *Botswana Journal of Teacher Education*, a journal for colleges of education, and the *Guardian Learner*, an educational supplement in Botswana's *Guardian* newspaper. He is a member of the Executive Committee of the Botswana Educational Research Association, where he has served as treasurer.

Tuelo Martin Keitumetse holds a Master's degree in mathematics education and is currently working in the primary department at Lobatse College of Education as a mathematics educator. He taught in primary schools from 1982 to 1986, and co-authored Books 1 and 2 of the Dipalo series of workbooks, together with their teachers' guides. These books are prescribed for use in the mathematics syllabus for Botswana's primary schools

CANADA

Robert Crocker has held a number of senior positions in education in Newfoundland and Labrador, including Director of the Institute for Educational Research and Development, Dean of the Faculty of Education at Memorial University, and Associate Deputy Minister of Education. He has been a consultant to the Department of Education in Queensland, Australia, and a visiting scholar at Stanford University, Michigan State University, and the Ontario Institute for Studies in Education. He has also participated in many national and international research studies, including the IEA Second International Science Study and OECD's Programme for International Student Assessment (PISA) 2000 and 2003. He is now Professor Emeritus of the Faculty of Education at Memorial University and President of Atlantic Evaluation and Research Consultants. His recent publications include *Parent and Teacher Views*

on Education: A National Survey (2005), *Human Capital Theory and Education* (2006), *Provincial Differences in Reading Achievement* (with Xin Ma, 2007), and *Teacher Education in Canada: A Baseline Study* (with David Dibbon, 2008).

Hervé Jodouin is an associate professor at Niagara University's College of Education. He is near to completing his PhD in developmental psychology and education at the Department of Human Development and Applied Psychology of the Ontario Institute for Studies in Education, University of Toronto. He holds a Master of Education in measurement and evaluation from the same institution. Jodouin taught science and mathematics at the high school level in Northern Ontario for 18 years before accepting a position as an education officer with the Education Quality and Accountability Office (EQAO) of the Ontario Ministry of Education. During his nine years at EQAO, Jodouin's responsibilities included the administration of pan-Canadian and international assessments in Ontario. He participated in the development, scoring, and reporting of these assessments. For the past four years, Jodouin has been a consultant on various pan-Canadian assessments and on international assessments involving the participation of several Canadian provinces. He has also acted as a consultant to the Council of Ministers of Education, Canada.

CHILE

Beatrice Avalos Davidson is an associate researcher at the new Center for Advanced Research in Education, University of Chile, and was national research coordinator (within the Chilean Ministry of Education) for TEDS-M 2008 in Chile. Between 1994 and 2002, she was coordinator of Ministry of Education programs concerned with improving teacher quality and with teaching in secondary education and teacher education institutions. She has published journal articles and books on teacher education, educational policy, and gender issues, particularly within developing countries, notably Chile and those in Latin America. In addition to her work in Chile, she has worked and taught in universities in Britain, Canada, and Papua New Guinea, and carried out consultancy work in Bangladesh and several Latin American countries on issues related to school improvement, teachers' professional development, and teacher education.

CHINESE TAIPEI

Feng-Jui Hsieh is an associate professor in the mathematics department of National Taiwan Normal University. She received her PhD at Purdue University in the United States. Her research focuses on mathematics learning, mathematics teaching, teacher education, and both preservice and inservice teachers' professional development at the secondary school level. She recently completed research on and developed indicators of professional development focused on helping junior and senior high school teachers teach mathematics. She was the Chinese Taipei national research coordinator for TEDS-M 2008 and is currently filling the same role for another crossnational study, Mathematics Teaching in the 21st Century (MT21). Hsieh was a major author of the last national standardized junior high school mathematics textbook and the chairperson of the first evaluation committee for the junior high school mathematics textbook. She was also the chairperson of the algebra division of the committee charged with developing the first national curriculum standards for private publishers preparing textbooks for use at the primary and junior high school levels. Hsieh has served in a wide variety of advisory and professional roles

on many local-government and national-government committees, such as the Department of Education of Taipei City Government and the Taiwan Ministry of Education. She also served as a member of the Common Core State Standards Initiative Validation Committee in the United States.

Pi-Jen Lin is a professor at the National Hsinchu University of Education of Taiwan. Her research focuses on mathematics instruction and preservice and inservice teachers' professional development. She was responsible for the Taiwanese component of international studies such as TIMSS 2003 and TIMSS 2007 at the fourth-grade level and TEDS-M 2008 at the primary level. Lin has authored or co-authored over 100 articles in national and international journals as well as book chapters, and she has lectured and presented at national and international conferences and institutes. She has served on several national commissions, including curriculum advisory committees at national and local levels. She is the editor of several national journals, such as the *Chinese Journal of Science Education*. Most recently, Lin was one of the international committee members of the International Group of Psychology of Mathematics Education (PME30–PME33).

Guoheng Chao is a doctoral student in the mathematics department of National Taiwan Normal University. He earned his Bachelor's degree in mathematics and his Master's degree in mathematics education from National Taiwan Normal University. His research interests focus on preservice teacher education. He worked as an administrative coordinator as well as a researcher for TEDS-M 2008 in Chinese Taipei.

Ting-Ying Wang earned her Bachelor's degree in mathematics and her Master's and doctoral degrees in mathematics education from National Taiwan University. Her research interests are the language of mathematics and preservice teacher education. She has presented, either as author or co-author, papers at national and international conferences. She also undertook research and administrative work relating to TEDS-M 2008 in Chinese Taipei.

GEORGIA

Natia Mzhavanadze is currently employed as national project manager for the Programme in International Student Assessment (PISA), and she served as a research group consultant at the National Examination Center (NAEC) in Georgia. Mzhavanadze is also a doctoral student at the School of Education, University of Massachusetts Amherst, Department of Education Policy and Research, where her focus is on international educational policy. In 2008, Mzhavanadze earned her Master's degree in the United States while at Teachers College, Columbia University, Department of International and Transcultural Studies, International Educational Development Program. Her area of study was international educational policy. Earlier, she gained extensive work experience in nongovernmental organizations, where she was a project manager and trainer of various programs dealing primarily with nonformal education of youngsters. The projects she helped design and implement included training on the following topics: intercultural learning, social inclusion and active citizenship, personal development, conflict resolution, and successful strategies for professional development. She has also been involved in international youth work within the framework of the Council of Europe and EU

youth programs. Her spheres of interest include but are not limited to international educational development, educational policy, and program evaluation, as well as the development and implementation of innovative educational initiatives.

Tamara Bokuchava is currently a doctoral student in organizational psychology at Georgia's Tbilisi State University. For three years, she worked as an invited lecturer within the psychology department of Tbilisi State University. Since June 2006, she has served as a research group consultant at the National Examination Center (NAEC), where she was national research coordinator for TEDS-M 2008. At the same time, she served as a coordinator of the general pedagogy skills group, a new project carried out by her research group. The aim of the group is to prepare a general teaching skills test for Georgian teachers. Since June 2000, she has been working in the area of project coordination at Tbilisi's Personnel Management Center. This work involves personnel selection, job description creation, performance appraisal, test creation for personnel selection, and the like.

GERMANY

Johannes König is a full professor of empirical school research at the University of Cologne, Germany. He previously worked as a research assistant within and project manager of the German TEDS-M 2008 team, which was led by Sigrid Blömeke at Humboldt University of Berlin, Germany. König undertook his First State Examination for Teachers at Humboldt University of Berlin in 2003 and completed his PhD at Freie Universität Berlin in 2006. His current writing and research endeavors include teacher education research and school research.

Sigrid Blömeke is a full professor of general education and instructional research at Humboldt University of Berlin in Germany and Director of the Center for Interdisciplinary Research in Education. Her areas of specialization include empirical research on the effectiveness of teacher education and the measurement of teacher competencies. Blömeke was Germany's national research coordinator for TEDS-M 2008 and is also the national research coordinator for another large-scale, crossnational assessment—Mathematics Teaching in the 21st Century (MT21). She is furthermore the national research coordinator of Germany's national funding initiative "Modeling and Measuring Academic Competencies," which encompasses 23 research projects from a variety of domains (e.g., engineering, economics, social sciences, and psychology). Blömeke was a visiting professor for two years at the Division of Mathematics and Science Education, Michigan State University, in the United States. She has authored several books and published articles in highly ranked journals on teacher education. She is also a member of several journal editorial boards, and is currently serving on a variety of advisory and professional boards.

MALAYSIA

Rajendran Nagappan is a professor at the Sultan Idris University of Education, Malaysia. He has served as Director of the Aminuddin Baki Center for Global Education at this university, and was also the national research coordinator for TEDS-M 2008. Nagappan has more than 35 years of professional experience in education. He received his PhD in curriculum, teaching, and educational policy

from Michigan State University (United States) in 1998 and returned there as a visiting scholar in 2006/2007. His research projects include investigations into teachers' pedagogical decisionmaking qualities, the professionalization of teachers, the issues, prospects, and challenges associated with teacher education, and bullying among Tamil and Chinese primary school children. His publications include *Teaching and Acquiring Higher-Order Thinking Skills: Theory and Practice* (2008) as well as book chapters and journal articles.

Nagendralingan Ratnavadivel is Director of the Center for Quality Education Division, Ministry of Education, Malaysia, Sultan Idris University of Education (UPSI). He is also a professor of philosophy of education and curriculum studies at the Faculty of Cognitive Sciences, UPSI. Ratnavadivel initially worked as a school teacher and then as a lecturer in teacher education colleges, and also served as a curriculum developer and a senior assistant director for curriculum within the Teacher Education Division of Malaysia's Ministry of Education. His educational qualifications include a BA (Honors) in history, a Diploma of Education, a MEd in the sociology of education, and a PhD in curriculum management and development.

Mohd Mustamam Abd Karim is a professor in physics specializing in materials in the Faculty of Science and Mathematics, Sultan Idris University of Education (UPSI). He has been teaching for more than 30 years. He received his BSc (Honors) with Education majoring in physics and mathematics from the University of Technology Malaysia (UTM) in 1982 and his MSc in physics from Ohio University, Athens, Ohio, United States, in 1985. Karim earned his PhD in physics from the University of Warwick (UK) in 1994. His areas of interest in teaching, research, and consulting include physics education research (PER), glass manufacturing, teacher education, and nano-materials. Karim was one of the two NRCs for TEDS-M in Malaysia.

Othman Lebar is a professor of education at the Faculty of Cognitive Science and Human Development, Sultan Idris University of Education (UPSI). His area of specialization is educational assessment and evaluation. He is currently teaching courses on educational assessment, research methodology, and action research. His research interests include educational assessment, gender differences in academic achievement, and teacher education.

Ismail Kailani is a professor in the Faculty of Education, University of Technology Malaysia (UTM). He was previously Deputy Vice-Chancellor for Development at UTM, and before that he held the position of dean or deputy dean within several divisions within the university, namely, the Faculty of Education, the Research Management Center, the School of Professional and Continuing Education, and the Faculty of Science. He has also been the President of the Johor State Science and Mathematics Association and a member of the National Council of Teachers of Mathematics (United States) and Kappa Delta Pi. His areas of interest include mathematics, mathematics education, higher education, and issues relating to quality-based policies.

Suseela Malakolunthu is an associate professor in the Department of Educational Management, Planning, and Policy, University of Malaya. Malakolunthu obtained her PhD in curriculum, teaching, and educational policy from Michigan State University (United States). She was also the recipient of a Fulbright visiting scholar award at Stanford University. Malakolunthu's wide range of career experiences includes secondary school teaching and responsibility for the professional development of school principals at the National Institute of Educational Leadership and Management, Ministry of Education, Malaysia. Her areas of interest include educational policy and practice, teacher education, multicultural education, principal leadership, instructional supervision, school management, case writing, and qualitative research methods. Malakolunthu has published journal articles, book chapters, research reports, monographs, and a book titled *Teacher Learning in Malaysia: Problems and Possibilities of Reform* (2008).

NORWAY

Trygve Breiteig is a professor of mathematics education at the University of Agder, Norway. He completed his earlier studies in chemistry and mathematics and received his higher degree in mathematics from the University of Oslo in 1970. Breiteig has worked in the area of mathematics in teacher education since 1971. He was one of the members of the teams that developed the Master's and doctoral degree programs in mathematics education at Agder. Internationally, Breiteig has been working with colleagues in South Africa for 10 years on the postgraduate project GRASSMATE. He was a board member from 2003 to 2009 in the Nordic Graduate School in Mathematics Education, which caters to PhD students from the Nordic and Baltic countries.

OMAN

Mohammed Al Ghafri is an assistant professor at the College of Education, Sultan Qaboos University, Oman.

Ali Al Abri is Deputy Director of the Quality Assurance Department, Directorate General of Private Universities and Colleges, Ministry of Higher Education, Oman.

Mohamed Al Shidhani is a senior planning and research specialist at Oman's Sultan Qaboos Center for Islamic Culture.

PHILIPPINES

Ester B. Ogena was the conational research coordinator for the Philippines' participation in TEDS-M 2008. She has been involved in various studies of Philippine mathematics and science education, scientific manpower development, educational policy, and gender-based educational achievement and opportunities in Asia. She was consultant for the World Bank during work on the science and mathematics and quality-assurance components of the Philippines' Basic Education Reform Agenda study, and for UNESCO Jakarta on evaluating educational programs in terms of serving gender equity. She holds a Bachelor's degree in mathematics education from the Philippine Normal University, a Master's degree in mathematics education from the University of the Philippines, and a doctorate in educational

research and evaluation from the same university. She has served as Director of the Science Education Institute, Department of Science and Technology, and is currently President of the Philippine Normal University.

Filma G. Brawner has worked on various educational studies in the Philippines and collaborated on crossnational studies (involving Philippine participation) of mathematics and science as well as information technology in education, with TEDS-M being one of these studies. She is a college lecturer in research and holds a PhD in educational research and evaluation from the University of the Philippines. Brawner served as Executive Director of the Philippine Science High School System. At present, she is Director of the Philippines' Science Education Institute, Department of Science and Technology.

Milagros D. Ibe is currently Professor Emeritus at the University of the Philippines, where she served as a faculty member in mathematics education for more than four decades. A multi-awarded mathematics teacher and educator in the Philippines, she has authored books and articles on mathematics and has been widely involved in teacher education in mathematics. Formerly Dean of the Graduate School of Miriam College, she is presently working as a consultant for the Philippine Regulation Commission and the Department of Education. She obtained her Master's from the University of the Philippines, and her PhD in mathematics education from the University of Toronto, Canada.

POLAND

Michał Sitek is the research director of the Educational Research Institute in Warsaw and an associate professor at the Institute of Philosophy and Sociology of the Polish Academy of Sciences. He specializes in educational research, institutional analyses, and public policy research. He has published on education, health care, and public administration. A member of the Polish OECD PISA team, Sitek was also the national research coordinator for TEDS-M 2008 in Poland.

RUSSIAN FEDERATION[7]

SINGAPORE

Khoon Yoong Wong completed his BSc (Honors) and Diploma of Education in Tasmania, Australia, and his doctoral studies in Queensland, Australia, He is an associate professor within the Mathematics and Mathematics Education Academic Group at the National Institute of Education, Nanyang Technological University, Singapore. Wong has worked as a secondary school mathematics teacher in Malaysia and a mathematics educator at Curtin University of Technology (Australia), Murdoch University (Australia), and the University of Brunei Darussalam. He teaches courses in mathematics methodology and research at teacher preservice, inservice, and Master's levels and has supervised Master's and doctoral candidates studying mathematics education. During the past 20 years, Wong has served on national committees to reform the mathematics curriculum in Malaysia, Brunei Darussalam, and Singapore. His research covers comparative mathematics curriculum analysis, teacher education, learning strategies in mathematics, and

7 Because of funding difficulties, the Russian Federation was unable to provide a report. The information on Russia in this volume contains only the overview prepared by the volume editors with the assistance of Galina Kovaleva.

use of technology in mathematics instruction. He was the Singaporean national research coordinator for TEDS-M 2008. Wong is also involved in funded research on student learning in mathematics and use of heuristics in problem solving. He has coauthored several mathematics textbooks for secondary schools.

Suat Khoh Lim-Teo holds the following qualifications: BSc (Honors) from the University of Singapore, a MSc in topology and functional analysis from the University of Queensland, a Diploma of Education with credit from the Institute of Education, Singapore, and a PhD in functional analysis from the National University of Singapore. She is an associate professor in the Mathematics and Mathematics Education Academic Group of the National Institute of Education (NIE), Nanyang Technological University, Singapore. Lim-Teo has conducted research on the mathematics pedagogical content knowledge of student-teachers at NIE. Since the 1980s, she has held various academic appointments and participated extensively in reviews of teacher education programs at NIE.

Ngan Hoe Lee is an assistant professor in mathematics education within the Mathematics and Mathematics Education Academic Group at the National Institute of Education (NIE), Nanyang Technological University, Singapore. He holds a BSc (Honors) in pure mathematics from Monash University, which he attended as a Colombo Plan scholar; a Diploma of Education with distinction from the Institute of Education, Singapore; a MSc in education from Southern Illinois University at Carbondale; and a PhD in education from Nanyang Technological University. He taught mathematics and physics in secondary schools before becoming a specialist in the education of gifted students at the Ministry of Education. Lee has been invited to give lectures and workshops for teachers, students, social workers, and parents in Singapore, Hong Kong SAR, Indonesia, Macau, Shanghai, Thailand, and the United States. His publication and research interests include the teaching and learning of mathematics at both the primary and secondary school levels. He is a coauthor of the primary mathematics packages Shaping Maths and Maths Works. He was the institutional coordinator for TEDS-M 2008 for NIE and is in charge of analyzing NIE's teacher education curriculum materials.

Kok Leong Boey began his career as a mathematics teacher at secondary school and junior college levels. Later, he joined the research and evaluation section of Singapore's Ministry of Education and took a leading role in international studies, serving as the national research coordinator for Singapore in TIMSS 2003 and TIMSS 2007. He is currently seconded to the National Institute of Education, where he teaches mathematics and mathematics education courses. He was the data manager for TEDS-M 2008 for Singapore.

Caroline Koh is an assistant professor with the Psychological Studies Academic Group of the National Institute of Education (NIE), Nanyang Technological University, Singapore. She obtained her Bachelor's and Master's degrees from the University of Cambridge (UK), and her doctorate in education from the University of Durham (UK). She taught biology in schools before her appointment at NIE, where she is currently teaching undergraduate, postgraduate, and inservice programs on aspects of educational psychology, educational assessment, and moral development. Her current research projects include TEDS-M-related studies of the cognitive and

motivational processes in project work in Singapore schools, the development of moral judgment in young Singaporeans, and the effectiveness of simulation-based learning for engineering students. She has edited and published several science textbooks and practical manuals, as well as peer-reviewed journal articles and book chapters on science teaching and educational psychology.

Jaguthsing Dindyal is an associate professor of mathematics education within the Mathematics and Mathematics Education Academic Group at the National Institute of Education, Nanyang Technological University, Singapore. Dindyal previously taught mathematics at the secondary level and was a lecturer in the Department of Mathematics at the Mauritius Institute of Education. He teaches mathematics education courses at teacher preservice, inservice, and Master's levels. His specific interests are in the areas of geometry and proof, algebraic thinking, teacher education, the mathematics curriculum, and various other aspects of the teaching and learning of mathematics.

Kok Ming Teo is a senior lecturer in the Mathematics and Mathematics Education Academic Group at the National Institute of Education (NIE), Nanyang Technological University, Singapore. He received his BSc (Honors) in 1988 from the National University of Singapore and his PhD in mathematics in 1994 from the University of Michigan at Ann Arbor, United States. He also obtained a postgraduate diploma in education in 1998 from NIE. He was a mathematics teacher in a junior college in Singapore for three years, and taught mathematics at the National University of Singapore for two years. His work at NIE involves teaching academic-subject courses and subject-knowledge courses in mathematics at the preservice and Master's levels. His research interest in mathematics is in the area of wavelets.

Lu Pien Cheng is an assistant professor with the Mathematics and Mathematics Education Academic Group at the National Institute of Education (NIE), Nanyang Technological University, Singapore. She obtained her BSc (with DipEd) from NIE, her MSc from the National University of Singapore, and her PhD from the University of Georgia (United States). She previously taught mathematics at the primary level. At NIE, she teaches mathematics education courses at preservice and inservice levels. Her specific interests relate to teacher education.

SPAIN

Encarnación Castro Martínez is a senior lecturer in the didactics of mathematics at the University of Granada. She has a doctorate in mathematics and has had a long professional career that embraces both teaching and research. During the last eight years, she was head of her department at the University of Granada. Both her teaching and research have resulted in books, book chapters, journal articles, conference proceedings, and other documents. Some of her research focuses principally on algebraic and numerical thinking, although she also works in other areas of education, including the performance of mathematics students on external tests, and the cultural status of female mathematicians throughout history. Her publications focus on teacher education for education professionals and mathematics textbooks for students in basic education.

Pablo Flores Martínez is a senior lecturer in the didactics of mathematics at the University of Granada. His doctoral thesis in mathematics was devoted to the study of the concepts and beliefs of preservice secondary mathematics teachers during their initial teacher education. He has had a long professional career, encompassing both teaching and research, with his teaching including preuniversity levels. His experience as a teacher and a researcher is reflected in his published books, book chapters, journal articles, and conference proceedings, as well as the conferences he has organized. His research focuses on teacher education for mathematics teachers and tends to be conducted within the group known as Knowledge and Professional Development of the Mathematics Teachers of the Spanish Society for Research on Mathematical Education. His work also encompasses teaching innovation groups in initial teacher education, and he is an active participant in working groups of mathematics teachers at preuniversity levels.

SWITZERLAND

Sandra Brandt's teaching qualifications encompass secondary school mathematics and natural sciences. She has studied psychology, pedagogics, and ethnology. She graduated in social sciences; her thesis focused on gender differences in mathematics. Brandt holds a teaching post at secondary school level as well as a post as a university lecturer in pedagogy at the University of Teacher Education, St Gallen, Switzerland.

Fritz Oser is a professor of education and educational psychology within the Department of Education, University of Fribourg, Switzerland. He completed his Master's (1973) and doctoral degrees (1975) at the University of Zurich, Switzerland. He was a postdoctoral fellow at the University of California at Los Angeles and at Harvard University, where he worked with Richard Shavelson and Lawrence Kohlberg. He received an honorary doctorate degree from the University of Mainz, Germany, in 1987.

Horst Biedermann is a professor of school education and head of the Center for Teacher Education at the University of Flensburg, Germany. His teaching qualifications in education and psychology cover both primary and upper-secondary schools. Biederman completed his Master's, doctoral, and habilitation degrees in education and educational psychology at the University of Fribourg (Switzerland). He was a postdoctoral fellow at Stanford University and at Arizona State University in the United States, and at the Max Planck Institute for Human Development in Berlin.

Margit Kopp trained as a secondary and upper-secondary school teacher in mathematics and physics. She gained research experience in mathematics education at the Federal Institute of Technology in Zurich, Switzerland. Kopp worked on the TEDS-M 2008 project at the University of Teacher Education of Central Switzerland, Lucerne, and is presently teaching mathematics and physics at an upper-secondary school.

Sibylle Steinmann is a lecturer and researcher at the University of Teacher Education Central Switzerland, Lucerne. She trained as a primary-school teacher. Her teaching qualifications also include the upper secondary school (education and psychology). Steinmann holds a Master's degree in education, educational psychology, and psychology from the University of Fribourg, Switzerland.

Samuel Krattenmacher is a lecturer and researcher at the University of Teacher Education St Gallen, Switzerland. He completed his Master's and doctoral degrees in education and educational psychology at the University of Fribourg, Switzerland. His teaching qualifications encompass the upper secondary school and include education and psychology. He has also worked as a lecturer at the police academy in Eastern Switzerland, and at the Swiss Federal Institute for Vocational Education and Training.

Christian Brühwiler is a lecturer and director of the Institute of Research on the Teaching Profession and Development of Competencies at the University of Teacher Education St Gallen, Switzerland. His completed his Master's degree in education and educational psychology from the University of Fribourg, Switzerland, and his doctoral degree at the University of Koblenz-Landau, Germany. His teaching qualifications encompass the upper-secondary school and include education and psychology.

THAILAND

Precharn Dechsri is Vice-President of the Institution for the Promotion of Teaching Science and Technology (IPST), Ministry of Education, Thailand. He obtained his Bachelor of Education and Master of Education in chemistry from Srinakharinwirot University, Thailand, and his doctoral degree in chemical education from the University of Northern Colorado in the United States. His career includes more than 30 years at IPST, where he was the head of the Standard and Assessment Department and the Chemistry Department. Dechsri has participated in various international research studies, serving as the national research coordinator for Thailand on TIMSS 2007 and TIMSS 2011. He is also a committee member of the PISA Governing Board and was one of the national research coordinators for TEDS-M 2008 in Thailand. He has also served on the executive committee of the International Association for Educational Assessment (IAEA) since 2011, and he chaired the IAEA 2010 international conference in Bangkok.

Supattra Pativisan is currently serving as the head of the Standards and Assessment Department at the Institution for the Promotion of Teaching Science and Technology (IPST), Ministry of Education, Thailand. She earned her Bachelor's and Master's degrees in mathematics education from Chulalongkorn University (Thailand) and her PhD in mathematics education from Oregon State University, United States. At IPST, she served as an academic staff member and subsequently as the head of the institution's Secondary Mathematics Department. Pativisan was one of the national research coordinators for TEDS-M 2008 in Thailand. Her current responsibilities involve developing achievement tests and teacher assessment tests in science and mathematics for the basic education level. Many well-known Thai universities have invited Pativisan to work as a visiting scholar in the areas of mathematical processes, research in mathematics education, curriculum development, and assessment.

UNITED STATES OF AMERICA

Peter Youngs is an associate professor of educational policy at Michigan State University in the United States of America. His research interests focus on the effects of education policy on teaching and learning in the core academic subjects. More specifically, his work concentrates on state and district policies related to teacher preparation, induction, and professional development in the United States and their effects on teachers' instructional practices, commitment to teaching, and retention in the teaching profession. Youngs is currently serving as principal investigator for a Carnegie Corporation-funded study of new teachers in Michigan and Indiana school districts. This study is employing social network analysis and experience sampling method (ESM) data in order to provide a better understanding of how teacher characteristics and school context affect beginning teachers' commitment, retention, and effectiveness. His recent publications have appeared in *Teachers College Record*, *Educational Administration Quarterly, Journal of Education Policy*, *and Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education.*

Erin Grogan is an advanced doctoral student in educational policy at Michigan State University (USA). Her research interests are in teacher labor markets and teacher hiring practices in traditional public and charter schools, the role of person-organization fit in new teacher commitment and retention, and patterns of attrition among traditional public and charter- school teachers.

Editors of the Encyclopedia

John (Jack) Schwille, a codirector of TEDS-M, is professor and assistant dean for international studies in education at the College of Education, Michigan State University (MSU), in the USA. In 2013, he reached the 50-year mark in his career in international research in education, having started out as a doctoral student in comparative sociology of education at the University of Chicago in 1963. Since 1972, and after initial research on France and French education, one of his primary interests has been in crossnational studies of educational achievement, primarily in the areas of civic education and mathematics. His contributions to IEA international assessment research include work on the first IEA Civic Education Study and other parts of the Six Subject Survey (1972–1975), organization of a databank for the Six Subject Survey (1973–1974), the design of the IEA Second International Mathematics Study (1976–1984), instrument development and qualitative research for the IEA Second International Civic Education Study (1993–2002), and all aspects of TEDS-M (2002–2012). In 2010, he was chosen as an honorary member of IEA. Schwille has also worked extensively on international development in education, primarily in Africa, with major projects first in Burundi, then Guinea, and now Tanzania. At the same time, he has been a college administrator for over 25 years. During this time, his responsibilities included developing an international dimension in research, teaching, and outreach throughout MSU's College of Education.

Lawrence Ingvarson, a codirector of TEDS-M, is a principal research fellow at the Australian Council for Educational Research (ACER). Before electing to move to a parttime position, he was Research Director of the Teaching and Learning Program at ACER. Ingvarson began his career as a science and mathematics teacher in Western Australia, Scotland, and England. His postgraduate degrees are from the University of Western Australia (MA) and the University of London (PhD). He has also held faculty positions at the University of Stirling and Monash University as well as visiting professorships at Michigan State University, Stanford University, and the University of East Anglia. He is internationally known for his research on teacher professional development, teacher quality, teaching and leadership standards, assessment of and compensation for teacher performance, and school improvement and program evaluation. In Australia, one of his major contributions has been to the development of teaching standards in collaboration with the Australian Science Teachers Association, the Victorian Institute of Teaching, the New South Wales Institute of Teachers, and Teaching Australia. He was honored with the Distinguished Service Award from the Australian Science Teachers Association in 2001 and also as a Fellow of the Australian College of Educators in 2005.

Richard T. Holdgreve-Resendez is a doctoral candidate in educational policy at Michigan State University in the United States. He received his Bachelor's degree in history from the University of Michigan and his Master's degree in educational foundations and policy from the University of Michigan's Horace H. Rackham Graduate School and School of Education. Previously, he worked as a research assistant on the Michigan Early Career Teacher Study at Michigan State University and within the Housing Research Office at the University of Michigan and the Developmental Psychology Department at the same university. He was also an assessment consultant for the Office of Student Activities at Eastern Michigan University. Most recently, he served as a research assistant on the TEDS-M 2008 project at Michigan State University and continues to serve as an international literacy consultant and teacher instructor for Miske Witt & Associates and UNICEF. Holdgreve-Resendez has furthermore worked extensively with, and continues to research, the relationship between literacy policy design and teacher literacy knowledge. He is also involved in international studies of literacy policy and practice.

CHAPTER 1:

Botswana

Editors' Overview

Botswana is a classic mixed system, in which some teachers are prepared at the university while others are enrolled in teachers' colleges without university status.

Institutions and governance

Under its Ministry of Education, Botswana has six colleges of education; four prepare only primary school teachers and two prepare only secondary school teachers.[1] Primary and secondary teachers are also trained at what was, until recently, the country's only university, the University of Botswana. It has more autonomy than the colleges (e.g., to set limits on admissions).

Program-types and credentials

Primary-school in Botswana extends from Grades 1 to 7—longer than in most countries. Junior secondary schools cover Grades 8 to 10; only 56 percent of the age group's population is enrolled in secondary education, a proportion that is less than in any other TEDS-M country. Teacher education aligns with these school types (Exhibit 1.1). One primary program-type was included in TEDS-M—the Diploma in Primary Education from the colleges, as portrayed in Exhibit 1.1. (The Bachelor of Primary Education from the university was not included in TEDS-M due to a lack of students.) Secondary teachers can be prepared in four program-types: one at the two colleges for teachers and three at the university. However, as is evident in Exhibit 1.1, only two were included in TEDS-M: the Diploma in Secondary Education at the colleges and the Bachelor of Secondary Education (Science) at the university.

The latter is a concurrent program-type with more demanding entrance requirements than the corresponding program-type at the colleges. Graduates of this program-type can teach up to Grade 12, whereas the graduates of the college program-type can teach only up to Grade 10. The two secondary program-types not included in the TEDS-M target population were the consecutive Postgraduate Diploma in Education, which produces almost no graduates, and the Bachelor of Education (secondary) program-type, which is intended for practicing teachers who have at least two years' teaching experience.

1 Since the TEDS-M data collection, the number of primary colleges of education has changed to three because the Lobatse College of Education was judged unsafe for use due to its dilapidated buildings.

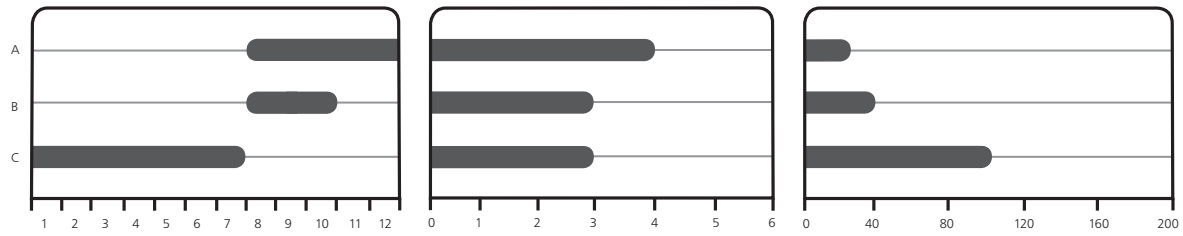
Curriculum content, assessment, and organization

The colleges offer a three-year, fulltime program-type. The first year, for example, includes courses in communication and study skills, educational technology, special needs education, two teaching subjects, and teaching practice. Although primary teachers are expected to teach all subjects, a new trend is to add a specialization in certain areas, such as primary education and mathematics/science. At the university, the Bachelor of Secondary Education (Science) produces teachers of mathematics as well as of science. It is a fulltime, four-year program-type, but students start taking education coursework only in their second year. Overall, this program-type is 70 percent content and 30 percent mathematics education. The instructor determines course content, and submits a course outline for approval to the department head.

Each program-type has different practicum requirements. The colleges of education require two weeks of classroom observation in the first year (for primary but not secondary future teachers), 10 weeks of internship (field experience) in Year 2, and a five-week practicum in Year 3. At the university, Bachelor of Secondary Education (Science) students complete seven weeks of teaching practice during both Years 2 and 3.

College students are required to complete written assignments, annual examinations, and a final research project. An external moderator conducts a final assessment of every student's work. The assessment includes the research project and teaching practice. At the university, the final grade for each course combines continuous assessment and a final examination. Teaching practice is graded pass or fail; there is no external moderation.

Exhibit 1.1: Teacher education program-types in Botswana



Key to program-type

A—Bachelor of Secondary Education (Science), university

B—Diploma of Secondary Education, colleges of education

C—Diploma in Primary Education

Note: Because the Postgraduate Diploma in Education one-year consecutive program produces very few graduates, it was not included in the TEDS-M target population. The Bachelor of Primary Education at the university was also excluded because of a lack of students. The Bachelor of Education (secondary) program was not included because it is intended for practicing teachers who have at least two years of teaching experience. It was therefore outside the scope of TEDS-M.

Preparing Teachers of Mathematics in Botswana

Kgomotso Gertrude Garegae, Thabo Jeff Mzwinila, and Tuelo Martin Keitumetse

Part I: Context and Conditions of Teaching as a Career

Historical roots

In the early years of independence, mathematics teacher education in Botswana, like the country's education system as a whole, was shaped by two national commissions on education. These commissions produced the policy documents of 1977 and 1994 known respectively as the National Policy on Education (Republic of Botswana, 1977) and the Revised National Policy on Education (Republic of Botswana, 1994). While the first report emphasized quantitative improvement, especially at primary level, the second one focused on the quality of educational services. Since independence, Botswana has thus been striving, through diverse means, to provide her citizens with an education comparable to that in much of the world—hence the following manifesto: "By 2016, Botswana will have a system of quality education that is able to adapt to the changing needs of the country as the world around us changes" (Republic of Botswana, 1997, p. 5). It is within this framework that Botswana participated in the international comparative study, TEDS-M 2008.

The Botswana colleges of education of today are the culmination of many decades of national development in Botswana. As a result of Christian and missionary work, schools in what was then Bechuanaland were founded in the 19th century. The national schools at villages such as Kanye, Tlokweng, Serowe, Molepolole, and Mochudi became the backbone of educational development in the country. Secondary and tertiary education, however, had to be found outside Bechuanaland, especially in South Africa and what was then Rhodesia. Plans were made to begin a tertiary institute for Bechuanaland at Palapye in 1902, but it did not materialize due to the conflict between the London Missionary Society and the Bamangwa Royal Court over the institution's ownership (Mgadla, 1989). A further obstacle to higher education arose when the South African government later restricted admission of foreign black students to its tertiary institutions.

After Botswana gained its independence in 1966, the country's government began to question and then to eliminate the restrictions of Botswana's colonial inheritance. This movement culminated in the establishment of a local university and also led to the founding of the first teacher education colleges at Lobatse and Serowe. Later, Francistown Teacher Training College was established to mount a five-year upgrading of teachers through correspondence work, residential study, and radio-delivered programs (Vanqa, 1998). This project was funded by the government of Sweden. Preservice and inservice education were strengthened, with emphasis placed on practical subjects such as home economics, wood and metal work, agriculture, and science, an emphasis which reflected the belief that much could be learned from practical as well as from academic work. In 1973, the three teacher education colleges—Lobatse, Serowe, and Francistown—were affiliated with the local university center.

Overall, the development of these teacher education institutions embodied the government's desire for an education system that would be responsible to Botswana's social and economic aspirations and rooted in Botswana's need for development. As in other developing countries, Botswana's education system was an integral part of the country's development plan. The belief that education is a transformative tool that every nation can use to develop its citizenry was prevalent in Botswana.

When the education system inherited from the British government was viewed from this perspective, it was deemed unsatisfactory, especially in terms of lacking fit with Botswana's needs for political, cultural, and socioeconomic development. For example, teacher education was of no concern to the colonizers. Few primary schools existed, the infrastructure for secondary schools was almost nonexistent, and there were no skilled personnel. As a result, the Government of Botswana set up a national commission on education in the 1970s with a mandate to determine goals for education, training, and development, to formulate the philosophy on which training would be grounded, and to recommend ways by which these goals could be achieved.

Although teacher education institutions strove to implement these recommendations, other constraints, especially of time and human resources, hindered the process. Teachers who were unable to handle mixed-ability and remedial classes were and still are produced, especially at secondary school level.

Historically, the teaching profession in Botswana was a lucrative career, and parents wanted their children to enlist in this vocation. The reasons why teaching was seen as attractive included, amongst others, the following:

1. Teaching was considered charismatic work. Teachers were respected in the community as the government's ambassadors and spokespersons. Upon receiving laws and regulations from the government, teachers disseminated these policies to the entire society and community; in effect, their role was to act in loco parentis (Manen, 1991).
2. The teaching profession appealed because teachers had (and still have) vacations in the middle and at the end of the year. They were able to carry out their home duties, such as plowing, while still being employed by the government.
3. Every teacher trainee was sure of finding a job after completing his or her teacher education. In fact, in the past, prospective teachers would apply for a job while still at college or university and get a job before writing their final examinations (Chakalisa, Garegae, Setlhare, & Kaino, 2007).
4. Teachers' accommodation and amenities such as water and electricity were and still are subsidized.
5. The teaching profession attracted many simply because it was one of the few careers known at the time of independence. When Botswana gained its independence from the British government in 1966, teachers and police officers were the only occupations in Botswana for which people could receive formal training, albeit not at an advanced level.

Conditions at the time of TEDS-M

Today, after completing their inservice education, teachers are hired by the Department of Teaching Service Management, otherwise known as TSM[2] Teachers from primary colleges of education apply for positions at primary schools, while those from secondary school teacher education colleges apply for positions at junior secondary schools. Until recently, these two groups of teachers were placed on two different salary scales. Those from primary were paid less than their secondary school counterparts. The argument for differentiated remuneration was that the training of primary school teachers was not as rigorous as the training of their secondary school counterparts in terms of content and duration. But now that this difference in duration has been rectified, there is no longer any rationale for scaling primary school teachers differently from those teachers holding diplomas in secondary education (Baputaki, 2007). Teachers' salaries are equivalent to those of other civil servants with comparable qualifications. The probation period for all teachers before confirmation of employment is two years.

Teachers' satisfaction is central to TSM because if the basic needs of teachers are not met, they will be unable to perform their duties to their maximum potential. Secondary school teachers are supposed to be provided with accommodation and to have other of their school-related needs met as a way of making their working conditions palatable. However, because of the phenomenal increase in student enrollments and the mushrooming of junior secondary schools, these privileges are not always available to all teachers. Consequently, it is not uncommon to find teachers without accommodation or having to share their home with teachers of the opposite sex. The latter consequence is not well accepted in Botswana culture, especially as teachers are expected to be role models for students.

Other challenges that teachers face include heavy workloads, a shortage of teaching and learning resources, large class sizes, a wide range of student abilities, language difficulties, and a shortage of classrooms (Garegae, 2001, 2002a, 2002b; Pendaeli, Ogunniyi, & Mosothwane, 1993; Republic of Botswana, 1990, 1994). Each class in a school has about five hours of mathematics lessons a week. This time allocation applies right across junior and secondary schooling. A mathematics teacher may be given as many as six classes, making for at least 30 hours of teaching per week. Given that classes are congested and the level of heterogeneity in the student population is high, teachers typically need extra time to develop and deliver remedial lessons. In such conditions, teachers soon burn out, a situation that is not conducive to quality education.

As a result of the wide ability range caused by universal basic education, most learners enter junior secondary school with limited fluency in English, the language of teaching and learning (Pendaeli et al., 1993; Republic of Botswana, 1990, 1994). This situation makes it difficult for learners to understand mathematical concepts and compels teachers to improvise through code switching (Garegae, 2002a, 2002b). Shortages of materials also sabotage teachers' efforts to provide quality teaching. For example, teachers find it difficult to teach certain topics, such as graphing, in outdoor teaching areas (Garegae, 2001). These are open spaces topped with corrugated iron roofs, and they were constructed to supplement classrooms in junior secondary schools. In these areas, a chalkboard is mounted on a wall, and students sit on one of three horseshoe-shaped cement benches nested together.

2 Currently, in a change implemented after the TEDS-M 2008 data collection, teachers are hired by the Directorate of Public Service Management, a department that is responsible for all government employees in the country.

Part II: Organization and Characteristics of Teacher Education

Qualifications

Although the Government of Botswana has charged all teacher education institutions with the responsibility of training high-quality inservice and preservice teachers for the country's rapidly growing education sector, the colleges of education offer only *diploma* programs for primary and secondary school teachers. Preservice and inservice teachers wanting to complete degree programs in Botswana can only do so through the University of Botswana, and the programs pertain only to secondary, not primary, school teaching.

The colleges of education are Ministry of Education institutions affiliated with the University of Botswana, which is responsible for validating the diplomas that the colleges offer. In contrast, the university itself is an independent body with autonomous responsibility for determining the number of places available for teacher education through the university admissions department. Today, Botswana has six colleges of education. Four of them produce primary school teachers, while the remaining two produce junior-secondary school teachers.

Lobatse College of Education is the oldest of the primary teacher colleges. It was established in 1947 at Kanye, but moved to its present site in 1956.[3] The Serowe College of Education, which used to prepare women teachers only, first opened in 1963. Francistown College of Education was founded in 1968, and originally was responsible for the upgrading of primary teachers who had not been formally trained. Tlokweng College of Education had its first student intake in 1984. In 1993, this college became the first primary teacher education institution to offer the three-year Diploma in Primary Education.

Molepolole College of Education was founded as a result of the recommendation of the National Commission on Education of 1977, which suggested that junior secondary school teachers should be specially prepared to meet the demands of the rapidly expanding junior- secondary sector. Later, the ever increasing need for expansion of this sector led to the establishment of a second teacher preparation institution for junior-secondary school teachers, namely, Tonota College of Education in 1990.

The colleges of education are owned and administered by the Ministry of Education of the Government of Botswana. The Department of Teacher Training and Development in the Ministry of Education is the highest body that deals with the education of teachers. It supervises all colleges of education. The ministry has a statutory mandate to hire lecturers for the colleges and to provide resources such as equipment and materials. Subject-matter panels at the ministry are responsible for determining the curriculum taught in the colleges.

Multiple program-types exist within the colleges of education, on the one hand, and the University of Botswana, on the other. The colleges of education for primary school teachers offer one program-type: the three-year Diploma in Primary Education (DPE). Learners can enter the DPE program through two routes: traditional entry and mature-age entry. The first requirement for the traditional or conventional route is a pass in the Botswana General Certificate of Secondary Education (equivalent to Cambridge

3 Now closed. See the editors' overview to this chapter.

examinations), with at least a credit in mathematics. To qualify for the mature-age entry into the DPE, a candidate needs to hold the Primary Teacher Certificate and to have at least two years of teaching experience. Such candidates start the program at second-year level.

The second current program-type for primary teachers is the four-year Bachelor of Primary Education—BEd (Primary). It is offered at the University of Botswana's Department of Primary Education, which is housed in the Faculty of Education. The entry requirement for this program is a credit in the DPE obtained from a college of education.

Although primary school teachers are expected to teach all subjects, a new trend is to have students specialize in certain areas, for example, primary education and mathematics and science. Thus, students who want to specialize in mathematics and science need to have performed well in the two subjects. On successfully completing their studies, these students are said to have obtained a double major, in this case, in primary education and mathematics/science.

Secondary school teachers are also prepared in these two different types of institution—the colleges of education and the university. Both Molepolole College of Education and Tonota College of Education offer the three-year Diploma in Secondary Education (DSE). Program standards are ambitious and challenging. The program curriculum is based on a set of teaching responsibilities, skill acquisition, and mastery of mathematics concepts that future teachers must demonstrate in order to obtain a teaching qualification. The future teachers move through the program in a cohort.

The entry requirements for Bachelor of Education students at the University of Botswana are higher than those for their counterparts in colleges of education. Students applying to study toward the BEd should have at least a minimum pass of Grade D[4] in English, a B in mathematics, and at least two credits in physics, chemistry, and biology or Grade BB on the Integrated Science Double Award. It is important to note here that these requirements are not static; they change from year to year depending on the availability of spaces at the University of Botswana, which was, until recently, the only national university in the country.

In this regard, a major area of concern is that mathematics teacher education programs attract weaker students. As an illustration, those candidates who do not qualify for the general BSc program apply for the BEd program. Then, while in the program, students can transfer to other more lucrative specialties if their record is good.

The inservice program, BEd (Secondary), was tailored for those who successfully complete the DSE from the colleges of education and who have taught for at least two years. In fact, few students meet the required standards, and those who fail to satisfy the University of Botswana standards are sent abroad, to South Africa or the United Kingdom, for instance, to pursue their education. While the other two program-types, the BEd (Science) and the PGDE, require candidates to undertake a teaching practicum, the BEd (Secondary) student teachers are exempted from this because they already have teaching experience. For this reason, the BEd (Secondary) did not fall within the scope of TEDS-M.

4 Botswana grades run from A to G where A is excellent and F to G are failing grades.

The Department of Foundations in the university's Faculty of Education offers those individuals who already have a Bachelor of Science (BSc) degree and would like to become teachers the opportunity to pursue the one-year PGDE program. However, this program has produced very few graduates who become teachers of mathematics; as such, it was not within scope for the TEDS-M main survey.

Curriculum and field experience requirements

Colleges of education

At the colleges of primary education, primary mathematics panels are responsible for developing the curriculum content, which lecturers from the Department of Primary Education at the University of Botswana then review. When reviewing a curriculum proposal from a college, lecturers participate in a panel hearing where a representative from the department, a lecturer from the university, a member of the Department of Teacher Training and Development, and a member from the Curriculum Coordinating Committee further assess the curriculum content before producing a final document.

In a similar process at the secondary colleges of education (i.e., Tonota College of Education and Molepolole College of Education), lecturers design the curriculum content, which is then moderated by University of Botswana lecturers. Lecturers from both secondary colleges of education meet to discuss and agree on the various components of the curriculum content.

The programs in the colleges of education are fulltime, extending over three academic years. In Year 1, the curriculum includes communication and study skills, special needs education, educational technology, two teaching subjects (major and minor subjects), and teaching practice. The courses offered to future mathematics teachers are designed to facilitate competent teaching of mathematics and even to enable them to progress to further education in the field of mathematics. The course content includes professional studies, calculus, statistics, and mechanics.

In the colleges, assessment is in the form of written assignments, tests, and a project. At the end of Years 1 and 2, students take end of year examinations. They must also earn pass grades (the minimum pass mark is 50%) in the Years 1, 2, and 3 continuous assessments. Teaching practice in Year 2 is supervised and assessed on a pass/fail basis. A pass in Year 2 teaching practice is a prerequisite for Year 3 teaching practice. At the end of Year 3, students are required to sit for final examinations in each subject and to submit a research project as part of continuous assessment in the major subject. To pass a subject, students normally need to achieve a minimum end of year grade of 50 percent in both continuous assessment and in the final examinations. To be awarded a diploma in the colleges of education at the end of Year 3, students must pass teaching practice and each subject.

Evaluation of a student's performance in the final assessment and project is externally examined by the external moderator and through the Centre for Academic Development at the University of Botswana. The final overall grades and diploma classifications for students are agreed at the joint meeting of the external moderators, external examiners, and the academic boards of the respective colleges of education. The boards of the affiliated colleges of education then send these results for approval to the senate of the University of Botswana.

University of Botswana

At the university, the BEd (Science) is a fulltime program that lasts four years or eight semesters. In the first year of the program, student teachers follow the BSc program in terms of the subjects offered. But in the second year, they are introduced to education courses that they take in addition to content courses. Students are required to study mathematics, mathematics education, and educational foundations and to undertake a practicum. Courses are designed by the lecturers assigned to teach them, but each course must first be approved by the department head. Students can major in pure or applied mathematics. The majority of the students' program is made up of mathematics content courses (70% of the total); the remainder includes courses related to mathematics education (i.e., 30% of the total).

In order for a student to graduate, he or she must complete 138 credits, of which 103 are core. The remaining credits relate to general education and electives. The student must also pass the practicum, which comprises six credits, but these are not counted in his or her final mark. At the university, the student's final mark is composed of all the overall marks obtained each year. This final mark determines whether the student receives a first-class pass, a second-class, upper-division pass, or a second-class, lower-division pass.

Field experience

Teaching practice, also known as field experience or practicum, is an integral part of preservice training. Student teachers, like student doctors, need to have a good sense of the field for which they are being trained. Teaching practice helps them in three ways. It helps them understand what the profession entails. It helps them to understand their beliefs about teaching and learning and about themselves as teachers to be. And it helps them put theory into practice.

Procedures for teaching practice in the three TEDS-M program-types differ. For students intending to teach in primary schools, school experience starts during the initial year of training. In Year 1, future teachers observe practicing teachers in schools for two weeks. Although they are not expected to engage in actual teaching, they can negotiate to do this, if they so want, with the practicing teacher. College lecturers come intermittently to the school. In Year 2, student teachers complete 10 weeks of internship in which they alternate teaching between lower (Standards 1 to 3) and upper (Standards 4 to 7) grades. Students at this stage are supervised by the college lecturer, the cooperating teacher, and school management.

During their final year of training, student teachers experience a five-week practicum. The last week is used for external moderation, whereby the University of Botswana's senate appoints an academic to validate the delivery of a subject or part thereof in the diploma program. The Centre for Academic Development (the affiliated institutions unit at the University of Botswana) undertakes this work with the help of university lecturers as well as of personnel from the Department of Teacher Training and Development.

Future secondary school teachers undertake teaching practice in their second and third years only. The practicum usually takes about 11 weeks and is done at the beginning of the academic year. The first week is for observation and preparation; the other weeks are for actual teaching. As in the case of the colleges of primary education, personnel from the University of Botswana carry out moderation, but only in relation to the Year

3 student teachers. As for the Year 1 future teachers, instead of teaching practice, they go through what is called micro-teaching, wherein a small group of about 12 learners is collected from nearby local schools and then taught by the student teachers. This exercise is conducted at college level and normally takes about four to six weeks.

In all the colleges of education (primary and secondary), the Teaching Practice Department is responsible for placing the student teachers. This department is, in most cases, manned by two people—the head of the department and his or her assistant. In general, this department also co-opts other lecturers and forms a committee to facilitate the department's operations.

At the University of Botswana, only preservice secondary future teachers, that is, the BEd (Science) and the PGDE students, participate in the teaching practice. As noted earlier in this chapter, the members of the inservice group—the BEd (Secondary) students—are exempted on the basis that they are already experienced in classroom practices. The BEd (Science) future teachers begin their teaching practice in the second year of the program and continue on in it for seven weeks. They are posted to both junior and senior secondary schools. Because this stage of the program is regarded as an initial trial, the marks awarded are not counted in the final assessment. In their third year, the BEd (Science) future teachers complete their last teaching practice, which again takes seven weeks. At this stage, the marks awarded are used to pass or fail these students. Unlike in the colleges of education, there is no external moderation for this group of students.

Staffing requirements

In the past, especially in the early 1980s to late 1990s, the Diploma of Primary Education and BEd graduates were deployed in primary teacher training colleges as lecturers. This trend changed in accordance with the recommendation of the second national commission on education. Once the colleges were fully staffed, the minimum standard set for college lecturer was a Master's degree, as the primary teacher training colleges were being upgraded to colleges of education. Thus, the majority of young lecturers hold a Master's degree (typically a MEd). Some also have a doctoral degree (PhD or EdD). Those holding first degrees can, however, be recruited as staff development fellows, with the aim of giving them further preparation to reach the required degree levels. They are expected to begin these degree programs after serving for two years.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

Teaching attracts above-average students, but not students in the top rank. Salaries for people holding university diplomas are the same across all government departments, a fact that may tend to hold teachers' salaries down. Students studying toward a degree in areas regarded as "scarce skills" can receive an allowance, but teaching is not one of these areas.

Policy pertaining to training places for teacher education students is dictated by the government, acting on advice from the Tertiary Education Council. However, the terms of admission and decisions relating to the admission of students are at the sole discretion of the admitting institution.

The Department of Teacher Training and Development usually initiates the recruitment process by advertising the teacher education places available at colleges in local newspapers. The advertisements state the prerequisites necessary to qualify for a place. Prospective students then apply to the college of their choice. It is up to the colleges to interview applicants and to make their final selection of students.

Choice of program-type depends on a student's performance in secondary school. Those students with the best results stand the greatest chance of studying at the University of Botswana; those with the next best results usually find themselves in colleges of education, where they train as future primary or secondary teachers.

All candidates for teacher education programs must have, as a minimum qualification, the Botswana General Certificate of Secondary Education (BGCSE), or a comparable qualification. Prospective primary teachers must have a credit in mathematics in the BGCSE in order to enroll in a teacher education program. Prospective Diploma of Secondary Education students must have an A grade in mathematics. A minimum of a first degree (with a lower second-class pass) is required for admission into the PGDE program.

Admission into all of these teacher education programs—the Diploma of Secondary Education, the Diploma of Primary Education, the BEd (Science), and the Postgraduate Diploma of Education—is competitive. Colleges of education select future teachers on the basis of them having obtained at least three credits in their BGCSE results. Candidates must also meet the subject requirements of the major and the minor they want to enroll in. In addition to assessing academic competence, admission procedures at colleges of education include a half-day interview that assesses future teachers' interpersonal and oral communication skills. At the end of the interview, future teachers are selected on the basis of best performance not only in BGCSE mathematics but also on the overall BGCSE.

Accreditation of teacher education institutions and programs

Colleges of education are Ministry of Education institutions affiliated to the University of Botswana, which, as one of two national quality-assurance agencies (the other is the Tertiary Education Council), is responsible for validating college diplomas. Both agencies are independent bodies that act as a buffer between the institutions and the government of Botswana.

The University of Botswana exercises its quality-assurance responsibilities through its Centre for Academic Development, which is a resource center for students and faculties at the University of Botswana. It supports and develops teaching and learning excellence in order to provide the best-possible academic support to the students and the surrounding community. It also sets quality-assurance standards and ensures that all colleges of education and the University of Botswana meet them. In the English tradition, an external examiner is appointed to ensure that the organization's standards are maintained or kept the same at all times. Another aspect of the examiner's role is to provide an assurance of fairness.

The University of Botswana adheres to "ten-step standards and criteria for affiliated institutions." These standards are used to assess institutions' facilities and programs. The process is followed as a way of validating program quality. An institution can be granted affiliation, rejected, or given a provisional status to make up for its deficiencies. The quality-assurance team visits colleges every three years.

The Board of Affiliation of the University of Botswana, which is chaired by the Dean of the Faculty of Education, decides on accreditation. Decisionmaking is based on how the college has marketed itself and also whether it undertakes visits to institutions for further verification. All institutions and programs have to be accredited for quality-control and benchmarking purposes. The increasing pace of globalization, which complements the trends toward wider international accreditation and convergence, also propel this stance.

The other accreditation body, the Tertiary Education Council (TEC), which was established in 2004, is responsible for regulating and registering tertiary institutions other than the University of Botswana. The TEC operates under the provisions of the Tertiary Education Act 1999 and of regulations published in 2005. Its role is to promote the development and coordination of the sector, as well as quality assurance and standards.

All tertiary institutions operating in Botswana have to apply to the TEC for an operating license. The council verifies the facilities, staff qualifications, enrollment ratios, institutional financial viabilities, governance structures, and programs offered before granting the operating license. The council may decide that some institutions must, for example, scale down their operations and tighten their focus, improve the qualifications of their academic staff, and do more to develop their financial investments, physical facilities, and governance structures.

Requirements for entry to the teaching profession

Botswana does not have an agency or authority responsible for the registration and licensing of teachers. However, the Revised National Policy on Education (Republic of Botswana, 1994) specified the need for a taskforce charged with looking into the formation of a body that would be responsible for registering teachers in Botswana.

The requirements for entering the teaching profession in Botswana are either a diploma certificate from any of the four colleges of education that train future teachers for primary schools in Botswana, or a diploma certificate from the two colleges of education that train future teachers for Botswana's junior-secondary schools, or a university degree in education. Candidates need no other examinations or licensing requirements in order to enter the teaching profession.

The Department of Teaching Service Management under the Ministry of Education recruits teachers for Botswana's primary schools and its junior-secondary and senior-secondary schools. Recruitment involves the following steps:

- Determining that all teacher applicants have teaching certificates (i.e., diploma or university certificates in education);
- Documenting each applicant's grade point average, which includes teaching practice grades and subject grades;
- Screening and short-listing applicants;
- Holding interviews;
- Determining and then filling vacancies (in terms of subject areas) in various schools.

The Department of Teaching Service Management also employs university graduates from other disciplines to teach in both the junior-secondary schools and senior-secondary schools of Botswana. These individuals must, however, also have a Postgraduate Diploma in Education.

References

Baputaki, C. (2007, April). Teachers in P187m windfall. *Mmegi* (newspaper), p. 1.

Chakalisa, P. A., Garegae, K. G., Setlhare, P., & Kaino, L. M. (2007). Mathematics teacher training in Botswana. In J. Adler, M. Kazima, W. Mwakapenda, T. Nyabiso, & S. Xolo (Eds.), *Mathematics teacher education: Trends across twelve African countries* (pp. 37–50). Johannesburg, South Africa: Marang.

Garegae, K. G. (2001). *Teachers' beliefs about mathematics, its teaching and learning and the communication of these beliefs to students: A case study in Botswana.* Unpublished doctoral dissertation, University of Manitoba, Winnipeg, MB, Canada.

Garegae, K. G. (2002a). *Challenges faced by learners in English as a language.* Paper presented at the Conference of South Africa and Society Education, Technikon, Pretoria, South Africa, September 26–28, 2002.

Garegae, K. G. (2002b). *Teachers' challenges in implementing Botswana's new curriculum: Using code switching as a classroom communicative resource.* Paper presented at the Second World Congress on Comparative Education, Beijing, China, October 14–16, 2002.

Manen, M. V. (1991). *The tact of teaching: The meaning of pedagogical thoughtfulness.* London, ON, Canada: The Althouse Press.

Mgadla, P. T. (1989). *Missionaries and Western education in the Bechuanaland Protectorate 1859–1904: The case of the Bangwato.* Gaborone, Botswana: Quickprint.

Pendaeli, J., Ogunniyi, M., & Mosothwane, M. (1993). *Strategies for improvement in science and mathematics at all levels of the education system of Botswana. Annex 15. Reports and policy studies of the National Commission on Education 1992–1993.* Gaborone, Botswana: Government Printer.

Republic of Botswana. (1977). *Education for Kaqisano.* Gaborone, Botswana: Government Printer.

Republic of Botswana. (1990). *The quality of basic education in Botswana.* Gaborone, Botswana: Government Printer.

Republic of Botswana. (1994). *Revised national policy on education.* Gaborone, Botswana: Government Printer.

Republic of Botswana. (1997). *Vision 2016: Towards prosperity for all.* Gaborone, Botswana: Government Printer.

Vanqa, T. P. (1998). *The development of education in Botswana (1937–1987).* Gaborone, Botswana: Lentswe la Lesedi.

CHAPTER 2:

Canada (New Foundland and Labrador, Nova Scotia, Québec, and Ontario)

Editors' Overview

In Canada, education is the responsibility of each province or territory; there is no federal body overseeing education at the national level. TEDS-M was conducted in four Canadian jurisdictions—Newfoundland and Labrador, Nova Scotia, Québec, and Ontario. These four provinces account for 66 percent of the total Canadian population, estimated at nearly 34 million in 2010 (in fact, 62% of all Canadian residents live in Québec and Ontario).

Institutions and governance

Teacher education is offered in a total of 56 institutions across all provinces in Canada. A small number of these are affiliates of larger institutions and include English- and French-speaking programs within the same institution. Multiple institutions are found in all but two provinces, Newfoundland and Labrador, and Prince Edward Island. Four institutions in Nova Scotia offer teacher education, three in English and one in French. Twelve institutions offer teacher education in Québec—nine in French and three in English. There are 13 faculties of education in Ontario universities. All 13 have offerings in English and two also in French. There is no preservice teacher education in Canada's three territories, as they tend to draw their teachers from the provincial teacher education institutions across the country.

Program-types and credentials

Canada has diverse program-types but they share commonalities. In general, teacher education institutions offer two routes to graduation—concurrent or consecutive. Concurrent program-types usually offer four years of professional education courses along with academic courses. Some of these concurrent program-types lead to a Bachelor of Education (B.Ed.) degree; others, which require five years, lead simultaneously to a degree in an academic specialty as well as the B.Ed. Consecutive program-types require candidates to obtain an academic degree before being accepted into a teacher education program-type, with the latter usually concentrated in one or two years. The duration is related to certification requirements. For example, the minimum requirement for certification in Nova Scotia is a two-year program-type following the first degree; in Ontario, certification follows a one-year post-degree program-type. The general trend across most provinces is toward consecutive program-types. The exception is Québec, where almost all preservice teacher education is concurrent.

Most institutions offer both primary- and secondary-level intakes for each of the two routes to the B.Ed. Primary teachers are usually considered generalists, but teachers at the secondary level are expected to specialize in one or more disciplines. Generally, secondary teachers are expected to specialize in school subjects, that is, subjects mentioned in certification requirements and provincial curricula, and taught in schools. Most primary program-types are concurrent, while secondary program-types are consecutive.

In some jurisdictions, teaching certificates are endorsed only for specific levels or subjects. However, the degree to which the teachers holding these endorsed certificates are restricted to their defined areas of specialization varies with jurisdiction and location, and depends on teacher supply and demand.

All teacher education program-types in Canada require future teachers to participate in some form of in-school teaching experience, referred to variously as a practicum, an internship, or student teaching. The longterm trend is toward longer in-school placements, distributed throughout the program-type rather than concentrated at its end.

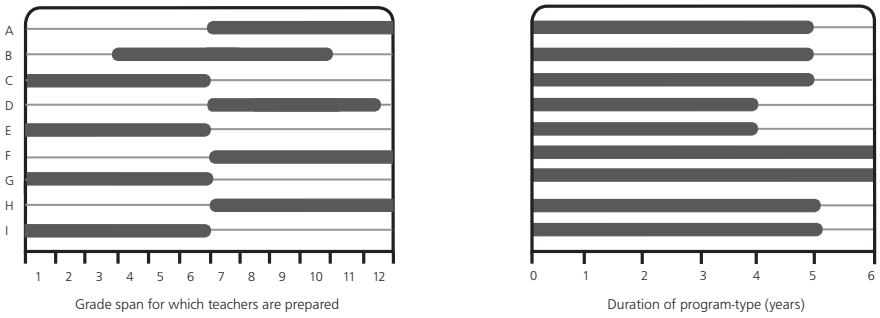
Because education is a provincial responsibility, curriculum content, assessment, and certification requirements vary from jurisdiction to jurisdiction (see Exhibit 2.1).

- *Newfoundland and Labrador:* The main program-type divisions are referred to as primary/elementary and intermediate/secondary. The primary/elementary program-type is concurrent, requiring a total of five years to complete. Students typically enter the professional component in the third year. The secondary program-type is a three-semester consecutive one, completed over 14 months. A representative body of stakeholders governs teacher certification in Newfoundland and Labrador; the Department of Education administers the system.
- *Nova Scotia:* Nova Scotia has the only system in Canada in which a two-year (four-semester) consecutive phase is the norm and is a requirement for certification. Teacher certification in Nova Scotia is administered by the Department of Education. It is offered at two levels—one for Grades 1 to 6 and the other for Grades 7 to 12.
- *Québec:* Given the concurrent nature of almost all Québec preservice program-types, future teachers in that system generally take four years to complete the B.Ed. degree. Teacher certification in Québec is governed by the *Comité d'agrément des programmes de formation à l'enseignement* (CAPFE), a representative body of stakeholders. Certification is for grade spans 1 to 6 and 7 to 11.

1 Note that the term *primary* as used in Ontario differs from its more general use in TEDS-M. In TEDS-M, primary is used consistently for what is generally the first level of compulsory schooling, even when the national terminology is different (e.g., *elementary*).

- *Ontario:* Almost all Ontario institutions offer consecutive program-types (of two semesters' duration) to students who already have a Bachelor's degree. The practicum takes up almost half of that time. Three program-types—primary[1]/junior (Grades K to 6), junior/intermediate (Grades 4 to 10), and intermediate/secondary (Grades 7 to 12)—are typical. This structure conforms to the structure for teacher certification, thereby allowing teachers to be certified to teach across a range of grade levels. Teacher certification in Ontario is governed by the Ontario College of Teachers, an independent body.

Exhibit 2.1 Teacher education program-types in Canada



Key to program-type

A—Intermediate/Senior (Ontario)
B—Junior/Intermediate (Ontario)
C—Primary Junior (Ontario)
D—Secondary 1–5 (Québec)
E—Primary (Québec)
F—Secondary (Junior and Senior High) (Nova Scotia)
G—Primary (Nova Scotia)
H—Intermediate/Secondary (Newfoundland-Labrador)
I—Primary/Elementary (Newfoundland-Labrador)

Note: The third graph was omitted because the nature of the data collected meant it was not possible to accurately estimate enrolments by program-type.

Preparing Teachers of Mathematics in Canada

Robert Crocker and Hervé Joduin

Part I: Context and Conditions of Teaching as a Career

Jurisdiction of education

Canada does not have a national education system. Education is under the jurisdiction of the 10 provincial and the three territorial governments. This structure extends to teacher certification, which is the responsibility of provincial/territorial bodies. Two types of teacher certification body exist. In most jurisdictions, certification is directly in the hands of the Ministry of Education. Policy is typically set by a body appointed by the province/territory, and administration of certification is under the purview of a registrar, who is a provincial employee. At the time of TEDS-M, a new type of certification body called a College of Teachers had emerged in two jurisdictions—Ontario and British Columbia. These bodies, akin to professional organizations of self-governing professions, function at arm's length from government and under their own legislation. However, they take a more explicit role in the quality control function than do their provincial counterparts in ministries of education.

Conditions at the time of TEDS-M

After completing their teacher education, most teachers in Canada are employed by local or regional school boards, which operate schools on behalf of the provincial/territorial jurisdictions. Only a small proportion of teachers are employed by private schools as well as by schools operated by Aboriginal bands and other schools not within the public system. Schools operating in both official languages—English and French—are found in all jurisdictions. Ability to function in the language of the school is a requirement for employment as a teacher. In some jurisdictions, a candidate's religion is also a factor in hiring, particularly where separate schools (usually Roman Catholic) exist; however, these schools are still considered to be part of the public sector.

Most jurisdictions are experiencing declines in school enrollment, although the teaching force has remained relatively stable over the past decade. Now, however, the situation is beginning to change as many teachers reach retirement age. Given that education falls under provincial jurisdiction, the labor market for teachers has generally not been a matter for national study. However, the broad picture—declining school enrollment but increased supply of teachers—varies significantly across Canadian jurisdictions, and there is no clear way to determine the match of supply and demand in local areas. The impression from provincial studies is that there is neither a general shortage nor a surplus of teachers, but rather an uneven distribution, especially of teachers who are specialists in mathematics and science or of those willing to teach in rural, remote regions of the country where staffing remains a challenge.

For new teachers, a common employment pattern is to spend some years as substitute teachers or in short-term replacement positions, building up experience for a résumé to use when seeking more permanent employment. Alternatively, some new teachers start teaching in remote communities before seeking employment in larger centers. However, because local school boards have the prerogative when selecting employees,

2 The British Columbia Teachers College no longer exists, but was operating at the time of TEDS-M.

the time a candidate has served in remote areas is neither a necessary nor a sufficient condition for selection in a larger community.

Teaching in Canada is primarily position based in the sense defined in the OECD (2005) report *Teachers Matter*. (However, it has some of the features of a career-based system as well.) For many who enter the profession, teaching is more a vocation than a career, and these individuals expect to pursue it in one form or another throughout their working lives. However, teachers are initially recruited for a specific position, one to which particular qualifications may be attached. After experiencing an initial probationary period, teachers might move based on seniority. When positions open up, established teachers are given preference over new teachers, subject to some conditions relating to qualifications. Salary scales are typically based on a candidate's years of education and university degrees; they are not generally differentiated by subject specialization or by assessed competence.

Teachers' salaries and working conditions are matters negotiated between employers and the teachers' unions or professional associations, which are typically quite strong. Although salaries are generally not high by the standards of other professions in Canada, teachers have strong job security and benefits. In most cases, salary scales and major elements of working conditions are based on province-wide collective agreements. However, in some jurisdictions, school boards, as the employers, may vary in terms of the working conditions they offer their teachers.

Part II: Organization and Characteristics of Teacher Education

Responsibility for teacher education

Up to the middle of the 20th century in Canada, teacher education usually took place in institutions offering specialized teacher education programs; some were affiliated with universities while others more closely resembled branches of the ministries of education. By the 1960s, most teacher education programs had been integrated into faculties of education in universities, but vestiges of the earlier system remained in some jurisdictions until the 1990s.

Nowadays, all teacher education across the country takes place in universities. Because universities are relatively autonomous from government, they are free to organize their programs as they see fit, while being conscious of provincial certification requirements. Most universities ensure that their programs conform to these requirements. In practice, this process is a matter of collaboration between the universities and the certification bodies.

Students enrolled and program size

Approximately 50,000 students enroll in teacher education programs each year (Statistics Canada, 2008). The trend in enrollment over time has been a slight decline in the 1990s followed by a slight increase since 2000. The ratio of females to males is more than three to one, and there has been a slight increase in this ratio in recent years. Just under 40 percent of those enrolled, or about 18,000 students, graduate in any one year, a figure that has remained fairly constant. However, due to the range of one-year and multi-year education programs offered, this percentage cannot be taken as a direct measure of productivity.

Programs range widely in terms of the number of students they enroll—from fewer than 100 to close to 4,000 students, and graduating about 30 to more than 1,200 students per year. The number of faculty members ranges from as low as six to more than 150. The number of programs reflects program variety and specialization. For example, programs in small institutions may take a liberal-arts focus, their rationale being that a general program in liberal arts and the foundations of education is appropriate preparation for teaching at any level. Such universities tend to consider their small size a virtue; they highlight in their promotional materials not only their small classes but also the close ties between faculty and students and their focus on liberal arts.

Qualifications

Because most jurisdictions have strong incentives for upgrading academic credentials built into their salary scale, most teachers continue their academic education beyond the first degree, and typically have two undergraduate degrees as their highest academic credential. However, close to 20 percent of teachers have a Master's degree, usually in education. The proportion holding advanced degrees varies across jurisdictions and is linked to the structure of the certification/salary scale.

In either of the two routes to the B.Ed., most institutions offer programs at two levels, primary and secondary. Teachers of the primary grades are usually considered generalists, but teachers at the secondary level are expected to specialize in one or more disciplines. Most primary programs are concurrent, and most secondary programs are consecutive. In some jurisdictions, teaching certificates are endorsed only for specific levels or subjects. However, the extent to which the teachers holding these endorsed certificates are restricted to their defined areas of specialization varies with jurisdiction and location and depends on teacher supply and demand. A nationwide survey of teacher education conducted by Crocker and Dibbon (2008) revealed that most primary teachers consider themselves to be generalists, whereas secondary teachers are divided on this matter: some perceive themselves to be specialists, while others believe they have the ability to teach a variety of subjects in addition to their main subject or concentration of subjects.

Beyond the two program routes and the two levels for which teachers are prepared, a variety of more specialized programs can be found. For example, physical education and music are often separated from mainstream programs and offered either through the respective academic units or through collaborative arrangements between units. Special education, second-language teaching, Aboriginal studies, and technological studies are other examples of areas in which specialized programs have been developed. Sometimes, these programs are organized as separate degrees (such as the Bachelor of Special Education or the Bachelor of Physical Education), but these areas are also found as specializations within the mainstream degrees.

Curriculum and field experience requirements

Universities establish the curriculum requirements for teacher education, but they generally design them to conform to provincial teacher certification requirements. The curriculum for those planning to teach at the primary level usually has a larger component of professional courses than the curriculum for those intending to teach at the secondary level because primary teachers are not expected to be specialists. This pattern at the primary level ensures greater emphasis on child development, particularly language development.

At the secondary level, most jurisdictions require candidates to specialize in one or more teachable subjects. Candidates who meet this requirement in consecutive programs usually have acquired an academic major during their first-degree program. This entry requirement, laid down by provincial bodies, effectively restricts the range of majors that applicants can cite as relevant to a teaching career. For example, applicants who have majored in psychology, philosophy, the classics, or other disciplines not common in secondary school curricula are not eligible for entry into a teacher education program unless they have also taken a substantial number of courses in an accepted teachable area. This situation means that some candidates who wish to teach must take additional courses beyond their first degree before they can be accepted into a program.

Most programs require courses in foundational areas—educational psychology, sociology of education, history of education. A course in student assessment is also common. Professional courses in a range of subjects taught in primary schools are also required for prospective primary teachers. Secondary teachers typically limit their professional courses to their subjects of concentration. In some programs, there is debate over whether the specialist/generalist division is justified, especially on the grounds that secondary teachers are often asked to teach outside their area of specialization.

The number and the nature of content courses in a program are strongly related to the length of the program. Short consecutive programs, such as those in Ontario, have little room to broaden their scope beyond the core courses, especially when the practicums take up the largest proportion of such programs. Programs of three or more semesters could offer more scope for either elective courses or increased depth in subject specialties.

All programs require some form of practicum experience. Indeed, this is one of the few areas in which program structure is substantially driven by external requirements. Respondents to the aforementioned National Teacher Education Survey (Crocker & Dibbon, 2008) reported that the total length of the practicum varied from about 8 weeks to 21 weeks or more. The number of weeks given over to the practicum was strongly connected to the length of the total program. For example, a practicum of 8 to 12 weeks was the norm in Ontario, where programs were the shortest; in Québec, most graduates reported having a practicum of 21 weeks or longer, reflecting the province's much longer program requirement. Practicums of 13 to 20 weeks were typical of institutions in other jurisdictions, with the exception of Nova Scotia, where the two-year consecutive program offered scope for practicums of 21 weeks or more.

Practicums operate through cooperative arrangements between universities and the school districts within the region. Students are placed in local schools under the supervision of a cooperating teacher, that is, a practicing teacher who assumes most of the responsibility for development of the student teacher. In most institutions, a faculty member or clinical associate within the faculty is responsible for periodically visiting the schools to observe the student teachers in classrooms and for then using those observations to evaluate each student teacher's competency. The extent of faculty involvement in the practicums varies substantially across institutions.

The National Teacher Education Survey also revealed that the student teachers surveyed regarded the practicum as the most valuable part of their teacher education experience, a view shared by school principals. Moreover, the student teachers judged the quality of supervision received from cooperating teachers to be higher than that provided by members of the faculty of education at the university.

Staffing requirements

Canada has neither national nor provincial requirements regarding the qualifications of faculty members in the country's teacher education programs. Today, almost every university sets the minimum requirement of a doctorate for teacher educators seeking a permanent position (tenure track) in the faculty of education. However, it is common for these same universities to draw upon either experienced teachers from the school system or graduate students to teach courses or supervise student teachers.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

Because universities are largely autonomous, operating independently of government, each university can determine the number of places available for teacher education students. In some jurisdictions, both provincial and institutional quotas govern the amount of funding the province provides. Although universities are not bound by these quotas, departing from them would mean allocating the funding for teacher education from the university's overall budget, because tuition fees do not cover the total cost of programs.

There seems to be no direct link in Canada between the number of student admissions and the market demand for teachers. Institutional quotas vary little from year to year and barely shift across areas of specialization in response to labor-market demand. Students are free to apply to a variety of institutions and to attend programs outside their provinces, without reference to local or national market demand.

Admission requirements are determined by individual universities, but for all of them, the core requirement is the applicant's academic record, expressed in terms of grade point average or percentage grades achieved in prerequisite programs. In the concurrent programs, the typical applicant's academic record includes grades attained in any previous university course and, in Québec, grades attained in college programs taken prior to entering university. Applicants to consecutive programs usually must have the minimum requirement of a first degree. In general, the applicant's minimum average grade in the first-degree program (or part of it if first-year grades have been disregarded) is included. Some consecutive programs may refer to grades attained in specific areas such as a language or a teachable subject. The minimum grade required for entry varies substantially across institutions and provinces.

Even where grades are the exclusive criterion for admission, a student's chance of admission depends on whether or not the stated quotas are firm and on the number of total applicants. Institutions with fixed quotas and large applicant pools undertake a ranking process, filling places by starting with applicants in the top academic ranks and working downward until the quota is filled. Institutions without fixed quotas are free to take all who meet the minimum requirements or to cut off admission at some arbitrarily determined point above the minimum.

Many institutions have admission requirements that extend beyond academic standards. The four main types of nonacademic requirements are work experience, essays or profile statements, references, and interviews. Work experience is the most common requirement, and usually refers explicitly to work with children and youth. Some institutions require essays or written profile statements as well as outlines of work experience; others require a description of why the individual wants to be a teacher or commentary on the challenges that teachers face in today's schools.

Only a few institutions require personal references, and interviews are relatively uncommon. In isolated cases, a criminal record check may be required. Several institutions state a preference for candidates who are resident in the province or who are from a minority group or other under-represented group. No institutions require applicants for admission to teacher education faculties to take specific aptitude or competency tests, even though tests of this kind are not uncommon for entry into the programs of other professions.

The entry requirements for prospective mathematics teachers are the same as those for all other disciplines, except for the small number of programs that focus specifically on mathematics. For consecutive programs at the secondary level, the first degree includes, among other fields, a major in mathematics. It is typical for these students to specialize in their major area and perhaps one other related subject area within their teacher education program, with the expectation that they will become specialists in these areas as teachers. For concurrent programs, reference is typically made to a teachable subject, with the expectation that candidates will take both academic and professional courses in that subject in preparation for subject specialization as teachers.

Applicants wanting to teach in primary or secondary schools are usually considered generalists. At this level, only a few subjects—typically music and physical education—are considered specialties. Although some teachers at primary level may have an academic degree with a major or a concentration of courses in mathematics, there is no expectation at this level that, on graduation, they will actually teach only mathematics.

Admission to an education faculty is highly competitive. However, no detailed information is available on how the academic standards of applicants to teacher education programs compare to those of applicants to other professional preparation programs.

Accreditation of teacher education institutions and programs

Both the development and the updating of teacher education programs lie in the hands of the universities. Although major changes to program structures, such as a shift from offering a concurrent program to offering a consecutive program, are relatively rare, internal changes to admission requirements, courses, sequences, practicums, and other components are common. Program revisions originating within faculties of education may require, depending on the extent of the changes, the approval of higher-level university bodies, such as a university senate. Sometimes the changes may be precipitated by changes to requirements for certification. For example, a few years ago in one province, extending the teacher education program from one year to two years as a condition for certification meant that all universities in that province had to shift to a two-year program. Such a change is unusual, in that it would rarely be done without collaboration between the universities and the certification body.

No system of accreditation for teacher education programs exists at the national or, with the partial exception of Ontario and British Columbia, at the provincial level. In addition, some programs are subjected to external review, either as part of a more general university review process or in response to public or professional concerns over quality. Beyond this, some jurisdictions have provincial bodies that oversee program quality. Such bodies may also commission external reviews or, in some cases, have an internal mechanism through which this is done. Proposals to establish new programs are almost always subject to external review, initiated either within the university as part

of a normal new program-approval process or by a provincial agency. In one region, an interprovincial body representing the provinces in the region conducts the review of new programs.

Requirements for entry to the teaching profession

Provinces such as Ontario and British Columbia have statutory professional standards agencies that provide certification automatically (apart from police checks and the like) to graduates of programs they have accredited. The Ontario College of Teachers, for example, provides certification, but only for teachers who have graduated from a university that the College of Teachers has accredited. Its certification is portable, given that all local employing authorities (school boards) and other provinces across Canada recognize it.

References

Crocker, R., & Dibbon, D. (2008). *Teacher education in Canada.* Kelowna, BC, Canada: Society for the Advancement of Excellence in Education. Available online at http://www.saee.ca/pdfs/Teacher_Education_in_Canada.pdf

Organisation for Economic Co-operation and Development (OECD). (2005). *Teachers matter: Attracting, developing and retaining effective teachers.* Paris, France: Author.

Statistics Canada. (2008). *University degrees, diplomas and certificates granted by program level: Classification of instructional programs, primary grouping and sex.* Retrieved from http://dc2.chass.utoronto.ca

CHAPTER 3:

Chile

Editors' Overview

Most teacher education provision in Chile focuses on preparing generalist teachers for all subjects of the eight-year basic school. In this respect, Chile differs from most countries, where teachers for Grades 7 and 8 (and sometimes 4, 5, and/or 6) are prepared differently and are more specialized than teachers in the lower grades.

Institutions and governance

Responsibility for teacher education in Chile is almost entirely delegated to the universities, as well as to a few tertiary-level professional institutes. During the 1990s, most teacher education in Chile took place in publicly funded universities. More recently, however, a growing number of private universities have started to provide teacher education. TEDS-M sampling information shows that when TEDS-M began in 2006, 16 public universities, 22 private universities, and 5 professional institutions were offering teacher education program-types for basic education teachers.

Chile has no established government policies related to coordination of teacher education. Instead, the Ministry of Education maintains an informal relationship with teacher education institutions.

Program-types and credentials

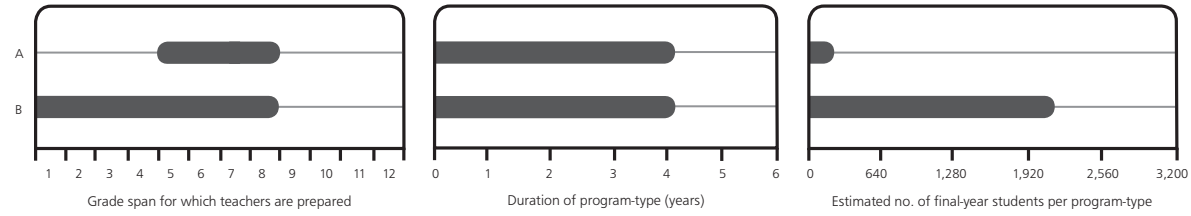
Applicants for teaching positions must have a teaching qualification from a university or professional institute appropriate to the level in which they are to teach. Beyond that, there are no national requirements governing appointment in schools. The Organic Law of Education (1990) defines teaching qualifications in terms of a licentiate degree in education and a teaching entitlement (*Titulo de Professor*).

In most institutions, teacher education is offered as a concurrent program-type, lasting from 8 to 10 semesters. However, as mentioned above, the main program-type prepares future teachers to teach all subjects in Grades 1 to 8, and 11 institutions offer supplementary subject-matter specialization, requiring candidates to take additional courses in a particular subject. As Exhibit 3.1 shows, compared to the program-type for Grades 1 to 8, the program-type with additional mathematics prepares only a few teachers.

Curriculum content, assessment, and organization

Within the Chilean program-types, the offerings are similar: subject-matter knowledge, pedagogy, general education, and field experience. A semester-long or four-month practicum is required in addition to the program-long field experiences. The licentiate mandates a written thesis. Students spend the majority of their last semester on this requirement, working individually or collectively.

Exhibit 3.1: Teacher education program-types in Chile



Key to program-type

A—Generalists, but with additional mathematics education

B—Generalists

Note: According to the national research coordinator for Chile, the program-type offering extra mathematics did not include enough mathematics to warrant it being designated a specialist program-type. Estimates for the final-year students per program-type were calculated as the mean of the estimates from the two subsamples for Program-Type B.

Preparing Teachers of Mathematics in Chile

Beatrice Avalos Davidson

Part I: Context and Conditions of Teaching as a Career

Historical roots

Chile has a long history of institutionalized teacher education that dates back to the 1840s. Chile, with the assistance of the Argentine educator Domingo Faustino Sarmiento, was the first country in Latin America to establish (in 1842) a normal school to prepare male teachers. A few years later, Chile entrusted the first normal school for women in the country to a religious congregation. With the assistance of Chilean educator Valentín Letelier and a group of German educators, Chile also pioneered, in 1889, the establishment of secondary teacher education. In the mid-1890s, this program became the Pedagogical Institute (Instituto Pedagógico) within the University of Chile, thus establishing Chile's tradition of secondary teacher education as a university task.

During the first part of the 20th century, primary teacher education in secondary-school-level normal schools grew considerably, with boarding facilities and recruitment of the best students from primary schools all over the country. For most of the 20th century, normal schools offered an important avenue of social mobility for students from middle- and low-socioeconomic groups.

By the mid-1960s, normal schools were well established as was secondary teacher education, which was offered at six universities, with the Faculty of Education of the University of Chile being the biggest and most prestigious institution of this kind. One other university also prepared teachers for secondary technical schools. All these institutions, however, were preparing teachers for an education system that needed to change.

In 1965, Chile began a major education reform that aimed to restructure the 6–6 system, that is, the six-year primary school (terminal for most of the population) followed by six years of a highly elitist secondary school. The new structure, in accordance with a UNESCO recommendation that all young people have at least eight years of general education, resulted in an eight-year basic general school and a four-year secondary school divided into an academic and a technical-vocational stream. In line with this structure, teachers are now prepared as preschool, basic generalist teachers (Grades 1 to 8) and as secondary teachers (Grades 9 to 12) in one or two curricular areas. Given the fact that it is difficult for generalist teachers to cover all subjects in the upper grades, another change was brought in that enabled small numbers of basic education teachers to receive extra subject-matter tuition directed toward some degree of subject specialization.

These reforms had an important effect on normal schools. They were restructured and upgraded to tertiary level and increasingly became associated with university faculties of education. Teachers prepared in the old system were offered the opportunity to upgrade their qualifications through special diploma courses at universities.

Teachers and teacher education suffered severely during the military dictatorship of 1973 to 1990 due to arbitrary dismissals of teachers and teacher educators and to erratic policies regarding the status of teacher education. One of the first decrees affecting

teacher education toward the end of 1973 resulted in the closure of the normal schools and the transferal of their programs to universities. This event led to the teacher-training curriculum being altered. Subject specialization was discontinued in favor of an entirely generalist preparation.

The military authorities interfered in teacher education programs in other ways, and many professors were dismissed and replaced by persons acceptable to the regime—persons who did not necessarily have the same level of qualifications. Then, in the early 1980s, the military government, reversing its earlier decision, decreed that preparation for teaching would no longer involve a university program or qualification. In order to implement this edict, the regime transferred all university teacher education programs, with a couple of exceptions,[1] to professional institutes or newly established higher pedagogic academies. This development saw the University of Chile's prestigious faculty of education "extracted" from the university and turned into a higher pedagogic academy, as was its branch in the city of Valparaiso.

These changes, as well as a new law that affected teacher working conditions (1979), lowered the intake into teacher education both in numbers and quality, especially from 1985 until about 1995, as documented by Ormeño et al. (1996). The changes also severely affected the quality of teacher education programs (Avalos, 2002).

The erratic nature of the military government decrees did not stop with the creation of pedagogic academies. In 1987, the government issued a new decree, which ruled that the two major pedagogic academies (former faculties of the University of Chile in Santiago and Valparaiso) be upgraded to pedagogic universities. Although this change "meant a reformulation of the official discourse … [it] did not necessarily imply a change in the corresponding political practice" (Núñez, 2002, p. 37).

Later, having passed the Organic Law of Education in 1990, which occurred just before the new government came into power, the military regime restored teacher education's status as a university program, ruling that it should entail the award of a licentiate degree. Existing professional institutes could continue with their programs, but without further changes unless authorized by the Ministry of Education.

Taken together, the policies and actions directed at teachers and teacher education during the military dictatorship dealt a severe blow to the tradition and quality of teacher education in Chile, from which it has only slowly recovered. Education historian Iván Núñez (2002, p. 35), referring to a speech of the military authority in charge of one of the higher pedagogic academies, wrote, "the demoting of teacher education to a nonuniversity career status affected not only its image and status. It also meant that a purely technical-methodological concept of teaching was repositioned and endowed with an authoritarian character (learn to teach, learn to obey in order later to command)."

When engaging in further discussion of teachers and their work in Chile, we need to understand the structure of the country's primary and secondary education system, which was last modified in 1965, and how well it functions. In terms of management and ownership, the system has three main types of school: municipal or public schools that are entirely funded by the state; subsidized private schools, also funded by the state but managed privately; and wholly private schools. There is also a small group

1 Teacher education programs in the Catholic University of Chile and the Catholic University of Valparaiso.

of schools that are publicly funded, but with administration delegated to corporate enterprises. Just over half of the school population attends the publicly funded system, but an increasing number of students are moving from the municipal to the subsidized private sector. Exhibit 3.2 shows the current distribution of teachers by school type.

Exhibit 3.2: Percentage of total pool of classroom teachers (N = 140,315) by type of school

Type of School	School Level*		
	Preschool (% of total teacher pool)	Primary or basic (% of total teacher pool)	Secondary or middle (% of total teacher pool)
Municipal	41.60	51.60	41.40
Private subsidized	37.60	38.30	40.30
Private	20.80	10.00	13.40
Corporate	0.00	0.01	4.90
Total percent	100.00	100.00	100.00
Total number of teachers	14,294	83,574	42,447

Notes: * Excludes special education and adult education teachers.
Source: *Ministry of Education Statistical Yearbook 2007.*

During the military regime, the government introduced a voucher system of funding for Chile's municipal and subsidized private schools, as recommended by neoliberal economists. The rationale for this change was to gradually privatize the entire system on the assumption that private schools would be better managed and have better achievement results, so persuading parents to move their children out of the municipal system. This, in fact, is now happening, but for reasons that link more to the nature of municipal management and the restrictions under which it works than to an inherent advantage over subsidized private schools. The voucher system has indeed introduced competition among schools for students, but it has also led to a certain degree of fraud in order to show high levels of school attendance, given that funding is based on student numbers and attendance at the time of inspections.

Until 1973, teachers in Chile were primarily "public servants" and identified themselves as such. With the exception of teachers in the entirely private schools, all teachers were employed by the Ministry of Education and deployed in schools according to need. Their status changed drastically under the military government, when teachers became employees of the municipal authorities to whom the management of government schools was delegated in 1980. This meant that municipal authorities, which during the military regime were government appointees, had the power not only to employ teachers but also to dismiss them.

Once teachers were removed from the national public employee payroll, their salaries no longer increased in line with those of other public servants; by the beginning of the 1990s, teacher salaries were considerably lower compared to what they had been in the early 1970s. The impact of these measures on how teachers saw and valued themselves, as well as on public opinion, was enormous. Lomnitz and Melnick (1991), in their study of teachers during the military dictatorship, noted that any governmental attempt to improve working conditions was undermined by the effect on teacher morale of being managed by municipal authorities and by the erosion of their salaries.

With the return of democratic government from the beginning of 1990, the government had, as a main priority, addressing teacher grievances, raising teachers' salaries, and

providing a legislative basis for teachers' conditions of employment. The next section describes the situation today as a result of the changes that occurred during the 1990s and on into the new century.

Conditions at the time of TEDS-M

The manner in which teachers are now hired and promoted in Chile depends on their employer. The hiring and promotion regulations for municipal teachers are established in the Teachers' Statute, a law that has been in force since 1991. Tenured teachers in municipal schools are hired by municipal authorities on a publicly competitive basis and may remain there until retirement. Teachers may also be hired on a fixed temporary contract to serve temporary needs (such as replacement of a tenured teacher) or to perform specific tasks. Tenured teachers can be dismissed only if they fail to comply with contractual obligations, or for other actions punishable by law. However, more recently, under a new teacher performance evaluation system affecting only municipal teachers, if a teacher receives a rating of an "incompetent" performance in three consecutive evaluations (after being provided with support), he or she is dismissed from the municipal system.

As set out in the Teachers' Statute, the contractual conditions of teachers in subsidized private schools and wealthy private schools are ruled by the labor legislation established for occupations in general (*Código del Trabajo* or Labor Code); these teachers do not have security of tenure as in the municipal system. However, the functions for which these teachers may be contracted are set out in the Teachers' Statute, as are their working conditions (e.g., maximum teaching hours).

In short, there is no teaching career in Chile in the sense described in the OECD's *Teachers Matter* (2005, p. 206). What is emphasized in the Teachers' Statute are the conditions for salary increases for teachers in municipal schools. These are "years of service," evidence of inservice training (courses taken), teaching under "difficult conditions" (school location or nature of the school's student intake), and becoming a school administrator (principal or pedagogic head). Teachers may also benefit from different incentive schemes in operation, such as the rewards system for high-performing schools known as SNED (*Sistema Nacional de Evaluación Docente*) or for teachers deemed to have exhibited "excellent performance" under the criteria set out within the teacher performance evaluation system. All of these incentives are temporary in nature.

The municipal schools throughout Chile negotiate teacher salaries with the government every two years. Increases are paid by the national government via the school subsidy system to the municipal authorities. Teacher salaries in private schools are negotiated with employers within the frame established by general labor legislation, but must not be less than the minimum salary wage for teachers in the municipal system. In general, teacher salaries in private nonsubsidized schools are higher. Since the beginning of the 1990s, when teacher salaries in municipal and private subsidized schools were at their lowest point, salaries have increased substantially through the negotiation processes. Today, they are more than 150 percent higher than they were in 1990.

Fulltime tenured classroom teachers are usually appointed for 30 or 44 chronological hours. However, they may be employed for a shorter time, depending on school needs. What this means in terms of workload is shown in Exhibit 3.3. Teaching hours in Chile of an average of 873 per year are above the OECD average and at the highest end of the range of countries included in the OECD's *Education at a Glance* 2006 figures.

Exhibit 3.3: Teachers' weekly workload according to terms of appointment

Appointment (in hours)	Recess (in hours)	Classroom Teaching Periods (45 minutes)	Classroom Teaching Periods (60 minutes)	Nonteaching Activities (meetings etc.)
44	3 hours	43	32 hours, 15 minutes	8 hours, 45 minutes
30	2 hours, 30 minutes	30	22 hours, 15 minutes	5 hours, 27 minutes
10	41 minutes	10	7 hours, 30 minutes	1 hour, 49 minutes

Source: Teachers' College (www.colegiodeprofesores.cl)

Teachers may work in classrooms of up to 45 students; these are mostly in the poorer neighborhoods of the big cities, such as Santiago. However, actual class sizes vary according to geographical regions (urban/rural) and the type of school involved. Average class size is 31 for basic-level schools (Grades 1 to 8) and 36 for secondary schools (Grades 9 to 12). They are higher than the averages in subsidized private basic and secondary schools (34 and 37, respectively) and lower in wealthy private schools (24 and 26, respectively) (Ministry of Education, 2007).

Because of the proportion of contract time that teachers must spend in classroom teaching and the number of students per class, teachers find themselves with little time to engage in other professional activities. Thus, over two-thirds of a sample of 6,000 teachers questioned in a national survey felt they had "little or no time" to prepare lessons, assist students with difficulties, and work professionally with other teachers (Microdatos Center, University of Chile, 2006).

Most teachers in preschools and basic schools are women (98% and 93%, respectively), while just over half of all teachers in the secondary-academic stream are also women (58%). However, less than half of all teachers teaching at the secondary technical-vocational level are women (42%). In terms of age, teachers tend to be older than their counterparts in other Latin American countries. Thus, 34 percent are between 41 to 65 years of age while only 10 percent are in the 26 to 30 range. In private subsidized and private schools, teachers are younger, probably because they are subject to fixed-term contracts and so can be dismissed more frequently.

According to a study on supply and demand of teachers conducted by Montoya in 2005, there appeared to be enough preschool teachers to serve the system, but it was thought that this situation could turn into a shortfall as policies aimed at widening access to this level were implemented. Basic school teachers were slightly insufficient in number to cover the needs as assessed in 2004, but this shortage was expected to gradually diminish due to lower birth rates in the country. Most of this shortage has been in the rural areas and some specific regions of the country.

Secondary education has more teachers than needed, but they are not equally distributed among specializations. Major shortfalls occur in the sciences and mathematics. Assuming that current conditions persist, the supply of teachers is increasing for almost every school level, but especially for secondary education, where a considerable oversupply is expected between 2010 and 2015 (see Montoya, 2005). This oversupply could diminish, however, if other scenarios are considered, one being a reduction in class size.

If addressed, a critical factor that is discussed later in this chapter might affect the supply and demand of teachers. This factor has to do with the fact that basic school teachers tend to have inadequate curricular knowledge due to their training as generalists for the entire eight-year span of the basic school. This lack relates especially to knowledge of subjects such as mathematics and science. Information gathered by the TIMSS 2003 teacher questionnaire made clear that only half of the Chilean Grade 8 teachers surveyed felt confident about teaching algebra and measurement, and only a third were confident of their ability to teach geometry and statistics (Ministry of Education, 2004). The teachers who expressed confidence tended to be those teaching in Grades 7 and 8 in private schools, and the reason for their confidence was probably the fact that they were qualified secondary teachers with a mathematics specialization.

In recent times, teacher education has become a subject of attention due to the persistence of unsatisfactory learning results as measured by the National Assessment System (SIMCE) as well as international studies such as IEA's Trends in International Mathematics and Science Study (TIMSS) and the OECD's Programme for International Student Assessment (PISA).[2] Ramírez (2006), having examined the low achievement in the TIMSS mathematics assessment of Chilean students, concluded that, among other factors, the preparation of teachers and the lower level of expected achievement in the school curriculum played an important role in this outcome. She also noted that students from socially advantaged groups attending private schools had benefited from the more demanding curriculum and more effective teachers in these schools.[3]

However, the number of young teachers in the system is not sufficiently high as to make recent teacher education responsible for the learning results on these tests.[4] The conditions of teacher education in the 1980s and early 1990s were more important, as was the fact that teacher education remained closely aligned with the educational structure and did not offer subject specializations for the eight-year basic school. Most of the private schools concerned about the lack of sufficient content knowledge among basic school teachers have endeavored to remedy this problem by employing secondary teachers who do have a subject specialization to teach Grades 8 and 7. However, this practice does not necessarily occur in the public municipal system.

Part II: Organization and Characteristics of Teacher Education

Responsibility for teacher education

Teacher education in Chile is defined in the Organic Law of Education (1990) as a university track leading to both a licentiate degree in education and a teaching entitlement (the *Título de Profesor*). The law also recognizes the nongraduate certification in teacher education offered by a small number of professional institutes.

During nearly all of the 1990s, most teacher education programs were located in universities that had traditionally received public funding (referred to hereafter as "traditional" universities). However, new programs gradually opened in private

2 Although recent results from PISA show a better picture of Chilean student learning.

3 A study analyzing 2003 TIMSS data (Akiba, Le Tendre, & Scribner, 2007) showed that Chile was in second place among 40 countries in terms of the "opportunity gap" favoring affluent students with access to "quality teachers" in mathematics.

4 The proportion of teachers 30 years of age and under is only six percent in the entire system. Eight percent of these young teachers are employed in the public subsidized system.

universities, mainly for the preparation of preschool and basic education teachers. The growth of these private providers is largely a result of market conditions. Starting a teacher preparation program is a relatively low-cost initiative. It is also fairly easy to attract candidates, given the growing number of secondary school graduates who aspire to a higher education qualification but who have yet to reach the entry level that the traditional publicly funded universities require.

Exhibit 3.4 illustrates the growth of these separate basic teacher education programs in private universities, most of which started only a few years before the TEDS-M data collection. Several of these universities offer the same or a similar program in different locations of the country, but the conditions on offer in these places are not necessarily the same as those in the main campuses.

Most basic teacher education programs in all types of institutions focus on the preparation of generalist teachers for all subjects of the eight-year basic school. A few programs offer a specialization over and above the generalist training, which in practice means three or four extra courses in the specific subject matter. But such cases are few and do not cover all of the major school curriculum subjects (Spanish language, mathematics, social studies, natural sciences, and English). Exhibit 3.5 illustrates the distribution of mathematics specialization by type of institution.

Exhibit 3.4: Changes in numbers of students enrolled in programs preparing basic education teachers, by type of institution

Type of Institution	2002		2006*	
	N	*Percent*	*N*	*Percent*
Traditional universities	6,100	52.70	5,260	28.10
Private universities	4,403	38.00	11,329	60.60
Professional institutes	1,079	9.30	2,105	11.30
Total	11,582	100.00	18,694	100.00

Note: *At this time, 17 traditional universities, 31 private universities, and 5 professional institutes were offering basic education teacher preparation programs.

Source: Prepared on the basis of 2002 figures from the Higher Education Division of the Ministry of Education (2003) (www.mineduc.cl) and 2006 figures from the Higher Education Council (2007) (www.cse.cl).

Exhibit 3.5: Number of teacher education programs that include extra mathematics for the basic school (Grades 5 to 8)

Type of Institution	Number of Programs Including a Mathematics Specialization	Total Number of Basic Teacher Education Programs
Traditional universities	5	25
Private universities	4	114
Professional institutes	3	11

Source: Institutional reports from the Higher Education Council, 2007.

In order to widen the scope of these specializations and improve their quality, the Ministry of Education is providing funds on a competitive basis, but only to four consortia of traditional universities (12 institutions), for the planning and implementation of specializations in four main curriculum subjects (mathematics, science, social studies, and Spanish language).

Public and private universities also offer secondary teacher education programs. In order to boost the numbers enrolled in mathematics teaching programs, these courses tend to be combined with those focused on another subject, such as physics or computer studies. As can be seen in Exhibit 3.6, which shows the number of future secondary school teachers of mathematics in each type of university program, the institutional base for secondary teacher education is the reverse of what happens in basic education. It is the traditional universities that prepare most of the secondary teachers. They not only have a long history in this area but also have, when carrying out this work, more academic resources than do many of the newly established private universities.

Exhibit 3.6: Total number of students enrolled in mathematics secondary teacher education programs by type of university

Type of Institution	Number of Mathematics Future Teachers	Percent
Traditional universities	2,789	86.10
Private universities	450	13.90
Total	3,249	100.00

Source: Higher Education Council, 2006.

Currently, Chile has no established government policies or coordination mechanisms for the country's system of teacher education. However, for a few years in the mid-1990s, Chile did have in place a formal policy geared toward improving the quality of teacher education (outlined in President Eduardo Frei's 1996 address to the nation). This policy resulted in around US$M25 (1996 exchange rate) being allocated on a competitive basis to university teacher education programs. Seventeen universities received funds to implement improvement projects.

Throughout the life of this project, which extended from 1992 to 2002, the Ministry of Education housed a national coordinating center. It provided a regulatory and coordination system for these universities. However, after the end of the project, the Ministry of Education ceased to have the same kind of involvement and instead currently maintains an informal relationship with the traditional universities and a few of the private ones, through a section within the Center for Inservice Training (CPEIP).

As for the institutions themselves, the deans of faculties of education in traditional universities have a longstanding organization that meets regularly two or three times a year. Also, at least two other different networks involving the deans or heads of education departments in private universities meet on a regular basis.

Finally, a network of authorities in traditional universities and a few private ones, initially convened by the Minister of Education in 2005 to review the teacher education system, produced a report (Ministry of Education, 2005) that was endorsed by the rectors of all the public universities and most of the private universities and professional institutes. However, the Ministry of Education has been unable—legally and logistically—to monitor implementation of the changes that were agreed upon.

This lack of regulatory power over teacher education was discussed during the meetings of a council convened to consider the quality of Chilean education. Council members agreed on several resolutions and incorporated them into their final report (Presidential Advisory Council on the Quality of Education, 2006). Of these resolutions, the most important, which is now part of a new law of education, is a change in the structure of the education system. The new system, which will be in place in 2017, will consist of a 6–6 structure, involving 10 years of general education and two further years of specializations (academic and technical-vocational).

The new structure is requiring teacher education programs to reform their curriculum and provide teachers with different kinds of specializations. Specifically, teachers wanting to teach at the six-year basic school level will need to specialize in a maximum of four subjects (language, mathematics, science, and social studies). Subjects such as the arts, English, and physical education will be taught by specialists who have been prepared to teach at any level of the education system. Secondary teacher education will move from preparing subject specialists for the four-year structure to preparing specialists for the new six-year structure.

Such a major overhaul of the teacher education system, designed as it is to fit the needs of the new structure and to ensure stronger content knowledge among teachers working at the basic or primary level, implies changes that many of the small basic-teacher preparation programs in private universities will have difficulty adopting. At present, these programs have insufficient resources to provide the specializations needed and may therefore have to concentrate solely on preparing teachers for the initial years of the education system.

In response to such problems, the Ministry of Education decided to allocate a significant sum of money to aid improvement of teacher education programs. Emphasis is on renewal of academic staff (with a fund for retirements), stronger academic preparation of teacher educators, a review of the teacher education curriculum, and better relationships with schools. Funds will be allocated on the basis of a competition that will be open to all institutions (public and private).

In most universities and professional institutes, teacher preparation is offered in concurrent programs that last from 8 to 10 semesters. A small group of universities prepare secondary teachers (Grades 9 to 12) in consecutive programs, generally by offering a two- to three-semester professional preparation (pedagogy, subject-teaching methods, and field experiences). These programs tend, however, to attract graduate degree holders in the humanities and arts, but not in the sciences or mathematics.

Until recently, several traditional universities offered teacher education programs using a distance or semi-distance mode of delivery. Due to pressures from their counterparts and, to some extent, from the Ministry of Education, and due even more so to their negative effect on the chances for gaining accreditation, all of these programs have been discontinued. The lack of studies comparing their graduates with graduates from campus-based program delivery makes it hard to know if the programs did indeed provide a second-rate preparation.

Curriculum and field experience requirements

A review of the curriculum in the different teacher education institutions (Avalos, 2002) revealed a similar organizational structure covering curricular-subject knowledge, pedagogy, general knowledge, and field experience. As a result of improvement projects developed between 1997 and 2002, most universities broadened the scope of the field experiences so that they began earlier in the program and ended with an extended practicum in schools. Generally, the final practicum, covering the last semester of the programs, receives varying degrees of oversight by university supervisors (from once a week to once a month). Classroom teachers who share this responsibility provide closer supervision.

Despite common features, differences still exist among the institutions. These differences relate especially to the weight given to school curriculum content knowledge. The weighting is clearly heavier with respect to the preparation of secondary teachers, and lighter in regard to the preparation of basic school teachers because of the generalist nature of the latter's programs. But, as indicated above, this differential will change due to the demands of the new school structure. To a large extent, also, and except where there are specializations, basic school teachers learn the subject matter in conjunction with teaching methods. As for pedagogical content, there are also some differences among the institutions in the weighting given to and the nature of the courses.

In regard to secondary teacher education, a survey carried out for a set of case studies funded by the World Bank and the UK Department for International Development showed that there tends to be a gulf in Chile between courses in teaching methods and the demands of the curriculum and schools. Another gulf exists between the faculties that offer subject-matter specialization and the faculties of education that offer professional preparation (Avalos, 2004).

There are also differences in requirements, depending on the type of certification received. University preparation includes the award of a licentiate[5] degree. This, in turn, requires the writing of a thesis. Students spend the major part of their last semester of studies on the thesis, which may be done collectively in a group or individually. All student teachers preparing for the licentiate degree, regardless of the school level for which they are being prepared, must complete a thesis. Professional institutes do not award a licentiate degree but only the teaching entitlement, that is, the *Título de Profesor*. In this case, the writing of a thesis may not be required.

Finally, there are differences among the programs in the number of courses students have to complete. In particular, there are differences in the role that completion of the final practicum plays in relation to other requirements. In general, most institutions have, as a separate requirement, success in the practicum. But it seems rare in these institutions for a future teacher to fail the practicum (although hard evidence of this is lacking).

5 In the tradition of the French degree system and roughly equivalent to a Bachelor's degree in the Anglo-Saxon system.

Staffing requirements

As noted earlier, two types of institutions have teacher education programs. By far the biggest are the universities. The second group includes the professional institutes. Requirements governing the employment of teacher educators at the universities are the same as for the rest of their staffs. Applicants must have at least a licentiate degree. However, more and more teacher education programs at universities are requiring a Master's degree and, to a lesser extent, doctoral degrees.

Depending on the content and level of its teacher preparation, a university's staff will need at least a licentiate degree in a subject specifically relevant to the school curriculum. If staff teach foundation subjects or other pedagogy subjects, then they should have at least a relevant Master's degree—in psychology or the sociology of education, for example. In addition, teacher educators who are in charge of teaching methods courses should have a relevant teaching qualification and school teaching experience, and ideally a Master's degree.

The requirements at professional institutes are similar to those at the universities, except that the former tend to have a smaller number of teacher educators with Master's or doctoral degrees. Mentor teachers in the schools where the practicum experiences take place are not generally contracted by the teacher education institution for this purpose. They fulfill this role based on agreements between their schools and the teacher education institution.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

Currently, there are no specified entry standards for teacher education, other than those in force for entry into university or nonuniversity higher education in general. In practice, this situation means that students are selected into universities in accordance with their secondary school grade average and their scores on the university entrance examination known as the PSU *(Prueba de Seleccion Universitaria*). However, only traditional universities require completion of the PSU examination and attainment of the minimum score set by the association of these universities. Private universities, with a few exceptions, require the PSU but do not set a minimum score. Students who enter professional institutes do not have to take the university entrance examination.

Scores on the PSU examination for new entrants to basic-level teacher education programs are significantly lower in private than in public universities. PSU scores for future teachers are generally lower than those required for similar professions, such as engineering, computing, mathematics, accountancy, and economics. Future teachers pay fees in all universities, although the amount varies according to what each institution sets. Overall, fees tend to be higher in private universities. However, with the purpose of attracting better entrants to teacher education programs, the government has established a new scholarship scheme that provides free tuition for the entire period of preparation. This scheme has led, during the first few years of its operation, to an increase in the number of future teachers with higher secondary school grades and PSU scores.

Accreditation of teacher education institutions and programs

At the time this report was first prepared, Chile had only a voluntary system of accreditation of teacher education programs. However, under the new Law of Education, passed in 2009, teacher education programs must submit to accreditation processes. The new law also stated that all teacher education programs would be subject to obligatory periodic accreditation and would have to submit to accreditation within the two years following promulgation of the law. Students who attend nonaccredited programs are ineligible for any of the scholarships or financial assistance granted by the state.

Beyond the accreditation requirement, Chile has no established government policies or coordination mechanisms for the system of teacher education. Neither the Ministry of Education nor any other public body has direct regulatory powers over teacher education. However, the Ministry of Education has been experimenting with a voluntary examination that future teachers can take as they leave their programs. The government is currently preparing legislation that will make the examination obligatory, while the Ministry of Education has already produced a set of content standards for it.

Requirements for entry to the teaching profession

In order for an applicant to be considered for a first-time teaching position, the only requirement that he or she must meet is the holding of a degree or a teaching diploma granted by a teacher education program within a university or professional institute. No other form of certification is required; nor is there a registration requirement. However, teachers who do not have a formal qualification may be allowed to teach on the basis of permission granted by Ministry of Education authorities if there is no qualified teacher available. More recently, within the context of the Law of Education of 2009, the government approved a resolution that allows secondary schools to appoint graduates who have not undertaken teacher education.

References

Akiba, M., Le Tendre, G. K., & Scribner, J. P. (2007). Teacher quality, opportunity gap, and national achievement in 46 countries. *Educational Researcher*, *36*(7), 369–385.

Avalos, B. (2002). *Profesores para Chile: Historia de un proyecto* [Teachers for Chile: History of a project]. Santiago, Chile: Ministry of Education.

Avalos, B. (2004). *Secondary teacher training in Chile: Learning to teach in the Knowledge Society.* Washington, DC: World Bank.

Lomnitz, L. A., & Melnick, A. (1991). *Neoliberalismo y clase media: El caso de los profesores en Chile* [Neoliberalism and the middle class: The case of teachers in Chile]. Santiago, Chile: Directorate of Libraries, Archives, and Museums (DIBAM).

Microdatos Center, University of Chile. (2006). *Encuesta longitudinal de docentes: Primera versión. Informe final* [Longitudinal survey of teachers: First version. Final report]. Santiago, Chile: Author.

Ministry of Education. (2004). *Chile y el aprendizaje de matemáticas y ciencias según TIMSS: Resultados de los estudiantes chilenos de 8° básico en el Estudio Internacional de Tendencias en Matemáticas y Ciencias 2003* [Chile and achievement in mathematics and science as assessed by TIMSS: Results for Grade 8 Chilean students in the Trends in International Mathematics and Science Study 2003]. Santiago, Chile: Curriculum and Evaluation Unit.

Ministry of Education. (2005). *Informe Comisión sobre Formación Inicial Docente* [Report of the Commission on Initial Teacher Training]. Santiago, Chile: Author. Available online at www.cpeip.cl/index_sub.php?id_contenido=6473&id_seccion=1185&id_ portal=200

Ministry of Education. (2007). *Indicadores de recursos: Versión preliminary* [Resource indicators: Draft version]. Santiago, Chile: Department of Research and Development.

Montoya, A. M. (2005). *Estudio de oferta y demanda de docentes en Chile: Proyección 2004–2015. Informe final* [Study of teacher supply and demand in Chile: Projections 2004–2015. Final report]. Santiago, Chile: Ministry of Education

Núñez, I. (2002). La formación docente: Notas históricas [Teacher training: Historical notes]. In B. Avalos (Ed.), *Profesores para Chile: Historia de un proyecto* [Teachers for Chile: History of a project] (pp. 14–39). Santiago, Chile: Ministry of Education.

Organisation for Economic Co-operation and Development (OECD). (2005). *Teachers matter: Attracting, developing and retaining effective teachers.* Paris, France: Author.

Organisation for Economic Co-operation and Development (OECD). (2006). *Education at a glance.* Paris, France: Author.

Ormeño, A., Gallegos, C., Jiménez, L., Guerra, J., Schiefelbein, P., & Torres, A. (1996). *Evolución de la formación de profesores en Chile: Documento de trabajo N° 4* [Evolution of teacher training in Chile: Working paper No. 4]. Santiago, Chile: University Development Corporation.

Presidential Advisory Council on the Quality of Education. (2006, December). *Informe final* [Final report]. Santiago, Chile: Available online at www.consejoeducacion. cl/view/ index.asp

Ramírez, M. J. (2006). Understanding the low mathematics achievement of Chilean students: A cross-national analysis using TIMSS data. *International Journal of Educational Research*, *45*(3), 102–116.

CHAPTER 4:

Chinese Taipei

Editors' Overview

Chinese Taipei is an example of a strong national policy-driven teacher education system that is rigorous and competitive. Few successful graduates can get teaching jobs, but once they do, they enjoy very favorable conditions and incentives.

Institutions and governance

In 2007, 59 universities in Chinese Taipei were authorized to provide teacher education. Of these, 48 admitted future secondary teachers, and 23 admitted future primary teachers. Chinese Taipei's current system of teacher education was developed after the end of World War 2 and the Japanese colonial era. The Nationalist (KMT) government at that time established advantageous conditions and incentives for becoming a teacher, in an effort to attract talented people to this occupation. Throughout this early period, the government exercised tight control over which institutions could educate teachers and when to increase or decrease the number of teacher education institutions, the number of teachers being educated, and the deployment of novice teachers.

From the 1960s to the early 1990s, as the economy developed rapidly and then slumped, this rigid control was relaxed. The government made changes to teacher recruitment, training, and employment policies and practices. For example, the Ministry of Education no longer took responsibility for assigning jobs to teachers. Instead, future teachers had to compete for specific vacancies. In short, Chinese Taipei was taking steps toward what the Organisation for Economic Co-operation and Development (OECD, 2005) calls *position-based* as opposed to *career-based* teacher employment.

Program-types and credentials

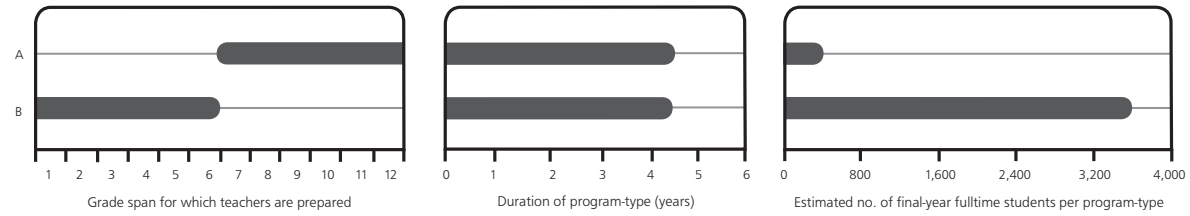
There are two types of teacher in Chinese Taipei—primary school teachers in Grades 1 to 6 and secondary school teachers who teach either lower-secondary (Grades 7 to 9) or upper-secondary (Grades 10 to 12) classes. Primary school teachers are generalists, but most secondary school teachers teach within a single level (either junior or senior high school) and a single subject. Hence, as illustrated in Exhibit 4.1, Chinese Taipei has only two program-types with respect to TEDS-M, one for primary school teachers and the other for secondary. In each one, future teachers take four years to complete the Bachelor's degree requirements and pedagogical credits, after which they complete a half-year practicum. Both program-types are concurrent; Chinese Taipei has no consecutive program-types.

Curriculum content, assessment, and organization

Both program-types include three components. These are general curriculum requirements for all university students from any field of study, a subject-matter curriculum, the goal of which is to improve student understanding of the subject(s) that they will teach, and a professional education curriculum. Universities may choose offerings from a list established by the Ministry of Education. In addition, future teachers must complete a practicum organized according to ministry guidelines.

Once these requirements have been completed, future teachers have to take the Teacher Qualification Assessment. This national test is the last step in quality control of preservice teacher education. The assessment includes two general subjects and two professional education subjects. The pass rates for 2007 and 2008 were just under 68 percent and 76 percent, respectively.

Exhibit 4.1: Teacher education program-types in Chinese Taipei



Note: Eleven institutions in the target population were excluded because they were very small—fewer than 26 future primary teachers and fewer than five future lower-secondary mathematics teachers in the final year of their programs. The primary and secondary programs both take 4.5 years to complete. This period of time includes the four-year Bachelor's degree and a six-month practicum.

Preparing Teachers of Mathematics in Chinese Taipei

Feng-Juh Hsieh, Pe-Jen Lin, Guoheng Chao, and Ting-Ying Wang

Part I: Context and Conditions of Teaching as a Career

The status of teaching in Chinese culture

In traditional Chinese culture, teaching is high in prestige and status. Current Taiwanese political, economic, and social contexts have reinforced these perspectives by providing teachers with generous salaries and other benefits. Because all remuneration for public school teachers is government funded, employment as a teacher is stable and ensured. Teaching is generally infused with dignity and authority, and therefore the role of teachers is viewed as being similar to that of a parent. Teachers not only teach students subject-matter knowledge, but also support students' personal development, foster conventional student behavior, and teach students social skills and understanding of their social context.

Teacher schedules also make teaching attractive. Teachers are given time to perform many routine chores in addition to teaching. Many teachers stay at their school during their free periods to work on homework, tests, and teacher–parent communication booklets. Some teachers prepare for the next class and some counsel students, while others read magazines and newspapers. When necessary, some hold teacher–parent conferences. Some teachers also utilize their time to socialize or participate in recreational events such as table tennis. Job security and supportive work conditions also foster the appeal of teaching.

These characteristics make teaching very attractive, especially to people who seek stability in life. As a result, becoming a teacher in Chinese Taipei is a very competitive process. Candidates face rigorous evaluation and serious competition throughout the teacher preparation procedures. These include being selected to enter the program, taking a teacher-qualification examination, and job screening. The government sets the guidelines for recruiting, training, and qualifying preservice teachers, and for developing inservice teachers' professional competencies.

Historical roots

Initiation of teacher education

The Chinese Taipei system of teacher education began during the Japanese colonial period (1895–1945). The first teacher education institution, established in 1896, was the *Kokugo Gakkou* (Japanese Language School). It prepared primary teachers for teaching the Japanese language and cultivating favorable attitudes toward Japanese culture and authority. From 1899 on, the colonial government established normal schools one by one; these schools prepared teachers to teach various primary subjects, including Japanese and arithmetic (Wu, 1983, p. 18). This development marked the first time mathematics teaching was included in formal teacher preparation. For most of the colonial period, the teacher education system had two branches: one for educating Japanese people and one for educating Taiwanese people. It was not until the final four years of the colonial period (1941–1945) that this segregation ended (Wu, 1983, p. 65).

In 1946, the second year after the Taiwan Retrocession,[1] a new page of teacher education in Chinese Taipei was written. The Provincial Taiwan Normal College, established as the first teacher education secondary school, became the first postsecondary-level teacher education institution as well. The following year saw enactment of the first official regulation regarding secondary-level teacher education (Cheng, 1998).The establishment of this and other teacher education institutions and associated regulations laid the foundation of the protectionist teacher education system that dominated the next several decades.

The rise and decline of the protectionist teacher education system

The rise and decline of the protectionist teacher education system in Chinese Taipei was in response to the country's political, economic, and social contexts. The KMT ruling party, which had retreated from Mainland China and continued to govern, venerated the Confucian tradition and therefore emphasized education, believing it was essential to the nation's success. The KMT government also wanted to break down the existing education system, which had been designed to instill the idea of "Japanization" into society and establish Japanese as an official language.

The KMT government believed that the best way for it to side against the Japanization ideology was to expose junior high school students to the Chinese language and anti-communist ideas. Acting on this belief, the government promoted a regenerated Taiwanese culture that reflected the Chinese culture based on the Three Principles of the People (Cheng, 1998). During this time, less than 32 percent of primary-school graduates continued on to junior high or vocational schools, so the government spent considerable effort encouraging secondary education (Ministry of Education, 1976, p. 1668). After years of such endeavor, the government finally established its nine-year system of compulsory education in 1968.

After the end of Japanese occupation, the KMT government maintained that the quality of teachers could favorably influence the thinking and inner quality of people, which in turn could influence politics, the economy, and the national defense of the country (Cao & Liang, 2002). Consequently, the government believed that all the expense and benefits of teacher education should be covered by the government as a way of stabilizing and reinforcing the teacher education system. Specifically, teachers, as with civil servants, were to be educated at the government's expense and guaranteed employment. A student not entering the profession via a government-funded program-type had little chance of becoming a teacher.

In a weak economy, teacher preparation paid for by the government was a strong incentive for attracting talented individuals. During this period, the government had the authority to determine which institutions educated teachers, to control the number of such institutions, the number of teachers being educated, and the schools to which novice teachers were assigned. Thus, the teacher education system during this period can be characterized as a "protectionist" one.

Also at this time, the government tried to expand and improve teacher education institutions. Between 1960 and 1967, the normal schools educating primary teachers became junior colleges, and teachers were educated in this way for more than 20 years.

1 Chinese Taipei was then ruled by a government controlled under a single-party—Kuomintang of China (translated as the Chinese Nationalist Party). This government later retreated from Mainland China to Chinese Taipei and was called the KMT government.

In 1987, all nine junior teachers' colleges were elevated to the status of teachers' colleges, thereby raising the requirements for becoming a primary-school teacher. Similarly, the Taiwan Provincial Normal College became the Taiwan Provincial Normal University in 1955, thus creating the country's first university-level teacher education institution (it ultimately became the National Taiwan Normal University) (Ministry of Education, 1996, p. 1089). The government established two more normal colleges in 1967 and 1971 to help the university prepare secondary school teachers. These two colleges became universities in 1989. During the protectionist era, a total of three normal universities were educating secondary school teachers, and nine normal colleges were educating primary teachers.

After World War 2, the KMT government established incentive packages to attract talented students to teaching. Before implementation of the new 1994 teacher education reform, these provisions included the following:

- Free tuition, free accommodation, and subsidies for books and clothing for student teachers;
- Automatic certification to become a qualified teacher upon graduation;
- Guaranteed employment upon graduation;
- The obligation to teach for a minimum of five years (including a one-year paid practicum) in return for a teacher preparation education provided free of charge; and
- Generous remuneration and lifelong benefits for those teachers who remained in the profession.

These latter benefits included salary, comprehensive health, disability, and life insurance, summer and winter vacations, and retirement pensions, all of which were aimed at retaining teachers by taking care of their needs throughout their lives. If graduates wanted to change their career, they had to repay the government for tuition, accommodation, and other subsidy costs (Fwu & Wang, 2002).

The rise of the competitive system

From the 1960s to the 1980s, Chinese Taipei's rapidly improving economy and living standards resulted in increased teacher salaries. However, by the 1980s, the protectionist teacher education system no longer aligned with the prevalent ideas of a free society and a free economy. The late 1980s saw many political changes: presidents gradually improved infrastructure, lifted martial law, and officially terminated the "period of communist rebellion." Multiparty politics took shape, public discussion was liberated, and the legislative system strengthened. These changes challenged the protectionist, narrow teacher education beliefs.

In the early 1990s, the economy slowed. When the number of college graduates overtook the number of available jobs, the public started demanding open access to teacher education, so giving universities more opportunities to educate teachers. This development again altered the old protectionist teacher education system. As a consequence of the pressure to open up access to teacher preparation, the government, in 1994, enacted the Teacher Education Act, which provided multiple means of access to teacher education. A significant event in the history of teacher education in Chinese Taipei, the reformed Teacher Education Act, changed recruitment, training, and employment in five important ways:

1. All four-year universities or colleges could now offer teacher education for K–12 teachers as long as students met the institutions' teacher education requirements;
2. Free tuition would be granted only to teachers willing to work in remote areas;
3. Teacher education graduates from universities/colleges would not be certified as qualified teachers until they passed the Teacher Qualification Assessment;
4. The government would no longer be responsible for teacher assignments: qualified teachers would have to apply for teaching jobs through onsite screening and selection in a school-based or city/county government-based process; and
5. There would no longer be a minimum service requirement, except for those teachers who received free tuition.

Conditions at the time of TEDS-M

The continued benefits of teaching

At the time of TEDS-M, Chinese Taipei's retention policy for teachers was unchanged; teachers were still enjoying favorable remuneration and benefits. A beginning teacher's salary in the TEDS-M era was 40,690 NT dollars per month (equivalent to about US$2,300, converted using PPPs for GDP). It was much higher than the 28,817 NT dollars (equivalent to about US$1,600) that fulltime employees from other industries were receiving.[2] If, from this time, a teacher's salary rank had been constantly raised over a period of 20 years, the final monthly salary would likely have reached 71,235 NT dollars (equivalent to about US$4,000).

Recently, the Chinese Taipei economy stalled, and the decreasing number of newborns has meant fewer school-age students. These circumstances have lowered the demand for teachers, and the government accordingly has limited and reduced the number of openings for teacher education within universities. This reduction has, in turn, increased competition for places in teacher education programs.

Currently, primary and secondary school teachers teach children 6 to 17 years of age. Primary teachers teach in primary schools, educating students in Grades 1 to 6 (i.e., 6- to 11-year-olds). These teachers are generalists at all grade levels. Therefore, teacher preparation institutions offer a broad array of subject training that includes languages, the humanities, social sciences, mathematics, natural sciences, music, arts, and crafts. During the 2007/2008 school year, Chinese Taipei had 96,000 primary school teachers, 99 percent of whom were serving in public schools.

Secondary school teachers teach in junior high or senior high schools, educating students in either Grades 7 to 9 or Grades 10 to 12 (spanning a student age range of 12 to 17). Most teach within a single stage (either junior or senior high school) and a single subject, such as Chinese, English, mathematics, history, biology, information technology, and home economics. Junior and senior high school teachers are prepared together in the same program-type. During the 2007/2008 school year, Chinese Taipei had 78,000 secondary school teachers, 85 percent of whom were serving in public schools.

The high percentages of primary and secondary teachers working in public schools is not surprising given that schooling is mainly provided through public authorities in Chinese Taipei. Public school teachers, military personnel, and civil servants are called

2 According to 2007 data given out by the Directorate-General of Budget, Accounting, and Statistics, Executive Yuan, R.O.C.

"military-civil servant-teachers." Employed and paid by the government, they receive a stable income and good benefits (Executive Yuan, 2005).

The percentage of teachers working in private schools catering for compulsory education (i.e., primary plus junior high) is very low—less than one percent of teachers. In contrast, 37 percent of teachers serve in private schools for the noncompulsory stage. Although private school teachers follow the government's education regulations and policies, they receive minimal funding from the government. Private-sector schools enjoy autonomy of employment while offering salaries and benefits comparable to those in the public sector.

Primary or secondary school students are assigned to specific classes. Students in the same class take all their courses in a single classroom except for special subjects such as physical education, music, and fine arts. In primary schools, one teacher usually teaches all the subjects for a class, except in Grades 5 and 6, where some subjects are taught by other teachers who are more competent in particular subjects. In contrast, secondary school teachers specialize in one subject.

While teaching is a desirable career, those who want to enter it confront many challenges. Under the influences of current school-system planning and the teaching-hours regulation, teachers often face relatively large classes, diverse student abilities, long school hours, and students with little motivation for learning. In addition, the traditional high status of teachers has slowly begun to erode as society becomes more open. Parents have more requests and questions, while many students are more autonomous and brave enough to challenge teacher authority. Additionally, due to decreasing enrollments in primary schools, a surplus of teachers in schools is common. In such cases, the teacher or teachers who had most recently entered the school must find employment in other schools.

Lower-secondary school teachers also face the pressure of preparing their students for the national examination that students are required to take before entering upper-secondary school. Teachers in Chinese Taipei tend to consider that they have just as much responsibility as their students for the grades achieved on this examination, and therefore feel obligated to devote extra time to help students prepare.

Although primary teachers do not face such pressures when their students advance from one grade level to the next, they do experience demanding teaching loads. About half of Chinese Taipei's primary schools have fewer than 12 classes (i.e., fewer than two classes per grade for each of the six grades). Each class is assigned 1.64 teachers on average. Class sizes average at least 28 students.[3] Also, because primary teachers need to teach more subjects than their secondary school colleagues, many of them find it hard to master and have enthusiasm for all subjects.

Despite these challenges, teaching is still attractive in terms of income, working hours, career development opportunities, and job security. As a result, many secondary school and university graduates dream of a teaching career, but know that they have to work through a very competitive selection process in order to become an officially qualified teacher with a fulltime teaching job in a public or private school. The Ministry of Education requires schools at all levels of the education system to hold public screenings and selections in accordance with laws and regulations to ensure they employ officially

3 This number is calculated from the 2007 year data in the dataset provided by the Ministry of Education (2009).

qualified teachers (Ministry of Education, 2005a). Screening and selecting teachers typically involves written tests, oral tests, teaching demonstrations, and onsite tests of teaching knowledge and ability. Applicants are generally assessed through a combination of two or more of these methods.

Efforts to change mathematics instruction

Education in Chinese Taipei focuses heavily on helping students achieve a high ranking on entrance examinations. Traditionally, mathematics teaching was dominated by formal mathematical content and narrative approaches. The pre-2001 junior high school and the pre-1996 primary school mathematics textbooks were standardized—one book per subject and grade for schools throughout the whole country. The questions in the senior high school entrance examinations were based on the standardized textbooks.

In 1997, the government brought in a new national standardized mathematics textbook for use in junior high schools. The authors of the textbook considered mathematics education had not kept up with Chinese Taipei's changing society and so needed a radical transformation. They were also mindful that students in Chinese Taipei, even those with high grades, generally disliked mathematics the most of any subject. These understandings were reflected in the new textbook. The changes centered on the links between mathematics and life, the cultivation of students' creativity, thinking, and reasoning abilities, and on a positive attitude toward learning mathematics and appreciating mathematics (Hsieh, 1997). The authors also maintained that the new textbook could be used to educate both preservice and inservice teachers. Because the questions on the senior high school entrance examinations were formulated from the textbooks, teacher educators usually included the textbooks in their teaching materials. The textbook reform therefore immediately affected inservice mathematics teachers, and at the same time changed the content for preservice lower-secondary school mathematics teachers as well.

In 1996, primary mathematics teacher education also experienced a big change: private publishers became responsible for producing primary-school mathematics textbooks, with publication reliant on government review of the content. These books encourage mathematics teachers to consider how students think, and in so doing have shifted teaching of this subject from a teacher-centered to a student-oriented approach. This shift was influenced by research in mathematics education that was initiated and promoted, beginning in the 1980s, by Fou-Lai Lin, a professor at Taiwan National Normal University. He and others began investigating mathematics teaching through research and literature studies.

Together, these developments saw mathematics teacher education in Chinese Taipei move in a new direction, in which practical experience was combined with mathematics education research.

Part II: Organization and Characteristics of Teacher Education

In Chinese Taipei, teacher education programs are an added component of the Bachelor's degree. Preservice teachers must obtain a Bachelor's degree, complete the preservice teacher education curriculum, and finish a practicum before being evaluated via the teacher qualification assessment. Preservice teachers do not undertake their practicum in a primary or secondary school until they have completed the rest of their inservice program. The universities and the schools share responsibility for supervising intern teachers.

Universities or colleges develop preservice teacher education curricula, which have to be approved by the Ministry of Education before they can be implemented. Students in Master's or doctoral programs also enter teacher education programs, but must still study the same preservice teacher education curriculum that undergraduates do. Chinese Taipei has no consecutive teacher education programs.

The current preservice teacher education system is regulated by the Teacher Education Act and the Teacher Education Act Enforcement Rules, which were enacted in 1994 and 1995, respectively. These regulations designate targets, institutions, curricula, and related contents of the teacher education system.

The Teacher Education Act overturned the traditional teacher education system and dissolved the normal university/college monopoly over teacher education. Before this reform, people wanting to teach had to attend normal universities/colleges. The entrance requirements of the top normal universities were high, with admitted students usually the top graduates from their secondary schools or other tertiary programs. The Act also enabled more universities to set up teacher education programs, so denying the normal universities/colleges their former monopoly.

The Ministry of Education actively encouraged normal universities/colleges to cooperate or merge with universities (Ministry of Education, 2006a). Three normal colleges pioneered in this cooperation and merged with other universities, or set up nonteacher-education-affiliated departments or schools and became universities providing various majors. Six other normal colleges changed their names to "universities of education" in 2005, and are still working toward transformation into comprehensive universities. In 2008, one university of education merged with a university to become a university with teacher education departments.

Since 1994, comprehensive universities have been able to establish teacher education centers. In order to establish a teacher education center, these universities must apply to the Ministry of Education and have their plans approved by the Teacher Education Review Committee (*shi zi pei yu shen yi wei yuan hui*). The actual establishment of these centers is subject to the Regulations of Teacher Center Establishment in Universities 1995, which control teaching staff numbers, library facilities, and the teacher education curriculum.

In summary, Chinese Taipei has three kinds of teacher education universities preparing primary and secondary school teachers:

1. Normal universities, which offer mainly secondary school programs, and universities of education, which offer mainly primary programs (these universities prepare the majority of teachers);
2. Universities with departments (majors) affiliated with teacher education; and
3. Universities with teacher education centers.

Some of the universities operate in more than one of these ways, for example, by having teacher education centers and teacher-education-affiliated departments. Some of the universities prepare both primary and secondary school teachers while others prepare teachers for one level only. Since the rapid reform of the teacher education system, the number of each kind of university has varied year by year. In general, the number of teacher education universities is neither regulated nor limited. Any university interested in teacher education that meets the guidelines can apply.

In 2007, 59 universities were authorized to enroll students in primary and secondary school teacher education programs. Of these, 48 were authorized to prepare secondary school teachers, and 23 were authorized to prepare primary teachers. However, in reality, 30 universities in 2007 were preparing 3,930 primary-level future teachers and 30 were preparing 398 secondary school mathematics preservice teachers.

Of the universities offering primary education, five were each preparing no more than 10 preservice teachers (of all teaching subjects combined), five were each preparing 11 to 20 such teachers, five were each preparing 21 to 30 preservice teachers, and four were each preparing 31 to 60 preservice teachers. Of the remaining 11 universities preparing primary teachers, two were each preparing 71 to 100 such teachers and nine were each preparing 201 to 400 primary teachers. Among the universities offering secondary school teacher education, 21 were preparing no more than 10 future mathematics teachers apiece, six were each preparing 11 to 20 such teachers, and each of the remaining three was preparing 61 to 80 preservice mathematics teachers.

Curriculum and field experience requirements

Preservice teacher education programs include three components—the general curriculum, the subject-matter curriculum, and the education professional curriculum. In order to qualify as teachers, students must graduate from university, successfully complete the educational practicum, and pass the Teacher Qualification Assessment.[4] In recent years, the government has been encouraging universities to increase the ratio of graduates with a Master's degree to non-Master's graduates among primary and secondary school teachers (Ministry of Education, 2006b).

According to the teacher education regulations, the general curriculum in preservice teacher education is the common curriculum required for all students, not just future teachers. However, the regulations do not clearly define the curriculum content. Many teacher education universities consider completion of a Bachelor's degree a sufficient indication of completion of the general curriculum.

According to the Enforcement Rules of the University Act, students must obtain 128 credits (semester units) in order to obtain a Bachelor's degree and to meet the completion requirements of a specific major. The teacher education regulations define the subject-matter curriculum as the curriculum that aims to improve preservice teachers' strengths in the subjects that they will teach. The teacher education universities each develop this curriculum and then submit it for approval to the Ministry of Education.

In the case of future teachers preparing to teach mathematics in junior high schools, the subject-matter curriculum consists of courses in mathematics. The Ministry of Education (2002) sets the upper and lower limits of the subject-matter credits. Mathematics teacher education students must complete a minimum of 30 credits, 24 of which must cover six areas: analysis, algebra, geometry, probability and statistics, general education in mathematics, and information. There is no regulated subject-matter curriculum for future primary school teachers because of the interdisciplinary nature of teaching at this level.

The education professional curriculum, which is designed according to levels of schooling, aims to develop and improve future teachers' pedagogical competencies. The teacher education universities choose subjects from the various subjects authorized by

4 Teacher Education Act, Articles 9 and 11.

the Ministry of Education (2003). The education professional curricula at the primary level must include the following:

- Basic subject-matter curriculum in teaching (10 credits);
- Foundations of education curriculum (4 credits);
- General pedagogy curriculum (6 credits);
- Materials and methods of teaching in three or four fields (8 credits);
- Teaching practice (2 credits); and
- Elective content amounting to 10 credits.

At the high school level, curricula must include:

- Basic subject-matter curriculum (4 credits);
- General pedagogy curriculum (6 credits);
- Materials for and methods of teaching mathematics (2 credits);
- Teaching practice for mathematics (2 credits); and
- Elective content amounting to 12 credits.

For future teachers training to teach in high schools and who are majoring in mathematics, attainment of a total of 154 credits allows them to meet the teacher education course requirements and to graduate from university. For students majoring in education, the 128 credits required for the major include the education professional curriculum. Thus, teacher education students need to complete only 30 to 48 credits worth of university-level mathematics courses.

At the primary level, if the preservice teachers come from education colleges or teacher education colleges or are majoring in education, then the 128 baccalaureate credits they require usually include part of the education professional curriculum. These students are required to take course content adding up to between 138 and 150 credits. Students from other colleges or those studying other majors need to add at least 40 credits of additional education professional curriculum to their 128 baccalaureate credits in order to meet the teacher education and overall university requirements.

Both primary school and high school preservice teachers need to complete the preservice teacher education curriculum and graduate from a university. Doing so qualifies them for the educational practicum. The content of the practicum includes teaching internship, homeroom teaching and supervision focusing on general class affairs, administrative work practice, and other relevant studies. Preservice teachers need to work as interns fulltime for half a year at either primary or secondary schools.

The Ministry of Education's overall guidelines (Ministry of Education, 2005b) for the educational practicum encompass the following requirements:

1. A universal starting date for educational practicums;
2. Teacher educators from the education universities visiting and advising the educational practicum schools;
3. Educational practicum schools establishing counseling groups charged with coordinating practicum counseling plans and promoting practicum-related work;
4. Educational practicum supervisors from teacher education universities who are faculty members working as teachers in universities;

5. Internship supervisors from schools having teaching credentials and more than three years of teaching experience;
6. Limits on the number of days that intern teachers can take off; and
7. Evaluation criteria based on 40 percent teaching internship, 30 percent homeroom teaching, 20 percent administrative work practice, and 10 percent study and training activities.

The system used to counsel intern teachers during their practicum period accords with the above regulations. In each practicum school, a team develops a systematic plan designed to guide them when counseling intern teachers. Fifty percent of the intern teachers' evaluations are scored by the internship supervisors, principals, and directors from the educational practicum schools; the other 50 percent are scored by internship supervisors from the universities who visit an intern one to three times during his or her practicum period.

Because preservice teachers know that the practicum schools determine part of their grade, they usually research a school's practice and counseling provisions before committing to an internship in it. Once both parties are satisfied, the intern teacher signs a practicum contract. Generally, intern teachers easily find schools in which to complete their practicum.

Staffing requirements

There are two categories of teacher educators in Chinese Taipei. The first includes the university-based teachers and the second those teachers responsible for the teaching practicum in the education professional curriculum and the educational practicum in schools.

Because both the general and subject-matter courses (i.e., those not in the education professional curriculum) within the preservice teacher education curriculum offered by the universities are not designed exclusively for preservice teachers, instructors include university professors in related majors. The universities rarely separate the teaching of future teachers from the teaching of other university students. The university-based instructors responsible for preservice teachers' education professional curriculum are usually professors with pedagogical specialties.

A few universities arrange for their students to teach in primary or secondary schools at the same time they are taking the education professional curriculum. For these universities, the preservice teachers' instructors include teachers in school. In general, the educators teaching the education professional curriculum and university supervisors of the educational practicum are university faculty members resident at the teacher education centers and teacher education-related colleges in universities. Most of these individuals have doctoral degrees.

The second category of teachers is composed of internship supervisors, directors, and principals in the primary or secondary schools that offer practicum or other field experiences for preservice teachers. The school internship supervisors teach the intern teachers about subject-matter teaching and homeroom operation. The directors, principals, and other administrative staff teach intern teachers about administrative procedures.

Part III: Quality Assurance Arrangements

Entry standards and selection methods

Chinese Taipei has clear requirements for every phase of teacher education—from entry to it through to certified teacher. Under the Teacher Education Act, students must be enrolled in their second or higher year of university or as Master's degree or doctoral students before they can be admitted to a teacher education program. They also have to pass various selection processes specific to the programs in their own teacher education institutions.

Each university determines its own teacher education screening and selection processes. However, these processes are still heavily influenced by the admission guidelines set by the Ministry of Education. Students who successfully complete the first year of academic work in their university are eligible to apply for a teacher education program. Many universities base their selection on applicants' grades in the first academic year, and they may also require candidates to take tests of, for example, general educational knowledge, language, and attitudes, and to engage in personality inventories. Some universities also take student character, moral conduct, and extracurricular activities into account. Because the Ministry of Education sets the admission guidelines for the teacher education universities according to the levels of schooling, not the subjects that their students intend to teach, this selection cannot be used to control the numbers of students who will become mathematics teachers. This situation forces the teacher education universities to avoid subject-specific questions in the selection process.

According to the selection standards, students in the teacher education programs, compared with other students in the same university, usually have high curriculum-related grades, maturity of personality development, and a passion for education. However, these standards give no indication of the readiness of these students to learn to teach mathematics, a required teaching subject in primary and junior high schools. As previously stated, primary-level teacher education students are prepared to teach a variety of subjects when they enter teaching. As a result, students' mathematics ability and their capacity to teach mathematics are not uniform.

Teacher education students training to teach in secondary schools are prepared to teach specific subjects once they take up teaching positions. Most students who intend to teach mathematics in junior high schools major in mathematics or science. Although there is no way to directly compare the mathematics capacities of primary and junior high school preservice teachers with students majoring in mathematics-related subjects, students majoring in mathematics or science who are admitted to the secondary school mathematics teacher education programs usually have better capacities in mathematics than other students.

Accreditation of teacher education institutions and programs

The preservice teacher education system in Taiwan is regulated by the Teacher Education Act of 2002 and the Teacher Education Act Enforcement Rules of 1995. Both required the Ministry of Education to establish a Teacher Education Review Committee, which has two clear functions with regard to Chinese Taipei's system of teacher education. One is the quality control of the teacher education institutes, and the other is the planning, execution, and control of the teacher education curriculum.

A feature of the Chinese Taipei system of teacher education is the extent to which the Ministry of Education entrusts experts and scholars in academia to research, plan, and make proposals relating to teacher education policies and practices. Once these proposals are passed by the Legislative Yuan and signed by the president, they become regulations enforced by the Executive Yuan. The regulations govern aspects of teacher education institutions and the curricula content of their programs.

According to the Ministry of Education's regulations, the Teacher Education Review Committee should have 21 to 27 members. As of 2008, the committee membership included 14 professors from teacher education universities, six Ministry of Education officers, four secondary school principals, two teacher representatives, and one Executive Yuan officer.[5] The Chinese Taipei government requires the committee to meet the following obligations:

1. Make recommendations and consult on teacher education policy;
2. Review the planning of important development projects in teacher education;
3. Review the establishment, recognition, evaluation, modification, and termination of teacher education universities; and
4. Review teacher education courses.[6]

Evaluation of teacher education programs

Evaluation of teacher education programs has taken a two-phase approach in Chinese Taipei. The first lasted from 1997 to 2004; the second began in 2005 and is still operating. During the first phase, the goal of the evaluation was to understand what progress the teacher education universities had made in establishing the teacher education curriculum. The evaluation included written evaluations and field visits. The institutions were graded according to a five-level rating system, the outcomes of which were not disclosed to the public. The government used the evaluations to aid improvements within the teacher education universities; they were not used as evidence for accrediting the teacher education programs.

During the first phase, the decreasing number of retiring teachers and decreasing birth rate led to a decline in the demand for new teachers. At the same time, society was demanding a higher standard of teacher professionalism. The public expected the government to supervise teacher education effectively and to conduct rigorous inspections of it (Ministry of Education, 2008). The Teacher Education Review Committee therefore decided, in 2005, the first year of the second phase, to adjust the admission quota of preservice teachers and to inspect the teacher education programs according to the results of their evaluations. The programs are graded according to a three-level rating system during this phase.

For universities with teacher education centers, those that received a Level 3 rating had to stop admitting students. Those that received a Level 2 rating had to decrease student admissions by 20 percent, and those that received a Level 1 rating were able to retain their existing admission quota (Ministry of Education, 2006c, p. 204). The same principle was also applied to normal universities/universities of education, all of which were evaluated for the first time in 2006. This system is still being used today.[7]

5 The member list is based on the 67th meeting record of the Teacher Education Certification Committee in 2008.

6 According to the Ministry of Education's Regulations Governing the Teacher Education Review Committee 2003.

7 Ministry of Education news release, "Evaluations of teacher education centers of universities, 2006, 2007."

Since the first round of evaluations of the normal universities/universities of education and universities with teacher-education-affiliated majors, the Ministry of Education has conducted evaluations on an as needed basis; there is no set schedule for this category of evaluation. In contrast, evaluations of teacher education centers are conducted on a regular and timely basis (Ministry of Education, 2007). Field visits are the method primarily used.

Newly established teacher education centers must be evaluated one year after establishment. After conducting the initial evaluation, the ministry evaluates these institutions every four years. Institutions that do not receive Level 1 ratings must be re-evaluated the following year. Evaluations focus on distinguishing program features, organization of institutions, selection and counseling of students, use of funds, quality of instructors, planning and execution of programs and teaching, educational practicums and associated counseling, employment counseling, and promotion of inservice teachers' education.

In general, evaluations include three phases—preparation, evaluation, and conclusion. The duration of each phase ranges from a few months to half a year, with the entire process taking about one and a half years. The field visit is the most crucial element of each evaluation round. Generally, evaluators take one day to evaluate one program in one university providing teacher education programs. Evaluations conducted in 2007 show that the field visit process included eight parts: status presentation by the schools (of education); collection of information and related documents; visiting environments and facilities; interviews with faculty and staff; interviews with students and intern teachers; field inspection of teaching; evaluation of committee meetings; and comprehensive discussion between evaluators and university staff. Through these processes, the evaluation committee collects a variety of evidence to help them determine what is happening at these institutions and the quality of their programs and students.

Teacher education evaluations are usually conducted at the program level. This is because some teacher education universities offer programs for different levels of schooling. Therefore, one university may receive different ratings for programs that prepare teachers for different levels of schooling. In the three years from 2006 to 2008, six universities received Level 3 ratings for some of their teacher education programs and were disqualified from providing them. Some institutions terminated their teacher education programs due to a lack of applicants, a situation that resulted from having too many such programs and the low employment rate of certified teachers. Seventeen universities terminated their teacher education programs completely, and nine eliminated some—but not all—of their teacher education programs.

Although the Ministry of Education can use the findings from these evaluations to limit the number of teachers or terminate programs, this is not the main purpose of the process. The primary purpose is to inspect and control the quality of preservice teachers and to improve the effectiveness of teacher education.

Requirements for entry to the teaching profession

Graduates from teacher education programs in Chinese Taipei face a rigorous set of quality- assurance procedures before they finally gain a tenured teaching position. After completing their teacher education program with a passing grade, graduates have to take the Ministry of Education's Teacher Qualification Assessment. If graduates pass

this test, the ministry issues them with a teaching credential, which means they are officially qualified to teach in the field. However, if they apply for a teaching position in a particular region, they must still participate in a further onsite screening and selection process in the selected location.

The Teacher Qualification Assessment is held once every year. It takes place two months after the students have finished their educational practicum, which occurs at the end of March. The assessment is a national test. It is also the last step of the quality control of preservice teachers, apart from onsite screening. The Teacher Qualification Assessment is developed by the ministry's Teacher Qualification Verifying Committee and an administrative work institution appointed by the ministry (Ministry of Education, 2005c).

To secure a teaching position, graduates must also undergo an onsite screening process, which the school district or individual schools administer in two stages (Ministry of Education, 2005a). The first stage consists of written tests designed to assess the applicants' education professional knowledge or subject-matter knowledge. Graduates who make it through to the second stage are required to give a demonstration of their teaching competency and to engage in a personal interview, both of which are usually evaluated by three to five judges (mainly school teachers and a principal).

References

Cao, R.-D., & Liang, Z.-M. (2002). Investigation of the transformation of the teacher education system in Taiwan. *Journal of National Taitung Teachers College*, *13*(2), 211–240 (in Chinese).

Cheng, K. S. (1998). Analysis of the transformation of the teacher education system in Taiwan. *Bulletin of the National Institute of Educational Resources and Research*, *23*, 171–195 (in Chinese).

Executive Yuan. (2005). *Key points in paying government military personnel, employees, and teachers.* Taipei City, Chinese Taipei: Author (in Chinese).

Fwu, B.-J., & Wang, H.-H. (2002). From uniformity to diversification: Transformation of teacher education in pursuit of teacher quality in Taiwan from 1949 to 2000. *International Journal of Educational Development*, *22*, 155–167.

Hsieh, F.-J. (1997). The essence and features of the new mathematics curriculum in lower-secondary schools. *Science Education Monthly*, *197*, 45–55 (in Chinese).

Ministry of Education. (1976). *The fourth annals of Chinese education.* Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (1996). *The sixth annals of Chinese education.* Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2002). *The referential ratification principles and connotation of subject-matter courses for teaching nine sequential curricula in the learning area of mathematics for lower-secondary school.* Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2003). *Subjects and credits of general education and the professional education curriculum for secondary school preservice teacher preparation.* Taipei City, Chinese Taipei: Author. Retrieved from http://www.edu.tw/files_temp/ regulation/ B0037/5540051801.doc (in Chinese).

Ministry of Education. (2005a). *Guidelines for screening and selecting teachers for public schools.* Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2005b). *Principles underlying the conduct of the educational practicum for teacher education universities.* Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2005c). *Key points for the Teacher Qualification Verification Committee.* Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2006a). *Primary plans in the year 2006*. Taipei City, Chinese Taipei: Author. Retrieved from http://www.edu.tw/secretary/content.aspx?site_content_ sn=1169 (in Chinese).

Ministry of Education. (2006b). *Proposal for promoting the quality of teacher education*. Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2006c). *Yearbook of teacher education statistics, Republic of China 2005*. Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2007). *Key points for conducting evaluations of teacher education at universities*. Taipei City, Chinese Taipei: Author (in Chinese).

Ministry of Education. (2008). *The scheme and execution plan for evaluating teacher education in universities*. Taipei City, Chinese Taipei: Author. Retrieved from http://tece.naer.edu.tw/con_detail.php?mtype=yplan&atype=plan&year=97&show_h=0 (in Chinese).

Ministry of Education. (2009). *Dataset of statistics on all schools*. Available from Ministry of Education site http://www.edu.tw

Wu, W. X. (1983). *A study of normal education in Taiwan during the Japanese colonial period*. Taipei City, Chinese Taipei: Graduate Institute of History, National Taiwan Normal University.

CHAPTER 5:

Georgia

Editors' Overview

Georgia has been undertaking educational reforms that are drastically changing the policies and practices inherited from the Soviet Union. Although the reforms are far from being completely implemented, the implications for teacher education are profound.

Institutions and governance

Ten institutions of higher education currently offer teacher preparation in Georgia. These are mostly state institutions, but there are also some private ones. The 2004 Law on Higher Education of Georgia mandated major changes in teacher education. Also, for the first time, the State Commission on Educational Facilities set upper limits on the number of teacher education students to be admitted to each university. Within these upper limits, institutions determine the actual number of students admitted. Previously, the institutions had complete autonomy in this respect.

Program-types and credentials

Candidates holding a Bachelor's degree in pedagogy or any other subject can become primary school teachers. They do not need any other certificate issued by the authorities. However, teaching is becoming a more regulated profession. The qualification being implemented for secondary school is a Master's degree in teaching. This requirement greatly increases the role of educational sciences in the preparation of secondary teachers.

Even under the new law, a person holding a Bachelor's remains eligible to teach Grades 1 to 6 and, until 2014, in secondary school. Once implemented, the new law will require any person entering a teaching career to pass a teacher certification examination after he or she has received a relevant degree and completed a one-year probationary period in school.

Given this complex, changing situation, where preparation for teaching still takes place in a wide range of departments, the TEDS-M sample for Georgia was defined in terms of four program-types (Exhibit 5.1): a four-year Bachelor in Pedagogy for future primary school teachers in Grades 1 to 4, and a Bachelor in Mathematics and two Master's in Teaching at the secondary school level.[1, 2]

1 The two Master's in Teaching program-types are only offered in two institutions and are identical (e.g., in terms of characteristics shown in Exhibit 5.1), except that in one institution the program is offered as a concurrent program and in the other as a consecutive one.

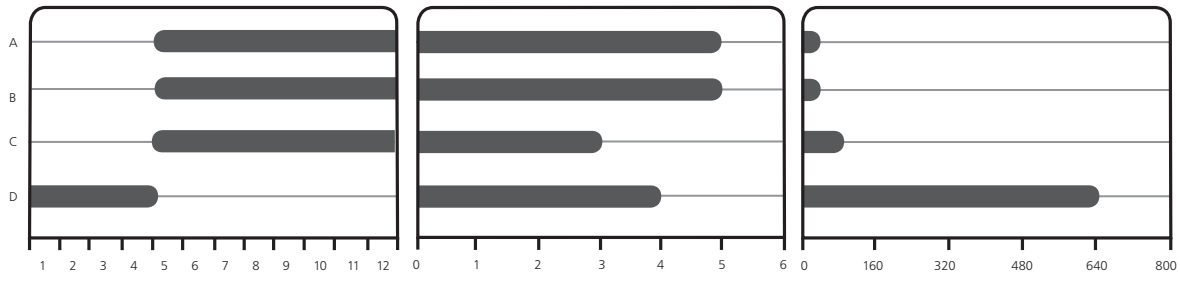
2 A fifth program-type, the five-year Bachelor in Pedagogy, is not included here because it had no students in the final year at the time of sampling.

Curriculum content, assessment, and organization

Each institution establishes its own entrance standards and requirements. In general, there are no specific content area requirements and no tests of prerequisite subject-matter knowledge for entrance into teacher education institutions. Applicants must have successfully completed a more general national examination. Institutions also develop their curricula independently. Each unit within a university department of education decides on the number and content of courses while, in principle, taking into account the professional standard in mathematics, the national teacher standard, and the student standard (created by the Ministry of Education and Science).

The traditional BA in education in Georgia typically takes 36 months and includes two phases, an academic phase and a nine-month practical training phase. However, the practical training phase has fallen into disuse.[3]

Exhibit 5.1: Teacher education program-types in Georgia



Key to program-type

A—Master's in Mathematics Teaching, consecutive
B—Master's in Mathematics Teaching, concurrent
C—Bachelor's in Mathematics
D—Bachelor's in Pedagogy

Note: During the current transitional period of educational reform in Georgia, future teachers in the Bachelor of Mathematics program will be qualified to teach Grades 1–12. However, according to the national research coordinator for Georgia, these students are typically found in Grades 5–12 and therefore the TEDS-M classification of level needed to be secondary, not primary–secondary. The Master's in Mathematics is a very small program that exists in only two institutions. It is listed twice in this figure because in one institution it is consecutive and in the other it is concurrent. The Russian and Azeri sections of the targeted institutions have been excluded from this figure, but they accounted for only 1.4 percent and 1.7 percent of the TEDS-M primary and lower-secondary fulltime student cohorts, respectively.

3 Chavchavadze State University, for example, decided to discontinue the period of practical training. Its instructors have compensated for this by using case studies, open lessons, and other practical experiences during the academic year.

Preparing Teachers of Mathematics in Georgia

Natia Mzhavanadze and Tamara Bokuchava

Part I: Context and Conditions of Teaching as a Career [4]

Historical roots

In Georgia, the education system is substantially changing the policies and practices inherited from the Soviet Union. At present, there is no good reason to state the fine detail of these changes given that they are far from complete and have not been fully specified. These measures are among the most radical and widely applicable reforms of the post-Soviet era in any country. They encompass, amongst other elements of the education system, national curriculum and programs, textbooks, evaluation systems, school management, teacher education and certification models, and higher education. Those responsible for assessing these reforms need indicators against which implementation can be monitored and the achievements justified.

Georgia has previously striven and is again striving for integration within the international sphere of education. In centuries past, Georgia's educational and cultural life was connected to similar developments in other countries. The first Georgian schools were set up in the fifth century. In the sixth century, Georgia established cultural and educational centers abroad, in such places as Palestine, Mount Sinai, and Antioch, and by the ninth and tenth centuries, Georgian schools were teaching foreign languages and philosophy. Georgia established its first higher educational institutions, two academies resembling the school centers of Byzantine, in the 12th century.

The first teacher-preparation institutions in Georgia appeared in the 19th century. In the first half of that century, public school teachers were prepared at the Theological Seminary (founded in 1817) and at gymnasiums for boys. The very first pedagogical school of Georgia was founded in 1866 and was later renamed the Teachers Institute. By 1919, the institute had prepared approximately 690 teachers. In 1919, the institute was again renamed, this time as the Pedagogical Institute of Tbilisi State University. Government action led to a similar school in Kutaisi, a large city in the western part of the country. This was followed by a number of new pedagogical institutions all over the country—in Tskhinvali, Sokhumi, Tbilisi, Batumi, Gori, Telavi, and Zugdidi, for example.

During the Soviet era, education came under strict central control and was one of the strongest elements in the ideological system binding the country together. The major role of teacher preparation was to nurture and implement Soviet ideology in society. Hence, teacher-preparation programs were overloaded with disciplines not directly connected or even relevant to the profession. For instance, subjects such as the history of the communist party, historical materialism, and scientific communism were the focus of the programs. Educational psychology, human development, and teaching and learning theories were either completely neglected or taught from the Soviet

4 The following sources were used during the writing of this chapter (Andguladze, 2007; Ministry of Education and Science of Georgia, 2007a, 2007b, 2007c).

ideological perspective. Such programs left little space for teachers to find out about modern learning and teaching theories, and about pedagogical approaches accepted and appreciated worldwide.

Conditions at the time of TEDS-M

The collapse of the Soviet Union led to the downfall of this system of values and a subsequent restructuring of society, together with an emerging system of new values that was incompatible with the practices and beliefs of teachers who were prepared under the Soviet pedagogical ideology. These teachers proved incapable of serving new generations with new needs and aspirations. Consequently, the need to alter and improve teacher-preparation programs and to reorganize the entire education system became a top priority on the national agenda. The reform process began in the 1990s and has continued to the present day.

As part of the reform, the existing state pedagogical institutions were converted into pedagogical universities in the 1990s, leading to modification of curricula and programs. In addition, many independent and private institutions were founded by individuals or groups of professionals. They started their own programs to prepare teachers for preschool, primary, and basic schools. The already chaotic situation was made much worse by the lack of a state-mandated system of standards. In addition, no accreditation system, either institutional or content based, was in place to ensure the quality of teacher education in general and what they were learning in particular.

Given challenges such as these, the main purpose of the reform became that of bringing about a high quality of teaching and learning at all levels of schooling. The management and financing of education also underwent crucial alteration. International experience was taken into account throughout this process.

Conceptualization of the reform led to a series of important developments:

- Formulation of the legal groundwork for this reform;
- Implementation of new management and financing models;
- Crucial changes to curriculum content and teaching methods;
- The beginnings of decentralization of the education system;
- Making the educational and research institutions autonomous entities;
- The first steps toward retraining teachers and academic staff;
- Renovation of technical equipment and provision of support in the educational institutions; and
- Creation of information and communication infrastructures.

Although some of these stages have been successfully completed, others are still under development.

One of the most important recent changes to the Georgian education system concerns the regulations governing entry to the teaching profession. Before the reform period, the only requirement to enter the profession was a document certifying graduation from a higher education institution. Nowadays, the process has become more complicated. During the initial implementation of the reform, Georgia adopted a new law on higher education, under which teaching became a regulated profession, that is, a profession with requirements above and beyond a first university degree, such as a certification examination. (Other regulated professions include law and medicine.)

The Law on General Education of Georgia defined the criteria for the new teaching profession. Under this law, the qualification required of basic and secondary school teachers is a Master's degree in education, although a person holding a Bachelor's in a particular subject remains eligible to teach in primary schools (Grades 1 to 6). However, it is likely that the requirement for the Master's degree will limit the intake of students to the departments of certain subjects (notably mathematics, chemistry, physics, and history), thereby contributing to a marked shortage of teachers of these subjects, unless the government agrees to subsidize study programs at Master's level.

The transitional period has highlighted a number of other tough challenges. One is the substantial difference between urban and rural schools with respect to teacher supply and demand. Although classes in certain urban areas and in certain schools can be large, most schools in rural areas are very small. To serve such schools and those subjects with shortages of teachers, persons not legally qualified have been allowed to enter the teaching profession. As a result, the number of teachers in rural schools has tended to remain the same while the number of students has gradually decreased, resulting in very low student–teacher ratios.

According to Georgia's Teacher Professional Development Center, only 85 percent of practicing teachers currently meet the criteria for holding a Bachelor's degree. Of these teachers, three percent report having studied toward but not completed a Bachelor's degree, approximately eight percent said they had only a secondary school education, and a negligible 0.05 percent reported having only a primary school education.[5] Unfortunately, the data do not tell us whether the teacher's tertiary field of study is relevant to the subject matter they are teaching in schools.

Another important challenge, for teachers especially, is the shift to the new teaching methodologies and curricula called for by the current reform. The teaching approaches prevailing in the schools are no longer suitable for contemporary conditions and requirements. The extent of changes to the content and organization of the curriculum is reportedly proving overwhelming for most teachers.

Sadly, teaching has become one of the least desired professions in Georgia. The still ongoing depreciation of the profession includes reduced salaries as well as decreased social status. While teaching was one of the most respected professions in Soviet times, it became less so when teachers appeared to be unprepared for the transition facing the country. According to the Teacher Professional Development Center, the only current effective incentive to join the teaching profession is the government-provided health insurance for school teachers.

Currently, the Georgian education system has approximately 72,000 teachers, the majority of whom are working in public schools (65,020 teachers). The private schools presently employ 6,819 teachers. The data also indicate that teachers of mathematics make up 24 percent of the entire teacher population (including all grades of primary, basic, and secondary school). This population also exhibits a familiar pattern in terms of gender preference. Teaching is still considered a female occupation, not one for both genders. The reason for this lies in females' assumption that a teaching career requires less daily time (working hours from early morning till 3 p.m.) and offers more weeks of vacation (notably the long summer holidays) than other jobs. These reasons make teaching more desirable for those women who have to take care of their families.

5 Four percent of teachers did not report their level of education.

To address these and other challenges, the government intends to make even greater changes to the teacher profession in general and the system for employing teachers in particular. All the policies and procedures currently in place are thus of relevance to the "transitional period" only. This period will end four years after the first certification examination has been put in place. Officials indicate that the proposed policies currently being debated and under development will soon be implemented, thus providing the teaching profession with strict and clearly defined regulations and procedures.

Part II: The Organization and Characteristics of Teacher Education

Important changes have taken place in Georgian teacher institutions since the TEDS-M data collection was conducted in spring 2008. At that time, the concurrent program-type consisted of two major phases—academic courses and practical training in schools. Now it includes one year of liberal education, three years of studying a specific subject (the degree major), and a one-year probationary period in school.

Eleven pedagogical institutions and universities offer the phases of liberal education and subject-matter major. The minimum requirement for an applicant to enter this program-type is completion of at least upper-secondary school, together with satisfactory performance on the national examinations taken by every applicant to higher education. The institutions offer Bachelor courses lasting 36 months. This academic phase is evaluated through ongoing internal examinations, and the Bachelor's degree is granted upon successful performance in the national examination once course requirements are completed. These curriculum requirements were more strictly defined after completion of the 2009 program accreditation.

Traditionally, Bachelor's programs in subjects taught in schools (e.g., mathematics, chemistry, history, languages) were sufficient for students wanting to become teachers because they included some pedagogy classes. A graduate with a degree in mathematics was considered qualified to teach in secondary schools, not just at primary-school level. However, as noted earlier in this chapter, the new law requires an applicant to a secondary school teaching position to hold a Master's or an upper degree in educational sciences. Although having teacher candidates who possess Master's-level knowledge of contemporary educational methods and approaches is advantageous, this requirement may also contribute to a considerable shortage of secondary-school teachers because it lengthens the training period and increases costs for students.

Given that there is no state subsidy for Master's programs (students have to cover their own tuition fees, which are at least 1,500 Georgian lari or about US$1,100 per term) and because teachers' salaries are very low in relation to the salaries of most other professions, graduates tend to see teaching as a field with insufficient financial return. Inadequate teacher supply is therefore unavoidable. To respond to this challenge, one of the biggest teacher-preparation programs in Georgia, that is, the program at Ilia Chavchavadze State University, has piloted a subsidized Master's program.

The need to obtain a Master's degree to teach in secondary schools is especially problematic with regard to the hard sciences (mathematics, physics, chemistry, etc.). Because career prospects for those who graduate from the less prestigious programs in these subject areas are poor, fewer applicants are entering Bachelor's programs in them. One of the most viable options for Bachelor's graduates used to be teaching, but this option is now, of course, precluded under the new regulations.

Precise data about the number of students in teacher education programs are not available. Even departments of education cannot give exact information about the number of students in each of their current programs. Because some of the departments have merged, it has also become impossible to determine how many students take classes in pedagogy as their major or minor concentration and enter the teaching profession upon graduation. (Students of fields other than education can take classes in pedagogy as their minor, and upon graduation will still be eligible to teach in primary schools.) Also, with the liberal education system recently implemented in certain universities, it has become even less easy to gauge how many students will choose education-related courses as their major after completing their year of general courses.

Curriculum and field experience requirements

The most important challenge facing teacher education in Georgia, especially with regard to preparation of future mathematics teachers, is the low quality of teacher-preparation programs. The new school curriculum and the teaching methods proposed for use in classrooms are not yet sufficiently incorporated in Georgia's teacher-preparation programs and curricula. Due to the record pace of reform, there has been a lack of coordination between innovation in the school system and changes in the education of future teachers. This situation has led to the use of outdated teaching materials and to content that does not comply with the requirements of the Teachers' National Standard. Faculty members and instructors commonly decide how to prepare teachers without referring to any external common standard.

Given the limits on acquiring data from all the institutions offering teacher education, we focus in this section on the education department of Ilia Chavchavadze State University (ICSU), which, as previously stated, operates the largest teacher-preparation program in Georgia. Reference to ICSU is still relevant to what occurs at Georgia's other teacher education institutions because ICSU's teacher-preparation policies and practices are relatively similar to those in the other institutions.

Each teacher education institution is free to determine and design the curriculum of the program it offers its students. At ICSU, the Department of Education designs the teacher education curriculum, but each directorate within the department (directorates of mathematics, philology, pedagogy, etc.) autonomously creates its components of the full curriculum. For instance, the department grants the directorate of mathematics a certain number of credits (in this case, 15 European Credit Transfer and Accumulation System [ECTS] credits), and the academic staff in charge of the directorate then determine, within this limit, the number and content of the courses to be made available.

Staff members also attempt, when developing their courses, to follow the Professional Standard in Mathematics, the National Teacher Standard, and the Student Standard created by the Ministry of Education and Science. The documents setting out these standards contain the vision and criteria against which teachers of mathematics, teachers generally, and students will be judged. As faculty members pointed out in interviews, although they enjoy greater autonomy than they did before the reform process began and although there is no mandated document or set of standards they have to follow, the education department voluntarily follows "nonwritten guidelines."

ICSU has used its autonomy to cut practicum and field experience to the minimum. Earlier, the academic phase of its teacher education program was followed by a nine-

month practical training phase at schools, immediately after which students took a state examination administered by the university. (Obtaining a degree has remained mandatory for all preservice teachers.) Practical training was still part of the teacher-preparation program during the main data-collection phase of TEDS-M in 2008. Special agreements existed with the host schools, and instructors were in place to guide students through their practical training.

More recently, ICSU has condensed primary-school teacher preparation from eight terms to six because the first two semesters are reserved for the mandatory university-wide general education courses. Because candidates for teaching positions have to complete a one-year probationary period after being hired, ICSU's Department of Education decided not to provide extra time for the field experience within the university program. But although the department chose to sacrifice field experience, it now offers laboratory practice opportunities, where instructors use case studies, open classes, and other practical experiences as means of expanding students' teaching skills. However, as the department regretfully admits, this approach does not provide students with real-life hands-on experience: that is deferred to the probationary period.

Staffing requirements

According to the Law on Higher Education, a person wishing to teach at tertiary education level must be either a doctoral student or hold a PhD degree. Doctoral students are eligible for the position of assistant professor only; the positions above this status (i.e., associate professor and full professor) require a PhD. All three positions are fulltime teaching ones. Requirements such as academic achievement and professional experience are tailored to the positions and can vary from institution to institution. However, because of the changes introduced in the field of education, qualified professionals tend not to be interested in these positions. The professionals who are available typically do not have the up-to-date knowledge and expertise currently needed.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

At the time when the Georgia report was prepared for the IEA TEDS-M survey (2008), each teacher education institution in the country had the right to determine the number of places it would make available to students. However, this practice has since changed, as have other aspects of teacher preparation that were evident at the time of TEDS-M.

First, at most institutions, the departments concerned with teacher preparation in mathematics have been merged with several other departments. This means that the students in these departments no longer have to undergo separate entry examinations in mathematics. Second, the Ministry of Education and Science now stipulates the maximum number of teacher education students each institution can accept. Institutions are still free to accept fewer students than the defined upper-limit number. Just how many teacher education students any one institution can accept is determined by state commissions, the members of which base their decisions on parameters such as total area of lecture rooms, number of lecturers, and so on. The actual number within this limit is then determined by each institution, according to its own policy. To date, Georgia's teacher education institutions have not endeavored to ascertain the existing demand for teachers and then tried to match the supply to this demand.

For the concurrent B.Ed.-route program-type, which is offered in 24 institutions, the minimal credential/qualification normally required for entry is completion of upper-secondary school. In terms of prior academic achievement, students entering the program-type are typically drawn from average and below-average achievers (for their age group). The main criterion used for selection into this program-type is a candidate's performance in a general national examination and not the level of attainment at the end of secondary schooling.

To a certain extent, the entry requirements reflect the preferences of each training institution. However, the institutions tend to place value on those subjects that are already offered under the national entrance examination instead of proactively selecting the content areas in which there are expected teacher shortages. Each institution thus independently determines the requirements and standards it uses to select teacher-education applicants onto its professional preparation programs. The standards and requirements at the lower-secondary level generally include knowledge of the secondary school mathematics courses that are mandated by the national curriculum. Beyond that, there are no specific prescribed areas of content, and future teachers rarely have to sit or pass tests of prerequisite subject-matter knowledge.

At most institutions, the academic standard of entrants to teacher education programs for teachers of mathematics at the lower-secondary level align with the standards for entry to most other mathematics-related professional preparation programs up to Bachelor's level. Future teachers are not required to meet any special requirement. At higher levels, such as the Master's program, there are major differences between the requirements for teacher-preparation programs and other mathematics-related programs.

Accreditation of teacher education institutions and programs

The Law on Higher Education of Georgia regulates the process of accreditation. This process began, in accordance with the law, in 2004. It consists of two main aspects—institutional accreditation and program (content) accreditation. Within the legal framework, accreditation is defined as the procedure for state confirmation of the status of a higher education institution or an educational program (more exactly, confirming permission for higher education institutions to issue the relevant diploma, certificate, etc.).

At the time of writing this report, only institutional accreditation was under implementation. Completion of all institution-based accreditation procedures was to have been accomplished by the 2010/2011 academic year. Until that time, all academic programs were automatically considered to be state-accredited.

There are, as yet, no specific guidelines for accrediting teacher education programs. Generally, in order to make the program accreditation procedures easier, most institutions offering teacher education have set up internal quality-assurance bodies charged with completing in advance all work needed to ensure the programs can meet program accreditation requirements once implemented.

Both institutional and program accreditation are the responsibility of the National Education Accreditation Center, whereas licensing procedures are under the licensing office of the Ministry of Education and Science.

Requirements for entry to the teaching profession

For the time being, there is no strict requirement in place for hiring and promoting teachers. As mentioned above, the only requirement under the Law of General Education is that an applicant should possess certain qualifications gained at the university, that is, a Bachelor's degree either in pedagogy or in any of the subject fields studied at school (mathematics, chemistry, history, languages, and so on). However, even this requirement is not being fully met, especially in the rural areas, where some schools continue to hire teachers who do not have a Bachelor's degree.

Schools are more or less autonomous in terms of recruiting, hiring, and promoting their teachers. Candidates are hired for teaching positions on a contractual basis by the school governing body. The terms and conditions of the agreement are established by the school itself in light of the minimum requirements of the Ministry of Education and Science. The certification procedures that have yet to be formally introduced in Georgia will include additional obligatory criteria for hiring teachers.

As the new regulations are implemented and procedures become stricter, there will be different requirements for those applicants wishing to become primary school teachers and those aiming to teach at the upper levels of the secondary school. For example, teachers with a university degree in hand will be able to start working at a school for a probationary year. During this period, they will be registered at the Teacher Professional Development Center, the main agency responsible for reforming the teacher profession. At the end of the probationary period, these teachers will receive a recommendation letter from their respective schools and the Teacher Professional Development Center confirming their readiness to take certification examinations administered by the National Examination Center. The certification examination will consist of two main parts: a professional skills test, compulsory for all applicants, and tests in the subject an applicant wishes to teach. One part of these tests will assess subject-matter knowledge, and one part will assess subject-specific teaching methodologies. Successful applicants will be granted a certificate, allowing them to enter the teaching profession.

References

Andguladze, N. (2007). *Background review for UNESCO national education support strategy*. Tbilisi, Georgia: Ministry of Education and Science of Georgia.

Ministry of Education and Science of Georgia. (2007a). *Education policy note*. Tbilisi, Georgia: Author.

Ministry of Education and Science of Georgia. (2007b). *Georgia: Consolidated education strategy and action plan (2007–2011)* (draft). Tbilisi, Georgia: Author.

Ministry of Education and Science of Georgia. (2007c). *Report on implementation of the International Pact on Economic, Social, and Cultural Rights*. Tbilisi, Georgia: Author.

CHAPTER 6:

Germany

Editors' Overview

German teacher education differs markedly from teacher education in the other TEDS-M countries in a variety of important respects. Also, because education policy in Germany is basically the responsibility of the 16 federal states, and because the primary and secondary school system is highly differentiated, the system varies internally as well.[1]

Institutions and governance

In Germany, the federal government does not make educational policy. Instead, development and coordination of common features are fostered by the Standing Conference of the (State) Ministers for Education and Cultural Affairs (KMK). In teacher education, the KMK has facilitated a national agreement (although with some allowance for variation) in the structure and duration of teacher education program-types, required coursework, and general contents of the program-types. The agreement also covers the main features of the two state examinations that future teachers must pass.

Notably, Germany is the sole TEDS-M country that appears to offer only consecutive program-types. All future teachers begin their preparation in one of the German universities with program-types that emphasize academic, theoretical study. This approach ensures a relatively advanced level of academic preparation for all future teachers given that university entrance is still selective in Germany, and especially so when compared to countries where universities reach a much larger proportion of the age cohort. Germany has 74 universities providing preservice teacher education. This first phase also contains a great deal of required education coursework that is characteristic of concurrent program-types in other systems, albeit with a heavy emphasis on theory.

Most of the practical preparation is provided in a second phase in special, generally small, institutions operated by state governments and known as *Studienseminare.*[2] Thus, despite appearing to have only consecutive program-types, Germany should be understood as having program-types that are not purely consecutive but rather a hybrid of consecutive and concurrent types.

1 In line with the Bologna Declaration, integration of Germany into European higher education is changing some of these traditional characteristics. This account represents the situation at an earlier point in time.

2 Two states do not have these institutions; instead, pre-university schools take responsibility for the second phase.

Program-types and credentials

In Germany, teaching careers, and therefore teacher education program-types, differ from one type of primary or secondary school to another. The German *Grundschule* or primary school ends at Grade 4 in most German states, and is shorter in duration than the international norm. All Grundschule students attend the same type of school; there is no stratification at this point. However, at Grade 5, students are stratified into four very different types of school: (1) *Hauptschule*,[3] (2) *Realschule*,[4] (3) *Gymnasium*,[5] and (4) *Gesamtschule*.[6] In some states, the Hauptschule and Realschule are combined.

In order to staff these different types of school,[7] the KMK has classified teaching qualifications into four categories:[8]

- Type 1: Primary (Grundschule) only, Grades 1 to 4;
- Type 2: Primary (Grundschule) or lower-secondary schools, Grades 1 to 9/10;
- Type 3: All types of lower-secondary school, Grades 5 to 9/10;
- Type 4: Grades 5 to 12/13.

Under the TEDS-M configuration of program-types, the first two types in the German terminology were each subdivided into two TEDS-M program-types. These included teachers with mathematics as a teaching subject and those without, thus producing six program-types in all, as featured in Exhibit 6.1. Before entering any of these program-types, all future teachers have to earn the *Abitur* secondary school completion diploma, which requires passing a high-stakes examination in at least four subjects.[9]

Curriculum content, assessment, and organization

Because Type 1 teachers teach all subjects, the study of mathematics as well as other subjects is usually compulsory for future primary teachers. Type 2 teachers preparing for Grades 5 to 10 and all Types 3 and 4 future teachers are more specialized than their Type 1 colleagues and undertake study that allows them to teach two subjects. Before the Bologna Declaration, future teachers did not progress through this phase in

3 This is the least academic and most practical type of lower-secondary education for Grades 5 to 9, accounting for 26 percent of eighth graders in 2006, according to the *TIMSS 2007 Encyclopedia*. On completing their schooling at this level, Hauptschule students either combine work with part-time vocational training or go straight to a fulltime vocational school.

4 This is a more selective form of secondary education for Grades 5 to 10, with 27 percent of eighth graders attending these schools. Realschule is considered an appropriate basic education for lower levels of white-collar and technical occupations.

5 This constitutes the elite form of secondary education, with 33 percent of eighth graders preparing for the Abitur, which is required for university entrance.

6 This, a comprehensive school, provides differentiated programs otherwise offered in separate schools. Comprehensive schools take in about nine percent of eighth graders, but do not exist in all German states.

7 Excludes vocational and special education because TEDS-M did not include teachers who were being prepared for these programs.

8 There is no longer a direct correspondence between types of schools and types of teacher education in the sense of drawing Gymnasia teachers solely from one type, for example. Nevertheless, new teachers in Gymnasia are more likely to come from Type 4 programs than from other types.

9 The nature and the organization of this examination vary from state to state, but some commonality has been established through an interstate compact between the federal states.

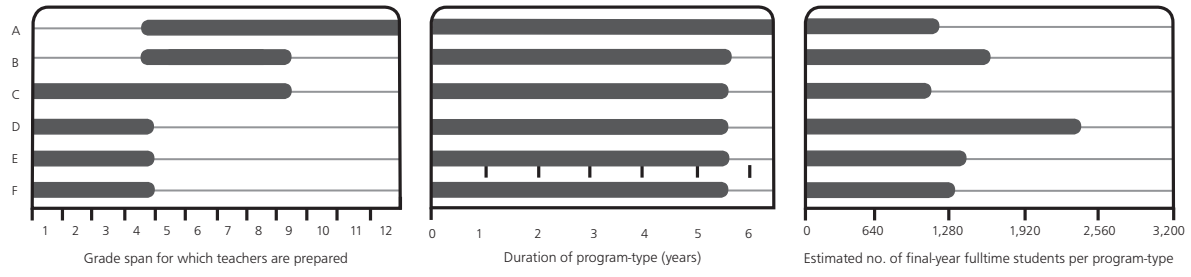
cohorts, nor were they required to attend classes. The first university phase typically lasts from 42 months for primary to 54 months for secondary future teachers. These time periods include breaks and vacations.[10]

The second phase lasts 18 to 24 months, depending on the state and level of teacher education. Future teachers in this phase teach parttime in schools, assuming all the responsibilities normally expected of a classroom teacher. They simultaneously attend courses in general pedagogy (*Hauptseminar*) and subject-specific pedagogy (*Fachseminar*) organized by their Studienseminar.

During teacher education, future teachers must pass two state examinations to be considered qualified to teach. They undertake the first state examination at the end of the first university phase. It consists of several written and oral assessments related to the subjects studied in the first phase, as well as a long essay. Successfully passing this examination constitutes a first university degree at ISCED Level 5A.

The second state examination is less academic and more practical than the first. Future teachers are required to teach lessons that are observed and assessed by a board of examiners. An essay on a practical issue is also required. One or more oral examination sessions may be included as well. Successful completion of the second state examination constitutes attainment of an ISCED Level 5A second university

Exhibit 6.1: Teacher education program-types in Germany



Key to program-type

A—Grades 5/7–12/13 with mathematics as a teaching subject (Type 4)
B—Grades 5/7–9/10 with mathematics as a teaching subject (Type 3)
C—Grades 1–9/10 with mathematics as a teaching subject (Type 2A)
D—Grades 1–4 without mathematics as a teaching subject (Type 2B)
E—Grades 1–4 without mathematics as a teaching subject (Type 1B)
F—Grades 1–4 with mathematics as a teaching subject (Type 1A)

Note: For organizational reasons, one small federal state could be included only at the institutional level. No further teacher data were collected, but this information would have accounted for only 3.7 percent of the TEDS-M primary population and for a similar percentage at the lower-secondary level. The grade span for primary school teachers is Grades 1 to 4, except in two states where primary school includes Grades 1 to 6. The duration of Type 1A and Type 2B programs is the same (3.5 + 2.0 years) in all federal states except one. The duration of Type 2A and 2B programs varies across federal states from 3.0 to 4.5 years for Phase 1 and 1.5 to 2.0 years for Phase 2. The values shown in the graphs are modal values. The duration of Type 3 is the same (3.5 + 2.0 years) for all but three federal states. In two of these states, the duration of Phase 1 is 4.0 years. In the other two states, the duration is 1.5 years. The duration of Type 4 is the same (4.5 + 2.0 years) for all federal states except one. Estimates for final-year fulltime students per program-type were calculated as the means of the estimate from the two split-half samples for Program-Type 2A.

10 Breaks are counted because future teachers have assignments to complete during their breaks (e.g., seminar papers school-based experiences).

Preparing Teachers of Mathematics in Germany

Johannes König and Sigrid Blömeke

Part I: Context and Conditions of Teaching as a Career

Historical roots

The development of German teacher education has close links with the development of Germany's school system. During the first decade of the 19th century, the core structural characteristics of the school system developed under the influence of Wilhelm von Humboldt. Since then, German federal states have demanded that secondary school teachers undergo a university-based teacher education program leading to a state examination. For Germany, this policy marked the starting point of school teaching as a career. From the 1820s, primary school teachers received a two- or three-year period of training at teacher education institutions. The remainder of the 19th century saw continual expansion of these institutions and their courses (Sandfuchs, 2004) and the introduction of examinations at the end of training.

During this era, primary school teaching and secondary school teaching were considered to be two different professions, a differentiation that can still be observed today. In the 1890s, a one-year on-the-job second phase of teacher education was established. At the beginning of the 20th century, a second state examination was introduced at the end of this second phase. As the school system expanded, middle schools emerged. Primary school teachers became qualified to teach at these middle schools by taking additional courses. However, there were no programs of study until the 1970s that allowed teachers intending to teach in these school to link these courses together (Sandfuchs, 2004).

Regional differences in teacher education were apparent as early as the 19th century. During the 20th century, the regional states maintained authority over educational issues and, after Nazi rule, even reinforced it. The political influence of the Nazi state on the education system was particularly strong between 1933 and 1945 (Bracht, 1998; Dithmar, 2001; Keim, 1995). As a consequence, one of the most important agreements after 1945 was never again to allow centralized, dictatorial control over educational matters. For West Germany, these safeguards were embedded in the establishment of the Federal Republic (FRG) in which the rights of each federal state are extensive, especially with respect to educational policy.

Legislation concerning education and the sciences is therefore one of the domains reserved to federal state jurisdiction (*Bundesländer*). At the national level in 1948, the FRG established the *Ständige Konferenz der Kultusminister der Länder* (KMK, or Standing Conference of the [State] Ministers for Education and Cultural Affairs) to coordinate educational matters as well as research and cultural affairs across the states. Since 1948, the KMK has served as a forum of permanent cooperation. However, its resolutions remain recommendations until the parliaments of the federal states (*Landtage*) enact these resolutions and the states implement them through regulations.

One good example of how the KMK works is evident in its 1999 resolution on the reciprocal recognition of teacher qualifications (*Gegenseitige Anerkennung von Lehramtsprüfungen und Lehramtsbefähigungen*). This resolution concerns categorization

of teacher qualifications and allows for labor market flexibility in order to make it easier for teachers to apply for a position in another federal state, thus easing problems of teacher supply and demand when they occur in individual states.

Traditionally, there has been a close connection between educational degrees and social status in Germany. The lower-secondary school system and, consequently, the teacher education system have been highly stratified. This stratification is based on the premise of three kinds of natural talent (manual, technical, and intellectual) that could supposedly be best developed in three different kinds of school (German Committee for Education and Training, 1966; Spranger, 1974). The resulting tripartite secondary school system—*Hauptschule, Realschule*, and *Gymnasium*—in reality prepared students for different social-class futures (working class, middle class, and upper class). This system now seems anomalous when compared to most other school systems in the world. Yet despite Germany being roundly criticized for this system and despite empirical findings disproving the underlying theory of talent (Roth, 1969), it persists.

After the Second World War, attempts were made to abandon the stratified lower-secondary system, a reform that would have required major changes to teacher education. However, West Germany reinstalled the fundamental characteristics of the systems dating from the 1920s, including the tripartite system (Führ, 1998). This stratification was a response to the German Democratic Republic (GDR, or East Germany) adopting a comprehensive school model for Grades 1 to 9. Because the two German countries were at the frontlines of the ideological struggle between East and West, the making of educational policy was highly sensitive in terms of possible repercussions for the East–West conflict. As a result, it has been almost impossible to reform teacher education in the postwar period in West Germany because proposals are ostensibly linked to Nazi or GDR communist precedents.

West Germany also tended to see East Germany as a competitor. As a frontline country during the Cold War, West Germany was deeply affected by the so-called "Sputnik shock" of the 1960s. When the USSR, the leading nation of the Eastern bloc, was the first to send a satellite into space, it raised doubts about the level of technical knowledge in the Federal Republic, and led to questions about the quality of its education system. In the decades that followed, educational policymakers discussed the need for innovation, and some reform was enacted.

For example, the status of teacher education was enhanced with the introduction of a second higher education phase. The subject-matter preparation of primary teachers was also improved, and in the 1970s the teacher education system for primary schools was brought into line with the system for secondary schools. Finally, in almost all federal states, teacher education was integrated into universities (Sandfuchs, 2004). Secondary teacher education, which had been exclusively subject-matter oriented, was simultaneously expanded to include at least some coursework (called "lectures" and "seminars") in subject-matter pedagogy and general pedagogy. Since that time, all individuals intending to become teachers must first enroll in this university-level special teacher education program.

More recently, the findings of crossnational research have pointed to the need for more reform of German schooling. In 1995, many German policymakers, academics, and members of the media were shocked when German students scored statistically significantly lower than the international average on IEA's Third International Mathematics and Science Study (TIMSS). Five years later, the OECD's Program for

International Student Assessment (PISA) confirmed the TIMSS results when German students again scored at or below the international average. In addition, the relationship between family background and student achievement in Germany emerged as the second strongest amongst the PISA countries (OECD, 2001). As a result, issues such as school structure, measures to integrate a third generation of immigrants, and concerns about teacher quality and the quality of teacher education were brought forcefully to the nation's attention. It is not surprising that Germany responded by initiating further reforms.

Conditions at the time of TEDS-M

Once teachers are fully qualified (i.e., have passed state examinations and the practicum phases of teacher education), they can apply for permanent school employment. The employment procedure varies across regional states. Teachers apply either through the Ministry of Education and Cultural Affairs (*Kultusministerium*) or through the regional or local education authority (*Schulaufsichtsbehörde*). In the past, the procedures used to fill job vacancies were subject to strict centralized control within particular states. Deemed indicators of academic performance, scores on the first and second state examinations played (and continue to play) a major role in selection. Subject-matter specialty has also continued to serve as a selection criterion.

Although these criteria continue to be used, an increasing number of federal state schools can now select teachers independently. In these cases, future teachers apply directly to individual schools, through a strictly monitored process. However, once hired, teachers are employed by the Ministry of Education and Cultural Affairs or by the regional or local education authority (KMK, 2004a; OECD, 2005). Individuals not hired have the right to contest this decision through legal action.

German teachers are either civil servants or salaried employees. Most federal states employ teachers as civil servants. Beginning teachers start out as probationary civil servants. On completing the probationary period, they become civil servants with tenured employment. The probationary period lasts two and a half years for primary school teachers belonging to the "higher service" (*gehobener Dienst*) and three years for secondary school teachers belonging to the "senior service" (*höherer Dienst*). The probationary period provides opportunity to monitor teachers' aptitude and performance.

Salaried-status teachers are employed on a contractual basis under general employment legislation. Their probationary period lasts six months. Salaried teachers are in the majority in states that belonged to the former GDR. Only teachers with salaried employee status can be employed on fixed-term contracts for a maximum of five years.

Teaching careers vary considerably across the federal states, but the categories describing their main features are used nationwide. For clarification purposes, the KMK has classified teaching qualifications into four categories of relevance to TEDS-M (KMK, 2004a, pp. 189–190):

- Type 1: primary (*Grundschule*) only (Grades 1 to 4);
- Type 2: primary (*Grundschule*) or lower-secondary schools (Grades 1 to 9/10);
- Type 3: all types of lower-secondary school (Grades 5 to 9/10); and
- Type 4: all types of lower-secondary and upper-secondary school (Grades 5 to 12/13).

Note that there is no correspondence between school type and types of teacher education in the sense of, for example, drawing all gymnasium teachers from one type. Such teachers, however, typically come from Type 4 programs.

TEDS-M did not cover the additional Type 5 and Type 6 teaching careers as defined by the KMK (2004a). Future teachers pursuing the Type 5 career for teaching in vocational schools or tracks are not eligible to teach at lower-secondary schools later on. They therefore did not fit the definitions of target populations for TEDS-M. Future teachers pursuing the Type 6 teaching career are appointed to teach at schools catering for students with special educational needs. Because these students are excluded from IEA studies such as TIMSS, they were also excluded from TEDS-M.

Teachers' working conditions, such as class size, working time, and salaries, are comparable to those of other OECD countries. In 2006, the OECD (2006) established that the average German class size at that time was slightly above the OECD average. Primary and lower-secondary classrooms had 22.1 and 24.7 students, respectively. However, class size has since increased significantly in most federal states due to reduced funding. Public and private institutions differ little in terms of average class size. However, only about five percent of all German students attend private schools.

In 2006, again according to the OECD, primary, lower-secondary, and upper-secondary teachers worked 40 weeks per year with 193 days of instruction for a total of 1,736 hours, slightly above the OECD average. (For an account of a German teacher's everyday work schedule, see Schmidt, Blömeke, & Tatto, 2011.) Comparison of Germany with most other OECD countries shows that teachers' salaries in Germany were relatively high in 2006 when equalized against the countries' gross national product (OECD, 2006). However, in comparison to the salaries of professions requiring a high level of education, the salaries of German teachers were relatively low.

In Germany, teachers do not compete with one another for salary increases. Teachers' salaries differ mainly according to the formal qualifications required. A teacher's age and family status are also taken into account during determination of a teacher's base salary (KMK, 2004a). Apart from the minimum qualifications that candidates must attain in order to enter teaching (i.e., successful completion of the first and second state examinations), no other criteria are considered. As a result, the salary range encompassing beginning through to experienced teachers in Germany is small compared with the range in other OECD countries (OECD, 2006).

The demand for new teachers is an important contextual factor in teacher education. Although the demand for teaching staff increased considerably at the end of the 20th century in West Germany, a sufficiently large number of teachers were on hand in the job market to meet this demand. Germany has not experienced a shortage of teachers for years. In contrast, a study conducted by the KMK in 2003 predicted that the demand for teaching staff would increase significantly in the 10 years between 2007 and 2017 (KMK, 2003). Because this period is also likely to coincide with a relatively large number of teachers retiring from the profession, the demand may not be met. This trend is unlikely to be evident across all levels of the schooling system, however. A sufficient number of primary school teachers (i.e., Type 1) and teachers of most subjects is probable at the lower- and upper-secondary levels of the Gymnasia. The teachers most in demand will likely be the Type 4 teachers of subjects such as physics, mathematics, and Latin, as well as the Type 2 and 3 teachers for all or individual lower-secondary schools. The study estimated that only 60 percent of the demand for such teachers will be met.

Part II: Organization and Characteristics of Teacher Education

The advanced school-leaving certificate (the *Abitur* or *Allgemeine Hochschulreife*) that students receive after successfully completing the upper-secondary school general education track (*Gymnasiale Oberstufe*) is the minimum qualification required for entry into any of the four types of teacher education. German universities rely on the Abitur for determining university admission and so do not use other entrance examinations. The Abitur corresponds to ISCED 3 (OECD, 1999) and requires students to sit examinations in at least four subjects. Today, the setting and marking of these examinations is generally a centralized responsibility within the federal states, with grading carried out on an anonymous basis. Formerly, schools and their teachers had considerable autonomy in organizing and grading examinations.

Teacher education has two phases—academic study at a university and practical preparatory service (*Vorbereitungsdienst*) (Blömeke, 2002; KMK, 2006). During the first phase, students complete their coursework at universities (*Universitäten*), technical universities (*Technische Universitäten*), or pedagogical universities (*Pädagogische Hochschulen*). Institutions offering the first phase of teacher education can be found in all 16 regional states. In total, 74 universities provide the first phase of teacher education, and the majority of them offer more than one teacher education program.

Completion of the first phase of academic studies typically takes 42 to 54 months, with that time span including breaks and vacations. Future teachers attend courses for about three and a half months each semester and have to write seminar papers or gain school experience during the breaks when no courses are offered. On average, future teachers spend about 9 to 18 months longer on the program than the recommended schedule (KMK, 2003, p. 20), a situation that is the result of both individual choice and university organizational problems, such as lack of course offerings.[11]

The second phase normally lasts 24 months (including breaks and vacations). However, in a few states, it lasts only 18 months. Several federal states intend to reduce the length of the second phase for all programs. All 16 regional states offer the second phase of teacher education, during which teachers must work parttime at schools and attend courses in general pedagogy (*Hauptseminar*) and subject-related pedagogy (*Fachseminar*). The second phase ends with the second state examination. In 14 of the 16 federal states, the second-phase courses take place at training institutions (*Studienseminare*), which are controlled by the individual states. In the other two states, pre-university schools are responsible for the second phase. Completion of the first phase and obtaining the first state examination certificate are the general requirements for entry into the second phase. The 16 regional states differ with regard to additional entrance criteria.

Exhibit 6.2 provides an overview of figures for cohorts of future teachers at different stages of teacher education in the years prior to the TEDS-M 2008 survey. The data in the exhibit include future teachers in the programs described above; no distinction is made between teaching subjects. The first row of the exhibit indicates students at the beginning of the first phase (i.e., their first or second term at university). The second row provides data for the students from the 2003 intake who successfully passed the first state examination in 2004. It is important to point out that the dropout rate of students during their first phase of training is usually relatively high, while the success

11 Note that this description of programs is based on the period when the TEDS-M 2008 cohort of future teachers experienced teacher education. It does not reflect changes made in response to the Bologna Declaration.

rate of candidates taking the first state examination is almost 100 percent (cf. Science Council, 2001). The third row references teachers who entered the second phase in 2004, and the final row references teachers who successfully passed the second state examination in that year.

Exhibit 6.2: Future teachers of different types at different stages of teacher education

Program-type	1	2	3	4
Grade levels	*Primary-school*	*Primary/lower-secondary school*	*Lower-secondary school*	*Lower/upper-secondary school*
Future teachers at the beginning of the first phase (2003)	6,550 6,550	6,288 6,288	10,981 10,981	22,745 22,745
Graduates of the first phase (2004)	3,064	4,283	2,901	7,779
Future teachers entering the second phase (2004)	3,105	3,758	3,379	7,624
Graduates of the second phase/fully qualified teachers	3,001	3,169	2,825	6,148

Source: KMK, 2005.

Because the information in Exhibit 6.2 does not distinguish future teachers of different teaching subjects from one another, a further breakdown is necessary to obtain the number of future teachers of mathematics. During the TEDS-M data collection, 10,991 primary and secondary future teachers of mathematics were completing their last year of training. Of this cohort, 3,657 were Type 1 future teachers of mathematics, 4,797 were Type 2 such teachers, 1,288 were Type 3 future teachers of this subject, and 1,249 were Type 4 future teachers of it.

Today, reforms are continuing to transform teacher education programs from state controlled to university controlled and from informal to formal accountability mechanisms. As universities and schools gradually received more autonomy during the 1990s (Altrichter, Brüsemeister, & Heinrich, 2005), the state shifted from reliance on budgets and regulations as instruments of control to more goal-based accountability. Today, funding mechanisms based on productivity criteria—dropout rates, success in securing research funds, and publication citation indices—are common.

In 2004, the KMK developed nationwide standards for teachers and teacher education to make programs more comparable across federal states and outcome expectations clearer (KMK, 2004b). Teaching staff standards are increasingly giving precedence to qualifications over seniority, which means that most teachers seeking promotion now have to take examinations designed to evaluate their teaching knowledge and skills (Strukturreformgesetz, 2005).

Internationalization is also affecting teacher education in Germany in major structural ways. Shifts toward a common qualifications framework throughout European education culminated in the Bologna Declaration, which had, as its objective, "increasing the international competitiveness of European higher education."[12] Since that time, German universities have had to make structural and organizational changes to their

12 For the text of the declaration, go to http://www.bologna-berlin2003.de/pdf/bologna_declaration.pdf

teacher education programs in order to comply with the declaration. These changes have included reducing the length of teacher education, minimizing dropout rates, and making the system more competitive with the systems of other countries. Today, most universities in most federal states have changed their traditional teacher qualifications into Bachelor's and Master's degrees.

Curriculum and field experience requirements

The federal states now have in place study and examination regulations governing the first-phase curriculum of all their teacher education program-types. In general, this curriculum requires students to study at least two teaching subjects or teaching subject areas, including subject-related didactics and general pedagogy, which normally includes the study of educational theory and psychology, as well as other areas such as philosophy and the social sciences. Students also have to complete field experience encompassing general pedagogy and their teaching subjects. At the national level, the KMK determines the components of the teacher education curriculum that all providers of teacher education should hold in common by (KMK, 1995, 1997a, 1997b, 1997c, 1997d).

Students' course content during the second phase of their teacher education is determined by the teaching subjects these future teachers chose at the beginning of the first phase. Secondary teachers (Grades 5 to 12/13) are subject specialists. Primary teachers, however, normally teach all subjects from Grades 1 to 4. Future primary teachers must study German and mathematics. Preparation for a Type 1 teaching career normally involves studying subjects additional to these two. The other three types of teaching career are much more specialized than the Type 1 career in terms of subject matter—normally two teaching subjects. The subjects that future teachers take during their university study must be ones that are normally taught at school, and there are also restrictions on the possible pairs of subjects these students can study. Due to the number of courses required during the first phase and for the first state examination, the first phase gives priority to subject-matter acquisition. However, the depth of knowledge that students must gain depends on the type of teaching career selected.

Subject-related didactics serve as a bridge between subject-matter acquisition and general pedagogy. Future teachers learn not only about the structure of subject-related curricula and subject-related teaching goals, methods, and media, but also about other aspects of subject-related didactics. (For a description of how this situation plays out in terms of teachers' general pedagogical knowledge and competency, see Blömeke, Houang, & Suhl, 2011.) General pedagogy, in turn, usually includes pedagogy, courses in psychology, and courses in sociology. (For a description of how these areas of teacher education serve teachers' pedagogical skills, see König, Blömeke, Paine, Schmidt, & Hsieh, 2011.)

Although there are no regulations at the national level governing the specifics of the first-phase course content, national regulations do govern the first state examinations. These regulations typically focus on the following categories of general pedagogy: general pedagogical theories, organization of educational systems, history of education, lesson planning and teaching, intercultural education, assessment, educational psychology, and sociology of education (Nolle, 2004). General pedagogy thus functions as a theoretical basis from which future teachers develop their pedagogical identity and a professional ethos. A central goal of this component is knowledge-based reflection.

No further national requirements for this phase exist.[13] Any additional regulations on curriculum content are set by the federal states and (for the first phase) the individual university. As a consequence, the length and components of the first phase, as well as the requirements for the first state examination, can vary from state to state, but the heterogeneity is less pronounced than is often assumed (Blömeke & Kaiser, 2012).

The curriculum requirements at the national level are more specific for the second phase of teacher education. The required curriculum content of the courses offered during this phase include topics related to pedagogy and psychology as well as to subjects, subject-related teaching methods, school legislation provisions, heterogeneity of students, students with disabilities, highly talented students, conditions of schooling, and the responsibilities of schools.

Although elements of the school-based field experience (practicum) differ by phase and across the regional states and programs, the overall form, content, assessment, and mentoring of the field experiences during each phase are nationally standardized (for detailed accounts, see Lenhard, 2004; Terhart, 2004; and Topsch, 2004). The regional states put in place and then oversee the regulations governing the practicum components of teacher education during the first phase. Although these regulations are based on the general regulations set by the KMK at the national level (KMK, 1995, 1997a, 1997b, 1997c, 1997d), there is provision for a university or faculty to modify the content and organization of the practicum. As a result, first-phase practicum components can differ across the federal states and the universities.

The field experience of every teacher education program has two components. The focus of the first component, which students usually experience on a fulltime basis over several weeks, is on exploring the school environment from a sociological, sociocultural, or general pedagogical point of view. This aspect of the field experience is also meant to help future teachers reflect on why they want to be teachers. Normally during each practicum, practicing teachers are responsible for mentoring the future teachers, who then write a report in which they describe and reflect on their experiences throughout this period of training and answer relevant pedagogical questions. The report is assessed by a general pedagogy university educator who teaches courses linked to the practical component.

The second component is very similar to the first with regard to its design and mentoring. However, its particular focus is on teaching. It requires future teachers to plan, teach, and analyze lessons. They are mentored by a teacher at the school and normally supervised by a university educator. The educator visits the future teacher at school and observes his or her teaching performance at least once. The future teacher then prepares a written report in which he or she reflects on his or her practical experiences. When the future teacher is assessed by the university educator, the report is more important than the observed teaching performance. The second component is also subject-matter specific.

In general, future teachers engage in about three periods of practical experience during the first phase of their training. Each period takes place over at least 12 days. During the first phase, the university or a particular faculty assigns the practicum placements. The number of placements available varies across universities.

13 The set of national standards is a very general description of outcome expectations relating to general pedagogy (KMK, 2004b).

The requirements of the two-year-long second phase are determined by the legal framework established by the KMK and the federal states. During the second phase, the form of the practicum and its requirements are the same throughout each state. Certain key features barely vary across regional states. The aim of the second-phase practicum is to integrate theory and practice. This integration requires future teachers to participate in a range of activities at their placement schools and to spend a large amount of time engaged in compulsory study of courses on subject-related didactics and general pedagogy.

At the end of the second phase, future teachers take the second state examination, which requires them to perform at least two lessons in two different subjects and undertake an oral examination. The examination also requires students to write an essay (*Zweite Staatsexamensarbeit*) in which they describe the planning and teaching of a sequence of lessons they have taught and present an analysis of that experience. One or two teachers mentor students during their placements in schools, and their post-placement work is assessed by the teacher educators of the courses they attended during the second phase of their training. Those future teachers enrolled in a 24-month second-phase program are required to be at school for roughly 240 days, while future teachers enrolled in an 18-month program must be at school for about 180 days.

Staffing requirements

Although overall staffing requirements for the teacher education program-types studied in TEDS-M differ only marginally across the federal states, these requirements differ considerably by phase (KMK, 2004a; Lenhard, 2004). During the first phase of teacher education, which takes place in universities, the teaching staff consist mainly of professors (*Hochschullehrer*), academic/research staff such as PhD students (*Wissenschaftlicher Mitarbeiter*), and a small number of teaching staff with responsibility for special tasks that require extensive practical classroom-based experiences (*Lehrkraft für besondere Aufgaben*). Professors must have, as a minimum qualification, a university degree. They must also have pedagogical ability and specific aptitude for academic work, normally demonstrated by acquiring a doctorate (also necessary for promotion) and a qualification known as the *Habilitation*, which denotes expertise compatible with the expertise of an assistant professor. The minimum qualification for research staff is a university degree (at junior level) or a PhD. The staff involved in specialist teaching tasks do not have to meet the academic requirements established for professors, but are expected to have a strong measure of practical experience as teachers.

During the second phase, two types of teacher educator work with the future teachers. The first group includes those teaching courses at the Studienseminar and assessing future teachers' performance. The second includes field-based educators whose primary responsibility is to mentor and support future teachers. The former teach courses in general pedagogy or subject-related pedagogy. They are usually denoted as *Hauptseminarleiter*, *Fachseminarleiter*, *Fachleiter*, or *Seminarleiter*. If given the duties of a manager (Hauptamtlicher Leiter) at a particular training institution (*S*tudienseminar), they work fulltime at the institution. Otherwise, they teach a small number of courses for future teachers and work parttime as an ordinary primary or secondary school teacher. These teacher educators must have the basic teacher qualifications. Typically, their highest level of educational attainment is the first and second state examinations. However, the teacher educators must also have spent several years working as a primary or secondary teacher. A study by Walke (2004) showed little control (regulations) over

recruiting and preparing these educators for teaching future teachers, either at the regional state level or the national level. Most educators of this type receive virtually no special preparation before starting this work, a circumstance that has attracted criticism (Terhart, 2000).

The field-based educators do not teach courses to future teachers; instead, they mentor and support them. They work fulltime as primary or secondary school teachers and so have passed the first and second state examinations. Usually, the headmaster of their school is the person who appoints them to the role of mentoring future teachers. During the mentoring, each future teacher also takes charge of some of the educator's periods so that the educator has fewer lessons to teach. This is considered compensation for the additional work of mentoring future teachers. Field-based educators of this type are normally not authorized to assess future teachers.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

Germany represents a country where entry to teacher education is a relatively open system. Apart from requiring teacher education applicants to hold the high-school exit examination (*Abitur* or *Allgemeine Hochschulreife*), German universities generally have no specific selection processes for the first phase of tertiary education. Since 1973, in line with a fundamental decision of the German Federal Constitutional Court (*Bundesverfassungsgericht*), every student who has successfully passed the high-school exit examination has the legal right to enroll at university. Courts at all levels of the German justice system have also long protected the right of a free choice of career, a pattern of rulings that has prevented universities from implementing selective admission procedures. The only circumstance under which universities have permission to introduce selection procedures is when the number of applications significantly exceeds the number of places available several years in succession, a situation which usually applies only to the universities in the big cities. When this is the case, the universities select students according to their grades in their high-school exit examination, that is, their overall level of attainment in their final years of secondary schooling.

In addition to the legal restrictions on selective entry, many people in Germany have resisted methods of assessing candidates for university places that go beyond the high-school exit examination. This examination has been highly valued for 200 years as the means of allowing entrance to university, and some fear its devaluation. Others believe that additional methods for selection would create an excessive administrative and financial burden. But these considerations aside, a student's performance on the high-school exit examination is one of the most important predictors of his or her success on a teacher education program (Blömeke, Suhl, Kaiser, & Döhrmann, 2012; for further details on the quality and equity of teacher knowledge achieved in teacher education, see also Blömeke, Suhl, & Kaiser, 2011).

However, this situation is changing as more people come to see that a strong advantage of selection procedures is better-quality students at the point of entry to tertiary education, and a better match between student strengths and the strengths of a particular university, thereby enhancing the university's ability to compete with other institutions (Hochschul Information System, 2006; Science Council, 2004). In line with a 2004 amendment to the German Higher Education Framework Act (*Hochschulrahmengesetz*), several federal states now allow their universities to select up to 60 percent of its student cohort according to criteria that go beyond passing the high-school exit examination.

As a consequence, universities are increasingly taking up this opportunity by bringing in a wider array of selection methods (e.g., giving higher weightings to subject-specific grades, entry tests, and interviews or essays). When universities select future teachers at entry to first-phase teacher education, they base their selection methods mainly on subject-related studies rather than pedagogical aspects. The criteria applied (i.e., in addition to the high-school exit examination) may take into account the grades a student received in those subjects of the school-leaving examination that correspond to the subjects he or she might teach. Examples include grades in mathematics and chemistry in the case of future teachers of mathematics and chemistry, and a language test for students wanting to teach a modern language such as English. Thus, the criteria applied relate mainly to academic background.

There are a few exceptions to this general observation. For example, the University of Bamberg asks candidates to its teacher education programs about their job motivation (Faust, Mahrhofer, Steinhorst, & Foerster, 2003). However, it is unlikely that German universities will make stronger efforts to select candidates for teacher education in the near future, because the increasing shortage of teachers will make it necessary to give entry to almost anyone who wants to enter the profession.

Every future teacher who has successfully completed the first state examination has the right to enter the second phase of teacher education. However, the number of places available for students wanting to enter this phase varies considerably across the federal states, as do the criteria determining which students can enter it. In some states, future teachers have had to wait for years because, for example, of a surplus of teachers of certain subjects such as geography or physical education. Programs in other states have more places available than are needed. If selection is necessary, it is based on the grades the candidate attained in the first state examination and on criteria such as social hardship and the time for which he or she has been waiting for a place.

Teacher education providers use the grades future teachers acquire in the first state examination to fill about 50 to 70 percent of the places available. About 10 to 30 percent of places are given to those applicants who have been waiting to enter the second phase, about 10 percent to future teachers who have studied subjects that are needed at schools, and about 10 percent to social hardship cases. If a program has enough places, no criteria are applied.

Accreditation of teacher education institutions and programs

Germany has not had an accreditation system, at least not in the sense that many English-speaking countries have. Instead, Germany has adopted quality control measures that fit the special characteristics of the country's education system. This situation is changing because of the need for the federal states to establish accreditation as part of compliance with the Bologna Declaration. A national accreditation council has been established, and a few universities now have accredited teacher education programs. Full-scale accreditation will require the development of nationwide standards for teacher education, including standards for subject-related pedagogy and subject-matter courses.

These changes are building on earlier policies. The KMK has an existing agreement (*Gegenseitige Anerkennung von Lehramtsprüfungen und Lehramtsbefähigungen*) stating that each federal state must recognize the first and second state examinations (i.e., the certificates denoting that one is qualified to seek employment as a teacher) taken

in any other state (KMK, 2002). This agreement also specifies the structure and the intended length of teacher education programs, the number of required courses (*Semesterwochenstunden*), curricular content, and general examination features. The KMK has also developed a set of nationwide standards for teacher education (KMK, 2004b). The standards include a general description of competencies mainly concerned with general pedagogy. Standards for other domains (e.g., subject-related knowledge) were published at the national level as early as 2008 (KMK, 2008).[14]

Requirements for entry to the teaching profession

The first and second state examinations at the end of the two phases of teacher education play a major quality-assurance role in the German education system. Future teachers must take the first state examination (*Erstes Staatsexaminationen or Erste Staatsprüfung*) at the end of the university phase of their training. This examination consists of several written and oral examinations related to the subjects studied during the first phase. Students must also write a long subject-matter essay as part of this first examination (*Wissenschaftliche Hausarbeit or Erste Staatsexamensarbeit*). Students who pass the first state examination are considered to have a university degree (*Hochschulabschluss*) that corresponds to the ISCED 5A first degree (OECD, 1999).[15]

The second state examination (*Zweites Staatsexamen or Zweite Staatsprüfung*), which students sit at the end of the second phase of their teacher education, has several components, which include school staff, teacher educators, and state officials observing and assessing candidates as they teach lessons in classrooms. One or more oral examinations can also be part of the examination, and an essay on a practical issue is required (*Zweite Staatsexamensarbeit*). The essay is normally less academic than the essay written for the first state examination. Completion of the assignments and announcement of the results in written form signal the conclusion of the examination. The second state examination corresponds to an ISCED-Level 5A second degree (OECD, 1999).

Special state institutions (e.g., *Prüfungsamt für Lehramtsprüfungen* for the federal state of Berlin) are responsible for carrying out the state examinations at the end of the two phases of teacher education.[16] The head of the examination committee for the first state examination must be a teacher who can be exempted from his or her teaching for this purpose. In larger federal states and in subjects with a high number of graduates, complements of teachers are employed fulltime to organize and administer the examinations. The state hires the professors responsible for preparing future teachers to conduct the examinations in their areas of specialization. They prepare written assignments for their students and are fully responsible for assessing them. Examination committees conduct the final oral examinations in each subject and in general pedagogy.

14 The German teacher education system as it had developed and as it existed at the time of the TEDS-M data collection was not affected by these standards. However, since 2012, teacher education at universities in Germany has increasingly become influenced by the national published standards (KMK, 2004b, 2008).

15 As part of the Bologna reform process, most of the federal states have replaced the first state examination with a Master's degree. This was one of the major changes that had been made to the German teacher education system at the time of the TEDS-M data collection. However, even in 2012, future teachers were still being required to take a state examination at the end of the second phase of their initial teacher education.

16 cf. http://www.berlin.de/sen/bildung/lehrer_werden/pruefungsaemter/

In similar vein to the procedure used for the first state examination, the second state examination is carried out by an examination committee established at a Prüfungsamt für Lehramtsprüfungen. The teacher educators of the Studienseminar responsible for preparing the future teachers are part of this committee. Because these examinations are often full-day ones, the teachers involved are usually principals. The assessment procedures for self-prepared assignments and the assessment criteria that are used to judge the future teachers' performances can vary considerably, however, within and across the federal states.

References

Altrichter, H., Brüsemeister, T., & Heinrich, M. (2005). Merkmale und Fragen einer Governance-Reform am Beispiel des österreichischen Schulwesens [Characteristics and issues associated with administrative reform, with the Austrian school as an example]. *Österreichische Zeitschrift für Soziologie*, *30*(4), 6–28.

Blömeke, S. (2002). *Universität und Lehrerausbildung* [University-based teacher training]. Bad Heilbrunn, Bavaria: Klinkhardt.

Blömeke, S. (2006). KMK-Standards für die LehrerInnenbildung in Deutschland: Ein Kommentar [Comments on the KMK standards for teacher education in Germany]. *Journal für Lehrerinnen- und Lehrerbildung*, *1*, 25–33.

Blömeke, S., Houang, R., & Suhl, U. (2011). TEDS-M: Diagnosing teacher knowledge by applying multidimensional item response theory and multi-group models. *IERI Monograph Series: Issues and Methodologies in Large-Scale Assessments*, *4*, 109–126.

Blömeke, S., & Kaiser, G. (2012). Homogeneity or heterogeneity? Profiles of opportunities to learn in primary teacher education and their relationship to cultural context and outcomes. *ZDM: The International Journal on Mathematics Education*, *44*, 249–264. doi: 10.1007/s11858-011-0378-6.

Blömeke, S., Suhl, U., & Kaiser, G. (2011). Teacher education effectiveness: Quality and equity of future primary teachers' mathematics and mathematics pedagogical content knowledge. *Journal of Teacher Education*, *62*(2), 154–171.

Blömeke, S., Suhl, U., Kaiser, G., & Döhrmann, M. (2012). Family background, entry selectivity and opportunities to learn: What matters in primary teacher education? An international comparison of fifteen countries. *Teaching and Teacher Education*, *28*, 44–55.

Bracht, H.-G. (1998). *Das höhere Schulwesen im Spannungsfeld von Demokratie und Nationalsozialismus. Ein Beitrag zur Kontinuitätsdebatte am Beispiel der preußischen Aufbauschule (Studien zur Bildungsreform, Bd. 31)* [The higher education system within the context of tension between democracy and Nazism: A contribution to the continuity debate, with the Prussian schooling system as an example (Studies on education reform, Vol. 31)]. Frankfurt, Germany: Lang.

Dithmar, R. (Ed.). (2001). *Schule und Unterricht im Dritten Reich. Interdisziplinäre Forschung und fächerverbindender Unterricht*, *7* [School and education under the Third Reich: Interdisciplinary research and curricular teaching, No. 7]. Ludwigsfelde, Germany: Ludwigsfelder.

Faust, G., Mahrhofer, C., Steinhorst, H., & Foerster, F. (2003). Auswahlgespräche zur Vergabe von Studienplätzen im Lehrerstudium. Erfahrungen im Fach Grundschulpädagogik an der Otto-Friedrich-Universität Bamberg [The use of interviews to determine places in teacher education: The experience of an elementary education specialist at the Otto-Friedrich University of Bamberg]. *Die Deutsche Schule*, *95*(3), 329–338.

Führ, C. (1998). Zur deutschen Bildungsgeschichte seit 1945 [The history of German education since 1945]. In C. Führ & C.-L. Furck (Eds.), *Handbuch der deutschen Bildungsgeschichte. Bd. VI: 1945 bis zur Gegenwart. Erster Teilband: Bundesrepublik Deutschland* [History of German education handbook: Vol. 6. 1945 to the present. The Federal Republic of Germany] (pp. 1–24). Munich, Germany: C. H. Beck.

German Committee for Education and Training. (1966). *Empfehlungen des Deutschen Ausschusses für das Erziehungs- und Bildungswesen 1953–1965* [*Recommendations of the Committee on Education and Training 1953–1965*]. Stuttgart, Germany: Klett.

Hochschul Information System. (2006). *Auswahl- und Eignungsfeststellungsverfahren beim Hochschulzugang in Deutschland und ausgewählten Ländern* [Selection and aptitude tests for access to higher education in Germany and selected countries]. Hannover, Germany. Available online at http://www.his.de/pdf/pub_kia/kia200603.pdf

Keim, W. (1995). *Erziehung unter der Nazi-Diktatur. Bd. 1: Antidemokratische Potenziale, Machtantritt und Machtdurchsetzung* [Education under the Nazi dictatorship: Vol 1. Anti-democratic potential, power bases and power enforcement]. Darmstadt, Germany: Primus.

König, J., Blömeke, S., Paine, L., Schmidt, W. H., & Hsieh, F.-J. (2011). General pedagogical knowledge of future middle school teachers: On the complex ecology of teacher education in the United States, Germany, and Taiwan. *Journal of Teacher Education, 62*(2), 188–201.

Lenhard, H. (2004). Zweite Phase an Studienseminaren und Schulen [Second phase of teacher training colleges and schools]. In S. Blömeke, P. Reinhold, G. Tulodziecki, & J. Wildt (Eds.), *Handbuch Lehrerbildung* [Handbook of teacher education] (pp. 275–290). Bad Heilbrunn, Bavaria: Klinkhardt–Westermann.

Nolle, A. (2004). *Evaluation der universitären Lehrerinnen- und Lehrerausbildung* [*E*valuation of university teachers and teacher training]. Munich, Germany: mpress.

Organisation for Economic Co-operation and Development (OECD). (1999). *Classifying educational programmes: Manual for ISCED-97 implementation in OECD countries.* Paris, France: Centre for Educational Research and Innovation, OECD.

Organisation for Economic Co-operation and Development (OECD). (2001). *Knowledge and skills for life: First results from the OECD Programme for International Student Assessment (PISA) 2000.* Paris, France: Author.

Organisation for Economic Co-operation and Development (OECD). (2005). *Teachers matter: Attracting, developing and retaining effective teachers.* Paris, France: Author.

Organisation for Economic Co-operation and Development (OECD). (2006). *Education at a glance 2006.* Paris, France: Author.

Roth, H. (Ed.). (1969). *Begabung und Lernen. Ergebnisse und Folgerungen neuer Forschungen. Gutachten und Studien der Bildungskommission, 4* [Talent and learning: Results and conclusions of new research. Reports and studies of the Education Committee, No. 4]. Stuttgart, Germany: Klett.

Sandfuchs, U. (2004). Geschichte der Lehrerbildung in Deutschland [History of teacher education in Germany]. In S. Blömeke, P. Reinhold, G. Tulodziecki, & J. Wildt (Eds.), *Handbuch Lehrerbildung* [Handbook of teacher education] (pp. 14–37). Bad Heilbrunn, Bavaria: Klinkhardt-Westermann.

Schmidt, W. H., Blömeke, S., & Tatto, M. T. (2011). *Teacher education matters: A study of the mathematics teacher preparation from six countries.* New York, NY: Teachers College Press.

Science Council. (2001). *Empfehlungen zur künftigen Struktur der Lehrerausbildung* [Recommendations for the future structure of teacher education]. Berlin, Germany: Author. Available online at http://www.wissenschaftsrat.de/download/archiv/5065-01.pdf

Science Council. (2004). *Empfehlungen zur Reform des Hochschulugangs* [Recommendations for reforming access to higher education]. Cologne, Germany: Author. Available online at http://www.wissenschaftsrat.de/download/archiv/5920-04.pdf

Spranger, E. (1974). *Gesammelte Schriften. Bd. 4. Psychologie und Menschenbildung* [Collected writings: Vol 4. Psychology and human development]. Tübingen, Germany: Niemeyer.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (1995). *Stellungnahme der Kultusministerkonferenz zur "Studienstrukturreform für die Lehrerausbildung." Vom 12 Mai 1995* [Opinion of the Standing Conference on "reform of the academic structure of teaching training" of 12 May 1995]. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (1997a). *Rahmenvereinbarung über die Ausbildung und Prüfung für Lehrämter der Grundschule bzw. Primarstufe (Lehramtstyp 1). Beschluss der Ständige Konferenz der Kultusminister der Länder (KMK). vom 28.02.1997* [Framework agreement on training for and examination of candidates for teaching careers at primary school or primary school (Type 1 teacher): Resolution of the Standing Conference of the (State) Ministers for Education and Culture (KMK) of 28.02.1997]. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (1997b). *Rahmenvereinbarung über die Ausbildung und Prüfung für übergreifende Lehrämter der Primarstufe und aller oder einzelner Schularten der Sekundarstufe I (Lehramtstyp 2). Beschluss der Ständige Konferenz der Kultusminister der Länder (KMK). vom 28.02.1997* [Framework agreement on the training and testing of candidates for teaching careers across the primary level and all or individual lower-secondary school types (Type 2 teacher). Resolution of the Standing Conference of the (State) Ministers for Education and Culture (KMK) of 28.02.1997]. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (1997c). *Rahmenvereinbarung über die Ausbildung und Prüfung für Lehrämter für alle oder einzelne Schularten der Sekundarstufe I (Lehramtstyp 3). Beschluss der Ständige Konferenz der Kultusminister der Länder (KMK). vom 28.02.1997* [Framework agreement on training and examining candidates for teaching careers at all or individual lower-secondary school types (Type 3 teacher): Resolution of the Standing Conference of the (State) Ministers for Education and Culture (KMK) of 28.02.1997]. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (1997d). *Rahmenvereinbarung über die Ausbildung und Prüfung für Lehrämter für die Sekundarstufe II (allgemeinbildende Fächer) oder für das Gymnasium (Lehramtstyp 4). Beschluss der Ständige Konferenz der Kultusminister der Länder (KMK). vom 28.02.1997* [Framework agreement on training and examining candidates for teaching positions at the upper-secondary level (general education) or for high school (Type 4 teacher): Resolution of the Standing Conference of the (State) Ministers for Education and Culture (KMK)) of 28.02.1997]. Berlin, Germany: Author

Standing Conference of the (State) Ministers for Education and Culture (KMK). (2002). *Gegenseitige Anerkennung von Lehramtsprüfungen und Lehramtsbefähigungen* [Mutual recognition of teaching degrees and qualifications]. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (2003). *Lehrereinstellungsbedarf und -angebot in der Bundesrepublik Deutschland – Modellrechnung 2002–2015. Statistische Veröffentlichungen der Kultusministerkonferenz. Dokumentation Nr. 169* [Teacher recruitment demand and supply in the Federal Republic of Germany: Model statements for 2002–2015. Statistical publications of the Standing Conference, Document No. 169]. Berlin, Germany: Author. Available online at http://www.kmk.org/fileadmin/veroeffentlichungen_beschluesse/2003/2003_09_01-Lehrerbedarf-BRD-02-2015.pdf

Standing Conference of the (State) Ministers for Education and Culture (KMK). (2004a). *The education system in the Federal Republic of Germany 2004: A description of the responsibilities, structures, and developments in education policy for the exchange of information in Europe*. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (2004b). *Standards für die Lehrerbildung: Bildungswissenschaften. Beschluss der Kultusministerkonferenz vom 16.12.2004* [Standards for teacher education: Education sciences. Resolution of the Standing Conference of 16.12.2004]. Berlin, Germany: Author. Available online at http://www.kmk.org/fileadmin/veroeffentlichungen_beschluesse/2004/2004_12_16-StandardsLehrerbildung.pdf

Standing Conference of the (State) Ministers for Education and Culture (KMK). (2006). *Lehrerprüfungen in den Ländern der Bundesrepublik Deutschland* [Teacher examinations in the states of the Federal Republic of Germany]. Berlin, Germany: Author.

Standing Conference of the (State) Ministers for Education and Culture (KMK). (2008). *Ländergemeinsame inhaltliche Anforderungen für die Fachwissenschaften und Fachdidaktiken in der Lehrerbildung. Beschluss der Kultusministerkonferenz vom 16.10.2008 i. d. F. vom 16.09.2010* [Content requirements for subject areas and subject didactics in teacher education across countries: Resolution of the Standing Conference of 16.10.2008 as amended on 16.09.2010]. Berlin, Germany: Author. Available online at http://www.kmk.org/fileadmin/veroeffentlichungen_beschluesse/2008/2008_10_16-Fachprofile-Lehrerbildung.pdf

Strukturreformgesetz. (2005). *Gesetz zur Reform der Strukturen des öffentlichen Dienstrechts. Entwurf vom 12.04.2005* [Act to Reform the Structure of Public Service Legislation: Draft of 12.04.2005].

Terhart, E. (2000). (Ed.). *Perspektiven der Lehrerbildung in Deutschland. Abschlussbericht der von der Kultusministerkonferenz eingesetzten Kommission* [Perspectives on teacher education in Germany: Final Report of the commission appointed by the Standing Conference]. Weinheim, Germany: Beltz.

Terhart, E. (2004). Struktur und Organisation der Lehrerbildung in Deutschland [Structure and organization of teacher education in Germany]. In S. Blömeke, P. Reinhold, G. Tulodziecki, and J. Wildt (Eds.), *Handbuch Lehrerbildung* [Handbook of teacher education] (pp. 37–59). Bad Heilbrunn, Bavaria: Klinkhardt-Westermann.

Topsch, W. (2004). Schulpraxis in der Lehrerbildung [The school practicum in teacher education]. In S. Blömeke, P. Reinhold, G. Tulodziecki, and J. Wildt (Eds.), *Handbuch Lehrerbildung* [Handbook of teacher education] (pp. 476–486). Bad Heilbrunn, Bavaria: Klinkhardt-Westermann.

Walke, J. (2004). *Die Situation des Ausbildungspersonals in der Zweiten Phase der Lehrerbildung. Eine Analyse auf der Basis vorhandener Informationen und Daten (ZfL-Texte Nr. 4)* [The current state of training teachers during the second phase of teacher education: An analysis on the basis of available information and data (ZfL texts No. 4)]. Münster, Germany: Westfälische Wilhelms-Universität Münster.

CHAPTER 7:

Malaysia

Editors' Overview

In time, Malaysia wants all of its primary and secondary teachers to be university graduates with degrees (i.e., "graduate teachers") rather than teachers who have teacher college diplomas only (i.e., "non-graduate teachers"). However, at the time of the TEDS-M survey, the non-graduate Malaysian Teaching Diploma was by far the largest of the program-types preparing primary school teachers (see Exhibit 7.1).

Institutions and governance

Initial teacher education in Malaysia has been conducted at two levels—public and private universities, and teacher training institutes.[1] While all public and private universities produce graduate teachers, the teacher education institutes still award non-graduate diplomas as well as Bachelor's degrees. The Ministry of Education has set the target of having, by 2015, all teachers in secondary schools and at least 50 percent of teachers in primary schools with the status of graduate teachers.

Program-types and credentials

Future teachers of mathematics intending to teach in Malaysian primary and secondary schools have at hand five different preservice program-types: three for primary Grades 1 to 6 and two for secondary Grades 7 to 13 (Exhibit 7.1). At the secondary level, the universities offer two concurrent program-types, the Bachelor of Science (Education) and the Bachelor of Arts (Education).[2] At the primary level, the concurrent Diploma in Education, for future teachers who already have a degree, and the Bachelor of Education are both offered to preservice primary teachers studying at the graduate level. The Malaysian teaching diploma is offered to future primary teachers at the undergraduate level.

Curriculum content, assessment, and organization

The Teacher Education Division of the Ministry of Education, with approval from the ministry's Central Curriculum Committee and the Malaysian Qualification Agency (which has been responsible for accrediting all higher education offerings since 2007), sets the curriculum requirements for teacher education institutes (i.e., the former teachers' colleges).

Until 2007, the Teacher Education Division also set the requirements for ongoing implementation of the goals of two important documents—the National Philosophy of Education (formulated in 1988 and revised in 1996)[3] and the Philosophy of Teacher Education (formulated in 1982).[4] The former emphasizes the need for

1 The teacher education institutes are former teacher education colleges that used to prepare teachers for primary and lower-secondary schools, credentialing them with certificates and later diplomas, but are now empowered to offer Bachelor's degrees to their students.

2 A Postgraduate Diploma in Education (PGDE) is also offered, but it was not included in TEDS-M because of the lack of students working toward this qualification.

3 See http://unesdoc.unesco.org/images/0019/001931/193184e.pdf

lifelong education and the holistic, balanced, integrated development of human potential from physical, emotional, spiritual and intellectual perspectives. The latter focuses on national unity, national culture, science and technology, and individual development.

All teacher education institutes follow a common curriculum, which has six basic components: teacher dynamics,[5] knowledge and professional competence,[6] subject options and specialization (major and minor subjects), self-enrichment,[7] co-curricular activities, and practicum. The universities are responsible for their own curricula, but must work within guidelines set by the Malaysian Qualification Agency and the Ministry of Higher Education. Practicum requirements differ somewhat among universities and institutes. Ten to 12 weeks of practicum are the norm.

The last major policy reform affecting the teaching of mathematics was introduced in 2003, when the government decided that mathematics should be taught in English instead of Malay (or Chinese or Tamil in the vernacular schools) in Grades 1 to 13. Because teachers had never been expected or prepared to do this, the decision had major implications for both preservice and inservice teacher education. The policy has since been rescinded and, from 2012 on, mathematics has again been taught in the other languages.

Testing and assessment in Malaysian teacher education is multifaceted. For purposes of selection, all future teachers are required to pass assessments, comprehensive examinations (oral and written) in each of the required subjects, and the Malaysia Teacher Education Test (M-Test) or the Malaysian Educators Selection Inventory (MEdSI). Future teachers must also present a portfolio and undergo an assessment of their classroom teaching competence. They also experience assessments of their knowledge and skills during each of their courses.

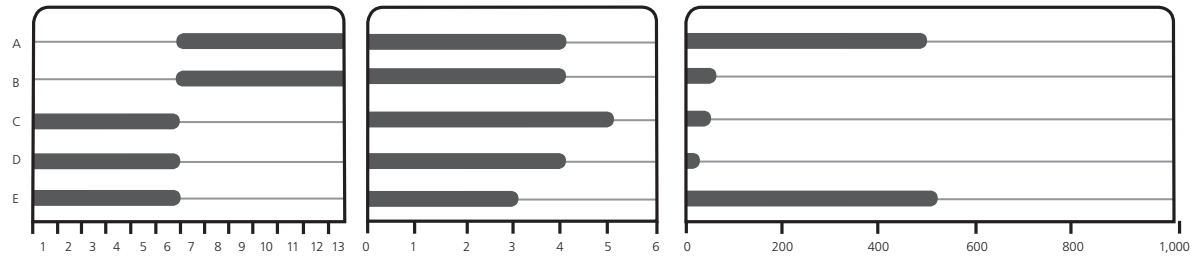
4 See http://aadcice.hiroshima-u.ac.jp/e/publications/sosho4_2-08.pdf

5 That is, language skills, thinking skills, environmental education, Islamic civilization, and Islamic education or, alternatively, moral education for non-Muslim students.

6 Learning about Malaysia, psychology, pedagogy, guidance, and counseling.

7 Art, physical, and health education.

Exhibit 7.1: Teacher education program-types in Malaysia



Key to program-type

A—Bachelor of Science in Education (Mathematics), secondary
B—Bachelor of Arts in Education (Mathematics), secondary
C—Diploma of Education
D—Bachelor of Education, primary
E—Malaysian Diploma of Teaching (Mathematics)

Note: The Bachelor of Education Teaching English as a Second Language (TESL) with mathematics program-type was not included in the TEDS-M target population. The Malaysian Postgraduate Diploma of Teaching (Mathematics) was also excluded because it had no eligible future teachers at the time of testing.

Preparing Teachers of Mathematics in Malaysia

Rajendran Nagappan, Nagendralingan Ratnavadivel, Mohd Mustamam Abd Karim, Othman Lebar, Ismail Kailani, and Suseela Malakolunthu

Part I: Context and Conditions of Teaching as a Career

Malaysia consists of 13 states and two federal territories. Politically, the country is a parliamentary democracy with a constitutional monarchy. The population, estimated at around 27 million in 2007, is a cosmopolitan blend consisting mainly of Malays, Chinese, and Indians in West or Peninsular Malaysia and numerous indigenous groups in East Malaysia and on the island of Borneo (such as Ibans, Kadazans, Kenyahs, Bidayuhs, Muruts, and Bajaus in Sabah and Sarawak). The Malay language is the official language of the country. However, English is accepted as the second language. Chinese and Tamil languages are also used as a medium of instruction in vernacular primary schools. Although Islam is the official religion of the country, freedom of worship is accorded to people of all other religions.

Although Malaysia is still the world's leading producer of rubber and palm oil, light manufacturing now accounts for the largest share of total merchandise export receipts. Malaysia is intensifying its efforts to invest in and grow capital-intensive, technologically sophisticated industries. In 2008, this rapid economic development was reflected in a 5.9 percent growth in nominal gross national product (GNP), and a 5.5 percent growth in gross domestic product (GDP).

The overriding objectives of education in Malaysia are national integration and national development. Education plays a crucial role in human resource development to meet the labor force needs of a growing economy. Education is also expected to provide social and economic mobility to the disadvantaged. The role of education in instilling positive values is also considered very important. The democratization of education, the need for quality graduates (including teachers), and the creation of first-class human capital are now three of the main goals of the Malaysian Master Plan. The success of this agenda depends on the education system and what it can achieve. The percentage of all 17- to 23-year-olds receiving higher education has increased to the current 30 percent. The target is for 40 percent of Malaysians to access higher education.

The importance that Malaysia ascribes to education is further reflected in education's share of the national budget. Since independence (i.e., over the last 50 years), the highest allocation in the national budget has gone to education. For example, in 2009, the government allocated, from the total RM51 billion in its development budget, RM9.18 billion for the education sector, a sum that accounted for 5.56 percent of the government's total development budget.

Historical roots

Within this overall context, the history of teacher education in Malaysia can be broken down into distinct periods, stretching from pre-independence to the present era. The British introduced teacher education to Malaysia in 1907 when they opened a teacher training college at Malacca. It provided a two-year course for the training of Malay school teachers (Ratnavadivel, 1985). In 1913, the British opened another college at Matang. However, both these colleges were subsequently closed.

In 1922, the Sultan Idris Training College, which was a combination of the two earlier colleges, started up in Tanjung Malim. It offered a three-year program. According to Loh (1975), the college's curriculum had four components: academic program, theory and practical, practical gardening activities, and basketry and other handicrafts. The medium of instruction was entirely Malay. Islamic religious knowledge instruction was also provided for a period of two hours every week for the three years of the course. Over the years, this college evolved first into an institute and then a university. It is currently known as the Sultan Idris Education University.

After these beginnings, teacher education continued on with further changes and transformations. In 1955, the Federation of Malaya (now also referred to as Peninsular Malaysia or West Malaysia) attained self-governing status. The local leaders, who understood the need to have a systematic and robust education system, set up a committee to design a new system that would standardize and democratize education and offer equality of educational opportunity. These efforts led to publication of the Razak Report in 1956. The report's recommendations called for a radical reconstruction of the teaching profession (Ratnavadivel, 1985). The report also recommended that similarly trained teachers should staff all primary schools. These recommendations formed the basis of the Education Ordinance of 1957. The Razak Report also called for a follow-up review, no later than 1959, of implementation of the report's recommendations. That review resulted in publication of the Rahman Talib Report of 1960. It recommended expanding the teacher education programs. The recommendations of the two reports became the basis of the Education Act of 1961.

Before Malaysia gained independence in 1957, the British temporarily set up Kirkby Teachers Training College and the Brinsford Lodge in England in 1951 and 1955, respectively, with the aim of supplementing Malaysia's local teacher education programs. The teachers trained in these institutes were destined only for English-medium schools in Malaysia. Note, however, that teachers for these schools were also being trained through Malaysia's Normal Teachers Training Scheme.

Teachers for Chinese schools received their training locally or were brought in from Hong Kong and China. Teachers for Tamil primary schools were trained locally or brought in from India and Sri Lanka. Organizing specific training courses for specific groups, purposes, and levels of teaching in schools became standard practice in teacher training in Malaysia. Different types of teacher training courses for different types of schools using different languages of instruction were common. In fact, even within the same type of school, one could find teachers trained under different types of teacher training programs, each of which was geared to a particular need or purpose.

However, the Razak Report's recommendations led to the decision to have a standard form of teacher training in the four different language mediums of Malay, Chinese, Tamil, and English in order to cater for the four different types of language-based primary schools. As a result, under the new education policy developed in 1957, the government set up day training colleges or centers and reorganized the two premier Malay training colleges (the aforementioned Sultan Idris Training College and the Malay Women's Training College) into primary training colleges. The duration of the training courses in these institutes varied from two to three years depending on the entry qualifications of the trainees (Lim, Taharuddin, Mat Piah, & Ratnavadivel, 1991).

In order to standardize teacher education in line with the common curriculum for schools, the government began playing a more active role in training teachers for the Chinese and Tamil primary vernacular schools. Initially, this era of teacher education required teachers to attend training conducted through normal institute classes during weekends and to teach in schools on week days. However, once appropriate teacher education facilities had been established and the teacher education curriculum standardized, teachers received their training at the day training colleges/centers.

The Razak Report (1956) also recommended that teachers of lower-secondary classes undergo specific training for a two-year period in Malaysian training colleges. By 1964, there were six of these colleges, all of which were coordinated under a so-called integrated teacher training plan. By 1967, the Ministry of Education had developed an even more coordinated pattern of teacher training, which raised the minimum academic qualifications for aspiring primary school teachers to a level on par with the requirements for individuals wanting to work as secondary school teachers. In principle, this development established parity between the training provided by the Malaysian training colleges and that provided by the Malaysian training colleges and the day colleges/centers. By 1970, through a series of systematization and standardization measures, the government had taken full control of education, including teacher education. The government's policy at this time was to provide education catering to all classes and the various social and ethnic groups of the multiracial polity as well as the political center (Lim et al., 1991; Ratnavadivel 1985, 1995).

Since 1970, the government's focus with regard to the education system has been on national integration and national development. Education is seen as the means by which to restructure Malaysia's pluralistic society and harness its energy toward achieving the common goal of national development. It took the postelection racial riots of May 1969 to shock the government and the people of Malaysia into realizing that national unity was at risk and that national integration was imperative for national development. This event led to the promulgation of the *Rukun Negara* (National Ideology), the Constitutional (Amendment) Act of 1971, and the introduction of the New Economic Policy. The Rukun Negara reflected the universal values acceptable to all sectors of the cosmopolitan population of Malaysia. The Ministry of Education has been responsible for articulating and operationalizing the underlying aspirations of the Rukun Negara in its educational policies and practices.

The government also intended the ministry's policies and practices to be consistent with the New Economic Policy, which was introduced in 1971 to promote national unity through a two-pronged strategy of:

(i) Eradicating poverty by raising income levels and increasing employment opportunities for all Malaysians irrespective of race.

(ii) Accelerating the process of restructuring Malaysian society to correct economic imbalance, so as to reduce and eventually eliminate the identification of race with economic function.
(Government of Malaysia, 1973, p. 1)

The need to use education as one of the prime means of achieving the aims of the Rukun Negara and the New Economic Policy has been spelt out in the major education and training objectives of all subsequent Malaysia Plans (i.e., the second to ninth such plans).

The year 1979 was another watershed in the history of education in Malaysia. The recommendations of the Cabinet Committee to Review the Implementation of Education Policy (1979) became a turning point for educational policy and practice in the nation, leading in 1980 to designation of a national committee for designing a new primary school curriculum. The New Primary School Curriculum (or KBSR, which is its local acronym) was piloted in 1982 and implemented nationwide in 1983. It was followed in 1989 by nationwide implementation of the Integrated Secondary School Curriculum (KBSM). These curricular changes made new and more pressing demands on teacher education and teachers. The basis of the KBSR and the KBSM is the National Education Philosophy. Although not documented until 1988, it has been the underlying spirit of the curricular changes.

The 1980s also ushered in a series of teacher education innovations in Malaysia, such as action research, collaborative and cooperative teaching, pair teaching, peer evaluation, clinical supervision, journal writing, and self-reflection. The introduction of these practices exemplified Malaysia's willingness to take on board international developments in teaching and learning. Whereas most of Malaysia's educational reform up to this point had been in response to national ideas on how to improve the country's education system, the new changes were more outward looking and represented an attempt to break into international mainstream thinking about teaching and learning and teacher education.

By the 1980s, the Ministry of Education's Teacher Education Division was in full control of the training of primary school teachers, including the training of teachers for vernacular schools. The curriculum used at this time to train teachers for national and vernacular schools was similar, except that teachers training to teach in the vernacular schools had to major in the teaching of Chinese or Tamil languages.

Conditions at the time of TEDS-M

A public school teacher's career starts when the Education Service Commission appoints him or her as a probationary education officer. This appointment is confirmed or extended after a three-year probationary period and is based on the teacher's annual performance report prepared by a head teacher or principal. Once confirmed, the teacher is treated as permanent staff until he or she retires at the age of 60.

Teachers are grouped into graduate teachers and non-graduate teachers in accordance with their academic and professional qualifications. Those who possess a university degree are called *graduate* teachers, and those who possess a certificate or diploma of teaching from outside the universities (i.e., from a teacher training college) are called *non-graduate* teachers. Although Malaysia is now geared toward an all-graduate teaching staff at both primary and secondary schools, this aim has yet to be fully realized. The Ministry of Education wants all teachers in secondary schools and at least 50 percent of those in primary schools to be university graduates by 2015.

The ministry has consequently been providing non-graduate teachers with financial support and study leave so that they can upgrade their academic and professional qualifications at university level (either locally or overseas). The leave entitlement allows practicing primary school teachers to take half-pay leave to follow undergraduate courses in public universities on a fulltime basis. Provision is also available for training graduate teachers through the *Program Khas Pensiswazahan Guru* (Special Graduate Program for Teachers) and for those teachers wanting to study parttime for degree courses at Malaysia's Open University.

When trained teachers are not available, schools do employ temporary teachers. In secondary schools, these teachers must have a degree or at least an "A"-level pass in mathematics. In primary schools, temporary teachers must have a minimum-credit "O"-level pass. These teachers are normally guided and supervised by heads of department or by senior or experienced mathematics teachers. Cross-appointment from primary to secondary school and vice versa is not practiced, and in most cases temporary teachers are not engaged to teach examination classes, such as Form 3 (Year 9) and Form 5 (Year 11, the final O-level year).

Malaysia places great importance on mathematics as a core subject for secondary education. But although mathematics is viewed as a critical vehicle for developing science and technology in Malaysia, the effective teaching and learning of mathematics has been a perennial problem in Malaysian secondary schools, and the Ministry of Education is continually emphasizing the need for more competent mathematics teachers. The preference is for mathematics teachers to have a Bachelor of Education (Mathematics) or to have a degree in mathematics and a certificate or diploma in education, specializing in the teaching of mathematics. A Master's degree, not surprisingly, is even more sought after.

Improved teaching conditions coupled with the fact that the economic slowdown has made securing employment in the private sector more difficult has made teaching a far more attractive proposition than previously among secondary school graduates, including those with high academic qualifications. Teaching in public schools is considered a government job with all the perks that other government servants enjoy, including job security. The Ministry of Education determines the number of teaching posts available by subject-matter for each year, based on the demand for teachers in those disciplines in schools nationwide. The demand for teachers increases each year as school enrollments continue to expand at each level of education—preschool, primary, and secondary.

In line with this increasing demand for teachers, teacher education institutions have been required to increase their intake of students. Exhibit 7.2 shows the number of teachers at primary and secondary schools in 2008. Just over 57 percent of this teacher cohort were teaching at the primary school level and close to 43 percent were teaching at secondary school level.

Exhibit 7.2: Number of teachers in primary and secondary schools as of January 31, 2008

	Male	Female	Total
Primary	64,958 (31.3%)	141,894 (68.6%)	206,852
Secondary	51,978 (33.7%)	101,965 (66.3%)	153,943
Total	116,936	243,859	360,795

Source: Ministry of Education, 2008.

Teacher demography is an important matter in Malaysia, particularly within the context of recent and future trends in student enrollment numbers. Gender imbalance is one of the areas of most concern. For example, in 2007, of the 9,962 individuals who graduated from the teacher education institutes, 3,495 (35.1%) were males and the rest (6,467 or 64.9 %) were females.[8] This gender imbalance, as might be expected, is also seen in the composition of the teaching force in Malaysian schools (Exhibit 7.2). Of the 206,852 teachers teaching in primary schools in early 2008, only 31.3 percent were males. In secondary schools, only 33.7 percent of the teachers were males.

The Ministry of Education is also endeavoring to ensure quality intakes into teacher education and (from there) quality education for school students by constantly reviewing school class size and student–teacher ratios. Current information indicates that the overall student–teacher ratio is 18:1 for both primary and secondary schools. However, there are schools that have high student–teacher ratios, especially the schools in urban areas.

In terms of the social status of teaching, Malaysians view teachers as a professional group, like doctors, who are highly respected by society. In economic terms, teachers are considered to be a middle-class income group. The Ministry of Education has worked to upgrade the status of teachers by raising the qualifications they must have in order to teach as well as their salary scales. As noted earlier, both preservice and inservice teachers now have more flexible routes into earning a degree. A shorter period of study as well as parttime study for experienced teachers along with distance learning and online learning are some of the newer approaches being used. Inservice teachers can also attend ongoing courses designed to improve their knowledge and skills. They can furthermore apply for scholarships that support their study toward Master's and doctoral programs in local or foreign universities.

The ministry has also introduced awards such as the Excellent Teacher Award for teachers and teacher educators. It uses stringent criteria to select and promote teachers to the higher grades of the teacher salary scale, including the "super-scale" category, which is equivalent in terms of salary and benefits to those enjoyed by top-level management officers in the public sector. The ministry furthermore gives supplementary allowances to teachers teaching "critical subjects" such as English, science, mathematics, and technical. For primary teachers, this allowance is 10 percent of their basic salary; for secondary teachers, it is five percent of their basic salary. Teachers teaching in remote areas receive a hardship allowance based on the location of their schools, infrastructure, and availability of other basic amenities. The ministry additionally provides teachers with incentive to write textbooks and other resource materials.

Teachers' quarters are today being built on the periphery of remote areas to provide accommodation and to ensure that teachers working in challenging circumstances enjoy a certain standard of living. Teacher activity centers and resource centers have been built in various districts to support teachers. These serve as a venue for teachers' professional development activities, such as courses and seminars. These centers are well equipped with books and equipment that enable teachers to develop context-based teaching and learning resources.

8 Source: Teacher Education Division, Ministry of Education.

Since 1993, the ministry has strongly encouraged teachers and teacher educators to engage in action research. The systematic and regulated action research programs that the ministry offers enable teachers to integrate their research findings into their daily teaching routine. Teachers are also encouraged to involve themselves in collaborative research projects with local public universities. Teachers share their action research findings in seminars and conferences organized by state education departments and local universities. Selected teacher research has also been published in journals produced by the state education departments. Involvement in action research is now a criterion for selecting and recognizing excellent teachers.

Educational technology has likewise become an integral part of teaching and learning. The use of technology has moved from mere usage of audiovisual aids to engagement with more interactive multimedia packages. This trend was further accelerated by the introduction of the Smart School project in 1996. This project encompasses a wide range of interrelated initiatives, including schemes to improve Malaysia's information and communication technologies (ICT) infrastructure, training in change management for teachers and school managers, a nationwide school management system designed to link schools to the communities they serve, integration of software, and a help desk facility. The result has been the incorporation of ICT into schools at a rate not far behind the rates of more developed nations.

In supporting this trend, the Malaysian Ministry of Education requires training to be implemented through face-to-face instruction so as to accommodate teachers' individual learning styles. Because of the high numbers of teachers to be trained, the ministry is collaborating with the private sector to teach teachers how ICT can be used to facilitate teaching and learning. For example, in 2004, the ministry conducted a fulltime, 10-day, face-to-face course for "master trainers," who then undertook the nationwide training of 100,000 teachers. The ministry completed the first phase of this program in mid-2007.

Part II: Organization and Characteristics of Teacher Education

Teacher education in Malaysia for preservice teachers is conducted at two levels: teacher education institutes and local universities (public and private). The teacher education institutes (formerly teacher education colleges that prepared teachers only for primary and lower-secondary schools and credentialed them with certificates and later diplomas) were recently upgraded. They are now empowered to award Bachelor's degrees.

In 2007, 30,937 students enrolled in the various preservice programs under the ministry's oversight. In the same year, 3,362 prospective teachers were admitted to various secondary teacher education programs at 13 different public universities. It is important to note that the sole university of education in Malaysia, the Sultan Idris University of Education, was responsible for 1,729 members (around 52%) of this student intake.

For mathematics alone in 2007, 170 students were admitted to a secondary mathematics teacher education program. In the same year, 435 prospective teachers were admitted into the primary mathematics teacher education program at the teacher education institutes.

Three different types of program train preservice teachers to teach mathematics in Malaysia's primary and secondary schools. The first is a consecutive program that

requires students to take a one-year postgraduate diploma in education after obtaining their first degree. In most cases, the Bachelor degrees these students earn are also in mathematics. The second type is a concurrent program, which means students simultaneously complete their teacher education and academic studies. Graduates of the four-year program are awarded a Bachelor of Science (Education) or a Bachelor of Arts (Education). The third program-type is the Bachelor of Education, which is another concurrent program, again of four years' duration and also offering mathematics as a major.

The teacher education programs provided by the universities are generally similar in structure and scope to the curriculum offered at the teacher education colleges. By the end of their respective programs, future teachers are expected to have accomplished the following:

- Passed each of the required subjects;
- Passed a comprehensive written examination/assessment;
- Passed a comprehensive oral examination/assessment;
- Passed the examination set by national authorities, which is known as either the Malaysia Teacher Education Test (M-Test) or the Malaysian Educators Selection Inventory (MEdSI);
- Presented and received a passing grade for a portfolio of work compiled during practicum and specified by the institution; and
- Successfully demonstrated the required level of teaching competency in the classroom.

Curriculum and field experience requirements

Until recently, the accreditation of teacher education programs had two different routes, one for the program-types offered by the teacher education institutes under the Ministry of Education and the other for program-types offered by universities under the Ministry of Higher Education. The Ministry of Education's Educational Planning Committee, which is chaired by the Minister of Education, determines the need for each program-type operating under the ministry's auspices. Once a need has been determined, the ministry's Teacher Education Division is entrusted with drawing up the framework of the program-type and its curriculum. This material is then tabled before the Central Curriculum Committee, which is chaired by the Director General of Education, Ministry of Education. If the committee approves the program-type, the Teacher Education Division takes over the responsibility of implementing it within the teacher education institutes. The curriculum requirements of the programs mounted by the universities are determined by the universities themselves. Once the university's Academic Planning Committee, Senate, and University Management Board have given their approval to the program, it is submitted for final approval to the Ministry of Higher Education.

When drawing up a program curriculum, the Teacher Education Division keeps in mind the teacher profile stipulated in the Ministry of Education's *Philosophy of Teacher Education* (Ministry of Education, 1982). The division's focus accordingly is on national unity, national culture, science and technology, and individual development. Individual development embraces professional, cognitive, physical, emotional, and spiritual development. Within the philosophy document, the qualities of the teacher are classified

under personal, professional, and social aspects, and these are operationalized through objectives and qualities set down for all areas of the program curriculum and the "co-curriculum." The former consists of basic courses, professional courses, teaching practice, and self-enrichment, whereas the latter has to do with sport, cultural and societal activities, and community service. The Teacher Education Division also pays particular attention, when designing the teacher education curriculum, to the requirements and demands of the integrated primary and secondary school curriculum.

In order to effectively deliver the integrated curriculum, teachers, both preservice and inservice, are required to focus on bringing a crosscurricular approach to the teaching of language, values, and thinking (cognitive) skills. The integrated curriculum also requires teachers to make sure the cognitive, affective, and psychomotor domains of learning are an integrated part of the context of the subjects they teach.

In line with the above principles, the Bachelor of Education curriculum (primary and secondary) encompasses the following:

1. *Knowledge domain*—includes subject content; professional knowledge; pedagogy and andragogy; program development, implementation, evaluation, and improvement; and management and administration of the educational environment.
2. *Generic skills*—these reference thinking skills; reflection, adaptation, problem-solving and decision-making skills; interpersonal and communication skills; ICT skills, including multimedia and information management skills; leadership skills; and entrepreneurial skills.
3. *Specific skills*—these encompass assessment, evaluation, and measurement; planning, managing, and assessing teaching and learning; helping students manage their work and motivating them to learn; learning strategies and styles; and counseling techniques.
4. *Research skills*—these relate to, amongst other skills, literature reviews, research methodologies, data analysis, and writing up and reporting research findings.
5. *Values and attitudes*—these include conformity to the teaching profession's code; maintaining a love for knowledge acquisition; engaging in ongoing professional development; employing justice and fairness in the interest of ensuring equal learning opportunities for students; understanding the parameters of teacher-based and student-based responsibility and discipline; and upholding the national philosophy of education.

Field experience (the practicum) is a central and essential component of all teacher education programs, whether for preservice or inservice teachers. However, programs across Malaysia differ in the number of credit hours allocated to this component. Noran Fauziah and Rajendran (2003) found differences across programs not only in the number of weeks and credits allocated for the practicum component but also in the total number of credits for the entire program. At the Sultan Idris Education University, for example, of the total 127 credits making up the Bachelor of Education, 10 (or just under eight percent of the total number of credits) are allotted to the practicum component. Realizing the need to increase the school and classroom experiences of prospective teachers, teacher education institutes in Malaysia are attempting to increase the credits allotted to the practicum component.

Staffing requirements

Until relatively recently, teacher educators in Malaysia were eligible to teach in teacher education institutes as long as they had a Bachelor's degree and a minimum of three to five years of teaching experience. This scenario is changing, and the teacher training colleges have been upgraded to teacher education institutes that offer the Diploma in Teaching and the Bachelor in Education degrees. This change of status requires all teacher educators presently working in the teacher education institutes to upgrade their qualifications to a Master's or a PhD.

In the case of the local public universities that conduct teacher education programs, the minimum qualification a person needs to be employed as an academic staff member is a Master's degree. In most cases, the teacher educators who teach general pedagogy courses and teaching methodology courses in the subject-matter content areas come with experience of teaching in school or at teacher education institutes. Those who teach mathematics content, however, rarely have this experience. If they held only a Master's degree when first employed in a teacher education institute, they are required to obtain PhDs in their respective areas. In fact, certain universities have already made a doctoral degree the minimum requirement for employment in their faculties.

Part III: Quality Assurance Arrangements

Entry standards and selection methods

In Malaysia, the Ministry of Education determines the number of teaching posts based on an assessment of the number of teachers needed to cover each subject area in schools nationwide. The number of students admitted to each teacher education institution depends on the institution's resources and the number of qualified applicants. The institution considers if it has sufficient resources to educate its postgraduate students and all other students within its various programs, the size and variety of its other programs, and its responsibilities for research, continuing education, and various other services. The size of the student intake for each session must be publicly stated and related to the capacity of the institution to effectively deliver programs at all stages of education and training.

The institution also reviews the size of its student intake and the characteristics of its students in consultation with relevant stakeholders (e.g., the Ministry of Human Resources) and modifies these periodically in order to meet the needs of society and the country. The review includes a consideration of gender and ethnic balance and social responsibilities such as special policies for disadvantaged and marginalized students. The Ministry of Education and the Ministry of Higher Education determine these guidelines in accordance with existing government policies. The guidelines are confidential. The universities also work to their own specific guidelines, as approved by their respective senates.

There is no specific mathematics requirement for future primary teachers in Malaysia. Most future secondary teachers are trained in concurrent programs that have no specific requirements about the level to which entrants should have studied mathematics during their secondary schooling.

Accreditation of teacher education institutions and programs

The Malaysian Qualifications Agency, established in 2007, is responsible for accrediting all higher education programs in universities, including teacher education. Programs offered by the teacher education institutes are the responsibility of the Teacher Education Division of the Ministry of Education. The Ministry of Higher Education publishes standards for teacher education. Transparency of the process is assured through the use of nationally agreed guidelines on criteria and standards for educational programs as well as through procedures for conducting quality assurance. The long-term objective for accreditation in Malaysia is for all institutions to become self-accrediting institutions, with that accreditation recognized by the Public Service Commission.

Requirements for entry to the teaching profession

After graduating from their teacher education programs, future teachers are not required to obtain any additional qualifications in order to seek employment as a teacher. Malaysia does not yet have a licensing body for teacher qualifications. However, graduates with teaching qualifications are required to apply to the Teacher Service Commission. The commission reviews the applications and interviews applicants. Based on manpower requirements for teachers determined by the Ministry of Education, the commission recommends applicants suitable for employment in schools throughout Malaysia. The Ministry of Education then selects teachers suitable for placement in public schools. Public school teachers are first appointed as probationary education officers who gain permanent status when they receive positive annual performance reports from the school principal over the first three years of their teaching career.

References

Government of Malaysia. (1973). *Mid-term review of the Second Malaysia Plan 1971–1975.* Kuala Lumpur, Malaysia: Government Press.

Lim, G. S., Taharuddin, S. N. A., Mat Piah, A. R., & Ratnavadivel, N. (1991). *Teacher education: Practices and prospects.* Paper presented at the Regional Seminar on Teacher Education: Challenges in the 21st Century, Penang, Malaysia, November 18–20, 1991.

Loh, P. (1975). *Seeds of separatism: Educational policy in Malaya 1879–1950.* Kuala Lumpur, Malaysia: Oxford University Press.

Ministry of Education. (1982). *The philosophy of teacher education in Malaysia* (report of the National Workshop and Survey). Kuala Lumpur, Malaysia: Teacher Education Division, Ministry of Education.

Noran Fauziah, Y., & Rajendran, N. (2003). *Program and teacher education curriculum: Analysis, views and recommendations.* Paper submitted at the National Convention on Teacher Education 2003, Kuching, Sarawak, Malaysia.

Ratnavadivel, N. (1985). *The social origins of the educational system in peninsular Malaysia (1957–1980).* Unpublished Master's dissertation, University of Malaya, Kuala Lumpur, Malaysia.

Ratnavadivel, N. (1995). *The management of innovation: An evaluation of curriculum change in Malaysian teacher education.* Unpublished doctoral thesis, University of East Anglia, Norwich, UK.

Report of the Committee on Education (the Razak Report). (1956). Kuala Lumpur, Malaysia: Ministry of Education.

Report of the Committee to Review Education (the Rahman Talib Report). (1960). Kuala Lumpur, Malaysia: Ministry of Education.

CHAPTER 8:

Norway

Editors' Overview

Norway has a national framework (*rammeplan*) for teacher education, which all institutions follow. However, each institution has a great deal of autonomy with regard to organizing the content and the structure of the subjects taught, although there is less autonomy than before.

Institutions and governance

Norway has seven universities and 27 university colleges. Two universities and 17 university colleges (*lærerhøgskoler*) offer the general teacher education program-type (*allmennlærer-utdanning* or ALU), designed to prepare future teachers to teach mathematics (as well as other subjects) in both primary and lower-secondary schools. All seven universities provide preparation for lower- and upper-secondary school teachers.

Program-types and credentials

Norway has four major program-types for teacher education (Exhibit 8.1). The ALU program-type for primary and lower-secondary school teachers is concurrent. It provides future teachers with four years of general subject knowledge, pedagogy, and subject didactics. Teaching practice is included every year.[1]

All ALU students choose optional subjects during their third and fourth years, thereby providing them with opportunity to obtain more indepth study of one of the subjects. Some students choose mathematics. TEDS-M considered these students a population of their own and tested them two years later than the ALU future teachers who had not yet reached the year when they could decide whether or not to choose mathematics. These two program-types have an extended grade range (1 to 10), which coincides with the compulsory school system in Norway and includes the lower-secondary school phase of basic education.

The third program-type is a concurrent five-year Master's degree offered by the universities. The fourth program-type is consecutive. It provides teachers with a subject-specific education (*adjunkt* or *lektor*) that prepares them for work in lower- and upper-secondary schools (Grades 8 to 13).[2] The final year (PPU) contains pedagogy, subject didactics, and teaching practice. The last two program-types normally provide qualifications in two teaching subjects. However, as Exhibit 8.1 shows, these two program-types prepare very few future teachers when compared to the ALU.

1 Note that the numbers do not correspond to the number of institutions in the TEDS-M database. This is because, unlike practice in other TEDS-M countries, TEDS-M counted an institution in Norway offering more than one program-type as more than one institution.

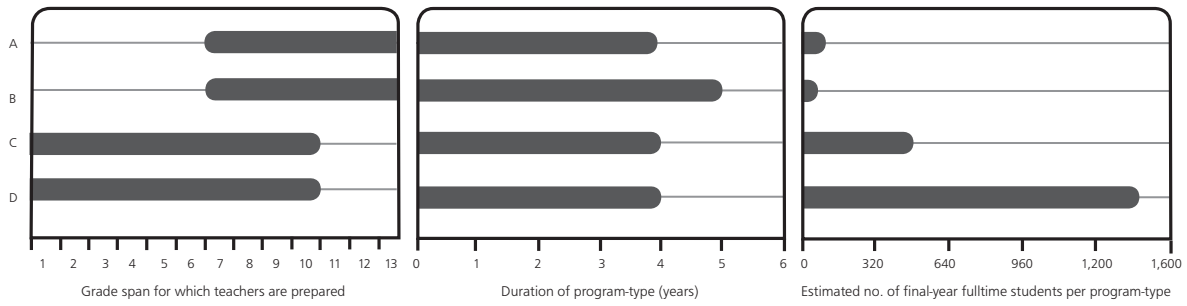
2 Formally, these teachers are declared qualified to teach in Grades 5 to 13. However, almost all of them actually go on to teach in lower-secondary schools (Grades 8 to 10) or in upper-secondary schools (Grades 11 to 13).

Curriculum content, assessment, and organization

Because Norwegian institutions enjoy a high level of autonomy, they are responsible for the quality of what they offer. The links between internal and external quality assurance are maintained through the Norwegian Agency for Quality Assurance in Education (NOKUT). However, there is no requirement to test or check particular skills or knowledge at the end of the teacher education program-types.

The 2003 national curriculum framework addressed the competencies teachers should acquire, but did not specify subject-matter content. The institutions themselves are responsible for designing the content that enables future teachers to acquire the requisite competencies. They are also responsible for demonstrating compliance with the frameworks. Nevertheless, universities typically resemble one another in terms of teacher education by offering an ordinary academic degree followed by "practical pedagogical education" (PPU). In university colleges, teacher education takes four years. Compulsory subjects such as pedagogical theory, mathematics, Norwegian, and religion account for half of the program-type. These required courses include subject-matter didactics. The rest are elective courses, which allow for more specialization. Guided practice takes place during 20 to 22 weeks of the program-type.

Exhibit 8.1: Teacher education program-types in Norway



Key to program-type

A—Teacher Education Program (PPU)

B—Master's degree

C—General teacher education (ALU+) with mathematics option

D—General teacher education (ALU) without mathematics option

Note: The most common PPU program-type is one in which future teachers first complete a Bachelor's degree in mathematics and another subject (three years) and then continue on with the PPU course (one year). However, students can elect to complete a Master's degree (five years) before taking the PPU course (one year). The Master's and PPU program-types formally qualify graduates for Grades 5 to 13, but almost all graduates end up teaching Grades 8 to 13. Future teachers in the ALU without extra mathematics were tested at the end of the second year of the program, whereas the fulltime students in the ALU without mathematics were tested at the end of the fourth and final years of the program. Thus, these two program-types overlap because those students in the ALU without extra mathematics in Year 2 can choose ALU with mathematics in Years 3 or 4. Estimates for final-year fulltime students per program-type were calculated as the mean of the estimates from the two split-half samples for Program Types C and D.

Preparing Teachers of Mathematics in Norway

Trygve Breiteig

Part I: Context and Conditions of Teaching as a Career

Historical roots

In Norway, teacher education, as well as schooling in general, is developed within the political and cultural settings of Norwegian society. It takes only a short sketch to show how teaching and teacher education is rooted in Norway's development as a nation (Breiteig & Goodchild, 2010).

Before the 19th century, Denmark was the dominant power in the region, and Norway was ruled by the Danish monarch and government for 400 years. After the defeat of the Napoleonic army in 1814, Denmark was forced to cede sovereignty of Norway to a union of Norway and Sweden, in which Sweden was the predominant power. Sweden's monarch became Norway's head of state, and the Swedish government controlled foreign policy. Nevertheless, Norway was able to set up its own constitution and parliament and launch a movement during the 19th century that consolidated a separate Norwegian identity. Increasing value was placed on national culture, as expressed through history and folklore, as well as through folk art, architecture, music, and literature. Especially significant was the development of a Norwegian written language.

When the union with Sweden was dissolved in 1905, Norway became an autonomous parliamentary democracy with a constitutional monarch as head of state. The quest to establish Norway's individual identity and culture continued through the development of a school system and curriculum that emphasized national as well as individual development. The first half of the 20th century was a time of difficult challenges and hardships for Norway, given that this period included the First World War, the Great Depression of the 1930s, and the five years of German occupation during the Second World War.

It is only in the last three decades that Norway has developed into one of the world's richest countries because of its exploitation of North Sea oil. Before this time, Norway's economy depended mostly on the fishing industry and subsistence agriculture, both of which are demanding occupations, given the harsh northern climate. There was also shipping and some industry, with the latter benefitting from an abundance of hydro-generated electricity.

In 1922, Norway introduced the first national curriculum for primary schools in rural areas, and in 1925 it introduced another national curriculum for schools in urban areas. In 1939, the government initiated a revised national curriculum informed by the German notions of *Bildung* and *Arbeitsschule* and the American concept of *learning by doing*. From the 1920s to the 1960s, there was a notable distinction between the manifestation of this curriculum in rural schools and in urban schools. In the rural schools, children attended on alternate days, just three days a week. On the days when they were not at school, they helped on the family farm or the family fishing business and did homework assigned by their teacher.

The 1939 curriculum remained in place for over 30 years. In the Norwegian context, this period now appears to be a remarkably stable one given that there have been five major revisions to the primary school curriculum since 1970. One possible reason for the stability is the quality of the curriculum at that time, which was based on serious research and sound pedagogical ideas. However, the stagnation that took place during and following the Second World War also has to be taken into account—first, while Norway was occupied, and then for a substantial period of reconstruction following liberation. The stability of the curriculum may also have been partially due to the fact that Norway was then a relatively poor country. "Tinkering" with the school curriculum may be more of a preoccupation of politicians in countries that have the resources to support change, such as new textbooks and the provision of inservice professional development for teachers.

By 1960, Norway was ready to take its school system in a new direction, and it began by trialing a national curriculum, implementation of which required extending the number of years of compulsory primary schooling from seven to nine. In 1969, legislation confirmed that compulsory schooling nationwide would now be of nine years' duration. Primary school was also divided at this time into primary school (*barnetrinnet*), encompassing Grades 1 to 6, and lower-secondary school (*ungdomstrinnet*), which included Grades 7 to 9.

A streaming (tracking) policy was also introduced into secondary schools during this period. It served as means of catering for students' diverse educational needs, interests, and abilities. It meant organizing core subjects, with students able to choose the ones they wanted to study, into three levels of difficulty. For example, in mathematics, students studying Plan 1 learned the basic mathematics needed in daily life and work, those studying Plan 2 had to work on more demanding mathematics concepts and tasks, and those studying under Plan 3 were required to learn the most theoretically challenging concepts and tasks.

During this period, the strong Norwegian tradition of a unifying school, *enhetsskolen*, acted as a guiding principle with regard to access to schooling. It implied that all students in an area should attend the same school, and that all students in the country should ideally have access to the same educational opportunities and offerings, regardless of economic, social, and geographical conditions.

Over the following years, discussion on the content and organization of the nine-year (and after 1997) 10-year compulsory period of schooling continued. A new national curriculum for primary schools was introduced in 1971 and revised in 1974. Here, the course-level system of streaming in secondary school was replaced by a system based on a more flexible pedagogic differentiation, with learning rate as the guiding principle. At this time, there were no compulsory minimum achievement standards in place. When the nine-year primary school came into effect, the question of just which teachers should teach at this extended level (i.e., the lower-secondary level) became a burning issue, as is discussed later in this chapter.

Three further curriculum reforms took place in 1986, 1997, and 2006. These are elaborated here from the point of view of mathematics. During the 1960s, the stability of the school mathematics curriculum, which had been used since the 1920s, began to be challenged by mathematics educators. One reason for this critique was the "modern mathematics" movement that originated in the United States. Modern mathematics had

emerged in the early 1950s as a serious and urgent response to the need to improve the quality of mathematics and science education in the United States. The developments in the USA spread to Europe, with the Nordic countries taking an active part in these changes. The Royaumont seminar in 1959, for example, gave momentum to the work of a Nordic committee (NKMM) charged with modernizing mathematics education. The committee's work resulted in preliminary curricula that included new textbooks which emphasized practical investigation. Educationalists, school leaders, and mathematics professors participated in this work.

The desire to change the way mathematics was being taught in Norway's schools was widespread. There was not only general dissatisfaction with mathematics in the school curriculum, which many regarded as outdated, but also recognition that mathematics had undergone considerable development. Stakeholders pointed to new areas, with new applications, and to recent work on the history and philosophy of mathematics. They argued that these developments should influence revitalization of school-based mathematics, and they also pointed to an increasing distance between school mathematics and university mathematics. In short, mathematics, as taught in schools, needed to be brought up to date and in line with these trends.

The notions and principles that influenced the work of NKMM included integrating arithmetic and algebra, exploring unifying concepts (in order to reduce the total number of basic ideas), standardizing the language used (especially in terms of precision), promoting understanding rather than mere mastery of skills, and using discovery learning approaches as a means of motivating students and keeping them interested in the subject (i.e., retention). Some key ideas pursued with regard to this work were "basic concepts," "structure," and "deeper understanding."

In retrospect, the influence of the modern mathematics movement on education was limited, especially as it never gained a strong foothold in Norway. Various commentators considered modern mathematics to be an academic movement and contradictory to the idea of Arbeitsschule in the preceding curriculum. Other developments were also beginning to influence thinking about the pedagogy of mathematics, such as those from England and Holland that emphasized hands-on experiences, investigations and inductive thinking, and inquiry, reasoning, and proving. As a result, the mathematics curriculum rolled out in 1971 had two forms, the first similar to the earlier curriculum, and the other building on the NKKM recommendations.

Another source of influence at this time was research into mathematics education, which brought a more locally-based flavor to the modern mathematics movement and so appeared better suited to the needs of Norwegian school students. Research by Stieg Mellin-Olsen was particularly influential. He argued that mathematics should be presented and taught in a way that encouraged democratic right of access to mathematics, especially for less academic students and for students who, perhaps because of their social and ethnic backgrounds, disputed the relevance of mathematics in their lives (Mellin-Olsen, 1972, 1987).

The new national curriculum reforms for primary schools launched in 1985 emphasized problem solving, computer technology and mathematics, teaching tailored to students' needs, and learning plans localized to the nature of the school and its community. A subsequent curriculum reform in 1997 emphasized the process aspect of mathematics, so requiring students to engage in investigations and project work, to search for patterns,

and to appreciate and learn those aspects of mathematics useful in daily life. The reform also emphasized the crosscurricular nature of mathematics by helping students see its relevance in other subjects. The reforms furthermore included a detailed list of areas of investigation that would allow students to work actively to construct their mathematical knowledge.

The last national curriculum reform in 2006 built on five basic competencies: reading, writing, speaking, calculating, and using digital tools. The most recent version of the national curriculum pertaining to mathematics focuses on mathematical literacy and provides teachers with an elaboration of the competencies that their students should gain in the different aspects and areas of mathematics. These competencies relate to, amongst others, calculation, number and algebra, geometry, measuring, statistics, probability, and combinatorics. The new national curriculum also lists competencies that students should have acquired in different school subjects by the end of their time in different grade levels. Implementation of the curriculum in the classroom was followed by the establishment of a system of national tests in mathematics, reading, and English at Grades 5 and 8, designed to determine students' competency at this stage of their schooling, and with the information gained then being used to enhance and monitor students' learning at individual, school, and macro levels.

In 1995, Norway participated in IEA's Third International Mathematics and Science Study (TIMSS), which administered achievement tests to students in Grade 4 and Grade 8. The average scores in mathematics of the Norwegian students at both grade levels were weak relative to the scores of students in countries with which Norway tends to compare itself (Lie, Kjærnsli, & Brekke, 1997). This pattern was confirmed in the 2003 iteration of TIMSS (Grönmo, Bergem, Kjærnsli, Lie, & Turmo, 2004).[3] Norway subsequently implemented a series of remedial measures that had implications for the 2006 national curriculum and teacher education.[4]

Conditions at the time of TEDS-M

Responsibilities for governance of Norwegian education are divided among various public administrative units. Norway is administered through 19 counties and 434 local communes. The communes are responsible for running primary and lower-secondary schools. The counties run the upper-secondary schools, and the state is responsible for higher, tertiary education. Private schools and private education play a very small role at all these levels in Norway.

The school owners—normally the commune or county—determine the school budget and employ teachers and school leaders. They advertise publicly for teachers as needed. Selection criteria include education, relevant experience related to the types of teaching tasks required, and references. The principal of the school assigns teaching tasks to each teacher. Salaries are standardized according to education and seniority. Teachers at different levels, primary or secondary, are all classified on the basis of their teacher education. Five different categories are in effect.

3 For reports on TIMSS in Norway, see also http://www.timss.no/timss05_03.html

4 For a detailed description of the relationships between mathematics teacher education, school mathematics, and research in mathematics education in Norway, see Breiteig and Goodchild (2010).

Additional years in service raise the salary in steps. According to the agreement reached with unions in 2008, 16 years are required to reach the top of the scale. For example, in 2009, the salary for a teacher adjunct with four years of teacher education started at US$49,120[5] and ended after 16 years at US$58,910, that is, only 1.20 times the starting salary[6] and 0.86 times the gross domestic product (GDP) per capita.[7] This low salary growth factor reflects support for young teachers starting their career. The salary agreement also gives some room for local negotiation, and is intended to serve as a tool that enables schools to compete with other industries in recruiting personnel, especially those who can bring particular competencies into schools and stimulate development in areas such as mathematics. This approach is contested by some, however, who see it as contradicting national principles of solidarity.

In Norway, nearly all primary school students attend public school. Only about two percent of the cohort are in private schools.[8] Approximately 65,000 teachers are employed in Grades 1 to 10 of Norway's public schools, and the majority of them (about 70%) are female. About 40 percent of these women work parttime. These figures do not accord with the national goal of a gender-balanced teacher workforce. The average age for the teachers in basic school in 2005 was 45 years. A relatively large proportion of the teachers (40%) were more than 50 years old. The age of retirement is usually 62 to 67 years, and many teachers do retire before the cut-off age of 67. The average age for newly retired teachers was 60 in 2006, compared to 57 in 2001. Current education authorities want to keep teachers in schools longer, especially given the demographics showing that Norway will need substantially more teachers during the coming decade.

Until 2010, all general teachers were certified to teach mathematics from Grades 1 to 10, even if they had not studied this subject area during their teacher education. In primary schools, mathematics is taught mainly by generalist teachers, some of whom are highly experienced in this area of teaching. However, 40 percent of teachers at this level had not studied mathematics at all during their preservice education, and only 14 percent had studied mathematics in depth (i.e., 60 credits or more), the lowest such percentage for all school subjects.[9] Since 2008, steps have been taken to strengthen teachers' knowledge of mathematics. To be employed as a teacher of mathematics in lower-secondary schools (Grades 8 to 10), teachers need to have at least 60 credits worth of study in mathematics. Also, since 2010, the general teacher education program has been differentiated into a lower school level and a higher school level. Teacher education students have to choose to become a teacher of Grades 1 to 7 or of Grades 5 to 10. The first level requires students to complete at least 30 credits of mathematics; the second requires them to complete at least 60 credits in this subject area.

These changes have applied only to preservice teachers entering teacher education programs after the dates given. As such, they have not been applied to teachers credentialed and/or in employment before these dates.

5 According to the rate of exchange on February 13, 2009.

6 This is part of the main agreement: http://www.ks.no/upload/4196/HTA_KS_08-10.pdf

7 According to the OECD.

8 In 2003/2004, 2.02 percent of the cohort attended private schools; in 2004/2005, the percentage had reached 2.08: http://www.utdanningsforbundet.no/upload/Pdf-filer/Publikasjoner/Faktaark/Faktaark_2005_01.pdf

9 Source: http://www.ssb.no/emner/04/02/20/rapp_200721/rapp_200721.pdf

Part II: Organization and Characteristics of Teacher Education

During most of the 20th century, special colleges of teacher education offered a program for general teacher education called *allmennlærer-utdanning* or ALU,[10] which wove together the program strands of subject knowledge, pedagogy, didactics, and teaching practice from its beginning to end. The aim of this *concurrent* program-type was (and still is) to educate teachers intending to teach primary and lower-secondary school children up to the age of 16. It used to be a four-year program intended for graduates of the *realskole* or folk high school, and was open to applicants from age 17. Gradually, it has become a program studied at tertiary level, and today is intended for graduates of upper-secondary schools (i.e., students from age 19).

The subject scope and composition of the ALU program-type has evolved gradually over time. The revised Norwegian national curriculum for schools implemented in 1939 was based on seven years of compulsory (primary) education, with children starting school at age seven. Children who wanted to continue their education after age 14 could attend *realskole* and follow a three-year program. Alternatively, after two years at realskole, they could transfer to the *gymnas* (upper-secondary school), which was the normal route into a university course. General teacher education (*allmennlærer-utdanning*) was, up to the mid-1930s, provided principally through a four-year program in teachers' colleges (*lærerskoler*), which normally enrolled students at the end of the *realskole* program. This form of teacher education continued until the mid-1970s. However, from the 1930s on, general teacher education became increasingly dominated by a two-year program, which was extended to three years in 1973 and to four years in 1992. Thus, over time, the old teacher education program gave way to one that (from about 1975) students could enter only if they had completed upper-secondary school.

Students wanting to teach specific subjects in schools now study under a different program-type. They first complete a Bachelor's or go on to a Master's degree, after which they spend one year studying pedagogical practice and education at a university school of education. This phase (or teacher education component) is called the *praktisk pedagogisk utdanning* (PPU), which is regulated through a national curriculum framework (i.e., the *rammeplan* for PPU). Until 1992, the PPU took up half a year, but it became a one-year unit of study after 1992.

Completion of the PPU route leads to qualification as an *adjunkt* (assistant professor) or a *lektor* (associate professor), depending on the level of the academic degree. This *consecutive study* program-type is offered to individuals wanting to teach the lower and upper levels of the secondary school, which means that some of them may be employed to teach from Grades 5 to 13.[11] An equivalent preparation is provided as part of an

10 By 1990, 23 colleges were offering general teacher education for elementary schools in Norway. In 1994, they were amalgamated, together with the polytechnic regional colleges, nursing colleges, engineering colleges, etcetera related to different regions. The new and bigger units were called university colleges. A university college can apply to develop research capacity, Master's and even doctoral programs, and through a rigorous process obtain the right to become a university.

11 Teacher education also encompasses three more program-types. The first, for teachers intending to work in preschools (*førskolelærer*), is offered at the colleges of education. However, if a teacher successfully completes some supplementary study, he or she can teach students in the first four years of elementary school. The second program-type, the *faglærer*, involves a three-year period of study. It plays a role in training teachers to teach practical and aesthetical subjects such as art, craft, home economics, and sport, and also language. The focus of the third program-type, *yrkesfaglærer*, focuses on preparing vocational teachers. Students studying under these program-types were not included in TEDS-M sample.

integrated five years of teacher education leading to a Master's degree (MAS). The numbers of students enrolling in the PPU or MAS are very small when compared to the number enrolling in the concurrent program-type (see Exhibit 8.1).

To secure employment as a school teacher, individuals must meet the preservice education and training requirements prescribed under Norway's Education Act (*Opplæringsloven*). The regulations complementing this Act delineate the grade span and subjects that can be included within the different types of teacher education.[12] Preschool teachers (*førskolelærer*) can teach Grade 1 students, but if they take on specialist additional study, they can also teach Grades 2 to 4 students. Subject teachers who specialize in one or more practical or aesthetical subjects can teach these to students in Grades 1 up to 10. Teachers who specialize in other subjects and those graduating from the PPU or MAS program-types (A and B in Exhibit 8.1) can teach their subjects to students in Grades 5 to 10 (i.e., subjects requiring at least 30 ECTS[13] credits of study). General teachers in primary schools (i.e., those teaching Grades 1 to 7) do not need to obtain specific qualifications to teach any school subject, including mathematics. From 2008 on, future teachers of mathematics, Norwegian, or English have had to obtain at least 60 ECT credits of study in these subjects before they can be employed to teach them. For all other subjects, the requirement is 30 credits. With this modification, adopted in 2008, generalist teachers, that is, teachers with ALU training, can teach all grades from 1 to 10.

The seven universities and 27 university colleges in Norway providing teacher education are spread throughout the country. Students wanting to enter ALU general teacher education programs have a choice of 20 institutions on 24 permanent campuses. Some of these institutions are small; only three of them enrolled more than 150 students in 2007. Small size can be a problem in terms of less ability to provide more specialized courses and content. All seven universities in Norway provide teacher education under the MAS program-type or under the program-type that involves acquisition of an academic degree followed by PPU study.

Traditionally, the colleges of education or *lærerhøgskolene* (now merged in bigger institutions in each region) educated teachers for primary schools, and the universities prepared teachers for the upper-secondary schools. However, when Norway extended the duration of compulsory schooling from seven to nine years in 1969 (and to 10 years in 1997), the question arose of who should be responsible for educating teachers for the extended level of schooling, that is, the lower-secondary school. The answer was *both* concurrent (ALU) and consecutive (MAS/PPU) programs. Teachers at this level can therefore receive their training in universities. However, many elect to study in colleges of education, and some may go on to complete additional university studies.

Despite this arrangement, the problem of how to differentiate primary, lower-secondary, and upper-secondary teacher education programs remains a burning issue in Norway. Institutions are now trialing different teacher education programs for primary and secondary teachers, even though they know that this differentiation does not comply with current regulations. Nevertheless, the general certificate for teachers (which covers all subjects and all grades from 1 to 10) is generally considered out of date, and is being replaced with qualifications that offer more specialist and indepth study. The trend

12 For details, see http://www.lovdata.no/for/sf/kd/xd-20060623-0724.html#map049

13 The European Credit Transfer System.

is to focus a teacher's qualifications on more specific levels and subjects of schooling, and thus raise the quality of the teaching force. Quality is also being seen in terms of ensuring that teacher education provides good teachers for the many small schools in the rural and sparsely populated areas of Norway. These matters, however, continue to be discussed, and the issues associated with them have yet to be resolved. Another issue of considerable interest is whether teacher education (for some or all) should include a Master's degree within a five-year program of study.

According to Tora Aasland, who was Minister of Education at the time of the TEDS-M survey, no matter what form future teacher education takes, it "must combine theory and practice in a much better way than now.[14] Calls were therefore made at this time to lift the quality of teacher education and the status of the teaching profession so as to ensure schools could serve the needs of a modern democratic and pluralistic society. In 2010, as an outcome of these concerns, the ALU general teacher education program became history. General teacher education in Norway is now more specialized in terms of levels and subjects, and two program-types, each involving four years of teacher education, are now being offered: one for Grades 1 to 7 and one for Grades 5 to 10. Both include one year of pedagogy (60 credits).

More specifically, the first program-type includes four subjects, each of 30 credits, with Norwegian and mathematics as compulsory subjects. The second program-type includes three subjects left to students' choice, each of 60 credits, thereby providing students with a greater depth of knowledge than was previously the case in teacher education. Efforts are being made to raise the educational demands and expectations of teacher education students, develop the research capacity of the staff, and enable teacher education to be based more on research. These elements should also contribute to a higher quality teaching force.

A systematic mentoring program is also being put in place for teachers during the starting phase of their career. The aim of this program is to address the problem of teachers leaving the profession soon after beginning work in the classroom. The Ministry of Education is now systematically monitoring teacher education, especially in terms of the quality and scope of its content and the quality of its graduates. Monitoring also focuses on the coordination and sharing of tasks across provider institutions. Essentially, the ministry is now taking a more active steering function with respect to teacher education.

All of the substantial changes noted here have been debated for some years. The reform measures implemented to date take into account the complexity of general teacher education and the need for a higher quality teaching force.

Curriculum and field experience requirements

General teacher education is provided in accordance with government legislation and regulations (Ministry of Education and Research, 2008/2009, 2010a, 2010b). The typical program for future primary and lower-secondary teachers consists of four years of study, or 240 ECTS credits. At the time of the TEDS-M data collection, half of the 240 credits were compulsory and half were optional.

14 Tora Aasland, in the journal *Utdanning*, No.17, 2008, p. 34.

The compulsory credits (i.e., 120) related to pedagogy, mathematics, and Norwegian (30 credits each), religion (20 credits), and basic reading, writing, and mathematics (10 credits). The remaining 120 credits related to school subjects organized as special courses, with students able to select the courses they wanted to study. These subject studies included subject-relevant didactical issues and teaching practice. At least 60 of the optional credits had to relate to subjects taught in primary school. The studies were intended to give students an indepth understanding of each selected subject and its teaching and learning. During their four-year program of study, students also spent 20 to 22 weeks of mentored practice in schools. In some programs, the fourth year of teacher education could include Master's degree content, providing students with the possibility of then completing the degree during a fifth year of study.

The content of Norwegian teacher education courses is described in the national curriculum framework (*rammeplaner*). Since 2003, the framework used in the ALU program-type has been based on the primary school reform of 1997. It describes the competencies that student teachers need to acquire. The 2003 framework does not, however, prescribe the content of courses, and there are no explicit national and verifiable criteria for each subject against which students can be evaluated. Instead, the framework gives short learning objectives for each subject, and the teacher education provider is responsible for implementing the framework and designing course content that aligns with those objectives. Thus, the framework gives little indication of the issues and components that have to be included and accordingly is open to different interpretations and different degrees of focus. This situation also means that the outcomes of teacher education are subject to provider rather than national standards. Although this approach provides freedom to develop innovative courses and the means of readily updating content, it precludes the development of national norms that can be used to monitor teacher quality nationwide and that make it easier for teachers to move to and work in different areas of the country (i.e., teacher mobility).

The teacher education framework implemented in 2003 contrasts with the earlier 1998 framework. The change mirrored changes in the national curriculum for primary schools. Also, whereas the reformed national curriculum of 1997 provided details about the content that should be included in each school subject, the national curriculum of 2006 changed the focus to the general competencies that students should acquire during the successive years of their schooling. Further discussion on the level of government control over the direction of teacher education, the content of its curricula, and the freedom that teacher education providers have with respect to each are discussed in more detail below in the quality-assurance section of this chapter.

Teacher education students at the University of Oslo enrolled in the *lektor* program (LP) have the option of completing a Master's degree, which is an integrated part of this program. Over six semesters, all *lector* students acquire advanced competence in two subjects of 60 and 80 credits, respectively. Students electing the 80-credit option are the ones who can continue on by completing the Master's degree over two additional semesters. In both cases, students complete their program with 60 credits of PPU, which includes didactical courses in two school subjects, such as mathematics education and science education, each of 15 credits. The university's Department of Mathematics is responsible for providing the mathematics courses within the program, and the content of these is based on the most advanced mathematics curriculum taught in upper-secondary schools.

In order to understand the reasons behind the inclusion and content of mathematics courses in Norway's teacher education programs, we again need to go back several decades. Earlier, the four-year teacher education program included a substantial mathematics element, with content similar to that in the "minimum" course in upper-secondary *engelsklinjen* schools. However, this content was gradually replaced in the years before 1975. In 1973, providers were required, under new legislation governing teacher education, to adopt programs that built on the content of subjects offered in upper-secondary schools. However, mathematics was not one of the compulsory inclusions. The subjects that were compulsory were Norwegian language, pedagogy, religion, and one practical or aesthetical subject. Mathematics thus remained an optional subject in teacher education programs for 27 years, until changes brought in by Parliament in 1990.

Several possible reasons for the weak position of mathematics in the three decades up to 1990 can be elucidated. The first centers on the dominant view of what mathematics in school should consist of (i.e., mainly procedures and calculations), the second on the culture of teacher education, and the third on the fact that only a few of the teacher education lecturers employed in the 1970s had a Master's in mathematics.

In 1990, the government brought in a compulsory basic course in mathematics of 15 credits for students training to be teachers. In 1998, the number of credits was extended to 30 (i.e., half a year's study). Arguments driving these changes were that mathematics is a key subject in school, teacher education students tend to have a weak background in mathematics, and student teachers need to have opportunity to develop their mathematics competency through coursework that encourages them to reflect on the didactics of teaching this subject. Hege M. Mandt (2006) provides a comprehensive analysis of providers' experiences of offering the compulsory course in mathematics in their ALU programs.

These developments in mathematics teacher education have not, however, ended discussion of what competencies teachers of this subject area should have. Through reference to the national curriculum and its social-constructivist framework, the Norwegian Council of Mathematics (*Norsk matematikkråd* or NCM) has continued to emphasize the need for preservice and inservice primary schools to take on indepth study of mathematics. According to the council, teams of teachers in schools that have strong mathematics content knowledge and strong mathematics pedagogical content knowledge should limit teaching mathematics in a way that emphasizes rote learning of skills and procedures at the expense of understanding. In short, the council argues for placing the greatest amount of emphasis on why, not how.

Today, teaching practice is an integrated part of teacher education programs, and still retains 20 to 22 weeks of study devoted to tutored practice in teaching or related pedagogical tasks. The progression of these experiences follows in well-structured order so as give students maximum experience of the profession of teaching. This component of programs includes teaching practice, reflections on theory and practice, considerations relating to implementation of the national curriculum, and using information and communication technologies as teaching aids. It also includes and focuses on classroom-based investigations, adjusting teaching to cater for students' different abilities, multicultural classrooms, cooperation between school and home, school management and teamwork, and professional ethics.

University lecturers meet with the teachers in the schools responsible for overseeing and mentoring the student teachers, and they help their students prepare for this component of their teacher education. Lecturers also regularly visit their students during school practice, observing their teaching and classroom management skills and discussing their progress with the mentoring teachers. Lecturers furthermore, from time to time, supervise their students' classroom practice in collaboration with the school-based teachers.

Staffing requirements

The Ministry of Education now has in place a set of criteria for the employment of university or university college teacher educators. One criterion is a higher academic degree; most recently employed staff now have a PhD. Prospective educators must also have a general teacher education or PPU. Close knowledge of the Norwegian education system is expected, and experience in teaching in primary or secondary schools is seen as especially relevant. Academic publishing and participating in research and development are additional important appointment criteria.

The requirements for teacher educators of mathematics can be met in different ways. For most, it will mean having a higher degree in mathematics as a foundation, and extending their competency in mathematics through additional education. Given the international development of mathematics education as an academic field over the last three or four decades (through research programs, publication in research journals, conferences, and the development of resources), it is deemed reasonable to expect teacher educators of mathematics to have a substantial knowledge of this field. Young, recently employed teacher educators of mathematics now typically have a degree in mathematics education, either a Master's or a PhD, and research experience in the area.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

A national central body—the Norwegian Universities and Colleges Admission Service—handles all applications for tertiary education. Applicants are rated according to marks obtained at upper-secondary school, studies completed, age, and work experience. The academic level of students enrolled for general teacher education differs little from that of other university college students.

Applicants for general teacher education must have earned "general student competency" status, that is, have completed three years of upper-secondary education or the equivalent. Students entering these programs typically range from average or below-average achievers for their age group. Since 2005, their marks in mathematics and in Norwegian have needed to be at least three (on a scale from 1 to 6). In addition, they need to have obtained at least 35 secondary school points in the subjects included in the national school curriculum. Candidates for general teacher education also need to be able to use both forms of the Norwegian language during their teacher training and to have in hand a "good conduct" certificate from the police. No parameters other than these are used to select students into general teacher education.

Since 1982, the Norwegian Council of Mathematics has tested all secondary school graduates who will need to study mathematics during their time at university (Nortvedt,

Elvebakk, & Lindstrøm, 2010; Rasch-Halvorsen & Johnsbråten, 2007). According to the last published report in 2009, the mean mathematics achievement score for students intending to enter general teacher education was 32 percent, whereas the total sample mean was 48 percent. Of the student teachers, 42 percent had studied mathematics for only one year during their upper-secondary schooling, 34 percent had studied this subject for two years, and 24 percent had studied it during all three years. Their mean achievement scores were 18 percent, 16 percent, and 66 percent, respectively. These data indicate that few general teacher education students have a particular interest in mathematics.

The report from 2007 showed that 21 percent of the students surveyed said that "Mathematics is one of the school subjects I have mostly disliked." Also obvious was the fact that students inclined toward mathematics and science were choosing university programs leading to careers and professions other than teaching, a situation which poses a special challenge for teacher education in general and the mathematics competency of teachers in particular.

The Norwegian Council of Mathematics has also investigated the effect of teacher education courses on mathematics knowledge. Student cohorts for 2000 and 2001 were tested after they had completed their compulsory mathematics course in their teacher education program. While significant improvement in performance was documented, the council still concluded that the mathematics achievement scores were unsatisfactory.

From 2006 on, future teachers have had to study at least 224 hours of upper-secondary mathematics in order to strengthen their mathematics knowledge and obtain general student competency, which means taking two years of mathematics during their upper-secondary schooling. This requirement may account, in part, for the drop in applications to teacher education programs during several years prior to 2008. The number of students dropping out of these programs also rose substantially at this time. As competition for study places diminished, academically weaker and less motivated students enrolled, which in turn added to the number of dropouts. However, the situation is now looking more positive, with the number of applicants for teacher education program increasing between 2008 and 2011.

In 2007 and 2008, the number of applicants to primary school general teacher education was slightly smaller than the number of places. General teacher education has become an open field of study at nearly all institutions. As such, all applicants fulfilling the requirements are enrolled. The author of the TEDS-M national report for Norway pointed out that this undesirable situation is a consequence of changing trends in students' study and career choices.

Until recently, the Ministry of Education determined the number of teacher education places for each year. However, teacher education providers are now autonomous. Each can decide how many students it will accept, with this number presumably based on the number of applicants in previous years and the market demand for teachers. However, each institution is generally keen to maintain its student capacity by enrolling the planned number of students, even when this number may not be justified. This desire is also a product of institutional economics and image. Furthermore, in order to keep enrollments up and to reach as wide a target group as possible, many providers now tailor their programs by offering, for example, studies of a single subject, distance

teacher education courses, and parttime study that enables students to combine study with parttime work and/or family commitments.

Despite this long history of changes to teacher education in Norway, concerns about whether enough students with a good background in mathematics and interest for the subject are being recruited to teacher education remain. And despite the Minister of Education's goal of raising the status of the teaching profession, the media continue to focus on negative aspects of schooling (e.g., the poor TIMSS and PISA results for Norwegian schools, the lack of resources, and the stresses associated with teaching). This malaise has also been evident in teacher disquiet over their salaries and working conditions. In 2008, the year of the TEDS-M data collection, Norway's national teacher union went on strike (during the month of May) over these matters.[15]

As already intimated in this chapter, the competitive labor market in Norway continues to contribute to the difficulty of attracting a steady stream of talented and dedicated students into science and mathematics-oriented programs, let alone teacher education programs. In its strategy plan for 2002 to 2007, the Ministry of Education and Research made special provision for encouraging young people, especially girls, to choose to study science and mathematics. However, at the time of writing, the effects of the plan had yet to be demonstrated.

Accreditation of teacher education institutions and programs

The Norwegian Agency for Quality Assurance in Education (NOKUT), established by law in 2002 as an independent public agency, is responsible for quality assurance in higher education and tertiary vocational education in Norway.[16] NOKUT accreditation empowers universities and colleges to award national degrees or diplomas.

Accreditation is not limited to a specified period of time, but is considered valid until explicitly revoked because of an adverse assessment. Evaluation of teacher education programs is based on collected information pertaining to:

1. *The institution*—program direction, organization and oversight, use of resources, staff qualifications, research and development, and incentives for development.
2. *The program*—its quality, professional relevance, inservice education, and mutual knowledge flow between teacher educators and those in the professional field.
3. *The students*—student background, intake level, working load, rate of fulfillment, examination results, and level of competency at program end.

All higher education institutions are regulated by the Universities and Colleges Act, which means they must operate according to the same academic standards and criteria. In line with their high degree of autonomy, these institutions are themselves responsible for assessing the quality of their educational provision. They must, however, be able to demonstrate that their self-monitoring employs an internal quality-assurance system that complies with nationally set criteria. The link between internal and external quality assurance is established through NOKUT's evaluations of whether each institution's internal quality-assurance procedure, prescribed by law, meets the requirements of these criteria. NOKUT has also brought out a set of more specific evaluation criteria, which include the European standards and guidelines for internal quality assurance in institutions of higher education that were adopted under the Bologna Accord.

15 For a deeper study of the background and working conditions of mathematics teachers, see Gjone (2006).

16 Source: http://www.nokut.no/en/

The evaluations cover an institution's quality-assurance system as a formal structure, the documentation it produces, and the institution's own assessment of quality through its compilation of a portfolio. The audits are designed to detect areas in need of improvement and/or instances where documentation of satisfactory internal quality assurance is lacking. They are supposed to be carried out in a manner that is helpful for the institution in its effort to develop a culture that embraces continuous improvement.

The audits cannot themselves lead to an institution's loss of accreditation, but may produce indications that trigger a "revision." The aim of a revision is to explore whether an accredited education unit (subject, program, or institution) meets the formal standards for program or institutional accreditation. A negative decision will lead to the loss of accreditation if the institution fails to remedy the identified shortcomings within a specified period of time. NOKUT's board is free to decide on any such revision at any time. According to the national TEDS-M report for Norway, no teacher education institution or program has yet been disaccredited, although this has happened in other tertiary education programs.

NOKUT is responsible for ensuring that its work will eventually accord with the European standards developed during the Bologna Process (European Association for Quality Assurance in Education, 2005). The agency also carries out other types of evaluation with the purpose of investigating, assessing, and developing the quality of higher education in Norway.

From time to time, NOKUT also carries out "national evaluations" designed to assess and develop the quality of higher education in Norway. Evaluations under this category have an investigative and analytical purpose and are aimed at enhancement rather than control. In 2001/2002, the Ministry of Education and Research asked NOKUT to conduct a special evaluation of programs for general teacher education. The focus of this evaluation was on the coherence of teacher education programs and the links between theory and practice, details of which can be found in the Norwegian TEDS-M national report (Grønmo & Onstad, 2012).

Requirements for entry to the teaching profession

In Norway, once a future teacher has completed an accredited teacher education program, there is no government requirement for him or her to pass a national test or complete a probationary period in school before gaining full registration as a teacher and entry into the profession. Several investigations associated with piloting a support system that involves mentoring new entrant teachers are presently underway. Mentoring of new teachers is the subject of much of the current discussion about teacher education reform.

The teacher education institutions are required to monitor their student-teachers' suitability for the teaching profession (*Skikkethets-vurdering*). The criteria for this evaluation are set through regulations[17] and relate to the ability to be caring, to guide learning processes, to create appropriate learning environments, and to ensure children's safety and health while at school. Criteria also include the ability to communicate effectively and to take responsibility as a role model. If the provider institutions identify students who cannot meet these fundamental requirements, those students are asked to leave the program.

17 http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-20060630-0859.html

References

Breiteig, T., & Goodchild, S. (2010). Development of mathematics education as a research field in Norway. In B. Sriraman, C. Bergsten, S. Goodchild, G. Pàlsdottir, B. Dahl Søndergaard, & L. Haapasalo (Eds.), *First sourcebook on Nordic research in mathematics educatio*n (pp. 11–13). Charlotte, NC: Information Age Publishing.

European Association for Quality Assurance in Education (ENQA). (2005). *Standards and guidelines for quality assurance in the European higher education area.* Brussels, Belgium: Author. Retrieved from http://www.enqa.eu/files/ENQApercent20Bergen percent20Report.pdf

Gjone, G. (2006). Mathematics teachers in Oslo: Background and working conditions. In L. Häggblom, L. Burman, & A. S. Röj-Lindberg (Eds.), *Perspektiv på kunskapens och lärandets villkor* [Perspectives on knowledge and learning conditions] (pp. 101–113). Turku, Finland: Faculty of Education, Åbo Akademi University.

Grønmo, L. S., Bergem, O. K., Kjærnsli, M., Lie, S., & Turmo, A. (2004). *Hva i all verden har skjedd med realfagene? Norske elevers prestasjoner i matematikk og naturfag i TIMSS 2003* [What on earth has happened to science? Norwegian students' performance in mathematics and science in TIMSS 2003]. Oslo, Norway: Department of Teacher Education and School Development, University of Oslo.

Grønmo, L. S., & Onstad, T. (Eds.). (2012). *Mange og store utfordringer: Et nasjonalt og internasjonalt perspektiv på utdanning av lærere i matematikk basert på data fra TEDS-M 2008* [Many and great challenges: A national and international perspective on mathematics teacher education based on data from TEDS-M 2008]. Oslo: Unipub.

Lie, S., Kjærnsli, M., & Brekke, G. (1997). *Hva i all verden skjer i realfagene?. Internasjonalt lys på trettenåringers kunnskaper, holdninger og undervisning i norsk skole* [What in the world has happened in science? Thirteen-year-olds' science knowledge and attitudes and teaching in Norwegian schools as viewed from an international perspective] (TIMSS report). Oslo, Norway: Department of Teacher Education and School Development, University of Oslo.

Mandt, H. M. (2006). *En kvalitativ tilnærming til Matematikk1-kurset i allmennlærerutdanningen høsten 2005* [A qualitative approach to the (first) course in mathematics in general teacher education, Autumn 2005]. Unpublished Master's dissertation in mathematics education, University of Bergen, Norway. Retrieved from https://bora.uib.no/handle/1956/1867

Mellin-Olsen, S. (1972). *Mathematics for "slow learners."* Report presented at an educational seminar on school-based research, University of Bergen, Norway.

Mellin-Olsen, S. (1987). *The politics of mathematics education.* Dordrecht, the Netherlands: Reidel.

Ministry of Education and Research. (2008/2009). *Stortingsmelding nr. 11, Læreren. Rollen og utdanningen* [Report No. 11: The role and education of the teacher.] Oslo, Norway: Author. Retrieved from http://www.regjeringen.no/pages/2150711/PDFS/ STM200820090011000DDDPDFS.pdf

Ministry of Education and Research. (2010a). *Nasjonale retningslinjer for grunnskolelærerutdanningen 1.–7. trinn* [National guidelines for primary school teacher education: Steps 1–7]. Oslo, Norway: Author. Retrieved from http://www.regjeringen.no/upload/KDRundskriv/2010/ Retningslinjergrunnskolelaererut danningen_1_7_trinn.pdf

Ministry of Education and Research. (2010b). *Nasjonale retningslinjer for grunnskolelærerutdanningen 5.–10. trinn* [National guidelines for primary school teacher education: Steps 5–10]. Oslo, Norway: Author. Retrieved from http://www.regjeringen.no/upload/KD/Rundskriv/2010/ Retningslinjer_grunnskolelaererutdanningen_5_10_trinn.pdf

Nortvedt, G. A., Elvebakk, G., & Lindstrøm, T. (2010). *Norsk matematikkråds forkunnskapstest 2009* [Norwegian Council of Mathematics' assessment of mathematics achievement 2009].Oslo/Tromsø, Norway: Norwegian National Council of Mathematics. Retrieved from http://matematikkradet.no

Rasch-Halvorsen, A., & Johnsbråten, H. (2007). *Norsk matematikkråds undersøkelse høsten 2007* [Norwegian Council of Mathematics survey, Autumn 2007]. Notodden, Norway: Telemark University College. Retrieved from http://matematikkradet.no/

CHAPTER 9:

Oman

Editors' Overview

A small number of institutions with evolving roles have been responsible for teacher education in Oman. All graduates of program-types that fit the TEDS-M population have Bachelor's degrees, but the program-type offered by colleges outside the university differs in certain respects from that offered at the university (e.g., language of instruction and practicum requirements).

Institutions and governance

Oman currently has no initial teacher education provision for Grades 1 to 4. The reason is insufficient demand for new teachers at this level. TEDS-M, therefore, encompassed Grades 5 to 12 only. Recently, the six colleges of education were converted to more comprehensive applied colleges of science. Five of them no longer offer teacher education, but at the time of the TEDS-M data collection, all six still had teacher education students in their final year and therefore participated as part of the target population. Teacher education is currently offered at only a few institutions—Sultan Qaboos University, one college for females under the Ministry of Higher Education, and three private universities.[1]

Program-types and credentials

In Oman, all secondary teachers of mathematics prepare for just one teaching subject, although they are actually required to study other subjects as well. Oman has three major program-types for preparing these mathematics teachers. One is a concurrent program-type at a college of education, leading to a Bachelor of Education (Exhibit 9.1). The second program-type also leads to a Bachelor of Education, but it is offered at Sultan Qaboos University, and the third is a consecutive program-type, consisting of a Bachelor of Science in Mathematics followed by a professional education diploma.

The Bachelor of Education that the university offers takes an average of five years to complete. In part, this is because most of these mathematics students have to spend one or two semesters studying English, given that English is the language of instruction for most of their courses. In the college of education, the Bachelor of Education takes four years to complete because there is less of an emphasis on English. Arabic is the language of instruction.

The Bachelor of Science in Mathematics program-type includes the normal two phases of a consecutive course of study. During the first phase, students are enrolled in the College of Science for five years, after which they receive a Bachelor's degree in mathematics. During the second phase, students enroll in the university's college of education for one additional year and then receive the Professional Education Diploma in Mathematics. All of these graduates are qualified to teach Grades 5 to 12.

1 The private universities had so few graduates in teacher education that they were not included in TEDS-M.

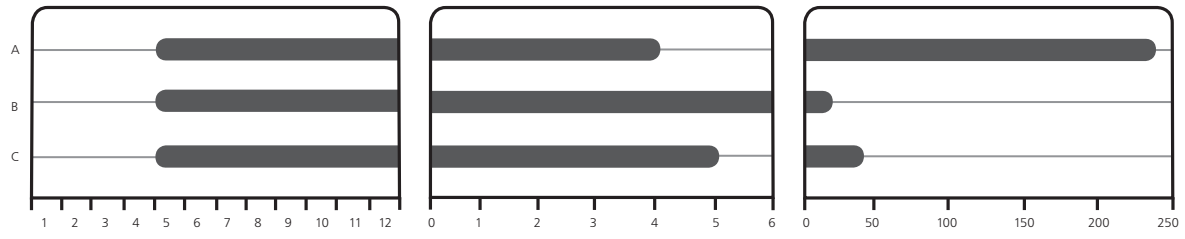
Curriculum content, assessment, and organization

The future teachers in the concurrent Bachelor of Education program-type have a heavy schedule of coursework. It includes

- A "cultural component" of seven courses, with an emphasis on the nature of Omani society and its Arabic and Islamic origins, plus English language and elective courses;
- Specialized coursework in mathematics, physics, and computer science (20 to 21 required courses); and
- Eleven courses in education.

At the university, the practicum takes place in the final year of Bachelor of Education study (one day a week in the first semester and two days a week in the second). In the consecutive program-type, the practicum is scheduled during the last semester only and for two days a week. In the college of education, dispersed requirements for field experience that began in the third semester and continued to the end of the program-type were discontinued and replaced with the two-days-a-week requirement in the final year.

Exhibit 9.1: Teacher education program-types in Oman



Key to program-type

A—Bachelor of Education, college of education

B—Bachelor of Science, followed by Diploma in Education

C—Bachelor of Education, university

Note: At the time of testing, Oman was not offering preservice teacher training for Grades 1 to 4 because of insufficient demand for new teachers at that level. Programs at private universities were not included because they had very few students.

Preparing Teachers of Mathematics in Oman

Mohammed Al Ghafri, Ali Al Abri, and Mohamed Al Shidhani

Part I: Context and Conditions of Teaching as a Career

Historical roots

Despite Oman's ancient history, modern education started only about 40 years ago when, in 1970, His Majesty Sultan Qaboos bin Said acceded to the throne. Before then, only three schools for boys existed in the country, and there was no girls' school. After 1970, education became accessible to all young people, spreading gradually to cover all villages and regions. According to the Ministry of Education (2007), the number of government schools reached 1,053 in 2007.

The same pattern is evident in regard to higher education institutions, which have expanded and diversified to include universities, colleges, and institutes. At present, there are four venues for Omani teacher preparation:

- Universities and colleges outside Oman, where Omani students study either at their own expense or with the aid of scholarships. These students work as teachers when they come back to Oman, thereby meeting the needs of the Omani Ministry of Education as well as other parties that hire teachers, such as private schools.
- Private universities, including the University of Sohar, the University of Nizwa, and the University of Dhofar. These universities, which opened relatively recently, offer teacher education programs. However, because only a few teachers have graduated from these programs, they were not included in TEDS-M.
- Six colleges of education affiliated to the Ministry of Higher Education and located in Nizwa, Al Rustaq, Salalah, Sur, Sohar, and Ibri. These colleges produced large numbers of teachers and so their programs were included in TEDS-M.
- The college of education at Sultan Qaboos University (SQU). This institution is the only government university in the country that took part in TEDS-M.

Teacher education in Oman has moved through several phases. Initially, several Omani nationals, holders of the General Secondary Certificate, and even holders of lower-secondary certificates received teacher training for a period that ranged from one to three years, depending on the qualifications they had obtained before commencing their preservice education. In 1978, Oman established specialist teacher training institutes. These catered to preparatory certificate holders who, after studying for three academic years, received a secondary certificate for teachers, which qualified them to teach in elementary schools (Grades 1 to 6). The teacher training institutes continued to take students until 1984/1985, and produced 2,521 teachers (Eisan, 1995).

In 1984/1985, the teachers' institutes were converted into nine intermediate colleges of education. These colleges, which were placed throughout the Sultanate of Oman, accepted General Secondary Certificate holders who, after studying for two academic years, obtained an intermediate diploma that qualified them to work as teachers of different disciplines at the elementary level (Grades 1 to 6). These intermediate colleges continued to admit students until 1995/1996. The total number of graduates from these colleges was 10,346.

Because of the large number of Omani teachers already employed at the elementary level and the dearth of Omani teachers able to work at both preparatory and secondary levels, Sultan Qaboos bin Said issued a royal decree (No. 42/95) in 1995 which required the intermediate colleges to be converted into university colleges under the supervision of the Ministry of Higher Education. This process saw the nine intermediate colleges reduced to six university colleges in the different regions of Oman.

Two of these colleges were for females only (the colleges of education in Al Rustaq and Ibri), and three were for both male and female students (Salalah, Sur, and Sohar). The college in Nizwa was for males only. All six colleges accepted holders of the General Secondary Certificate. Students studied for four years, at the end of which they obtained a Bachelor's degree in education. Of the programs offered, one focused on training teachers for the preparatory grades (i.e., 7 to 9) and the other for the secondary grades (10 to 12). The program required all its students to study major and minor specializations in different subjects. These specializations included mathematics/computer science and mathematics/physics.

The programs were offered in only four colleges during the academic years of 1998/1999 through to 2001/2002, after which the preparatory and secondary teacher education programs were reconfigured as major specializations instead of the major/minor configuration (Ministry of Education, 2002a, 2002b). The first students under this new system were admitted at the beginning of school year 2002/2003 into the different specializations. This program takes four years or eight semesters of study (a total of 132 credit hours) to complete.

In response to labor market conditions and the lack of vacant teacher positions in basic education, five of these colleges ceased admitting students in 2004/2005. These five colleges were converted into colleges of applied sciences, leaving only one to provide teacher training. The last cohort of students to prepare for teaching preparatory or secondary school graduated from the converted colleges at the end of academic year 2007/2008. However, because that year was the year of the TEDS-M data collection, these students were included in the TEDS-M target population. In addition to these colleges, a faculty of education at university level was established at SQU when it opened in 1986.

Conditions at the time of TEDS-M

Two types of teachers teach mathematics in Oman's primary and secondary schools. The first type includes teachers who specialize in mathematics only and are trained to teach in both the lower and upper levels of secondary school (Cycle 2, Grades 5 to 10, as well as post-basic education Grades 11 and 12). The second type includes teachers of both mathematics and science in Cycle 1 (basic education) schools (Grades 1 to 4). Most of the teachers in this category are females, as called for by ministry policy.

Despite earlier measures, there is still a great need for mathematics teachers for Omani lower- and upper-secondary schools and for post-basic education schools. Teachers of mathematics continue to be recruited from other Arab countries to work in schools at both levels to cover these shortages. In contrast, there is a surplus of Omani teachers eligible to work in Cycle 1 or basic-level schools.

The Ministry of Education is the only government agency responsible for hiring qualified graduates and assigning them to government schools on a needs basis. Owners

of private schools carry out their own selection procedures and then approach the Ministry of Education to obtain approval to hire the teachers they have selected.

The Ministry of Education's procedures for recruiting teachers are subject to Oman's civil service law as is the case with other government positions. University graduates are appointed at Grade 6 of the civil service payroll scale. All employees are promoted to the next salary grade once they have completed four years in service. Promotion to other posts of an administrative or technical nature is possible if the employee has worked as a teacher for at least four years and is then nominated to the post of assistant headmaster or headmistress or to the position of subject supervisor, curriculum officer, school activities specialist, or any other technical or administrative role. The nominee must pass written tests and interviews, which are carried out at both regional and central levels.

Because teachers are part of a national civil service, they have to accept that they may be required to take up teaching positions in schools distant from their home towns and villages and in geographically isolated and/or impoverished areas. However, effort is made, as much as possible, to assign teachers to schools near their home towns or villages. Also, unlike other public-sector employees, teachers enjoy annual leave at the same time that their students go on summer vacation at the end of the school year. Teachers also have another period of leave, half way through the school year, in February.

Part II: Organization and Characteristics of Teacher Education

All teacher education programs currently offered in Oman produce teachers for Cycle 2 of basic education and for the two grades (11 to 12) of post-basic education. As noted above, Oman no longer offers specialized training programs for individuals wanting to teach in Cycle 1 schools (Grades 1 to 4).

The higher education institutes presently producing secondary school teachers are SQU, one college of education, which operates under the auspices of the Ministry of Higher Education, and three private universities (Sohar, Nizwa, and Dhofar). In this chapter, we focus on the teacher education programs of the college of education at SQU and the college associated with the Ministry of Higher Education. Our reason for doing so is that these were the only Omani teacher education institutions involved in TEDS-M 2008.

Curriculum and field experience requirements

SQU provides two types of teacher education: a Bachelor of Education concurrent program-type and a Bachelor of Science in Mathematics followed by the Professional Education Diploma—in other words, a consecutive program-type (SQU, 2005). The concurrent Bachelor of Education in Mathematics program-type at SQU offers two options: mathematics/physics and mathematics/computer science. Mathematics is the major specialization in both options. The minor specialization is either physics or computer science. SQU students in this program-type study the prescribed courses for four years, at the end of which they receive a Bachelor of Education. Those graduates seeking teaching positions are then interviewed and sometimes are also required to sit written tests. Those who pass the interviews and the tests are hired as teachers by the Ministry of Education.

The teaching plan for the Bachelor of Education includes courses that enable students to develop knowledge, skills, and competencies relevant to the mathematics curricula and mathematics teaching in Cycle 2 schools (Grades 5 to 10) and post-basic education schools (Grades 11 and 12). These courses are grouped into three components. The cultural component consists of a set of courses that all students at the university must study for 18 credit hours. These courses endeavor to provide students with knowledge, skills, and values relevant to the historical, cultural, and nationalist aspects of Omani society and its Arabic and Islamic origins. Arabic language, Omani and Islamic civilization, and Omani society constitute three of the courses. Two other courses focus on English language and computer skills. Students can also elect two further courses from a range of options, with their choices dependent on their personal interests and aptitudes.

The second component contains the major specialization courses (in our case, mathematics), which involve 72 credit hours of study distributed over 22 courses in mathematics/computer science, and 21 courses in mathematics/physics. These courses cover mathematical knowledge (such as concepts, generalizations, skills, and problem-solving strategies) as well as mathematical values and attitudes, and the history and development of mathematics. Students study all 13 courses of mathematics regardless of whether their minor specialization is physics or computer science.

The third component is a professional education component, which requires students to study 11 courses relating to education for 39 credit hours. Three of these courses cover educational principles, educational objectives, and educational systems and management, and a further three focus on psychology, guidance, and educational statistics. The remaining courses encompass education technology, curriculum study, teaching methodology (two courses), and teaching practice (the practicum).

Mathematics students are not allowed to enroll in any of these courses unless they first pass an English language examination. Because English is the means of instruction for most courses, nearly all mathematics students spend one to two semesters studying English before they pass the exit examination and qualify to enroll in other courses. The number of students enrolled in the science and mathematics specialization over a recent five-year period ranged from 99 to 116.

The length of time needed to complete a Bachelor of Education program ranges from four to six years according to the academic regulations of the university. However, most students complete this program in five years due to the need to learn English or because of academic probation requirements.

The consecutive program-type at SQU (the Bachelor of Science followed by the Professional Education Diploma) has two phases. The first phase is defined by the Bachelor of Science in Mathematics, and the second phase by the Professional Education Diploma in Mathematics. During the first phase, students enroll in SQU's College of Science for five years after which they graduate with a Bachelor's degree in mathematics. These graduates can immediately enter the labor market as nonteaching mathematics specialists or they can move to the second phase of the consecutive program should they wish to become a teacher. During the second phase, these graduates of SQU's College of Science enroll in the university's College of Education. They continue their studies at the college for two semesters, after which they are awarded the Professional Education Diploma, which qualifies them for teaching.

The Professional Education Diploma qualification was also put in place to serve other purposes:

- The Ministry of Education's aim to accelerate "Omanization" of the teaching force so that the ministry is less dependent on expatriate teachers;
- Providing an employment opportunity for holders of the Bachelor of Science in Mathematics, who currently are experiencing limited employment opportunities because of job vacancies being occupied by earlier graduates and employment opportunities having decreased over time; and
- Meeting the increased interest in teaching as a career, especially among women, because of the advantages and privileges that teaching affords.

The consecutive program-type was introduced into SQU College of Education in 1999. Before that, mathematics students completed their studies at the SQU College of Science and then obtained a certificate in education abroad if they wanted to work as teachers. Students enrolled in this program-type complete their study in six to eight years: their period of study in the College of Science ranges from five to seven years, and they then spend one more year in the College of Education. Most of these students need six and a half years to obtain the Bachelor of Science degree for the same reasons as those concerning the number of years of study for the concurrent program, that is, the need to engage in intensive courses in English language or being placed on academic probation. A total of 73 students finished the consecutive program in its first six years (2001 to 2006); there were almost no dropouts or failures.

Outside the university, another secondary teacher education program-type was being offered at the time of TEDS-M by the colleges of education under the supervision of the Ministry of Higher Education. In 2007/2008, there were still 3,550 teacher education students enrolled in these colleges, where their course work included Islamic studies, Arabic language, geography, history, physics, chemistry, mathematics, computer science, biology, and English language. Arabic was the language of instruction in the colleges, whereas both Arabic and English are used at SQU.

The concurrent program at the colleges of education lasted four years or eight semesters, with students being awarded the degree of Bachelor of Education on successfully completing the program. Admission to one of the colleges of education required a relatively high level of achievement on the General Secondary School Certificate. Admitted students were not subject to any further entry examination except English language for those students who were interested in studying English further.

The teacher education program of the colleges of education was developed for all of the program disciplines (specializations) not by the colleges themselves but by subject specialists and pedagogical experts from the Ministry of Education and SQU, both operating under the supervision of the Department of Academic Programs of the Directorate General of Colleges of Education. The main elements of the program were identified in several workshops that laid out degree requirements and study plans as well as the main documents informing the program. Each document included a detailed description of the courses for each specialization that included their content, number of credits, teaching hours, objectives, concepts, terminologies, teaching aids, bibliographic references, and so on.

At SQU, in contrast to the colleges, the education programs are developed by experts from the university itself in consultation with the Ministry of Education. The university revises and updates these programs every five years. Revisions are made by the department concerned through a departmental committee and then submitted for approval to a department board and finally to the college curriculum committee and board of SQU.

All Omani program-types include a practicum (Ministry of Higher Education, 2003). However, the practicum at SQU differs from those at the colleges of education as well as from one program-type to another within the university. In the colleges of education outside SQU, the practicum required future teachers to be instructed two days a week during their seventh and eighth semesters. In the Bachelor of Education program-type at SQU, future teachers in the Bachelor of Education program did their practicum during their last year for one day a week during the seventh semester, and for two days a week during the eighth semester. In spring 2008, this requirement was changed to three consecutive days a week in the last semester only. The first future teachers to experience this change were those who had joined the university in 2004. In the consecutive Professional Education Diploma program, the practicum requirement takes up even less time. Future teachers do their practicum in schools during the last semester, and for two days a week only.

During their practicum, future teachers are supervised by both college and school personnel. In the case of the university, this means staff who teach mathematics curricula and methods of teaching mathematics. If the college does not have enough staff in this specialty, it recruits visiting professors from other countries or seconds educational supervisors from the Ministry of Education. These individuals not only supervise students during their practicum, but also conduct follow-ups with them afterwards. In all cases, the grades these supervisors give account for 80 percent of the total practicum grade. The headmaster or headmistress of the school to which a future teacher is assigned awards 10 percent of the total mark, and the supervising classroom teachers award the remaining 10 percent.

Staffing requirements

In order to work as a teacher in the colleges of education under the Ministry of Higher Education, an applicant ideally had to hold a PhD or at the least a Master's degree. The Ministry of Higher Education also hired outstanding graduates of these colleges and appointed them as demonstrators (teaching assistants) for one academic year, after which they went on to SQU or were sent abroad to obtain a Master's degree, before returning to Oman to teach in one of the colleges.

At SQU, no staff member is allowed to teach unless he or she is a holder of at least a Master's degree. In fact, most SQU staff members hold PhDs in their specializations. Staff members at the various academic levels of SQU teach courses in both the Bachelor of Education in Mathematics and the Professional Education Diploma programs.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

The Ministry of Education develops five-year plans to meet its needs for teachers. The Ministry of Higher Education and SQU then use these projections to determine the number of students holding the General Secondary Certificate they will admit to their respective programs.

In academic year 2006/2007, the Ministry of Higher Education established the Higher Education Admission Center to facilitate admission of students to all higher education institutions. It is responsible for setting admission requirements for all colleges of education under the Ministry of Higher Education. It also coordinates with SQU and other higher education institutions so as to keep up to date with the number of students each institution wants to enroll and does enroll.

The required numbers of students are admitted to the teacher education program according to the results they obtained in the General Secondary School Certificate examinations in general and their marks in mathematics in particular. Specialist committees within the Higher Education Admission Center use a computer program to select the students who will be offered places in the mathematics teacher education program. The center monitors each institution's admissions by checking the names of the students enrolled against the list of the students offered a place. This is done to ensure neutrality of the admission process.

Accreditation of teacher education institutions and programs

The Oman Accreditation Council was established in the Sultanate of Oman by royal decree in 2001. The council is charged with assisting the development of the Omani higher education sector through institutional quality audits and institutional and program accreditation processes. The council, working in collaboration with the Ministry of Higher Education, also has responsibilities for establishing academic standards and providing training and networking opportunities. By 2007, the council had developed a quality audit plan for all higher education institutions. The plan included a timeline for carrying out audits in all private and public institutions. However, no such audits took place in the colleges of education.

Each higher education institution in Oman also has its own method of maintaining quality. In 1998, SQU commissioned an external evaluation of all departments in its College of Education, including mathematics. The college is presently seeking academic accreditation from foreign organizations, similar to the academic accreditation obtained by the university's College of Engineering, which was granted accredited status for all its programs by the Accreditation Board for Engineering and Technology. The College of Education is also seeking accreditation from the National Council for Accreditation of Teacher Education in the United States.

Several quality-assurance projects were implemented in the colleges of education under Ministry of Higher Education jurisdiction. The aim of these projects was to assure high-quality graduates. The projects included the following:

- A general quality-assurance project;
- A project to evaluate the performance of newly graduated teachers;
- A project designed to scrutinize the quality of examination questions; and
- Evaluations of courses and lecturers.

Subcommittees chaired by assistant deans for each college of education and a main committee headed by the Deputy Director General of the Directorate General, Colleges of Education were formed at the beginning of 2003. These committees were assigned the responsibility of supervising the implementation of each quality-assurance program. The committees began their work by setting up plans to foster a culture of quality among the colleges' administrators, staff, and students. Plans also included familiarizing specialists with the mission and vision of these colleges. In mid-2005, the colleges finished writing their first self-evaluation reports. When compiling them, colleges referred to criteria and indicators issued by Oman's Accreditation Council. In addition to an introductory statement about the college, each report included content relating to its:

- Mission and planning;
- Management;
- Teaching and learning;
- Student services;
- Learning resource centers;
- Facilities and equipment;
- Financial and administrative planning;
- Procedures for hiring academic staff;
- Scientific research;
- Relationships with community; and
- Recommendations for development and improvement.

Requirements for entry to the teaching profession

Students are considered to have fulfilled all the academic requirements of their teacher education program, including specialization courses and education courses that include curricula studies, methods of teaching, practicum, and cultural content, when they have obtained the specified number of credit hours for those courses. Graduates are then awarded the Bachelor's degree, which enables them to teach in both public and private schools after fulfilling other requirements, such as doing well in an interview and passing a written test. Students on a consecutive teacher preparation program must obtain two certificates—the Bachelor degree (Bachelor of Science) and the Professional Education Diploma before they can begin their work as teachers in schools.

References

Eisan, S. A. (1995). *The status of teacher education and training in the Sultanate of Oman: A case study*. Muscat, Oman: Ministry of Education.

Ministry of Higher Education. (2003). *Guide book for the practicum*. Muscat, Oman: Department of Academic Programs, Directorate General of Colleges of Education.

Ministry of Higher Education. (2002a). *The teacher education of preparatory and secondary levels following the single major pattern*. Muscat, Oman: Department of Academic Programs, the Directorate General of Colleges of Education.

Ministry of Higher Education. (2002b). *The teacher education of preparatory and secondary levels following the major/minor pattern*. Muscat, Oman: Department of Academic Programs, the Directorate General of Colleges of Education.

Sultan Qaboos University (SQU). (2005). *Undergraduate academic regulations*. Muscat, Oman: Author. Retrieved from http://sisinfo.squ.edu.om/

CHAPTER 10:

Philippines

Editors' Overview

In contrast to most TEDS-M countries, the Philippines has a large number of teacher education institutions, both public and private. Key requirements, however, are set at the national level.

Institutions and governance

The Philippines has a total of 323 primary-level institutions offering mathematics for future teachers (72 public, 251 private) and 546 at secondary level (139 public, 407 private). Although these institutions have considerable autonomy, the Commission on Higher Education (CHED) has the legal authority to set minimum standards, evaluate course offerings, and establish policies and guidelines for the creation of new institutions.

The Technical Panel for Teacher Education reviews teacher education curricula as well as the overall capabilities of teacher education institutions.

Program-types and credentials

As Exhibit 10.1 shows, the Philippines has a very simple structure of one primary program-type (Bachelor of Elementary Education) for Grades 1 to 6 and one secondary program-type (Bachelor of Secondary Education) for Grades 7 to 10, both of which take four years to complete and are concurrent. The Bachelor of Secondary Education requires candidates to take a major subject, and sometimes a minor specialization; a few institutions require two major specializations.

Because secondary school in the Philippines ends at Grade 10, students are eligible for vocational training or university. Future teachers, therefore, go into teacher training after Grade 10, but they continue with basic general education courses in their first year, before beginning to specialize.

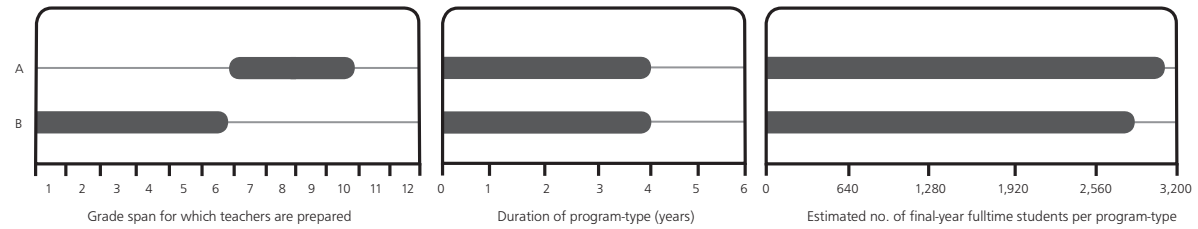
Curriculum content, assessment, and organization

In 2004, a CHED directive required implementation of a new curriculum in 2005/2006.[1] This curriculum includes a 6- to 12-week student teaching requirement. Student teaching includes both on- and off-campus components. Although there are guidelines for assessing this practicum component, much of the assessment is ad hoc, according to the authors of the country report.

1 The earlier curriculum, at the beginning of the 1990s, was thought to be too heavy in general education courses, without enough specialized coursework or enough field experience. More subject-matter content was added to the program-types in the subsequent reform. The new curriculum also emphasizes curriculum development, lesson planning, instructional materials development, assessment, and innovative teaching, and gives greater emphasis than previously to experience in the field and in classrooms.

All primary and secondary teaching candidates are required to take the Licensure Examination for Teachers (LET). The LET includes three main tests—professional education, general education, and the field of specialization—and is weighted 40 percent, 20 percent, and 40 percent, respectively. The syllabus is publicized and disseminated to teacher education institutions.

Exhibit 10.1: Teacher education program-types in the Philippines



Key to program-type
A—Bachelor in Secondary Education
B—Bachelor in Elementary Education

Note: Sixty-one institutions in the target population were excluded because they were very small (fewer than five primary future teachers and fewer than three lower-secondary teachers).

Preparing Teachers of Mathematics in the Philippines

Ester B. Ogena, Filma G. Brawner, and Milagros D. Ibe

Part I: Context and Conditions of Teaching as a Career

Historical roots

Tertiary education in the Philippines began in 1611, during the Spanish regime, with the establishment of a college seminary that later became the University of Santo Tomas. The establishment of other colleges, some of which still exist today, came later. These colleges had as their mission "social refinement and distinction." Higher education at that time was intended only for the sons of the Spaniards, and generally was accessible only to the elite. A college education thus became a status symbol, highly prestigious, and extremely socially desirable to Filipinos.

Although Filipinos in general could not access higher education at the time, a new breed of intellectuals emerged, namely, upper-class Filipinos and "mestizos" (the children of mixed marriages of Filipino natives and Spaniards or other foreigners), who either took their degrees at the University of Santo Tomas or attended school in Spain or other European countries. Later, these were the Filipinos who led the revolutionary movement that came to a head in 1896 and won the day in June 12, 1898, with the proclamation of the first Philippine Republic. This republic, however, had a very short life because on August 13, 1898, Spain surrendered Manila to American forces. Several days later, a U.S. military government reopened the schools, with U.S. Army soldiers as teachers. These soldiers took up the task of teaching Filipino children rudimentary reading and arithmetic, with English as the medium of instruction. They were subsequently replaced because of the belief that "experts" would do a better job of teaching English.

The year 1901 was a landmark in the education sector because the United States-Philippine Commission passed Act 74 on January 1901, which established a new nationwide education system and the Department of Instruction. In August of that year, the U.S. Army transport ship *Thomas* arrived with teachers on board. The teachers, later known as "Thomasites," were deployed in Manila and in the provinces. They were a highly select group of professionals whose qualifications included good health, at least two years of teaching experience, at least three testimonials from school and state officials attesting to the teachers' character and competence, and a willingness to work for two years in the Philippines.

The first school for training teachers, the Philippine Normal School, was established in September 1901, and this was the time when teacher education began to take shape. The first teacher education program was a two-year one for individuals intending to teach in primary schools. However, the new education system made clear the urgent need to train teachers to teach in different parts of the country. To cope with the shortage of teachers, other normal schools, patterned after the Philippine Normal School, were created in 1902 in the provinces, namely Nueva Caceres (now Camarines Sur), Cebu, Iloilo, Vigan, Cagayan, and Misamis. These normal schools acquired a good deal of prestige, with their students held in high esteem. Entrants to these schools were among the best of their generation. Applicants experienced rigorous selection procedures.

English quickly became the language of instruction in the public school system, and textbooks, curricula, and educational innovations were patterned after those used in American schools. Philippine education was thus based on American education in terms of its philosophy, content, and technology. This public school system produced the first batch of Filipinos sent for further study in the United States. On returning to the Philippines, these individuals assumed positions of responsibility and leadership in the education system.

The associated policy of reaching the masses through free and secular education brought about greatly increased enrollment from a small number in 1903 to 1.9 million by 1941 (Isidro, 1993). The American period also gave rise to a profound public/private split in the Philippine education system. Sectarian colleges and universities established during the Spanish regime resumed operations. As free and secular basic education expanded, still more private sectarian and nonsectarian colleges were established.

This development was interrupted by the Second World War from 1941 to 1945. Schools closed temporarily because of low enrollments, irregularity of student attendance, shortage of teachers, and lack of instructional materials. The Japanese occupiers tried to establish a system in place of the American one that was Asian and nationalist in perspective. It emphasized vocational, technical, and science education at all levels of the education system.

After the war and the declaration of Philippine independence from American rule on July 4, 1946, the education system grew rapidly, overcoming the setbacks of the war and striving to meet the accumulated social demand for education. Many private tertiary institutions were founded because available government funds were needed simply to cover the requirements of the primary and secondary system. This rapid expansion put a strain on resources and led to growing concern about the quality of education.

The 1960s, in particular, were troubled years for Philippine education. The resulting unrest called for a thorough study and analysis of the education system in order to explain the reasons for and nature of these difficulties. In 1969, the Philippine Commission to Survey Philippine Education noted, on presenting its findings, that one of the strengths of Philippine education was the high regard that people had for education, resulting in relatively high enrollment rates, as well as high levels of public and private expenditures on education. On the downside, the commission identified serious distortions in or imbalances between expectations and standards, facilities and standards, supply and demand for specific workforce skills, location of educational facilities, and regional development needs.

As a result of the commission's findings, the government put into law the Educational Development Act of 1972 with the aim of linking educational efforts to national development goals. This work subsequently led to the Education Act of 1982, the aims of which were also closely tied to the goals of the earlier Development Act. Both Education Acts laid out guidelines to operationalize and facilitate the attainment of national development goals, all of which had to do with accelerating economic and social progress, intensifying public participation in national affairs, and strengthening the cultural, social, and moral values of the population.

Conditions at the time of TEDS-M

As a result of this history, a college education is now one of Filipino families' most dearly held values. Filipino parents try to make sure that their children obtain a college education because it is seen as a key to social mobility. Education has become accessible partly because nearly every college or university offers teacher preparation. This provision accounts for the large number of teacher education institutions (561 in total), many of which are located in the provinces. Also, tuition fees are lower than those of other fields. The accessibility of teacher education institutions and the low cost of studying in them make it easy and convenient, especially for those whose resources are limited, to take up and finish an education program.

It is a common observation in Philippine universities that education students come from families with relatively low income levels, thus making clear that even families at this level are able to send their children to school and then have them enter teacher training when they graduate from secondary school. Because these education students tend to be female, the education system is presumably female-dominated.

In 2006/2007, the total number of teachers in Philippine basic education (comprising primary and secondary education levels) was close to 550,000. Of this number, 86 percent were in public schools and 14 percent were in private schools. These teachers were deployed in 50,590 schools, of which 42,430 (or 84%) were public primary and high schools, and 8,160 (16%) were private schools. Close to 20 students were enrolled in primary and secondary schools throughout the country at this time.

The average teacher–student ratio in 2006/2007 was 1:35 in the primary public schools and 1:39 in the public secondary schools. A more realistic appraisal, however, of teacher–student ratios would take into account the fact that these ratios vary considerably across regions. In extreme situations, class size can have as many as 80 or 90 students or as few as five.

Public primary schools at this time also varied (and still do) in terms of grade span. Some primary-schools are complete, comprising Grades 1 to 6; others incomplete with fewer than six grades. There are also multigrade schools, where each teacher teaches more than one grade level, making for more difficult teaching conditions. Adding to the challenges of class size and grade span is the remote location of many schools, which more often than not lack transportation and communication facilities.

By the time of TEDS-M, a good number of improvements over the previous system of education were or had long been in place, such as the process involved in teacher recruitment. Today, as was the case in 2006/2007, the Department of Education provides guidelines for recruiting and selecting public school teachers. The department implemented these guidelines with the aim of guaranteeing a rigid criteria-based and carefully documented process for hiring teachers. Other significant improvements over the previous system of screening and evaluating teacher applicants have included the following:

- Ensuring selection committees include representation from the school level through to the divisional level;
- Broadening the composition of the committees to include members of support groups such as parent–teacher and community associations; and
- Giving school principals considerably more say in recommending the best applicant for the job.

Despite the establishment of national criteria for hiring teachers, the law also provides for giving local applicants who meet the minimum requirements priority status during hiring procedures. The Department of Education and other educational stakeholders think that local teachers are better able than nonresidents to understand and fit in with the culture of the locality. They also claim there is more contact time with students and the community because teachers do not have to travel long distances to and from their school. The disadvantage, though, is that choosing to hire locally may mean hiring less-qualified applicants over better-qualified applicants who reside outside the locality (and who might be willing to relocate if selected).

At the primary level, mathematics teachers continue to be mainly generalists teaching all subjects in the grade level to which they are assigned. At the secondary school level, teachers are expected to be specialists in the subjects they teach. However, not all teachers are qualified. The Science Education Institute of the Department of Science and Technology's survey of secondary school science and mathematics teachers (Ogena, 2008) showed a number of trends in the qualifications held by teachers of mathematics. These are depicted in Exhibit 10.2.

The table shows that teachers of mathematics are more likely than teachers of science to be qualified. One reason for this pattern could be the availability of this specialization in tertiary institutions. Mathematics is a less expensive course to offer because it does not require laboratory facilities, which tend to be relatively expensive.

Exhibit 10.2: Percentage of all science and mathematics teachers who were qualified, by year

Subject Area	1986 (%)	1992 (%)	1998 (%)	1998a (%)	2003 (%)
Mathematics	55	71	78	80	83
Biology	30	41	41	44	31
General science	34	40	41	42	45
Chemistry	15	21	28	34	16
Physics	4	8	16	27	8

Note: The difference between the figures in columns 1998 and 1998a reflects the additional percentage of teachers in that year who became qualified to teach the subject as a result of attendance in short-term, specialized training programs.

In 1998, educational experts engaged in focus-group discussions in an effort to determine the state of science and mathematics education in the Philippines (see Ogena & Brawner, 1998). They identified and then analyzed a number of problems in the delivery of these subject areas that include both human and nonhuman limitations. The overriding problem was an acute shortage of qualified mathematics and science teachers. The group recommended the following changes: improving and developing institutions, producing quality teachers on a massive scale, and ensuring the support of the universities training teachers. Not surprisingly, the group highlighted the need for highly qualified mathematics and science teachers because of their potentially positive impact on the quality of science education.

Educational stakeholders have also continued to agree that teachers' working conditions are generally far from ideal. One of the first efforts the government made to improve these conditions was the enactment in 1966 of RA 4670 or the Magna Carta for Public School Teachers. Almost three decades later, in the 1990s, a Civil Service Commission

study (see Congressional Commission on Education, 1991, 1993a, 1993b, 1993c) of teachers' employment conditions showed that teachers were generally living below the poverty line. They had low aspirations and tended to be dissatisfied with their working conditions.

In 2000, another study conducted to determine the working conditions and status of Filipino teachers found a good many teachers were teaching more than six hours a day, whereas RA 4670 stipulated five to six hours of actual teaching per day. Many teachers were also engaged in other types of work in order to augment their income, and most were drawing on personal funds to buy the instructional materials they needed (Senate Committee on Education, Arts, and Culture, 2000).

In 2006, the National Economic Development Authority put the poverty threshold at 8,000 Philippine pesos (PhP) a month for a family of six.[2] An entrant teacher at this time was receiving a monthly salary of PhP10,000, which was just a few notches above the poverty threshold. More recently, Congress has been deliberating on a proposal to exempt teachers from paying income tax. If approved, this change would greatly improve teachers' financial circumstances.

Another factor that brought attention to these issues by the time of TEDS-M was teacher emigration. The call for teaching jobs in the West, particularly in the United States, affects the Philippine stock of leaders in mathematics and science education. During the last 10 years or so, faculty members of teacher education institutions with specialization in mathematics and science have tended to seek employment overseas because of better financial prospects and employment conditions. At present, those who go abroad for foreign employment as teachers are mostly those with Master's and doctoral degrees; they come either from teacher education institutions or are among the most respected practicing teachers in the public and private schools.

A substantial number of these individuals are also relatively young teachers who earned their Master's degrees from the top universities in the country. For example, in one state university, which is also a regional science teaching center, at least one faculty member has left for foreign employment in each of the last five years. As a result, the internal capacity of Philippine universities with teacher education programs in mathematics and science continues to be seriously affected by the opportunities for employment abroad.

Part II: Organization and Characteristics of Teacher Education

As mentioned in the historical-background section above, the first seven normal schools established in the Philippines in the early 1900s provided systematic training for teachers of primary schools through a two-year curriculum. This curriculum included mathematics, science, English (reading and writing), history, music, health, home economics, and practical arts. This curriculum later became the basis for the Elementary Teacher Certificate program. More recently, most of the original normal schools were transformed into universities with teacher education as just one of the Bachelor's degree programs offered.

2 At that time, the exchange rate was PhP51.40 to US$1.00.

Unlike other countries, the Philippines has never had an agency tasked with setting the number of university places for postsecondary education, including teacher education. For at least the first four decades of the 20th century, teacher education took in as many students as sought admission. The accessibility and low tuition fees made teacher education a popular choice for students enrolling in tertiary education.

The lack of political will with respect to the regulation of university programs makes it difficult for the government to close substandard programs, including those in teacher education. As a result, the Bachelor degree programs in elementary (BEEd) and secondary (BSEd) education are treated as a business enterprise by many small private colleges and universities, which admit large numbers of students for the first two years of college, but offer no guarantee of sufficient openings in more specialized programs once students reach their third year.

At the secondary level, the preparation of teachers has required four years of study leading to the degree of Bachelor of Science in Education. After 1991, this became the Bachelor of Secondary Education.

By the time of TEDS-M, 561 teacher education institutions were offering programs to prospective teachers. Of this number, 157 were government supported and 404 were privately owned. These institutions fall under one of two structural arrangements. One group consists of colleges of education situated within a bigger organization. In this instance, the university can be either privately or government owned. Also, as noted earlier, teacher education is only one of many offerings in these universities. However, the group of tertiary education institutions known as *normal* schools or universities offer only teacher education. An institution such as this may offer education at different levels, from Bachelor's through to Master's and PhD degrees. At the Bachelor level, teacher preparation programs may include those for primary school or those for secondary schools, or even both.

Teacher education providers also offer programs for Bachelor of Science graduates who might want to go into teaching. Graduates of science-related programs, such as nursing and engineering, who wish to enter this profession have to take a total of 18 or more education units to qualify for a certificate in teaching. While this alternative is one that qualifies these graduates to teach in primary or secondary schools, those who choose it tend to teach in secondary schools because of the lack of teachers in these subject areas. There is no system for channeling these graduates into mathematics as opposed to science. Instead, future teachers in mathematics generally come directly from the BEEd or BSEd programs, not from a Bachelor of Science. For this reason, the TEDS-M survey did not cover this option. Statistics compiled from all teacher education institutions nationwide at the time of writing indicated, however, that of the Bachelor of Science graduates in mathematics or related disciplines who had elected to enter teacher education programs, 13,151 were enrolled in the BEEd 18 credits (mathematics) program and 15,444 in the BSEd (mathematics) program.

Curriculum and field experience requirements

The Commission on Higher Education is mandated by law to promote quality education in the Philippines. It sets the minimum standards for programs, monitors and evaluates the programs, and lays down policies and guidelines for the creation of new institutions as well as the conversion or elevation of schools to institutions of higher learning. The Technical Panel for Teacher Education is responsible for reviewing the curriculum

content of teacher education programs and also has the right to recommend curricular programs and to evaluate the capabilities of teacher education institutions.

In the middle of the 20th century, the curriculum preparing teachers for primary-level mathematics was so structured that all those preparing to teach primary-level mathematics took the same courses. Much later, in the 1980s, some teacher education institutions formulated a modified teacher education curriculum for future primary school teachers by prescribing areas of specialization that would better prepare future teachers of the intermediate grades (Grades 5 and 6) to teach core academic subjects such as mathematics, science, and English. Thus, when mathematics was the area of concentration, future primary school teachers learned algebra (beyond the secondary level), geometry, trigonometry, and business mathematics.

The new curriculum of 2004 (implemented 2005/2006) attempted to remedy the perceived weaknesses of the preceding 15 years. The 1991 curriculum and earlier curricula were heavy on general education courses. Also, the specialization courses provided insufficient content given the technological advancements taking place by this time. In addition, the teacher education curricula were not providing enough field experience and practice teaching.

The 2004 reform was promulgated in Commission of Higher Education Memorandum Order Number 30, 2004, titled "Policies and Standards for Undergraduate Teacher Education Curriculum." It underwent a series of public consultations before the government approved and officially implemented the new curriculum in academic year 2005/2006. The first batch of students to experience this curriculum graduated in April 2009.

Under this policy, the curricula for the secondary BSEd and the primary BEEd consisted of 174 units, distributed as shown in Exhibit 10.3. The specialization in mathematics included subjects such as general mathematics, intermediate and advanced algebra, plane geometry, trigonometry, spherical trigonometry, probability, analytics, differential and integral calculus, and business mathematics and statistics.

The requirements for the professional education component of the new curriculum were distributed as shown in Exhibit 10.4. This curriculum was competency based in order to help prospective teachers develop a wide range of process skills, including curriculum development, lesson planning, instructional materials development, assessment, and innovative teaching approaches. In addition, direct experience in the field, such as classroom observation, teaching assistance, and practice teaching, received more emphasis than before.

Exhibit 10.3: Distribution of units in secondary BSEd and primary BEEd qualifications

Course Area	Curriculum Implementation 2005/2006		2001 Curriculum	
	Number of units	Percentage share of total units	Number of units	Percentage share of total units
Traditional universities	6,100	52.70	5,260	28.10
Private universities	4,403	38.00	11,329	60.60
Professional institutes	1,079	9.30	2,105	11.30
Total	11,582	100.00	18,694	100.00

Exhibit 10.4: Requirements for professional education component of curriculum implemented in 2005/2006

Course Area	BEEd Units	BSEd Units
Professional education	54	51
Theory/concept	12	12
Methods/strategies	27	24
Field study	12	12
Special topics	3	3

Further changes over the past two decades were motivated in part by the performance of Filipino students in the TIMSS international assessments of 1995, 1999, and 2003, which necessitated a serious review of teacher education. The Commission of Higher Education, through its Technical Panel for Teacher Education, undertook reforms designed to strengthen both the content and professional components of the teacher undergraduate program. The National Competency Based Teacher Standards developed in 2007 provided a framework specifying the dimensions of effective teaching and learning for all aspects of a teacher's professional life and development. The Mathematics Framework for Teacher Education, which was also developed at about this time, specified the philosophy and standards for teaching mathematics and for developing mathematics teachers of basic education.

Despite these reforms, the TEDS-M research team, in the course of doing its survey, identified certain practices that undermined the quality of the country's teacher education provision. The validation work done by the research team revealed that, in some cases, students for both the BEEd and BSEd groups were mixed together in courses in a number of the sampled colleges and universities. The team concluded that practices such as this were contributing to a watering down of the intended curricular program, especially with respect to mathematics content and pedagogical courses. The team also found that although a large number of institutions were purportedly offering a major or a specialization program in mathematics, this was not actually the case in many other institutions. Of all the sampled institutions for the TEDS-M main survey, 32 percent and 12 percent of the BEEd and BSEd programs, respectively, were not active. Some had never existed, some had been closed, and some were on the books but had no students.

In addition to problems such as these, there is continuing concern in the Philippines over the supply of tertiary students who are willing to specialize in mathematics and science. This had led to proposals to give Bachelor of Science graduates in the basic and engineering sciences incentives to become teachers. Statistics show that across 10 years, about 60 percent of the graduates in seven engineering programs either never took the teacher licensure board examination or, if they did take it, did not pass it (Ogena, 2008). This percentage represented a large pool of graduates, about 21,000 in number, who could be given scholarships for a certificate program that would allow them to take 18 units of education and pedagogy subjects and thereby qualify to take the licensure examination. The 18 units of education subjects taken by Bachelor of Science graduates with strong content backgrounds is a compensatory strategy directed toward strengthening the teaching profession.

All future teachers, whether intending to teach in primary or secondary schools, must undertake the preservice practicum and field experience. The four-year BEEd and BSEd programs for teachers are capped with a practice teaching component of at least one semester's duration as preparation for actual teaching after graduation. The practicum, or student teaching as it is often called, can be on campus or off campus, or both.

On-campus practice teaching is carried out in teacher education institutions that have "laboratory" schools for basic education, or which have primary and secondary schools as part of the institution and so are not necessarily laboratory schools. Traditionally, teacher education institutions have had their own laboratory schools where future teachers could engage in practice teaching. However, recent developments mean that teacher education institutions can now engage primary and secondary schools outside of their institutions but with whom they have linkages as another option for training future teachers. On-campus and off-campus student teaching ranges in length from 6 to 12 weeks. During this period, future teachers are also initiated into the routine of the education system.

Different categories of education personnel are involved in the student teaching component. Among them are the following:

1. The regular teacher(s) of the class(es) in which the student teacher does his or her practice teaching;
2. The principal or department head of the subject in which the teaching practice takes place;
3. The university faculty supervisor or teacher in charge of practice teaching, or the university teacher handling the teaching practice course/subject; and
4. The school supervisor or head of the grade or year level or subject involved.

Finding schools where future teachers can do their practicum can be a problem. Some schools welcome such students because they not only relieve the regular teachers of some of their tasks but also provide them with opportunities to observe up-to-date teaching strategies, especially when faculty members or mentors demonstrate such strategies and activities while coaching the future teachers. Supervising students on practice and serving as critics encourages regular teachers to examine their own practices.

Some providers of teacher education afford regular class teachers other benefits, including access to the institutions' teacher inservice development courses, invitations to attend other types of professional activities on campus, and various forms of recognition of the regular teachers' contributions to the education of future teachers. However, some school teachers do not welcome practice teachers. They claim that monitoring, critiquing, and assessing the practice teaching sessions reduces the time they have with their own classes.

The Philippines has no set standards for assessing the practicum component of the country's teacher education programs. Much of the assessment is ad hoc in nature. The practicum can be very effective if adequate time is given for planning both it and the type of field experiences on offer to the student teachers. However, due to the large number of teacher education students, the practicum component tends to suffer, especially when there are insufficient practicum sites available or when the faculty members supervising practice teaching are unable to adequately supervise all the students assigned to them.

Staffing requirements

Where possible, faculty members of teacher education programs should have qualifications beyond the Bachelor's degree so they can teach and supervise their respective programs effectively. They should have subject-matter content knowledge and pedagogical knowledge, familiarity with and a working knowledge of the goals and objectives of their programs, ability to supervise, monitor, and evaluate the programs, and ability to serve as models to the future teachers they work with.

Although the expectation is for staff and faculty of teacher education institutions to have graduate degrees or other advanced studies, research shows that many teacher education faculties fall short of this requirement. For example, a report by the Teacher Education Council (1998) showed that although 90 percent of the faculty members in the 815 teacher education institutions surveyed in the Philippines had a Master's degree in education, their fields of specialization tended not to be their major teaching assignment. It is partly for this reason that 87 percent of the graduate programs in the country are in education, not in major subjects or disciplines.

A survey by the Commission on Higher Education conducted in 1998 found that of the 1,028 faculty members of 21 so-called centers of excellence and centers of development, only 15 percent had doctoral degrees, 48 percent had Master's degrees, and 37 percent had only Bachelor's degrees. Savellano's (1996) study of 207 teacher education institutions in the country revealed that only 12 percent of them had faculties in which all the members had graduate degrees.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

For most of the 20th century, teacher education in the Philippines took in as many students as sought admission. Unlike in other countries, there was no agency in the Philippines tasked with determining the number of university places for postsecondary education. And this is very evident in teacher education. As the years went by, the easy access and low tuition fees made teacher education a popular choice for college-bound students.

Until 1972, there was no national screening test for secondary school graduates who were planning to enroll in teacher education. Later, because of the thousands of high school graduates seeking admission to university, the need to limit university admission was acknowledged. In 1976, the National Evaluation Research and Testing Center instituted the National College Entrance Examination (NCEE) to reduce the numbers of students who were at risk of failure. All students aiming to go on to university had to sit this examination. Each admitting college could define its admission criterion or percentile rank score on this examination as long as it was not lower than the 50th percentile. The admission score that most teacher education institutions required in 1983 was set at the 60th percentile rank. In the years that followed, this score was lowered to the 50th percentile, even as other colleges with stricter admission criteria were specifying scores higher than the 70th percentile.

Problems in implementing the NCEE and the view that the examination was elitist and undemocratic led to abolition of the examination as a requirement for admission to college or university. As a result, some tertiary-level institutions admitted students with very low scores on the NCEE (e.g., 20th percentile). Some of the stricter schools

administered their own entrance tests as well as other measures to determine admission to their degree programs. The additional requirements could be an IQ test, an essay, or an interview. However, these developments were not uniform across teacher education. Without the NCEE or a score on the National Secondary Achievement Test, most institutions used an applicant's average grade in the last one or two years of secondary school as an admission criterion.

Standards still vary today. Some colleges, including those preparing teachers of mathematics, have no standards for entry to teacher education. Having discredited the NCEE, they have no suitable replacement standard to speak of. However, the original normal schools and state colleges and universities can still impose strict criteria for teacher education, largely because they are supported by government funding. They try, through adherence to these strict criteria, to maintain the tradition of excellence for which they are known.

Nevertheless, academic standards of entrance to teacher education remain low compared with those for such degree programs as engineering, business, dentistry, and medical technology. Teacher education programs attract mainly students with low to average intellectual ability. Moreover, teacher education students generally come from economically poor/disadvantaged families, with many institutions tending to be more than willing to accept them as teacher education entrants. Also, rather than go on to mathematics teacher education, mathematically inclined secondary school graduates are more likely to apply for a Bachelor of Science program in mathematics, statistics, or engineering. The standards for mathematics teacher preparation are lower than the standards for entry to most other university programs.

Accreditation of teacher education institutions and programs

Responsibility for developing or revising the teacher education programs in the Philippines rests with the Commission on Higher Education. However, as with other programs, accreditation of teacher education programs is voluntary. Two systems are recognized—one for privately run colleges and universities and the other for government (i.e., state and local) colleges and universities. The Philippines has a large number of private as well as public providers of teacher education.

The accreditation system in the Philippines uses the United States' model of a regional accreditation system for universities, with emphasis on program evaluation. Accrediting associations carry out these evaluations. Teacher education is one of the programs subject to evaluation and accreditation by these associations.

Applicants for accreditation conduct a self-evaluation. Areas covered include purpose and objectives, faculty, curriculum and instruction, library, laboratories, personal services for students, research, social orientation and community involvement, physical plant, and administration and organization. The levels of accreditation awarded as a result of this process are:

- *Candidate status*—programs that have undergone a preliminary institutional survey;
- *Level I status*—programs that have undergone an initial form of institutional survey;
- *Level II reaccredited status*—programs that have successfully met the minimum resurvey requirements;

- *Level III reaccredited status*—programs that have undergone resurvey and have been granted a further five years of accreditation, with the reaccreditation based on a clean recommendation, and with that recommendation, in turn, based on the fact that the programs met the reaccreditation criteria;
- *Level IV status*—programs that have met all the criteria formulated for the purpose by the umbrella accrediting agency, and that have strong internal mechanisms for quality assurance and strong international linkages.

The Technical Panel for Teacher Education evaluates the universities, both public and private, offering teacher education and recommends to the CHED which of them should be designated centers of excellence and centers of development in teacher education. These centers serve as models for other teacher education institutions. The technical panel also evaluates proposals from private universities seeking CHED approval for their new teacher education programs. The evaluation process includes looking into the capacity of the university to offer the proposed programs in terms of faculty capability, institutional resources, and student pass rates on the Licensure Examination for Teachers (LET), which is further described below.

The CHED's regional offices are required to monitor the extent to which teacher education institutions comply with the standards prescribed for teacher education programs. The regional offices designate their own regional quality-assurance teams for each field of specialization. Each team consists of educators and experts from each region. New programs in private universities have to go through the local quality-assurance team and the CHED regional office. The CHED has the authority to close programs that have not adhered to the specified standards.

Requirements for entry to the teaching profession

A special feature of teacher education in the Philippines is that graduate teachers must take the LET. This examination is prepared and administered by the Board of Teachers for the Professional Regulation Commission, an agency that grants licenses to all professions. The board schedules the examination, selects examination centers or sites, and ensures that test security is maintained. It oversees the electronic scoring of the tests and the release of the names of successful candidates.

The scope of the LET differs for primary and secondary teachers. The LET for primary teaching applicants consists of two parts, professional education and general education, with the former constituting 60 percent of the total score and the latter 40 percent. At the secondary level, the test consists of three parts—professional education, general education, and the field of specialization. The weighting given to each part is 40 percent, 20 percent, and 40 percent, respectively. The mathematics specialization component consists of 120 test items grouped into eight subject content areas: arithmetic and number theory (20%), basic and advanced algebra (25%), plane geometry (15%), circular and trigonometric functions (10%), probability and statistics (10%), analytic geometry (10%), business mathematics (5%), and calculus (5%).

For both primary and secondary teachers, the professional education examination component consists of 200 items covering, for example, educational theory, foundations of education, and tests and measurements. The general education test consists of 200 items distributed across science, mathematics, English, literature, history, general information, and values education.

Passing the LET and subsequently gaining a license are the only criteria that the Professional Regulation Commission sets for teacher education graduates applying for teaching positions. Schools that employ the licensed teacher may impose additional requirements on applicants, such as an interview or a teaching demonstration to make sure applicants are ready to teach. Should applicants be required to demonstrate their teaching competency, they are usually observed by a panel of educators and administrators of the hiring school. Sometimes, applicants are also required to take a test of subject-matter knowledge. In some school divisions, applicants for teaching positions sit a competitive examination. This is usually done when there are many more applicants than teaching positions available.

Some elitist schools in the Philippines take the liberty of hiring mathematics teachers prior to their licensing if they consider the applicant's ability and potential exceptional. However, they still make sure that the selected teachers take the LET as soon as possible. These schools may even help the applicant maximize chances of passing the licensure test by having him or her take advanced education courses beforehand.

References

Commission on Higher Education. (1998). *Teacher education plan*. Manila, the Philippines: Author.

Congressional Commission on Education. (1991). *Making education work: An agenda for reform*. Quezon City, the Philippines: Congress of the Philippines.

Congressional Commission on Education. (1993a). *Making education work: Book One. Areas of concern in Philippine education: Teacher welfare, compensation and benefits*. Quezon City, the Philippines: Congress of the Philippines.

Congressional Commission on Education. (1993b). *Making education work: Book Two. The educational ladder*. Quezon City, the Philippines: Congress of the Philippines.

Congressional Commission on Education. (1993c). *Making education work: Book Three. Consultative reports*. Quezon City, the Philippines: Congress of the Philippines.

Isidro, A. (1993). Education, politics and social equity in the Philippines. In J. Cortes (Ed.), *Explorations in the theory and practice of Philippine education 1965 to 1993*. Quezon City, the Philippines: Claretian Communication Inc.

Ogena, E. B. (2008). *Status of Philippine science and mathematics education*. Paper presented to the Science, Mathematics, and Engineering Panel of the Congressional Commission on Science, Technology, and Engineering, the Philippines.

Ogena, E. B., & Brawner, F. (Eds.). (1998). *Science education in the Philippines: Challenges for development*. Manila, the Philippines: Science Education Institute.

Savellano, J. M. (1996). Profile of the faculty in teacher education institutions: Some issues and concerns. *Education Quarterly*, *39*–43.

Senate Committee on Education, Arts, and Culture. (2000). *A profile of the Filipino teacher* (Project TAO or Nationwide Survey on Teacher Advancement for Optimum Well-Being). Manila, the Philippines: Author.

Teacher Education Council. (1998). *Master plan for teacher education 1998–2008*. Manila, the Philippines: Author.

CHAPTER 11:

Poland

Editors' Overview

In Poland, specialists teach mathematics from Grade 4 on. Poland thus differs from the norm in other TEDS-M countries with respect to the knowledge expected of teachers who staff most of the basic education grades.

Institutions and governance

Higher education plays a major role in teacher education in Poland. Although teacher training colleges, which are not considered to be a part of higher education, also offer teacher education, they produce only a small number of teachers. Students in teacher training colleges follow a curriculum that is very similar to the university curriculum of Bachelor-degree studies. Their graduates are awarded a diploma (*dyplom ukończenia kolegium nauczycielskiego*). Recent reforms have raised the qualification levels required for entry into teaching, but there is no licensing; qualifications are defined solely in terms of required higher education degrees. Teacher education operates within the general legal and institutional framework of higher education. Special regulations of the sort developed for all fields of study set requirements for the curriculum and practicum of teacher education.

Program-types and credentials

The organization of primary and secondary education changed in 1999. Primary schools in Poland now offer six years of general education, with a further three years in lower-secondary schools. The primary school curriculum has two stages: a stage of integrated learning in Grades 1 to 3, where most subjects are taught by one teacher, and a second stage (Grades 4 to 6), where different school subjects are taught by teachers specialized in the subject.

Future teachers wanting to teach mathematics in Grade 4 must complete a higher education degree in mathematics, with required teacher education content.[1] Future teachers of Grades 1 to 3 must be qualified in "integrated teaching"—a qualification acquired through pedagogical study program-types. The pedagogical-study program-types include very little opportunity to learn mathematics and mathematics' pedagogy, but provide substantial academic knowledge in general pedagogy.

A two-cycle structure has been introduced as part of Poland's implementation of the Bologna Accord—a three-year Bachelor of Arts (second and fourth bars in Exhibit 11.1), and a two-year Master of Arts. The first-cycle (Bachelor's) degree in mathematics qualifies graduates to teach in primary and lower-secondary schools, while the second-cycle (Master's) degree in mathematics qualifies graduates to also teach in upper-secondary schools. The pedagogy degrees usually qualify teachers to teach in kindergartens and Grades 1 to 3. The old five-year Master's has been phased

1 Majoring in a degree with substantial mathematics content can also be considered satisfactory. The determination is made by the school principal, who is responsible for teacher employment.

out (first and third bars in Exhibit 11.1). While this program-type is no longer offered, it was included in TEDS-M because students were still completing their final year of study in 2008. Graduates of the first cycle (Bachelor's) programs may enroll in second-cycle (Master's) programs. For this reason, second-cycle program-types were included in the TEDS-M survey, but are not reported internationally because they are offered mostly to persons already qualified to teach in primary and lower-secondary schools.

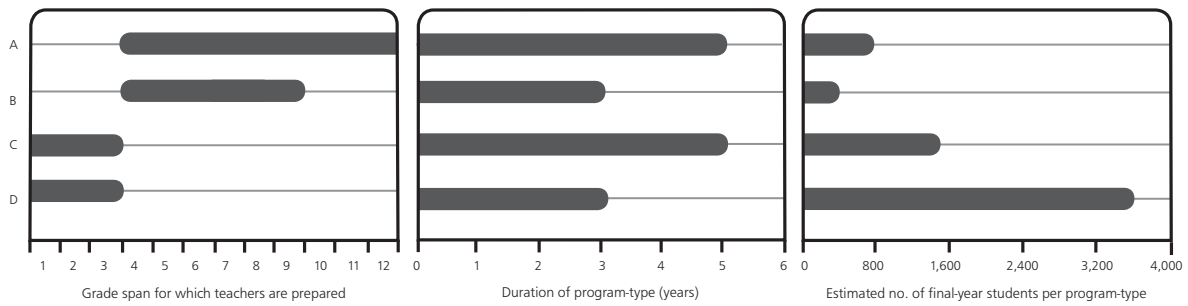
In the first-cycle Bachelor's program-type, future teachers prepare to teach two subjects. The more advanced degree prepares them for even more specialization in just one subject (although they still may also teach two). Exhibit 11.1 shows that the top two program-types (or bars) preparing future teachers for Grades 4 to 12 and 4 to 9, respectively, are relatively small program-types compared to those represented by the third and fourth bars in the exhibit, which focus on Grades 1 to 3. This pattern reflects the popularity of pedagogy program-types for Grades 1 to 3, which are less selective and less demanding than the mathematics program-types.

Administrative and survey data show that most of the teachers in Poland hold Master's degrees. A survey of specialist mathematics teachers in primary and lower-secondary schools indicates that 95 and 97 percent, respectively, hold Master's degrees. However, many teachers of mathematics major in other fields of studies. As many as 31 percent of the primary school mathematics teachers and 25 percent of the lower-secondary mathematics teachers had qualified in this subject through postgraduate study. A large majority of them had previously taught other school subjects, mainly physics or other science subjects.

Curriculum content, assessment, and organization

Teacher education is offered as one of the specializations within higher education program-types, which means that a major part of the future teachers' curriculum is the same as that in other tracks within the mathematics field of study (or pedagogy, in the case of future teachers for Grades 1 to 3). In addition to meeting the standards set for all graduates in mathematics, students in the teacher education track must complete required coursework in pedagogy, psychology, didactics, and a practicum, as defined in a decree put out by the Minister of Education. According to the TEDS-M national center in Poland, teacher education suffers from the "academic drift" characteristic of Polish higher education in general (Fulton, Santiago, Edquist, El-Khawas, & Hackl, 2007). There is a greater emphasis on academic subject-matter content than on knowledge of teaching practices and the related pedagogical skills needed in schools.

Exhibit 11.1: Teacher education program-types in Poland



Key to program-type

A—Master's in Mathematics, long cycle

B—Bachelor's in Mathematics, first cycle

C—Pedagogy, integrated teaching, long cycle Master's

D—Pedagogy, integrated teaching, first cycle Bachelor's

Preparing Teachers of Mathematics in Poland

Michał Sitek

Part I: Context and Conditions of Teaching as a Career

Historical roots

The changes to Poland's education system that followed the return to a market economy and democracy in 1989 were gradual but radical. The inherited system was extremely centralized, with all aspects of schooling regulated by the state. In July 1991, the government passed a new School Education Act that defined the framework of the current education system. This law mandated gradual school decentralization and increased school and teacher autonomy, and it enabled nongovernment, religious, and private organizations to establish schools. The orientation of secondary education shifted from a heavy emphasis on vocational education toward a more general education that provided for entry into higher education.

The government initiated further educational reforms in 1997, and implemented the ensuing changes in 1999. The goals of the reform were to increase educational attainment, improve the quality of education, and ensure equal educational opportunities throughout the entire system. The school structure was changed to one that included primary schools (six years in duration), lower-secondary schools (three years), and education in the vocational or general tracks of the upper-secondary schools (two to four years' duration depending on the track). Primary education was further divided into two stages—Stage 1 (Grades 1 to 3), offering integrated learning, and Stage 2 (Grades 4 to 6), offering subject-matter instruction.

The central government also devolved responsibility for school administration to local governments as part of its reforms, but did not completely surrender financing of schools. Local government agencies (*gminas*) took over the operational responsibilities for primary and lower-secondary schools while the newly created self-governments (*poviats*, which form an intermediate level of self-government between about 2,500 *gminas* and 16 regions) took over responsibility for the upper-secondary schools.

These changes in school structure were followed by curriculum changes that moved teaching and learning away from rote memorization of facts toward the acquisition of functional competencies and skills. The core curriculum (i.e., the centrally set standards for given subjects) became the basis for the expanded curriculum decided at the school level. New curricula were introduced first in the early primary and the lower-secondary grades and were subsequently implemented grade by grade.

The reforms also gave more autonomy to school principals and broadened teachers' authority over what they taught, albeit within the limits of the centrally determined core curricula. External standardized examinations, developed and implemented independently of the schools, were gradually introduced. Today, these examinations are used to assess the achievement of students at the end of their primary schooling, lower-secondary schooling, and upper-secondary schooling. The first of these national examinations was introduced in 2002 for the final primary grade and the final lower-secondary grade. In 2005, the government introduced the first national external examination for students at the end of their final year of upper secondary school as

well as those students completing technical secondary schools. This examination, called the maturity or *Matura* examination, replaced the previous tertiary education entrance examinations.

These policy changes also affected teacher education. Here, the reforms included a new model of teacher professional development, differentiated teacher pay, and a rise in the qualification standards for entry into teaching. These developments improved the general level of education for teaching and fueled the demand for continuing education.

All of the efforts to reform Poland's education system have been very successful, with support for this claim coming from the results for Polish students participating in the OECD's Programme in International Student Assessment (PISA). While the Polish cohort of PISA 2000 students was drawn from the highly stratified structure of the old system, most of the PISA 2003 and PISA 2006 Polish cohorts were in their final year of the newly established general lower-secondary schools. Of all the countries participating in PISA, Poland was the one that showed the most dramatic improvement in students' performance in reading between 2000 and 2006. While performance was significantly below the OECD average in 2000, it was above the OECD average in 2006. The particular strength of the Polish system is the relatively low number of students within the lowest levels of performance. However, the results of Polish students in science and mathematics have been close to the OECD average; the lack of progress in these domains is a matter of concern.

Higher education has also experienced significant change. Before 1989, the government closely controlled all higher education activities. However, the Higher Education Act of 1990, which introduced a basic legal framework for a new system, limited the Minister of National Education's control over management of higher education institutions by granting autonomy to both individual such institutions and the faculties within them. Other changes included making the financing of state universities dependent on student enrollment numbers, requiring students in parttime programs to pay fees, and permitting private institutions to offer higher education.

Participation in higher education increased dramatically from the early 1990s on. The number of students in higher education increased from 403,800 in academic year 1990/1991 to 1,584,800 in 2000/2001 and to 1,937,400 in 2007/2008, with the corresponding net enrollment rates for the age group 19 to 24 of 9.8 percent, 17.2 percent, and 30.6 percent. In academic year 2007/2008, Poland had 324 nonpublic higher education institutions but only 131 public ones. Currently, 34 percent of tertiary-level students are enrolled in nonpublic institutions. This outcome was the result of policy intended to increase the number of nonpublic providers of higher education and so avoid substantially increasing the public costs of tertiary-level education. The resultant anticipated expansion increased access to tertiary education, especially in those areas of Poland whose geographical location had not previously been well served by tertiary education providers. However, this expansion has also created problems of inequitable access to education, because students from higher socioeconomic background are more likely to enter the less costly and more prestigious publicly subsidized programs. Moreover, the increase in the number of teachers in higher education institutions did not parallel the expansion of higher education enrollment. As a consequence, the teacher–student ratio decreased, and it became quite common for the higher education staff in public institutions to have additional employment in nonpublic institutions.

The boom in higher education since the early 1990s reflects the increased educational aspirations of Poles and stronger links between education and the labor market. The higher levels of educational attainment have meant higher salaries (Rutkowski, 1996), a relationship that has also held true for the unemployment rate, which is significantly lower for people with higher education attainment.

Strong pressures on supply and demand for educational services are also being exerted by demographic trends. Until recently, Poland had one of the highest birth rates in Europe. Over the past decade, however, this rate steadily decreased, causing a decline in the school-age population. Between 1990 and 2008, enrollment in primary and secondary education fell by 24 percent. The number of teachers also decreased, although at a lower rate than that of students. As a result, by the 2007/2008 school year, the number of teachers was down from about 440,000 in 1990 to about 421,000 (fulltime equivalents). On average, teachers were relatively young, with an average age of 41 years. Over 80 percent of the teachers at this time were women, and half of all teachers were working in primary schools. The other half were split between lower-secondary and upper-secondary schools (Central Statistical Office, 2008a).

The over-supply of teacher education along with demographic trends have helped Poland avoid a teacher shortage, but there is a surplus of early education teachers (Grades 1 to 3). At the time of the TEDS-M survey, nearly 42,000 individuals were qualified to teach these grades but were not doing so, compared to 109,500 who were actually teaching (Zarębska, 2008a). According to similar data for teachers of mathematics, there was a slight surplus (4,430) of teachers qualified to teach this subject but who were teaching another subject, compared to 53,033 of those actually teaching mathematics (Zarębska, 2008b). The majority of primary and lower-secondary schools in Poland are public: of the 14,330 primary schools existing in school year 2007/2008, 94 percent were public. The corresponding figure for Poland's 7,142 lower-secondary schools at this time was 90 percent.

Conditions at the time of TEDS-M

The majority of public schools are managed by local governments with the authority to appoint and dismiss school principals (Central Statistical Office, 2008b). Principals, in turn, are responsible for hiring, disciplining, and dismissing teachers. However, these decisions are heavily constrained by government regulations. Teachers are not subject to general civil service regulations, but they have a special status in law and are entitled to the protections accorded to civil servants. The major regulation governing teacher rights and obligations is the Teacher Charter, which was adopted in 1982. This law granted teachers a number of privileges, including a lower teaching load, the right to early retirement, and increased salaries. Although the law has changed several times since, igniting fierce conflicts between government and powerful teachers' unions, it still contains favorable terms of employment for teachers. In contrast, local governments prefer flexibility of teacher employment at the local level in the interest of making schools more cost-effective.

According to Article 9 of the Teacher Charter, teaching positions can be filled by any person with higher education (or a certificate confirming completion of a program of study in a teacher training college) who has the required formal pedagogical qualifications (with some exceptions), who holds to basic moral values, and who is in sufficiently good health. The authority to hire teachers is specified in Article 39 of the Education System

Act. The heads of *kuratoria* (the agencies responsible for administering government-provided education) are required to monitor compliance with hiring requirements.

The Teacher's Charter regulates teacher salaries, appointments, career paths, and teaching load. A revision of the charter in 2000 introduced important changes in remuneration and career advancement for teachers. Five levels of professional status were introduced: trainee teacher, contract teacher, appointed teacher, licensed teacher, and professor of education. Only the first four are of practical importance since the final one is an honorary title. The level of professional advancement influences the type of employment. Teachers at the two lowest levels of the professional advancement system are employed on the basis of an ordinary employment agreement. Teachers in the two higher levels are employed on the basis of appointment subject to Teacher Charter regulations.

The Teacher Charter also defines the stages of a teacher's professional career. The assumption behind these regulations is that professional development and performance are the main factors to be considered with regard to professional advancement. At every stage, teachers are supposed to provide evidence of their development with certificates, student work, data from classrooms, and the like. The results of this new system have been mixed. First, during the initial few years of implementation, many teachers were advanced automatically to higher positions in hopes of "buying in" their support for the system. Second, most teachers found the procedures and complex governance structure of career advancement burdensome. Third, there was an increased demand for formal professional development services. During the 2007/2008 school year, as many as 37 percent of all teachers held appointed teacher status, and an additional 37 percent had reached the licensed teacher level. Seventeen percent of all teachers at this time were contract teachers, and 5.5 percent were trainees (Central Statistical Office, 2008a).

Until recently, teachers had low salaries and low professional status. This situation was partly offset by substantial privileges such as reduced teaching load, long vacations, and job security. This situation was, in effect, a "tacit contract" between the strong unions representing teachers and the government, in which little work was exchanged for little pay with a relatively flat wage distribution (Białecki, 2003). However, the 2000/2002 changes to the Teacher Charter tied teacher salaries to professional career levels, and local governments gained the power to set remuneration higher than that set down in the state budget. As a result, teacher salaries increased markedly and are now more differentiated. However, despite the average teacher salary now sitting slightly above the national average, it is still (when adjusted using purchasing power parity) among the lowest of corresponding salaries in the OECD countries. Moreover, entry-level salaries are comparably low, while the salaries of long-tenured teachers are relatively high, a circumstance that impairs ability to attract the best candidates to teaching (Rodriguez & Herbst, 2009).

Part II: Organization and Characteristics of Teacher Education

Teachers are trained in two parallel legal and administrative structures: the higher education system and the pre-university system (Białecki, 2003). Provisions regulating teacher education are included in the Law on Higher Education, the School Education Act, and regulations issued by the Minister of Education. Individuals must have special qualifications to teach school subjects. They usually acquire these qualifications by completing a university degree corresponding to the subject taught (first degree or

second degree studies, leading to an ISCED 5A diploma). This requirement can also be satisfied through postgraduate studies or during inservice training offered by teacher education institutions or higher education institutions.

Mathematics teachers are prepared at two levels, with Level 1 covering the first three primary grades and Level 2 covering primary Grade 4 on, through to postsecondary school (ISCED 4). There is no distinction at the first level between school subjects. Teachers at this level are required to have qualifications, known as "pedagogical studies," in "integrated teaching." In the higher grades (the second level), mathematics is taught by teachers qualified to teach mathematics. These teachers are usually graduates in mathematics.

One criticism of the Polish higher education system is that it is overly academic. According to OECD experts, the "academic" drift is a pervasive tendency that leads to the neglect of professional preparation. Experts also claim that it results in the less selective and vocationally oriented institutions inappropriately aspiring to emulate the style of more elite universities (Fulton, Santiago, Edquist, El-Khawas, & Hackl, 2007). This problem has ramifications for teacher education. On the one hand, academic programs in mathematics give future teachers a very good knowledge of mathematics. On the other hand, they limit the learning of more practical and school-related skills, as evidenced by the opinions of school principals regarding candidates for teaching (Wiłkomirska, 2005).

In Poland, institutions of higher education are classified as universities if they are authorized to award doctoral degrees in at least one organizational unit. The rest are categorized as nonuniversity higher education institutions. Institutions are distinguished by specialty (i.e., academies of economics, teacher education schools, medical academies, and physical academies).

Higher education studies, including teacher education, are organized in various ways. The Law on Higher Education makes the following distinctions:

1. *First-cycle programs*—undergraduate programs providing knowledge and skills in a specific area of study, preparing for specific professions, and leading to the degree of *Licencjat or Inżynier* (Bachelor's level);
2. *Second-cycle programs*—graduate programs providing specialist knowledge in a specific area leading to the degree of *Magister* (Master's) or an equivalent degree;
3. *Long-cycle programs*—graduate programs for applicants holding a secondary school certificate and who have passed the maturity (*Matura*) examination, providing specialist knowledge in a specific area leading to the *Magister* degree.

The first two program-types are relatively new. The long-cycle programs have been phased out, but as of 2008 there were still students in the final years of these programs.

Detailed statistics on teacher education are not available. However, the Central Statistical Office publishes aggregated data for groups and subgroups of studies (based on the ISCED 97 classification). According to these data, the education and training field accounted for a substantial part of the intake in higher education institutions. It is well known that the number of future teachers graduating exceeds labor-market needs, and that many graduates who complete a teacher education specialization do not pursue a teaching career (Wiłkomirska, 2005).

Higher education institutions enjoy enrollment autonomy. Nonpublic institutions tend to run courses that are the cheapest to offer and do not require large investments (The World Bank, 2004, p. 9). This state of affairs pertains to (in addition to teacher education) the fields of management, economics and finance, law, the humanities, and the social sciences. As a result, relatively small proportions of students study the physical sciences and engineering.

The dramatic improvement in the educational attainment level of Polish teachers over the last two decades is evident in Exhibit 11.2. At the end of the 1980s, about 47 percent of teachers had qualifications gained at the level of secondary schools or postsecondary schools of teacher education; only 54 percent had higher education. In 20 years, the share of teachers with higher education increased to 96 percent. This improvement occurred mainly because of the upgrading of the qualifications of teachers already in the profession.

Exhibit 11.2: Educational attainment of teachers in Poland from 1988 to 2007

Level of Educational Attainment	1988 (% teacher cohort)	1992 (% teacher cohort)	1994 (% teacher cohort)	1996 (% teacher cohort)	1998 (% teacher cohort)	2000 (% teacher cohort)	2002 (% teacher cohort)	2004 (% teacher cohort)	2006 (% teacher cohort)	2008 (% teacher cohort)
Secondary education	18.10	11.40	9.10	7.60	5.90	4.80	2.80	na	1.40	1.10
Postsecondary schools	28.60	30.20	29.20	22.80	15.10	9.90	6.30	na	1.80	1.30
Teachers' college	0.00	0.00	0.40	1.10	0.80	0.80	0.50	na	0.90	0.60
Higher education	53.30	58.40	61.30	68.50	78.30	84.40	90.20	na	95.90	97.00
Total percentage	100.00	100.00	100.00	100.00	100.10	99.90	99.80	na	100.00	100.00

The structure of Polish teacher education programs reflects the gradual move toward a two-cycle structure, put in place in order to comply with the Bologna Accord. Although the first Bachelor's degree programs in Poland were established in the early 1990s, the transition to the two-degree structure accelerated after 1999. In most of the 118 existing fields of study, the two-cycle structure became mandatory from 2007. When the differences between first and second degree studies within ISECD 5A are taken into account, it becomes evident that most teachers have second degree attainment. In the TEDS-M survey of teachers of mathematics in primary schools (Grades 4 to 6 and lower-secondary schools) conducted in 2008, the share of those with the title of *Magister* (ISCED 5A, second degree) was 95 and 97 percent, respectively.

The Law on Higher Education distinguishes between parttime and fulltime programs. Fulltime day studies are provided free of charge. Since 1990, public higher education institutions have been allowed to offer tuition-based parttime programs. Parttime programs are more common in nonpublic institutions. More than half of Poland's students study parttime.

Because individual institutions can decide on student enrollment numbers, the Ministry of Education's influence over teacher education enrollments is indirect. However, increased coursework requirements in the education-related subjects (psychology, pedagogy, didactics) seem to have discouraged higher education institutions from opening new teacher education programs.

Teacher education is also offered by teacher education colleges, which are not legally a part of the higher education system. The colleges are controlled by the Minister of

Education, are part of the pre-university system (internationally, they are classified as ISCED 5B programs), and have close links with the higher education institutions. In order to operate, a college must be formally aligned with a higher education institution. The alignment agreements cover issues such as scientific and educational supervision and the possibility for college students to continue in higher education. It is common for the partner institution to grant graduates of the college the first-cycle title of *Licencjat* once they have fulfilled the partner's institutional requirements.

Currently, only 25 colleges exist. The three-year curriculum, specified in a separate regulation by the Minister of Education, closely follows the requirements set for regular teacher studies. Specializations correspond to the subjects to be taught. Each teacher education college awards its graduates a diploma (*ddyplom ukończenia kolegium nauczycielskiego*) that qualifies them to teach in primary and basic vocational schools. Most students continue their education and gain the title of *Licenjat*, which opens the way to the second-cycle studies and the *Magisterium*.

Completion of postgraduate study is another way to become a teacher. In the TEDS-M 2008 survey of primary and lower-secondary mathematics teachers, 31 percent and 25 percent of teachers, respectively, revealed that they gained their mathematics teaching qualifications during postgraduate study. Of the teachers working in lower-secondary schools, 32 percent were teaching other subjects in schools before they started teaching mathematics. This teacher education option is available to graduates without teacher qualifications as well as to practicing teachers, although the large majority of the latter already have teaching qualifications (Wiłkomirska, 2005). Postgraduate studies are tuition based. However, in recent years, the Ministry of Education has funded some postgraduate studies in order to enhance teacher qualifications.

Curriculum and field experience requirements

General content standards, or minimum course requirements, for specific areas of study are set out by the government minister responsible for higher education. Detailed study plans and curricula, while respecting degree program requirements established by legislation, are defined by institutions. General standards are proposed by the General Council for Higher Education, an independent advisory body established in 1991. Teacher education is not officially recognized as a separate field of study; rather, it is a specialization within other fields of study. Future teachers in Grades 1 to 3, where education is integrated, are trained within the scope of "pedagogical studies." Teachers for higher grades are trained in mathematical studies. Teacher education in these cases is highly academic because the mathematics curriculum focuses heavily on mathematics, with only minimal attention paid to pedagogical studies.

Implementation of the higher education reforms saw the structure and content of the teacher education curriculum at the higher education level being initially subject to regulation in 2003. One year later, however, it was replaced by a new regulation that continues to govern teacher education today. The main assumption underpinning this latter regulation is that teacher preparation should prepare teachers who are competent specialists in their field while at the same time well prepared in subject-matter didactics and general pedagogy. According to the regulation, subject-related training should be implemented in accordance with the standards for a given field of study. The standards define the general content of the teacher-related subjects and competencies to be developed in teacher education programs.

For specific programs, the regulation specifies the minimum number of hours of coursework related to teaching (including psychology, general pedagogy, general and subject-related didactics, and additional subjects), as well as the minimum number of hours to be dedicated to the practicum. The regulation stipulates that first-cycle studies authorize future teachers to teach two subjects. Second-cycle and long-cycle programs prepare future teachers of one or two school subjects. This regulation also defines the practicum as the acquisition and development of practical classroom skills, as well as a means of fostering teacher understanding of school organization and operation. The regulation furthermore sets general objectives and regulates student activities during practice teaching, as well as the obligations of the cooperating school. Finally, training also includes familiarizing future teachers with information and communications technologies so that they can successfully employ these in their teaching.

Staffing requirements

Individual institutions determine staffing in line with the minimal staffing requirements defined by the ministry responsible for higher education. Observance of these requirements is the responsibility of the State Accreditation Committee. The Law on Higher Education established specific academic staffing categories, such as research *and* teaching staff; teaching staff; research staff; and qualified librarians and qualified scientific documentation and information staff. It also defined research and teaching categories such as professor *zwyczajny* (full professor), professor *nadzwyczajny* (associate professor), professor *wizytujący* (visiting professor), *adiunkt* (lecturer), and *asystent* (assistant lecturer).

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

The minimum requirement for entry to higher education is completion of the upper-secondary education certificate and passing the external examination called the *Matura*. Universities enroll as many students with the Matura as they wish. Because there is no national body in Poland determining the total number of teacher education places and controlling supply, higher education institutions themselves define how selective their recruitment policy will be. Higher education institutions are free to define the requirements for entry to first degree studies and postgraduate studies that lead to a qualification to teach.

In the past, entry was usually based on evaluation of school grades and the results of the old Matura examination (conducted by school personnel) as well as the results of separate institutional entry examinations. Since 2005, entry to higher education programs has been based solely on results obtained on the Matura examination, which is today conducted independently from schools by the Central and Regional Examination Offices. The examination is composed of the obligatory subjects of Polish and a foreign language as well as elective subjects, such as mathematics, physics, and biology. Institutions generally announce what weighting they give to the grade-attainment levels of specified subjects in the Matura examination when selecting students. In the case of future teachers of mathematics in primary and lower-secondary schools, a pass in the nonobligatory mathematics examination for the Matura is required. In pedagogy (future teachers in Grades 1 to 3 of the primary school), the obligatory subjects (Polish and a foreign language) are usually the main reference. Mathematics only became an obligatory part of the Matura in 2010.

Accreditation of teacher education institutions and programs

The State Accreditation Committee conducts mandatory evaluations of programs. It evaluates teacher education provided by universities in accordance with general regulations for quality control, but refers to specific regulations when assessing the programs offered by the teacher education colleges. Higher education institutions have enjoyed substantial autonomy with respect to their academic and budgetary functions, but when the expansion of higher education in the 1990s led to students of lesser quality than previously entering tertiary education, initiatives to provide external quality assurance emerged in response. In 1993, the General Council for Higher Education (GCHE), the major advisory body operating under the 1990 higher education law, developed a framework for quality assessment of education. In 1997, the government established the Accreditation Committee for Higher Vocational Education (ACHVE).

In parallel, higher education institutions began to set up their own peer accreditation committees for specific types of institutions or fields of study. Between 1993 and 2001, such committees were set up for classical, technical, medical, agricultural, pedagogical, and physical education universities and arts education institutions, with two further committees covering economics and business and management studies. Today, these committees work under the auspices of the Conference of Rectors of Academic Schools in Poland.

In 2001, the government established the State Accreditation Committee. It took over the responsibilities of the GCHE and ACHVE with regard to applications for new institutions and programs, and it is the only statutory body for mandatory external quality assessment and accreditation whose decisions are legally binding. The State Accreditation Committee is a fully independent body. It conducts, in particular, subject-area reviews of higher education institutions, relying on self-evaluations prepared by the institutions, verification of the documentation submitted, and site visits.

Requirements for entry to the teaching profession

All candidates who have the required educational credentials are allowed to teach. There are no special governance arrangements for licensing, nor are there external examinations for candidates wanting to enter the teaching profession after graduation.

References

Białecki, I. (2003). Teacher education in Poland. In B. Moon, L. Vlasceanu, & L. C. Barrows (Eds.), *Institutional approaches to teacher education within higher education in Europe: Current models and new developments*. Bucharest, Romania: CEPES/UNESCO.

Central Statistical Office. (2008a). *Mały Rocznik Statystyczny 2008* [Statistical yearbook 2008: Brief edition]. Warsaw, Poland: Author.

Central Statistical Office. (2008b). *Oświata i wychowanie w roku szkolnym 2007/2008* [Education in school year 2007/2008]. Warsaw, Poland: Author.

Fulton, O., Santiago, P., Edquist, C., El-Khawas, E., & Hackl, E. (2007). *Poland: OECD reviews of tertiary education*. Paris, France: OECD.

Rodriguez, A., & Herbst, M. (2009). *A public sector expenditure review for the education sector in Poland*. Washington DC: The World Bank.

Rutkowski, J. (1996). High skills pay off: The changing wage structure during economic transition in Poland. *Economics of Transition*, *4*(1), 89–112.

The World Bank (2004). *Tertiary education in Poland.* Warsaw, Poland: The World Bank Warsaw Office.

Wiłkomirska, A. (2005). *Ocena kształcenia nauczycieli w Polsce* [Evaluation of teacher education in Poland]. Warsaw, Poland: Institute of Public Affairs.

Zarębska. (2008a). *Nauczyciele kształcenia zintegrowanego i wychowania przedszkolnego w roku szkolnym 2007/2008* [Teachers of integrated learning and preprimary education in school year 2007/2008]. Warsaw, Poland: Center for Teacher Training.

Zarębska. (2008b). *Nauczyciele matematyki i fizyki w roku szkolnym 2006/2007* [Teachers of mathematics and physics in the school year 2006/2007]. Warsaw, Poland: Center for Teacher Training.

CHAPTER 12:

Russian Federation

Editors' Overview

The Russian Federation is transitioning from the system of teacher education that existed in the Soviet Union to a double-level system that complies with the principles of the Bologna Accord, which are being applied in many European countries. Thus, in similar vein to the situation in Poland, the old program-type of a single unified five-year teacher preparation, in which all of the TEDS-M sample were enrolled, has been largely replaced by a Bachelor's followed by a Master's degree. At the same time, most of the former pedagogical universities have become faculties of education situated in more conventional university settings.

Institutions and governance

In the Russian Federation, public universities, established at national, regional, or municipal levels, are responsible for qualifying teachers of mathematics. There are no private institutions preparing mathematics teachers in the federation. Changes made in response to the Bologna Accord have been rapid. When the TEDS sampling frame was prepared in 2006, 165 higher education institutions in Russia were preparing teachers for work in primary, basic or secondary schools. Among them were 111 pedagogical universities or institutes and 54 state universities. However, by 2009, the number of pedagogical universities preparing mathematics teachers had dropped sharply—to 62. By that time, many universities had started offering the new Bachelor's plus Master's program-type, but others were still offering the traditional five-year program-type surveyed in TEDS-M. Some universities at the time were offering both the old and the new program-types.

Program-types and credentials

At the time of the TEDS-M data collection, students in the new Bachelor's/Master's program-type, established in 2005, had not reached their final year of study and therefore did not belong in the TEDS-M target population. The population also did not include students in the pedagogical colleges whose programs were due to be phased out. These colleges offered either four years of teacher education at secondary school level (starting at Grade 10) or three years starting immediately after secondary school (Grade 11). The number of colleges and future teachers in these college program-types at the time of data collection was unknown (the number of remaining colleges was estimated to be about 80).

According to the Russian Federation TEDS-M national research coordinator, many of the graduates of these colleges have continued on to the pedagogical universities, starting at these institutions in their second or third year of study. Also, at the time of data collection, an estimated five percent of newly qualified teachers were people who had a first university degree but had not studied education in any form. After

1 This chapter consists only of this overview because, due to a lack of sufficient funding, the TEDS-M Russian national study center was unable to submit a national report. The content here was assembled with the assistance of Galina Kovaleva.

a special short course, they received their qualification to teach. The TEDS-M target population, however, was defined only in terms of two program-types, both five years in duration: one for primary schools, Grades 1 to 4, and the other for secondary schools, Grades 5 to 11 (see Exhibit 12.1). Today, the universities educate both future primary school and future secondary school teachers. However, one department is responsible for the primary teachers and a different department for the secondary.

Curriculum content, assessment, and organization

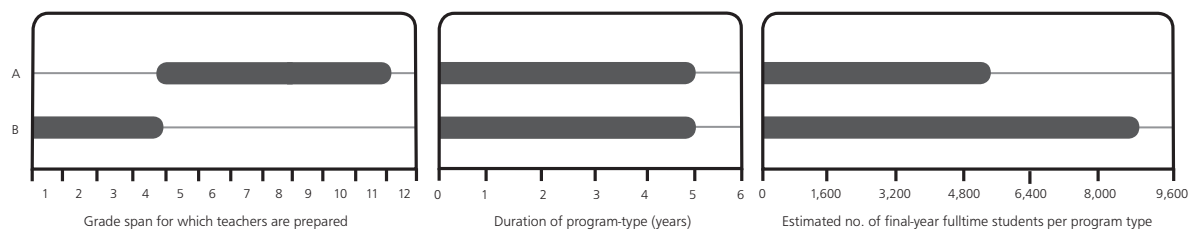
The new Bachelor's plus Master's and the old TEDS-M program-type are still based on the model developed during the Soviet era. Although the national government has a set of state standards for teacher education, each institution can select from these standards to tailor the curriculum more to its own requirements and emphases, which are mediated by such factors as subject-matter specializations, research capability, and regional traditions. However, the Ministry of Education and Science must approve this choice.

The mathematics content in the state standards for teacher education is very similar to the mathematics standards for other mathematics-focused professions. For example, the standards for the mathematics department of the pedagogical universities, at the Bachelor's degree level, include a two-year course in classical mathematical analysis (calculus) and its applications, a five-term course in algebra and geometry, a course in probability theory, and electives in mathematics. Special attention is paid to elementary mathematics courses during the first and seventh terms of study. There are also demanding requirements for computer literacy, computer architecture, computer programming, informatics, mathematical modeling, and multimedia.

In addition, during the first two years of this program-type, students experience three terms of pedagogy and psychology. They study didactics and mathematics pedagogy during their second and third years and teaching methods specific to lower- and upper-secondary school in their third and fourth years. One month of teaching practice is scheduled in both the third and fourth years.

Under the new Master's degree program, offered during the fifth and sixth years of study, students generally have three days of instruction at the university and two to three days of practical experience at school each week. This same mixed format was used during the last academic year of the former five-year program-type. At the end of both the old and new program-types, future teachers must pass two state examinations and defend a thesis.

Exhibit 12.1: Teacher-education program-types in the Russian Federation



Key to program-type

A—Teacher of mathematics

B—Primary teacher education

Note: Coverage of the TEDS-M target population did not include pedagogical colleges, the programs of which were about to be phased out. Nor did the population include the new Bachelor's/Master's program-types because their students had not reached their final year. Another estimated five percent of the target population that was not covered consisted of the university graduates who became qualified to teach after a special short training course.

CHAPTER 13:

Singapore

Editors' Overview [1]

The city-state of Singapore has only one teacher education institution, the National Institute of Education (NIE), which is an autonomous institute of Nanyang Technological University (NTU). As a result, the institution has maintained a high degree of control over teacher training and certification in the nation. Teachers are recruited by the Ministry of Education and sent to NIE for training. NIE offers a number of different program-types.

Institutions and governance

Graduating from the NIE automatically qualifies candidates recruited by the Ministry of Education to teach in Singapore's public schools. The permanent secretary of Singapore's Ministry of Education chairs the NIE's governing council. In general, NIE works very closely with the ministry and individual schools.

Program-types and credentials

Although only one institution offers teacher education in Singapore, the structure of program-types is complex (see Exhibit 13.1). Teacher education aligns with the grade split between primary and secondary education: primary education in Singapore includes Grades 1 to 6; secondary includes Grades 7 to 10. Post-secondary education includes Grades 11 and 12. Most future teachers go into teacher education after Grade 12 (A-Level), but some acquire a polytechnic diploma and generally enter this course of study after completing Grade 10.

Teachers are trained in four concurrent and four consecutive program-types. The concurrent program-types include two variants of a general diploma program-type (two years), as well as a Bachelor of Arts (Education) or a Bachelor of Science (Education) degree (four years). The diploma program-type is the only concurrent TEDS-M program-type requiring fewer than three years in an institution of higher education. The primary diploma has A and C options. Students studying under the A option are trained to teach two subjects, while those studying under the C option are trained to teach three subjects.[1]

Students completing the consecutive program-types receive a postgraduate diploma in education (PGDE), one form of which qualifies graduates to teach in primary schools and the other in secondary schools. These postgraduate diplomas cater to future teachers who have already gained a degree and who then enroll in NIE for this one-year second phase of the program-type. The top four bars in the middle chart in Exhibit 13.1 refer to the postgraduate diplomas but include the four years of degree study plus one year of teacher education training, giving a typical duration of five years for this program-type.

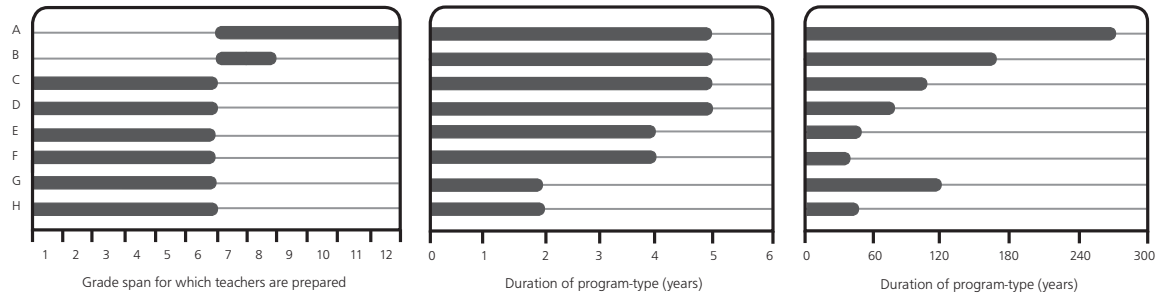
1 The diploma program-type is not officially recognized as being a university-level course, even though it takes place within a university. In particular, these future teachers do not complete university-level mathematics. However, those future teachers who receive the nondegree diploma are considered officially qualified to teach, even though other future teachers who obtain a university degree have a higher level of academic achievement.

Within the school system, about 75 percent of the teaching force are graduates and the remaining 25 percent are nongraduates. The program-type enrollments in Exhibit 13.1 are based on the numbers of future teachers who took part in the TEDS-M survey in November 2007 and May 2008. The numbers enrolled in the various program-types in Singapore tend to change considerably from one year to another.

Curriculum content, assessment, and organization

All teacher education candidates are required to complete core courses in education studies, subject knowledge (primary only), curriculum studies, academic studies (degree only), practicum, and what are termed language enhancement and academic discourse skills (LEADS). LEADS courses are unique to Singapore. They focus on developing the skills required to use English for communication, in general, and academic and professional purposes, in particular. Emphasis on the practicum varies by program-type: diploma, 23 percent of total preservice education; Bachelor's degree, 16 percent; and postgraduate diploma, 25 percent.

Exhibit 13.1: Teacher education program-types in Singapore



Key to program-type

A—Postgraduate Diploma in Education, secondary
B—Postgraduate Diploma in Education, lower secondary
C—Postgraduate Diploma in Education, primary Option C
D—Postgraduate Diploma in Education, primary Option A
E—Bachelor of Science in Education, primary
F—Bachelor of Arts in Education, primary
G—Diploma of Education, primary, Option C
H—Diploma of Education, primary, Option A

Note: There is only one institution of teacher education in Singapore. All eight program-types co-exist in the same institution.

Preparing Teachers of Mathematics in Singapore

Khoon Yoong Wong, Suat Khoh Lim-Teo, Ngan Hoe Lee, Kok Leong Boey, Caroline Koh, Jagusthing Dindyal, Kok Ming Teo, and Lu Pien Cheng

Part I: Context and Conditions of Teaching as a Career

Singapore is a small island nation with about five million people of whom nearly four million are officially Singapore residents. Given the nation's small size, teacher education for public schools in Singapore is centrally managed by the Ministry of Education and just one teacher education institution—the National Institute of Education (NIE), an autonomous unit of Nanyang Technological University (NTU). Schools in Singapore range from government schools and government-aided schools to independent schools and autonomous schools, but in some respects they all come under the ministry's umbrella.

Historical roots

The close working relationship between the Ministry of Education and the NIE that exists today is the outcome of the evolution in teacher education in Singapore from its colonial days through to full national independence in 1965 and on to a subsequent stage of nation building dependent on a strong teaching force. This teaching force has contributed in major ways to the success of Singapore students, whether that contribution is measured in terms of public examination results or Singaporean students' scores in crossnational surveys of educational achievement. For example, Singapore took top place among the education systems that participated in the 2003 iteration of IEA's Trends in International Mathematics and Science Study (TIMSS) and second place among the education systems that participated in IEA's Progress in International Reading Literacy Study (PIRLS) of 2006. In PIRLS, Singaporean students competed successfully in English with students in those participating countries where English is more frequently spoken within society at large.

In addition to preparing students academically, Singapore's teachers are seen as important agents in promoting national values. However, the responsibilities placed on Singapore's teachers can be achieved only if they are well trained in rigorous pedagogical knowledge and skills that can match instructional practices to the ever-changing needs of the nation and its individual students.

The story of teacher education in Singapore is closely linked to the history of the current NIE and the uniqueness of this institute as the sole agency of teacher education in Singapore. This situation, which is a departure from teacher education in most countries, where teachers receive their training in different types of institutions, is possible because of Singapore's small population of teachers (26,804 in 354 schools in 2006).

However, the NIE is not a one-size-fits-all institution. Besides serving the diverse needs of teacher education, which ranges across teacher education curriculum development, quality control, professional development, and educational research, the NIE has to address the special requirements of training teachers to serve in schools with students from diverse racial, religious, cultural, and economic backgrounds. This diversity of the student population (numbering about 530,000) at school level is a microcosm of Singapore's multiracial, multireligious, multicultural, and multilingual society.

A proportional breakdown of each of these first two categories reveals 77 percent Chinese, 14 percent Malays, 8 percent Indians, and 1 percent other races; 42 percent Buddhists, 15 percent Muslims, 15 percent Catholics and other Christians, 15 percent no religion, and 13 percent others. Although English is the main working language and medium of instruction, Singapore's three other main mother-tongue languages (Chinese, Malay, and Tamil) are also official languages. With the exception of courses that focus on teaching other languages and their literature, all teacher education courses are conducted in English.

The interrelationship between the NIE and teacher education is captured by the informative montage that greets visitors at the institute's main administration building. It depicts "riding the waves of changes … [to] pursue excellence in teacher education" from 1950 to the present day (Goh & Gopinathan, 2008; NIE, 2002). But the genesis of the close relationship began long before that.

In Singapore, from the early 1900s to the beginning of the Second World War, different types of schools operated largely on their own. They included English-medium schools established by the colonial government, privately owned vernacular schools, and missionary schools. Each type of school recruited its own teachers on an ad hoc basis, and probably required the teachers to have only a general knowledge of the subject disciplines. In 1928, Raffles College was established to offer diplomas in arts and science subjects. Ten years later, the college offered a diploma in education program as an additional fourth year of study in education for graduates who wished to join the teaching service under the British administration.

After the Second World War, school enrollments increased substantially, and it became necessary to train a large number of nongraduate and graduate teachers. In 1950, the government established the Teachers' Training College, which conducted certificate courses for nongraduates (under a two-year fulltime concurrent program) for persons wanting to teach in primary schools. In the same year, a school of education was established at the then University of Malaya (founded in 1949 and later to become the University of Singapore in January 1962, and the National University of Singapore in August 1980). The university's school of education offered a diploma in education program (a one-year fulltime, consecutive program) for university graduates intending to teach in secondary schools.

The training of nongraduate teachers at college level and graduate teachers at university level is still a common practice in many countries. Singapore maintained this dual system for about 20 years and then made a radical change in December 1971. It closed the school of education at the then University of Singapore, and moved many of its teacher educators over to the Teachers' Training College. The training of graduate teachers was transferred to the college under a unique certification arrangement whereby the training college offered the professional diploma in education and postgraduate degrees in education but the University of Singapore awarded the actual certificates. This special arrangement lasted until 1991.

On April 1, 1973, the Teachers' Training College became the Institute of Education (IE). In addition to offering the two-year fulltime certificate in education program for nongraduates and the one-year fulltime diploma in education program for graduates, the institute introduced a parttime 18-month diploma in education and a three-year certificate in education program under the Teaching Cadetship Scheme. Trainees in

this scheme divided their time between teaching in schools and studying on campus. In 1980, this scheme was replaced by a fulltime teacher-in-training scheme. These changes were instituted to meet the demands for more and better-qualified teachers. Subsequent changes are described below under the current organization and characteristics of teacher education.

Conditions at the time of TEDS-M

The OECD (2005) defines two basic models of teacher employment, namely, "career-based" and "position-based." In a career-based system, "teachers are generally expected to stay in the public service throughout their working life" (p. 8). In this sense, teaching in Singapore is largely a career-based occupation. Teachers in Singapore public schools are employed by the government. They are civil servants and are on permanent appointment, although the Ministry of Education also employs relief teachers and adjunct teachers on a contractual basis.[2] Conditions of employment are determined by the ministry and not by a collective agreement between employer and teacher unions as is the practice in many other countries.

Most of Singapore's teachers join the teaching service as fresh graduates from junior colleges, polytechnics, or universities and before they enter initial teacher education. However, in recent years, there has been an increase in applications from people making mid-career changes from other professions to teaching. These mid-career teachers (i.e., persons with at least one year of past working experience) constitute about 22 percent of the total teaching population, an increase from 15 percent five years ago. In addition to screening local applicants, the Ministry of Education also conducts selective recruitment of experienced (trained) teachers from overseas. The ministry currently employs about 400 expatriate teachers. They are initially given a contract of two to three years.

Recruitment of teachers is conducted centrally by the ministry and not by the individual schools. Positions are advertised on an open basis, with the selection criteria developed and applied by the central authority (rather than decentralized to the schools). The process of employment and training is integrated in the sense that the ministry initially employs successful applicants as "untrained teachers" and then sends them to the NIE as "trainee teachers" or "student teachers."

It should be clear from the above description that student teachers sent to the NIE for preservice education are already employees of the Ministry of Education. This distinctive system of "paying" people to be trained as teachers is indicative of a career-based system in its fullest sense. This salary component is seen as an essential part of the funding for training teachers in Singapore. Thus, while undergoing training at the NIE, student teachers receive a monthly salary that accords with their entry qualifications. Salaries for students who enter with an A-Level pass range from about US$1,000[3] to US$2,250 per month. Teachers in the degree program receive a salary for only their first two years of study. During the third and fourth years of the degree, about half of these prospective teachers receive a scholarship stipend of about US$3,500 per annum, while the rest are on "no-pay leave" from the ministry as untrained teachers. The ministry

2 Adjunct teachers are teachers who have retired or resigned but are then re-employed by the Ministry of Education under the adjunct teaching program. In 2007, there were about 2,000 adjunct teachers, making up about seven percent of the teaching force.

3 US$1 = S$1.407 as of February 26, 2008.

pays the full tuition fees of those of their sponsored student teachers who are making satisfactory academic progress. Students not making satisfactory progress still receive a tuition grant, but they have to pay the difference between the full fee and the grant.

After trainees graduate from the NIE, their salary is increased to the next point on the trained teacher scale. As an example, diploma student teachers with an A-Level entry qualification are paid a monthly salary of US$1,070 during their second year of training, whereas after graduation they are likely to be paid US$1,160 per month. Hence, the salary during training is very close to the salary after training. This payment approach is singular to Singapore's system of teacher training.

NIE graduates are posted to schools as trained teachers. Those with a diploma or postgraduate diploma in education serve under a bond of three years. Those with a degree serve four years, and those with a Ministry of Education scholarship serve up to six years. Throughout their first year in school as trained teachers, these individuals are on probation.

During their initial years of teaching, teachers take part in the Structured Mentoring Program (SMP), first introduced in 2006. It has three components:

1. An induction component at school, cluster, and Ministry of Education levels, designed to provide these teachers with an overview of the education system and school culture;
2. School-level mentoring, the purpose of which is to address job expectations and day-to-day operations as a teacher; and
3. Practice-oriented training in classroom management, which includes basic counseling skills, assessment skills, reflective practice, and planning one's own development as a teacher.

Experienced teachers who serve as school-level mentors receive training in mentoring and counseling skills.

Primary school teachers in Singapore are trained to teach either two or three subjects. Once in the classroom, many of them teach mathematics or English together with other subjects. Some primary schools are experimenting with having teachers specialize in teaching a specific subject, such as mathematics, at the upper-primary level. Secondary school teachers, however, are trained to teach one major and one minor subject. The school principal is responsible for deploying the teachers within the school.

Singaporean teachers play many roles in the schools. They plan schemes of work and lessons based on the national curriculum of the subjects they are trained to teach. They assess students' learning through continuous assessment and summative assessment, with both scheduled at regular periods of the school terms. A typical teacher has about 16 hours per week of classroom teaching during formal school hours (i.e., 7:30 a.m. to about 1:00 p.m. daily). Most teachers conduct remedial or enrichment classes as part of their normal workload, and mark students' work after the formal school day. They also supervise co-curricular programs such as sports and club activities and community-based projects. In short, the responsibilities of Singaporean teachers are diverse and time-intensive.

In order to help teachers effectively complete their duties, the Ministry of Education recently introduced various support schemes. These include employment of teacher-aides to take over some administrative duties, hiring of co-curricular program

administrators, an entitlement of up to 100 hours per year of paid-for professional development taken during nonteaching official time or the teacher's own time, and the "white space" concept,[4] first introduced in 2005.

The average class size in Singapore is between 30 and 40 for primary and secondary levels and slightly below 25 for postsecondary junior college level. Singapore schools are generally well equipped, and most classrooms have a computer-based projection system, which means that all the teacher needs to do is to bring along a laptop to connect to this system and deliver his or her ICT-based lessons.

The education profession has three career tracks—teaching, leadership, and senior specialist. This career structure was introduced in 2001. The teaching track is for teachers who have demonstrated strengths in teaching and wish to remain as teachers, advancing to the pinnacle level of master teacher. The leadership track provides opportunities to take on leadership positions, such as departmental head, principal, and director of a unit or division at the Ministry of Education. Individuals who have developed expertise in specific areas such as curriculum, assessment, and educational psychology by gaining higher qualifications or engaging in professional development courses can opt for the senior specialist track.

Each teacher's performance is appraised annually at the end of the school year. This evaluation, which focuses not only on performance but also on potential to progress in one of the three tracks, is conducted by the school principal using the Enhanced Performance Management System (EPMS) introduced in 2003. The EPMS is a competency-based system that spells out in great detail the knowledge and skill requirements as well as the professional characteristics teachers need to do well in each of the three tracks. A teacher's performance grade affects the amount of salary increment for the following year, the performance bonus paid for work done in the current year, and opportunity for promotion.

In general, there are sufficient numbers of suitably trained mathematics teachers in Singapore at the primary and secondary levels. The Ministry of Education recruits enough teachers annually to cater for a resignation rate of two to three percent per year and to fill "float" posts for teachers on various types of leave.

Part II: Organization and Characteristics of Teacher Education

Around the mid-1980s, the Singapore government considered establishing a second university to cater to the expanding need for professionals. During this process, the roles of the Institute of Education and the College of Physical Education were reviewed as part of proposals to upgrade primary teacher education (Seet, 1990). The result was that on July 1, 1991, the government merged the two institutions to form the National Institute of Education (NIE). On the same day, the government established Nanyang Technological University (NTU) as the second university in Singapore by combining the then Nanyang Technological Institute with the NIE. However, the NIE, like its predecessors (the Teachers' Training College and the Institute of Education) remained part of the Ministry of Education. In April 2006, Nanyang Technological University, of which the NIE is an autonomous institution, was "corporatized," which means that it

4 As a result of content reduction in many subjects, some curriculum hours are designated as "white space." Teachers can use this time to plan more engaging lessons in their subject area(s) or to work with colleagues to plan interdisciplinary activities for their students.

became a nonprofit, self-governing public organization, autonomous from Ministry of Education control. However, the NIE is still governed by a council chaired by the permanent secretary of the ministry.

There are no national curriculum requirements for teacher education in Singapore. The content of the teacher education curriculum is determined by teacher educators and the Foundation Program Office[5] of the NIE. As an autonomous institute of NTU, the NIE now offers its programs under NTU rather than through its former link with the National University of Singapore. In 1991, as part of the establishment of the NIE, certificate programs were upgraded to the current diploma in education for nongraduates, and the previous diploma in education was upgraded to the current postgraduate diploma in education for university graduates. Also, for the first time, a one-year postgraduate diploma in primary education (PGDE) program was introduced to train university graduates to teach in primary schools. The purpose of this new program was to raise the quality of primary school teaching by supplying these schools with graduate teachers.

New first degree programs (namely, the four-year Bachelor of Arts with Diploma in Education and the Bachelor of Science with Diploma in Education, each with an optional fifth year of Honors in a subject discipline) were also introduced in 1991. Their purpose was to prepare graduate teachers to teach several primary school subjects and two secondary school subjects. The two degree programs were thus concurrent programs because they required students to study education courses together with disciplinary subjects from their first year onward. However, because learning to teach in both primary and secondary levels proved to be very demanding, the programs were separated into a primary track and a secondary track in July 1998. Further revisions to the two programs in 2001 positioned them as a Bachelor of Arts (Education) and a Bachelor of Science (Education), making these four-year programs a direct Honors degree, which meant that Honors was conferred on the basis of excellent overall academic performance rather than an additional year of study.

The 2001 degree programs trained only primary school teachers. During their time in these programs, future teachers had to specialize in one academic discipline and learn to teach four subjects—English, mathematics, science, and social studies. The last cohort of future teachers in these degree programs took the TEDS-M achievement test in May 2008. These programs were further revised in July 2005 to allow future teachers to specialize in either primary or secondary school teaching but not both. Future teachers in these most recently revised degree programs did not participate in TEDS-M because the first cohort graduated only in May 2009. The three major changes in the degree programs outlined above were partly in response to new ideas about teacher education from international trends and were partly an attempt to meet the changing demands of the local education system.

In summary, in addition to specialized programs in physical education, music, arts, special education and the three mother-tongue languages of Chinese, Malay, and Tamil, the NIE offers three concurrent teacher education programs:

1. The Diploma in Education for primary school teaching;
2. The Bachelor of Arts (Education) or the Bachelor of Science (Education), also for primary teaching; and

5 The current name is "Office of Teacher Education."

3. The Bachelor of Arts (Education) or the Bachelor of Science (Education) for secondary teaching.

The NIE also offers two consecutive programs—the Postgraduate Diploma in Education (Primary) for primary school teaching, and the Postgraduate Diploma in Education (Secondary) for secondary school teaching.[6] Furthermore, and in line with its university status, the NIE now has in place Master's and doctoral programs in subject disciplines as well as education. These involve a combination of coursework and research. In addition to training local teachers, the NIE is today heavily involved in training educators and teachers from overseas countries, such as Abu Dhabi, Bahrain, Indonesia, the Philippines, and Thailand. Training encompasses education leadership and pedagogies, including mathematics education. These various programs have established the NIE as a leading international education consultancy institution, with outreach conducted through its External Program Office,[7] established in 2005.

Curriculum and field experience requirements

Since July 2007, each of the NIE's programs has included core courses in education studies, curriculum studies, subject knowledge, academic studies (the degree program only), practicum, and language enhancement and academic discourse skills (LEADS courses). Future teachers in the degree program also take some elective courses.

Curriculum studies courses deal with the pedagogy of the selected school subjects, including use of ICT, curriculum analysis, and classroom techniques. The mathematics curriculum studies courses cover the nature of the Singapore mathematics curriculum, learning theories underpinning mathematics pedagogy, assessment of student learning, error analysis, and techniques to teach specific topics, such as fractions, geometry, and algebra. Mathematics educators at the NIE have published two resource books for these courses (Lee, 2007, 2008).

Subject-knowledge courses help student teachers gain a deeper understanding of the content of the school subjects they will teach. These courses align with the respective curriculum studies courses, and the resultant combination is an innovative feature of teacher education programs found in only a few countries around the world. The NIE first introduced this subject knowledge component (previously called curriculum contents) in 1998 for the degree program, 2001 for the diploma program, and 2005 for the Postgraduate Diploma in Education (Primary) program. Subject knowledge is a core component of all the primary education programs. The mathematics subject-knowledge courses include deeper understanding of whole numbers, such as different numeration systems, as well as the Euclidean algorithm, geometry, deductive and inductive reasoning, statistical investigations, and problem-solving heuristics.

Academic studies courses are traditional tertiary courses that provide indepth mastery of the respective disciplines. The course content of mathematics in the degree program (primary or secondary) includes calculus, linear algebra, statistics, mathematics modeling, operations research, analysis, and so on.

6 Another postgraduate diploma, the Postgraduate Diploma in Education (Junior College), trains future teachers to teach only one subject from Grades 7 to 12. This program was introduced after completion of the main TEDS-M survey.

7 The current name is "NIE International."

The LEADS courses, which are designed especially for school teachers, develop the skills needed to use English for communication and for academic and professional purposes. Another course, called Group Endeavors in Service Learning, is a compulsory course for the degree and postgraduate diploma programs, but it does not carry academic credit. During this course, future teachers participate in a group project designed to help them acquire the generic skills of project management, with the expectation that they will apply these skills when they supervise similar projects in schools.

Each course is typically assessed using diverse modes of assessment, for example, tests (including practical tests), essays, project work, micro-teaching, and class participation. Most academic studies courses also have final examinations at the end of each semester.

The practicum component (field study) requires student teachers to spend some time in assigned schools so they can develop teaching skills and link theory to practice. Students must pass this practicum component in order to graduate. Every student teacher is assigned a senior mentor, one or more co-operating teachers, and one NIE supervisor. These persons together form a panel that assesses the performance of each student teacher under its charge and then awards a grade commensurate with that performance. Student teachers who are at risk of failing or who are vying for distinction in the practicum must have their performance moderated by another senior NIE supervisor. The practice of involving school teachers in supervising student teachers and grading their teaching performance is an important bipartite relationship that the NIE has carefully nurtured with schools over the years.

During the practicum, student teachers who are trained to teach primary or secondary mathematics may or may not be supervised by NIE supervisors who are mathematicians or mathematics educators, but they will normally have a cooperating teacher who is teaching mathematics. This less than ideal situation arises because there are not enough mathematics educators and mathematicians to supervise the large number of mathematics student teachers.

The developmental approach employed on the diploma and degree programs, two years and four years long, respectively, enable student teachers to acquire practical teaching skills in two or more stages. In contrast, the postgraduate diploma program, which takes just 10 months to complete, has time for only one practicum segment. However, in terms of academic credits across these qualifications, the weight given to the practicum is considerable: about 23 percent for the diploma, 16 percent for the degree, and 25 percent for the postgraduate diploma.

The practicum component of the diploma program consists of two parts. The first is a five-week teaching assistantship in June between the end of Year 1 of the program and the beginning of Year 2. The second is a 10-week period of teaching practice from February to April at the end of Year 2 of the program. During the teaching assistantship phase, future teachers observe their co-operating teachers conduct lessons, help them plan lessons, perform some guided teaching, and reflect on the roles of teachers. During the period of teaching practice, student teachers conduct lessons under supervision and engage in other school activities.

The degree program practicum has the following four components:

1. Two weeks of school experience in July before the beginning of Year 2, with one week in a primary school and one week in a secondary school. The main task is for student teachers to note similarities and differences between these two types of school.
2. Five weeks of teaching assistantship during June through July after Year 2. During this time, student teachers observe their co-operating teachers carry out lessons, and they reflect on the roles and responsibilities of teachers.
3. Five weeks of teaching practice (Stage 1) in June and July after Year 3. This is the time when the students begin independent teaching.
4. Ten weeks of teaching practice (Stage 2) from February through April in Year 4. At this stage of their training, students are expected to teach independently and to learn more about the roles of teachers. This is also the stage at which their teaching performance is graded by the assessment panel.

The practicum of the postgraduate diploma in education program consists of a 10-week attachment to a primary or a secondary school. During this time, the students are expected to teach the curriculum subjects they have elected to teach.

Staffing requirements

There are no national requirements that the teaching staff and faculty members at NIE must meet. Four types of NIE staff are involved in the teacher education programs:

1. *Faculty members in the professorial track of NTU holding the ranks of assistant professor, associate professor, and full professor:* All of these individuals must have a doctorate. They include teacher educators as well as experts in the disciplines, such as mathematicians and scientists. These faculty members are recruited through stringent procedures from local and international pools. They are expected to teach, conduct research in their areas of expertise, and provide services to the university and the profession.
2. *Lecturers, with the ranks of lecturer, senior lecturer, and principal lecturer:* The NIE only recently established the lecturer track, the members of which are faculty members who are strong in teaching and who publish papers about innovative practices rather than academic matters. Lecturers must hold a Master's degree, and many of them will work toward their doctorate either at the NIE or through parttime study with overseas universities. Senior lecturers and principal lecturers are expected to hold a doctorate. The performance of lecturers in this track is assessed with the weights 8 (teaching): 2 (research): 2 (service).
3. *Teaching fellows:* These persons are experienced school teachers or ministry officials who have been seconded from the Ministry of Education to the NIE for a period of two years at a time. The aim is to provide the NIE with additional teaching resources and to widen the professional experience of these teaching fellows by having them teach teacher education courses at the NIE (in contrast to teaching school students) and conduct educational research.
4. *Parttime tutors:* These individuals have at least a Master's degree and strong experience in school teaching. They are often employed to make up for a shortage of teaching staff at the NIE.

Members of the NIE teaching staff are grouped in academic groups (AGs). Each AG reflects a major disciplinary area of study and is under the charge of a head. Mathematics and mathematics education (MME) is one of 12 AGs. It offers courses in mathematics and mathematics education; most of the TEDS-M team members for Singapore were from this AG.

The MME faculty comprises mathematicians as well as mathematics educators, an arrangement not common in most universities, where these two groups of experts typically belong to different faculties and seldom work together. The NIE structure provides many opportunities for the members of these two groups to work together on committees and projects that draw on the expertise of both disciplines in order to achieve the common goal of preparing competent mathematics teachers for Singapore schools. All the mathematicians at MME also supervise the practicums of student teachers at secondary schools, and they are expected to keep abreast of the Ministry of Education's education initiatives so that they can adjust their own course content and delivery mode to ensure they align, in terms of relevance and currency, with those initiatives (Wong, 2008).

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

Recruitment

Singapore is able to recruit teachers from the top one third of each age cohort primarily because it has a concerted set of national policies to ensure teaching is an attractive career choice for young adults. In order to continue to attract a steady stream of talented and dedicated young people into the Education Service despite the competitive labor market, the remuneration package for teachers is pegged at a level that attracts just as good a share of talent into the teaching profession as other professions do.

The remuneration package consists of monthly salaries, performance-based bonuses, and a long-term incentive plan that rewards teachers who remain in the Education Service. Teachers are also eligible for professional development leave, medical and dental benefits, and miscellaneous benefits.

In 2006, the Ministry of Education, having conducted a comprehensive review of teacher remuneration and conditions of employment, introduced its GROW Package, for the professional and personal Growth of Education Officers, through better Recognition, Opportunities, and seeing to their Well-being. Building on the foundation of the GROW package, the ministry developed and announced the rollout of GROW 2.0 in December 2007. GROW 2.0 provides teachers with an even more attractive remuneration package than previously, in terms of more career and development opportunities and greater flexibility to balance the demands of work and family. The main enhancement was a new Education Scheme, introduced on April 1, 2008, directed toward making teachers' pay more competitive and in line with market forces. More recently, the ministry has increased the performance-based pay differentiation among teachers, commensurate with feedback from teachers that there should be a sharper differentiation in pay based on performance. These various measures exemplify the ministry's concerted and ongoing effort to make teaching an attractive career.

Entry standards/selection

In Singapore, the Ministry of Education determines the number of student teachers to be trained and the types of programs in which they should enroll. This number is based on the projected number of teaching positions that will need to be filled. It also takes into account demographic data trends, rates of resignation or retirement from the Education Service, and additional teachers required to achieve various intended initiatives, such as class size reductions at lower primary levels, reduction of administrative loads for teachers, and covering teachers on various types of professional development and personal leave.

Applicants who wish to join the teaching profession submit their applications to the Ministry of Education. They are mainly young people who have just graduated from secondary school, diploma holders from polytechnics, graduates with a relevant degree, and people who make a mid-career switch. The entry requirements, determined jointly by the Ministry of Education and the NIE and based on academic and nonacademic criteria, vary according to the types of training programs offered at the institute.

Applicants are shortlisted by the Ministry of Education's Human Resource Department. Decisions are based on the applicants' academic qualifications and relevant experience in comparison with the qualifications and experience of the rest of the teaching applicants. Shortlisted applicants are interviewed by a panel of serving or retired principals, ministry officials, and representatives from the NIE. The interview panel assesses each applicant's academic achievements, his or her interest in teaching, and whether he or she has the personal and leadership qualities of a good teacher.

Entry to primary teacher education programs

The main academic criterion for someone wanting to enroll in a teacher education program is his or her results in the Singapore/Cambridge GCE O-Level or A-Level examinations, or the holding of a diploma from one of the various Singapore polytechnics. There are general requirements for each program as well as specialized requirements for specific subjects, such as mathematics. All programs require O-Level passes, or the equivalent, in mathematics and English language. In recent years, the overall percentages of students passing these two crucial subjects have been about 85 percent. This pass rate underscores the importance of mathematics in the training of Singapore teachers. All applicants must also pass the relevant Entrance Proficiency Test unless they meet certain exemption criteria. On average, only one in six applicants is accepted for each training place available (Barber & Mourshed, 2007).

Applicants for the Diploma in Education program possess qualifications similar to those for the degree program, but at lower standards. Student teachers at the NIE who have just graduated from the diploma program with very good grades may be invited to apply to cross over to the degree program. Nongraduate school teachers may also apply to join the degree program if they satisfy the entry requirements. The Ministry of Education supports these attempts by deserving nongraduate teachers to upgrade their qualifications.

The minimum entry qualification for those who wish to study mathematics in the degree program is grade C for A-Level mathematics or the subject called further mathematics. Applicants from the polytechnics or other institutions have to pass the Mathematics Qualifying Test set by the Mathematics and Mathematics Education (MME) academic

group at the NIE. Applicants for the PGDE (Primary) program must hold a relevant and recognized degree from local or overseas universities and have passed English and mathematics at the O-Level.

Entry to secondary teacher education programs

Applicants for the Postgraduate Diploma in Education (Secondary) program who want to study mathematics as their major teaching subject must pass tertiary mathematics up to the end of the third year of their degree. Those who choose mathematics as a minor teaching subject must have a grade of at least C in at least two tertiary mathematics courses, in addition to a grade of at least B in A-Level mathematics. Those in the mathematics (lower-secondary) option do not have to study tertiary mathematics, but they must have good grades in their O-Level or A-Level mathematics.

Accreditation of teacher education institutions and programs

Singapore does not have an agency dedicated to certifying the quality of the teacher education programs offered by the NIE. However, it was clear from the Singapore TEDS-M national report that there is a tight coupling between government policy regarding educational quality and the NIE's quality-assurance practices, which involve gathering independent feedback on its programs. The dean of the institute's Foundation Programme Office (FPO) is responsible for monitoring the quality of programs in several ways.

First, the FPO gathers feedback from the student teachers toward the end of their training, when they return to the NIE after their last practicum to complete a two-week period of enrichment activities and reflection. Second, the FPO conducts regular meetings with school principals to obtain their views on the performance of student teachers during the practicum and of newly graduated teachers during the probation period. Third, several committees and taskforces are formed to review the implementation of the programs. For instance, in March 2006, lecturers of curriculum studies courses and education studies courses attended a retreat to map out the linkages between these two types of core courses. Their aim was to strengthen understanding of education theories from the generic and discipline perspectives, to include applications of education theories under different situations, to reduce unproductive overlaps in content coverage, and to streamline submission of assignments to these two types of courses. Last, but not least, the FPO carries out longitudinal studies designed to collect feedback from the student teachers.

In the past, NIE degree programs were validated through a system involving external examiners from reputable overseas universities. These examiners checked the standards of the examination papers and moderated the marking of examination scripts and assignments by independently marking a sample of student work. However, in 2005, this external validation was abolished when the NIE felt confident enough to attest to its own quality, with that confidence based on the institute's strong faculty and reputable research. A new external assessor scheme took over from the old one. Under this new scheme, distinguished teacher educators or experts in the disciplines from overseas are invited to provide feedback on the content and delivery of discipline-based courses in the preservice programs.

In addition, in 2009, the NIE appointed an external examiner panel[8] to review the first cycle of implementation of the revised degree programs. The role of this panel was to provide feedback in four key areas: teacher education curriculum, teacher education outcomes and standards, teacher performance and management, and the practicum.

These various activities demonstrate that the quality assurance for teacher education at the NIE is a dynamic process. It responds to current practices, evidence gathered from various sources, alternative perspectives from external experts, and proactive positioning for future challenges.[9]

Requirements for entry to the teaching profession

As noted above, Singapore operates an integrated system of teacher recruitment and training. It does not have an agency to grant licenses for teachers to teach in Singapore. For student teachers recruited by the Ministry of Education, graduating from the NIE automatically qualifies them to teach in the public schools.

References

Barber, M., & Mourshed, M. (2007). *How the world's best-performing school systems come out on top*. London, UK: McKinsey & Co.

Goh, C. B., & Gopinathan, S. (2008). The development of education in Singapore since 1965. In S. K. Lee, C. B. Goh, B. Fredriksen, & J. P. Tan (Eds.), *Towards a better future: Education and training for economic development in Singapore since 1965* (pp. 12–38). Washington, DC: The Word Bank & the National Institute of Education, Singapore.

Lee, P. Y. (Ed.). (2007). *Teaching primary-school mathematics: A resource book*. Singapore: McGraw-Hill Education (Asia).

Lee, P. Y. (Ed.). (2008). *Teaching secondary school mathematics: A resource book*. Singapore: McGraw-Hill Education (Asia).

National Institute of Education (NIE). (2002). *Moulding lives, shaping tomorrow: The NIE story*. Singapore: Author.

Organisation for Economic Co-operation and Development (OECD). (2005). *Teachers matter: Attracting, developing, and retaining effective teachers*. Paris, France: Author.

Seet, A. M. (1990). *Teacher education in the 1990s: Issues and strategies*. Singapore: Ministry of Education.

Wong, K. Y. (2008). M2E@NIE/NTU: Promoting mathematics education. *Mathematical Medley*, *34*(1), 23–28.

8 The panel is now defunct. Its functions have been largely taken over by the Office of Academic Quality Management, which aims to strengthen the academic quality of NIE programs through self-improvement.

9 The latest outcome of this continual review of teacher education programs at NIE is the new TE21 teacher education model for the 21st century (report available from http://www.nie.edu.sg/about-nie/teacher-education-21).

CHAPTER 14:

Spain

Editors' Overview

In Spain, state-issued guidelines direct much of the teacher education curriculum of all universities. This situation has been in force since the creation of Spain's education system in the 19th century. Multiple laws and royal decrees continue to define and develop the complex framework of this system.

Institutions and governance

Teachers in public schools in Spain are civil servants. To prepare these teachers, as well as teachers in private schools, Spain has 76 public and private institutions for primary teacher education (in faculties of education or schools of teacher education) and 28 for secondary mathematics teacher education (in faculties of mathematics). Private institutions must meet minimum conditions laid down by the Spanish government, but those not receiving public funds are free to establish their own internal rules, guidelines, and regulations. Before 2002, public institutions had to have their teacher education curricula approved by the Ministry of Education. After 2002, another public agency (the National Agency for Accreditation) took on this responsibility. Even the curriculum requirements established by and specific to individual universities must ultimately be validated by the national authorities and published in the official state gazette.

Program-types and credentials

At each level of education, the academic requirements for teaching are consistent throughout Spain, varying only with respect to the level taught. Primary education in Spain includes Grades 1 to 6. Compulsory secondary education includes Grades 7 to 12. Teacher education is aligned with these two school types. At present, a degree commonly called the teacher certificate and offering specialized preparation in primary education is required to teach students 6 to 12 years of age. Teachers at this level are generalists, usually teaching all subjects except foreign languages, physical education, musical education, and religion.

Until 2010, the teacher certificate took three years to acquire and was awarded by university schools of teacher education and associated entities. The curriculum and guidelines for this certificate dated back to 1995, and changed little in subsequent years. Secondary education candidates before 2010 were required to complete a five-year university degree and then to obtain a Certificate of Pedagogical Aptitude (CAP) at the end of a short-term course.

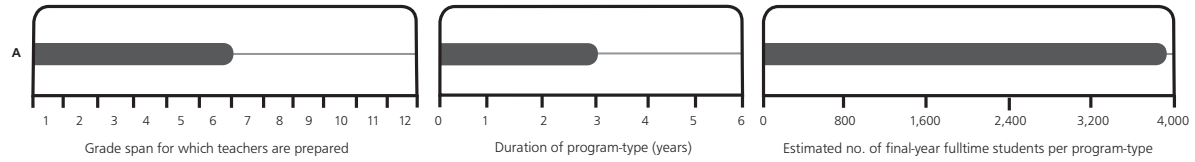
Note that TEDS-M in Spain was limited to primary education because of difficulties anticipated in collecting data from dispersed and hard-to-reach future teachers at the secondary level. Due to this omission, Exhibit 14.1 shows the simplest structure in TEDS-M, with only one program-type. This program-type is currently being modified and aligned with the Bologna Accord, adopted in order to "Europeanize" the continent's universities.

Curriculum content, assessment, and organization

The common core subjects for the primary teacher certificate are the psycho-pedagogical foundations of special education, general pedagogy, organization of educational institutions, educational and developmental psychology and school-age development, educational sociology, educational theory and contemporary educational institutions, and use of information and communication technologies (ICT) in education. The specific core subjects are natural science and its didactics, social science and its didactics, artistic education and its didactics, physical education and its didactics, foreign languages and their didactics, and language and literature and their didactics. Mathematics and its didactics vary considerably from one university to another. Students must also complete a practicum. National guidelines specify that the three years of study must include two weeks practicum in the first year, one month in the second, and two months in the third.

According to national policy, in order to be appointed to a teaching position in a government school, teacher certificate graduates must pass a fixed-quota competitive state examination, established for entry into the national civil service. The fixed quota is based on the number of vacancies in teaching available in a given year.[1]

Exhibit 14.1: Teacher education program-type in Spain



Key to program-type

A—Teachers of primary education

1 This selection process takes place in three phases. The first involves a written and oral test to assess knowledge of the curriculum to be taught, as well as of pedagogical and teaching resources. The second is an evaluation of the candidates' additional qualifications (their average grades during academic studies, teaching experience outside the civil service system, and even aspects such as participation in conferences). Candidates who successfully complete these two phases continue with another period of teaching practice, for at least three months, to further verify their aptitude for teaching

Preparing Teachers of Mathematics in Spain

Encarnación Castro Martínez and Pablo Flores Martínez

Part I: Context and Conditions of Teaching as a Career

Historical roots

Universal basic education arrived late in Spain. Although compulsory schooling was promulgated in 1857 and subsequently extended in 1964 to encompass children 6 to 14 years of age, this law did not become a reality until the middle of the 1980s.[2] Realization of the ultimate objective, a quality education for all, has yet to happen.

During this history, the preparation of primary school teachers was gradually upgraded from training at secondary school level to university level, a process strongly influenced and conditioned by historical, cultural, political, and social factors. But even though this process is still not entirely finished, it is now giving way to a new stage. Recent social and cultural forces have led to calls for further changes, and to widespread debate among stakeholders on what should be expected from teacher education. Today, the decisive force behind change is the incorporation of Spain into the European Space for Higher Education, as prescribed by the Bologna Accord.

The professional level and working conditions of primary school teachers in Spain remained precarious until the 1970s, even though their salaries had been covered by the state from the beginning of state-provided schooling. Scarcity of resources and large numbers of students relative to number of teachers were obstacles facing the teaching profession throughout this time, especially in rural areas.

The General Law on Education of 1970 (LGE)[3] began to overcome the negative legacy that had held the Spanish education system back. It brought about substantial improvement in both economic aspects and working conditions. The Organic Law on 1985[4] added to the momentum of modernization. A later Organic Law on Education (LOE),[5] passed in 2006, put even more emphasis on a quality education for every young person in Spain.

At the beginning of the 20th century, school provision in Spain was insufficient due to a scarcity of school places despite schooling being compulsory for six- to nine-year-olds. In 1908, the number of schools needed throughout the entire country fell short by 9,536 (Ruiz de Azua, 2000), and despite an insufficient number of teachers, teachers' professional preparation, salaries, and social prestige were far from optimal.

In Spain, teacher education at primary school level was likewise regulated by the state, which provided guidelines for each level of qualification. These guidelines in large part determined the teacher education curricula of all universities, a situation that has been the case ever since the beginnings of the education system in the 19th century. From that time on, the government began issuing directives aimed at regulating both the institutions where teachers were trained and the teaching that their graduates would undertake.

2 LOE, OSG (Organic Law on Education, *Official State Gazette*), May 4, 2006.

3 *OSG*, August 6, 1970.

4 *OSG*, July 4, 1985.

5 *OSG*, May 4, 2006.

The first teacher education institution, known as a normal school, was founded in 1839. This institution became a model that was to last for more than a century. Its curriculum was designed so that teachers could acquire not only a general education but also practical teaching experience in primary schools attached to the teacher education institution. This model spread. By 1845, 42 normal schools had been established in as many provinces. However, the normal schools had insufficient resources to carry out their mission and were in effect abandoned by successive governments between the years 1875 and 1931.

Nevertheless, teacher education did undergo some change in both the institution where teachers were trained and the teacher education curriculum. As a general rule, the period of teacher education was two years for the elementary teaching certificate and four years for the higher teaching certificate. Trainee teachers were enrolled at the age of 17 years in the case of men, and at 16 in the case of women. They came from the lower-middle classes, and nearly all came from rural areas; admission requirements were minimal (Puelles, 1985). The Moyano Law of 1858, which set the standard for primary teacher education up until the end of the 19th century, gave normal schools the status of professional institutions but not at the same level of prestige and resourcing as secondary schools and university faculties.

During the first decade of the 20th century, the educational efforts of successive governments focused above all on school reform and on primary teacher education. From 1908 to 1923, the state established 2,568 schools. By school year 1930/1931, Spain had 33,446 school buildings; by 1935/1936, there were 42,766 (Ruiz de Azua, 2000).

In 1914, the government amended the curriculum of normal schools, and this directive remained in effect until 1931. In line with government regulations, admission to normal schools was contingent upon passing an entrance examination directly after completing primary school. The duration of studies was four academic years, culminating in a final examination. Access to a civil service teaching position was through a competitive state examination.

The curriculum had a marked encyclopedic bias that worked to the detriment of pedagogy and the professionalization of teaching (Ruiz, 1998). In 1931, the government implemented a plan known as the Professional Plan, which granted primary school teacher education the status of university studies and mandated three stages of education to become a teacher: receipt of a Baccalaureate from a secondary school, three years in a normal school sanctioned by an overall test at the end of the course, and one year of teaching practice in a primary school. The plan also established coeducation in the normal schools, with male and female teaching staff, and direct access to state primary schools.

In contrast, the Law on Primary Education of July 17, 1945, which was proposed under the regime of General Franco and remained in force until 1967, favored the denominational and patriotic character of schools and recognized the authority of the Catholic Church to establish schools at any stage of education, as well as the right to inspect both state and private educational institutions on all matters relating to the Catholic faith and customs. Coeducation was prohibited, ideological neutrality disappeared, gender differences were insisted upon when establishing the content of education, and private institutions were promoted, especially those under the control of religious congregations. Their teaching staffs were not required to have the appropriate professional certificate: a certificate of

pedagogical aptitude was sufficient. Only 6,000 schools were built in the period from 1939 to 1951, and the shortage of school places exceeded one million. Furthermore, there was a shortage of teachers. With the Baccalaureate certificate no longer required for admission to normal schools, teacher education became downgraded. Finally, the number of teacher education students barely changed at all until the 1960s (Ruiz de Azua, 2000).

In 1970, the General Law on Education (LGE)[6] once again aligned primary teacher education with the university system. From then on, university schools of teacher education replaced the normal schools. The university schools provided initial teacher education for prospective preschool and basic general education teachers (today known as preprimary and primary school teachers).

In 1971, the government drew up a new a teacher education plan leading to the teacher certificate (in basic general education), with specializations in philology, humanities, and science. This plan, of an experimental nature, introduced several innovations, such as the requirement that individuals wanting to enter the schools of teacher education had to pass the final year of the Baccalaureate in order to be admitted. The plan also established direct access to the teaching profession for students with the best academic results and grouped curriculum subjects into three blocks: common core subjects, optional subjects, and specializations. Because each university adapted the plan according to its regional characteristics, and given the situation of their schools of teacher education (see below), the outcome was a wide variety of curricula for future teachers, much of which often depended on circumstances that were not educational in nature.

In addition to incorporating teacher education into the university system, the General Law on Education[7] introduced some changes in primary education (now called basic general education) and in the two branches of secondary education—vocational education and Baccalaureate. Basic general education teachers now had to teach extended primary school courses and age groups up to the age of 14.

In recognition of their new status and the functions they were obliged to perform, university schools of teacher education required a new organizational and regulatory framework. Although some attempts were made to do this, the situation was not resolved until enactment of the Organic Law on the General Organization of the Education System of 1990 (LOGSE).[8] This law introduced further changes in primary education, converting it into a new level of schooling for students from the ages of 6 to 12. At the same time, students aged 13 and 14 were transferred to compulsory secondary education. That event, in turn, prompted a reassessment of the needs of primary school teachers, who considered their position undermined.

A royal decree published in the *Official State Gazette* on October 11, 1991, established new guidelines for the teacher certificate, with seven specializations: preprimary education, primary education, physical education, music, special education, foreign languages, and hearing and speech therapy. The curriculum included four types of subjects:

- *Common core subjects*, compulsory for students at all universities;

6 *OSG*, August 6, 1970.

7 *OSG*, August 6, 1970.

8 *OSG*, October 4, 1990.

- *Obligatory subjects*, proposed by each university and compulsory for all students at that university;
- *Optional subjects*, proposed by each university for a major field of study; and
- *Elective (free choice) subjects*, offered by the university in order to provide greater flexibility in the curriculum and to give students some choice in the subjects they wished to take.

In 2002, enactment of the Organic Law on Quality in Education (LOCE)[9] saw the structure of education up to university level maintained (as proposed by the LOGSE[10]) and the establishment of a general legal framework for teaching staff. Then, after considerable debate, the Spanish parliament passed yet another Organic Law on Education (LOE)[11] in a plenary session on December 15, 2005. This law once again addressed the question of how initial teacher education could best meet the certification and qualification needs of the education system. In particular, Article 100 provided for adaptation of initial teacher education to the graduate and postgraduate system of the European Space for Higher Education, a process to be completed by the year 2010.

Conditions at the time of TEDS-M

The Spanish Constitution of 1978 decreed that all Spanish citizens have the right to education. The public authorities offer public education in order to guarantee this right. However, the constitution also guarantees the right to freedom of educational provision and, consequently, recognizes the rights of Spanish citizens and legal entities to create private educational institutions. This right has resulted in a "dual system" in which state institutions are owned by a public authority, and private institutions are owned by a person or a legal entity, and must be registered as such in accordance with Article 13 of the above law.

Some private educational institutions are supported through public funds and are known as grant-maintained institutions. These institutions must meet a number of minimum conditions laid down by the government regarding educational provision. Private institutions that do not receive public funds are free to establish their own internal rules of procedure, select their teaching staff (provided they are duly qualified), set admissions procedures, lay down their own rules and regulations, and determine tuition fees.

The total number of teachers in pre-university education in Spain in academic year 2004/2005 was 583,426. Of this number, 426,989 (or 73 percent) were in state schools and 156,437 (27 percent) were in private schools.

The working and social conditions of teachers vary according to whether the educational institution they work in is publicly or privately owned. In state institutions, teachers are civil servants or substitute teachers, whereas teachers in private institutions are employees working on a contractual basis. Teachers in the state sector therefore belong to a national system that largely conforms to a career-based model (OECD, 2005). They spend their entire working lives in the public service. Entry to an official teaching institution is usually by means of a competitive state examination. However, when the General Law on Education of 1970 was in force, "direct access" to such an institution

9 *OSG*, December 24, 2002.

10 *OSG*, October 4, 1990.

11 *OSG*, May 4, 2006.

was allowed. On acquiring civil servant status, a teacher is appointed to a position, that is, one of the vacancies still open after all civil service teachers have had opportunity to apply for a transfer through the nationwide competitive process covering these vacancies.

Every year the number of students who graduate from schools of primary teacher education and faculties of education is higher than the number of teachers required by both the private and state sectors of the education system. This situation means there are many more candidates than vacancies in primary schools.

This surplus of primary school teachers has been the outcome, in part, of a decrease in the number of students in the 6 to 12 age group because of a fall in the birth rate. Some of these surplus primary teachers, especially those who had completed the second cycle of university studies and had specialized in science or language, were transferred to compulsory secondary education schools. As a result, the needs for teaching staff were satisfied at both the primary and compulsory secondary levels.

At the time this chapter was written, the average age of primary school teachers was over 40, with relatively few teachers under 30 years of age. Also, as evident in Exhibit 14.2, the percentage of females in Spain's teaching force is lower than both the EU19[12] and OECD averages (2006 figures). This difference is particularly noticeable in the pre-university levels of education. Even so, the percentage of females in Spain at these levels is over 50 percent, providing evidence of feminization of the teaching profession, at least at the lower levels of education.

Exhibit 14.2: Average percentages of females in the civil service teaching workforce in Spain compared with average percentages in EU and OECD countries

Education Sector	Spain (State Schools) (%)	European Union (%)	OECD (%)
Preprimary	91.30	95.80	96.10
Primary	69.00	81.50	75.30
Secondary	60.30	68.00	64.80
Postsecondary	48.50	55.40	51.90
Tertiary	38.40	38.70	38.20
Total	60.50	66.90	64.10

Source: OECD (2006).

The number of hours that civil service teachers are required to work per week is the same as the hours for all civil servants, that is, 37.5. However, teachers are only obliged to stay in the institution for 30 hours per week. The teaching load in preprimary and primary education is 25 hours a week, while in secondary education it amounts to 18 hours per week. The remaining time is for, among other activities, class preparation and professional development, which may be done away from the institution.

Official holidays for teachers in both the state sector and the private sector are established by statutory regulations: one month in summer, plus the same holidays as the students at Christmas (around 15 days) and Easter (approximately eight days). Because teachers

12 Refers to all countries that were members of the European Union (EU) before May 1, 2004, as well as the four eastern European member countries of the OECD—the Czech Republic, Hungary, Poland, and the Slovak Republic.

in the state sector further adjust their working calendar to fit the school calendar, the majority of teachers do not have any teaching responsibilities from the first of July to the 31st of August.

The state pays the salaries of primary school teachers, whether they are working in state or grant-maintained schools. Initial salaries are relatively high, with a bonus based on length of service and on the General Law on Civil Service Employees. Salary increases are usually based on length of service and on undertaking professional development courses. Exhibit 14.3 shows the salaries (in US dollars) of primary school teachers in Spain and in the European Union and OECD countries in 2004. It can be seen that the average salaries in Spain in state educational institutions in 2004 at each level of experience amply exceeded the averages in both the European Union and the OECD. However, this difference decreases with years of experience (Rico, 2000). In 2004, teachers' salaries were higher in Spain than in neighboring countries, except at the top of the scale, where Portugal and Germany had the highest salaries.

Exhibit 14.3: Average salaries of civil service teachers in Spain compared with average teacher salaries in EU and OECD countries (US$ as of 2004)

Education Sector	Spain	European Union	OECD
Starting salary	$31,381	$26,006	$25,727
After 15 years	$36,342	$34,684	$35,099
Top of scale	$45,334	$41,945	$42,347

Source: OECD (2006).

Exhibit 14.4 shows the salary differences between primary teachers, secondary teachers, and university lecturers in academic year 2002/2003. The exhibit table has two points of reference: teachers' salaries at the beginning of their teaching career, and teachers' salaries after 30 years of service. It is noteworthy that the salary of a recently appointed primary teacher is slightly higher than that of a university lecturer, and 14 percent lower than that of a secondary teacher. However, after 30 years, the three salaries have increased at a different rate: 42 percent higher in primary education, 49 percent higher in secondary education, and 120 percent higher in university education.

Exhibit 14.4: Gross annual salary of civil service teachers in Spain across their career (figures for academic year 2002/2003)

Type of Teacher	Initial Salary in US$	Salary in US$ after 30 Years
Primary school teacher	22,786	32,285
Secondary school teacher	26,444	39,379
University lecturer	22,691	49,908

Source: http://www.ince.mec.es/pre/que_inecse.htm

Other factors besides salaries limit the appeal of teaching. Once Spanish teachers have obtained a post, they have little incentive to continue with their professional development, since from beginning to end teaching offers very few career advancement opportunities. The centralization of the legislative process and the organization of education by Spain's central government and the country's autonomous communities,[13]

13 Spain's autonomous communities were mandated by the Spanish Constitution of 1977. Currently, there are 17 such communities and two autonomous cities. Each can exercise its own executive, legislative, and judicial power within the constraints set by Spain's national constitution.

all far removed from educational institutions, have generated excessive regulations that limit the capacity and the incentive of institutions to respond to local conditions. Nevertheless, the employment situation in Spain remains such that a position in a state primary school is attractive in regions where there is a scarcity of professional work. This is not the case in urban, industrial areas, where the characteristics of the career advancement system and the low social esteem of teaching, among other reasons, make the profession a relatively unattractive one.

Part II: Organization and Characteristics of Teacher Education

Although the academic qualifications required to teach are the same throughout Spain, they do vary according to the different levels of the education system.[14] Programs of study leading to the teacher certificate are provided by university schools of teacher education and faculties of education and by the teacher education institutions associated with these faculties.[15] The majority are state institutions, although some are private. Within the state sector, there are two types of institution—state-owned and associated. Associated institutions sign an agreement with a state university that entitles them to award the same certificates as the university.

The principle of university autonomy, established in Spain's constitution and further developed in the Organic Law on University Reform[16] and the Organic Law on Universities,[17] gives each university a separate legal personality and management powers. By virtue of this principle, state universities can formulate their respective statutes, and private universities can formulate their own organizational and operational rules. The universities also have the autonomy to carry out their own corporate governance, personnel and resource management, and academic functions. They have the legal capacity to prepare and implement the curricula for the various university degrees awarded. However, before implementing a curriculum, the university must prove that it complies with the common general guidelines established by the government, which can seek this assurance itself or rely on a report from the university's coordination council, or on a proposal from the council.

In order to teach in secondary education, which includes compulsory secondary education, Baccalaureate education, and specific vocational education, candidates must have a university *graduate* degree (or the equivalent). The Organic Law on the General Organization of the Education System requires future secondary teachers to complete a five-year university degree course and obtain the Certificate of Pedagogical Aptitude (CAP). This certificate is given in 16 specializations, corresponding to the different subjects taught in secondary education. The certificate is taught over a nine-month period (one academic year) and includes theoretical and practical subject matter as well as teaching practice supervised by practicing teachers in secondary schools.

14 These qualifications are set out in the Organic Law on the General Organization of the Education System of 1990 (*OSG*, October 4, 1990) and the Organic Law on Quality in Education of 2002 (*OSG*, December 24, 2002). The teacher certificate, which individuals must have in order to teach in preprimary education (catering for children 0 to 6 years of age) and in primary education (6 to 12 years of age), is regulated by Royal Decree 1440/1991. This decree also provides details on the specializations and general guidelines for the curricula leading to the award of this certificate.

15 Institutions in Spanish universities have one of three names: faculty, school, and institute. The name "school" is given to institutions whose qualifications are of a professional nature. There are two types of school: higher schools and university schools. The degree courses of higher schools take five or more academic years to complete. The degree courses of university schools take three academic years. "Institutes" are institutions dedicated to research or to providing specific education programs to postgraduates.

16 *OSG*, September 1, 1983.

17 *OSG*, December 24, 2001.

The CAP was first taught in institutes of educational science. These institutions, which were established under the General Law on Education and belonged to the universities, were responsible for both initial teacher education and continuing professional development. They were created inside universities but remained independent of the faculties. Not having their own teaching staff, they contracted for teachers from different levels of education as needed. These teachers taught the CAP apart from their professional work in university or preuniversity educational institutions.

According to the TEDS-M national report for Spain, these features, combined with a lack of good organization in most cases, meant that the preparation of future teachers in the institutes of educational science differed from preparation in other programs and, in some cases, were very deficient in quality. Over time, the institutes of educational science gradually disappeared, and today different official bodies belonging to the universities are responsible for developing and implementing courses in pedagogical aptitude. Effort was also made during this time of transition to replace the CAP, under the provisions of the Organic Law on Quality in Education, with the Teaching Specialization Certificate, but the latter failed to consolidate its position.

In order to improve this situation, a proposal was put forward in 1995 for a pedagogical qualification course (Royal Decree 1692/95) that would mean extending secondary teacher education by two years. That, in turn, meant a significant increase in credits and opened up the possibility of faculties of education participating in teacher education for secondary teachers. This proposal was not, however, put into practice because of political vicissitudes and because the pedagogical qualification component required a greater investment in time and money than the CAP.

New regulations established by the Organic Law on Education of 2006 and the Organic Law of 2007, which had the effect of amending the Organic Law on Universities of 2001,[18] modified the structure of university programs and curricula in accordance with the European Higher Education Area. This legislation also established a new way for individuals to qualify as secondary teachers in Spain. The new regulations, which came into effect in 2010, brought in a four-year specialized degree, followed by a Master's course called the Master for Secondary Education Teachers.

Teacher education in private educational institutions is carried out through programs developed by the institutions themselves, as well as in professional colleges, business organizations, unions, and other institutions.

Curriculum and field experience requirements

Primary school teachers must be prepared to teach all the curriculum subjects at this level of education, with the exception of those subjects reserved for specialists (specifically, foreign languages, physical education, music, and religious education). Development of a teacher education curriculum, whether for the primary or secondary level of schooling, begins with guidelines published by the corresponding ministry (generally, the Ministry of Education) in the *Official State Gazette*. These guidelines specify the total number of credits the qualification must have, the common core subjects and their corresponding number of credits, the number of compulsory credits that the university can propose, and the optional and free choice subjects from which students can choose.

18 *OSG*, April 13, 2007. See also the royal decree published in the *Official State Gazette* of October 30, 2007, establishing the organization of official university studies. For further details and documents, see the Ministry of Education and Innovation website (http://web.micinn.es).

According to the general guidelines for teacher education curricula set out in Royal Decree 1497/1987, which are common to all universities, the overall requirement for these studies should not be fewer than 180 credits. Coursework time can vary from 20 to 30 hours per week, including teaching practice, and under no circumstances can the time dedicated to theoretical knowledge of teaching exceed 15 hours per week.

Those universities introducing degree courses in teacher education establish a committee whose responsibility is to prepare a specified curriculum. Once the committee has completed this work, its members must submit the curriculum for approval to the board of the institution (faculty or university school), which then sends it to the rector of the university who hands it on for further review to a committee that the rector approves. After completion of these formalities, the curriculum has to be validated by a ministerial committee and published in the *Official State Gazette* before it can come into effect.

The curriculum and guidelines for the primary teacher certificate date from 1995 and have barely changed since then. The curriculum for graduates in mathematics dates from 1990, but has been partially changed in various ways by the different Spanish universities teaching this qualification. Assessments of these qualifications by the National Agency for Quality Assurance and Accreditation have detected strengths and weaknesses with regard to, among other features, the content of the subjects, the development of this content, and the availability and nature of teaching and learning facilities.

The common core subjects, which are the basis of study programs for primary teachers, established without prejudice to university autonomy, are the following: psycho-pedagogical foundations of special education (8 credits), general pedagogy (8 credits), organization of educational institutions (4 credits), educational psychology and school-age development (8 credits), educational sociology (4 credits), contemporary educational theory and institutions (4 credits), and use of ICT in education (4 credits), giving a total of 40 credits.

The *specific core subjects* for primary education are natural science and its didactics (8 credits), social science and its didactics (8 credits), artistic education and its didactics (4 credits), physical education and its didactics (4 credits), foreign languages and their didactics (4 credits), language and literature and their didactics (12 credits), mathematics and its didactics (8 credits), and the practicum or initial teaching practice (32 credits), for a total of 80 credits specific to primary education.

Additional to these common core subjects are the *compulsor*y subjects for each area of specialization. Compulsory means that these subjects are common to all teacher education curricula throughout Spain. However, each university has sufficient autonomy to establish compulsory subjects for its students and to offer a complement of optional and free-choice subjects.

Comparative studies on the curricula of 68 different universities (Ruiz, 1998) show considerable variation in the number of compulsory credits (i.e., the common core subjects and the compulsory subjects of each university). Twenty percent of the institutions surveyed had more than 16 compulsory credits; 22 percent had fewer than 12. More than half of the universities (58 percent) had between 12 and 16 credits.

These same studies revealed major differences across the universities with regard to the subjects presented under the umbrella of mathematics and its didactics. These

differences included the names given to the subjects, the distribution of these subjects throughout the academic years, their number of credits, and the descriptor names. This same variation from university to university was evident even when subjects relating to mathematics and its didactics were presented as optional subjects. At the time of writing, five universities were offering no such optional subjects, and two were offering, as mathematics options, the subjects of other specializations. The optional subjects relating to mathematics and its didactics identified by the surveys were information technologies (37 institutions), statistics (25 institutions), mathematics laboratory/ workshop (22 institutions), problem-solving (20 institutions), and recreational mathematics or games (8 institutions).

Initial teacher education for primary schools has two phases of teaching practice: *practicum* experiences within the university-based program, and *teaching practice* for graduates who have passed the first two parts of the competitive state examination to become civil service teachers. The practicum is a required core subject during initial teacher preparation, with the teaching load set at 32 credits, which is equivalent to 320 contact hours. Faculty members from the university institutions are responsible for developing the practicum and for taking part in it by monitoring and supervising the future students during their practicum time in primary schools. Each practicum student has a tutor. This person is the classroom teacher where the student is placed.

The general guidelines for the teacher certificate established that the practicum should be spread out over the three years of study: two weeks in the first year, one month in the second, and two months in the third academic year. During the first year, students are expected to gain an initial sense of the reality of working as teachers in schools, and in the second, to acquire a general knowledge of the school, as well as a general approach to teaching. In both years, students can have any teacher as their practicum tutor, irrespective of area of specialization. The practicum in the third academic year is considered to be of a specific nature, so students must do it in their own area of specialization. This means that their tutors must be specialist teachers in the same subject, whereas the practicum in the first and second year is generic in character.

As a general rule, the function of tutors is to introduce their student teachers to teaching practice and to advise them on pedagogical and other teaching matters. Tutors also assess their students' performance during teaching practice, following guidelines given out by the corresponding university institution. Usually, a tutor is expected to be responsible for only one future teacher during each practicum period of any one year. Faculty supervisors, however, usually oversee at any one time the teaching practice of a group of 15 to 20 students, maintaining contact with them through regular seminars or emails, responding to their requests, and providing subject-based information as well as pedagogical and teaching support.

The process of assigning students to practicum placements in primary schools generally takes place as follows. First, the state and private primary schools that wish to participate in a practicum submit a request to the teacher education institution (in some cases, this request is channeled through the local education office in the city) indicating they are willing to accept students. Next, after studying the requests, the teacher education institution draws up a list of available places and specializations. The institution makes these lists available to the student teachers, who must, by a specified date, choose several institutions from this list, in order of preference, where they would like to do their practicum. The teacher education institution then assigns each student to a school,

having taken into account that student's preferences, and any preferences the schools might have as to type of trainee teacher. A school can also offer to take in a particular student, in which case the place is removed from the list.

Future secondary school teachers doing the course in pedagogical aptitude (CAP) or the pedagogical qualification course (CCP) must also undertake a practicum. Each practicum student is supervised by a secondary school teacher who has specialized in the same subject area or areas as the student. Thus, future teachers intending to teach mathematics do their practicum in secondary schools under the tutelage of a secondary school teacher of mathematics. Each such teacher may be responsible for several prospective teachers during the course of a practicum, which usually extends across four weeks.

During the recommended time at the school of 20 hours per week, each student teacher must attend the classes given by the classroom teacher, first sitting in as an observer, later as a participant, and, finally, preparing and giving at least one class to one of the groups taught by the teacher. The teacher tells the student teachers the content of the topics they will teach so that they can prepare and give the teacher a lesson plan. After the class, the teacher evaluates each student's performance in private interviews or in seminar sessions with the other students on teaching practice. At the end of this practicum, each future teacher has to prepare a report on his or her practical teaching experience in the school.

A second period of teaching practice takes place after graduation for university teacher accreditation. This practice is part of the competitive state examination for entry to teaching, and it is strictly regulated by Royal Decree 276/2007 in order to verify the aptitude of the selected candidates for the teaching profession. It is carried out under the tutelage of experienced teachers and extends over more than three months but fewer than 12 (one school year). During this teaching practice, candidates are based in primary or secondary schools and have all the responsibilities of a primary or secondary school teacher.

Just a few years before the TEDS-M survey, the Spanish government published two summary books ("white papers") in anticipation of the changes to teacher education curricula required by the European Space for Higher Education. One of the papers concerned the primary school teacher certificate (National Agency for Quality Assessment and Accreditation, 2005) and the other the graduate degree in mathematics (National Agency for Quality Assessment and Accreditation, 2004).

The white paper on primary teaching pointed out that the creation of subject specializations in primary education had led to extraordinary improvements in the areas of music, physical education, special education, hearing and speech therapy, and foreign languages. However, some undesirable deviations had crept into the system as well. Since 1991, education authorities had considered that all teachers of the six specializations would have the same teaching competencies in the areas of language, mathematics, social studies, and artistic education, but this was not borne out by the preparation specialist teachers were actually receiving in these subject areas. Also, in addition to these specialist teacher qualifications, a generalist teacher of primary education qualification had been created, and it further muddied the waters with regard to consistency of teaching competencies.

When commenting on the current system of primary teacher education in general (i.e., encompassing different specializations), the white paper on the mathematics degree concluded that this system was totally ill-suited to the needs of the modern labor market because it did not prepare teachers who could help ensure that primary education achieved this aim. The white paper proposed that teacher education should therefore offer two degrees in teaching, one for preprimary education, and the other (of 240 European credits) for primary education. It also recommended with regard to the mathematics degree course that it should comprise 240 European credits, corresponding to four years of study, and include the minimum number of core mathematics subjects permitted by law. On the basis of labor-market surveys, the authors of the white paper determined that the mathematics subjects within the degree should focus on three areas: applied mathematics, educational mathematics (which includes teacher education at secondary and university levels), and academic mathematics.

Staffing requirements

The essential requirement for anyone wanting to be a university teacher of any subject area is to have a university degree in that area of knowledge. When a university faculty or department wants to fill a teaching position, it calls for applicants on a competitive basis and uses the curricula vitae (CV) of the individuals who respond as a screening device, taking into account both the teaching and research acumen included in those documents.

In Spain, it is assumed that any new university teacher is qualified to teach any year and degree course within the purview of the department that has appointed him or her. In universities, the department of didactics of mathematics is responsible for teacher education in mathematics. To be hired to this department, an applicant must have a degree in mathematics. Although formal preparation in mathematics pedagogy is not required, it can be important in influencing who is hired, as explained below.

Teacher education in mathematics for future secondary school teachers of that subject is provided by staff in departments of mathematics in the science faculties (each of which preferably offers courses in mathematical analysis, algebra and topology, geometry, statistics and applied mathematics). Likewise, in order to be hired to these departments, a candidate needs to be a graduate in mathematics. A good academic record is essential because it means the applicant may bring research grants to the department should he or she be hired.

Whenever a university department announces a teaching staff vacancy, many applications are the usual result. Consequently, applicants go to great lengths to provide a CV (citing, for example, a doctoral thesis, publications, and other competitive advantages) that they hope will favorably single them out from the other applicants. In the case of departments offering courses in the didactics of mathematics (which preferentially deals with primary teacher education, but also collaborates in the Certificate in Pedagogical Aptitude and in some subjects of the degree courses in mathematics), these advantages include teaching other educational levels and having published or being able to publish resources relevant to teaching in general and mathematics teaching in particular. In the departments of mathematics, in contrast, mathematics research, not teaching, is considered to be of prime importance.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

Attractiveness of teaching as a career

Initial salaries for teachers in Spain are relatively high. Although there are few career development and advancement opportunities, teachers can expect salary increases essentially based on length of service and undertaking professional development courses. The pension scheme for teachers is linked to a percentage of the base salary of civil servant teachers.

The employment situation in Spain means that a position in a state primary educational institution is attractive in regions where there is a scarcity of professional work but not so attractive in industrial areas. Also, according to teachers, the characteristics of the career advancement system within teaching, the low social esteem in which the profession is held, and various other reasons makes the teaching profession a generally unattractive one.

Entrance requirements

Under the Spanish constitution, universities have considerable autonomy over student selection. Each university proposes the number of students to be admitted to its degree courses, with the number based on the university's existing teaching staff or the number of teachers who can be hired for the courses according to budgetary constraints, as well as the seating capacity of the institution (basically, the number of classrooms). The final number of places on offer is determined by the university's council and its general assembly on university policy. Once the number of student places has been established, the entrance requirements for admission to university schools and faculties are the same as those for all university studies.

The mathematical abilities of future primary teachers vary widely when they enter university. There are no special requirements with regard to mathematical knowledge, nor do these prospective teachers have to take a specific test in order to enroll in the course of studies leading to the teaching qualification. Students entering the primary route are typically described as average and below average achievers for their age group.

The entry requirements for prospective secondary school mathematics teachers are the same as those for all other disciplines. While applicants must have passed the secondary school Baccalaureate degree in any of its specializations, those who have passed the science and technology or the natural and health specializations are given priority. Applicants must then pass a university entrance examination with a result high enough to be accepted to the mathematics or other science faculties. Once these individuals have obtained their university degree, they are required to enroll in a short pedagogy course. In Spain, the requirements of the Bologna Accord recently led to this program of study being developed into a two-cycle program—a degree in mathematics or science and a Master's in secondary education pedagogy.

Accreditation of teacher education institutions and programs

The National Agency for Quality Assurance and Accreditation, established in 2001 as the Spanish agency responsible for quality evaluation, accreditation, and certification of higher education, verifies and accredits all curricula leading to an official university

degree. It also carries out inspections of tertiary education institutions every six years, and it assesses and accredits the teaching staff. However, at the time of the TEDS-M survey, not one teacher education program had been the subject of such a procedure.

Spain is in a period of rapid change with respect to the regulation of teacher education institutions. Universities have traditionally enjoyed a high degree of autonomy, but the central government (generally operating through the Ministry of Education on matters educational) has again established common curriculum guidelines for teacher education programs that align with those previously established by royal decree in 1991 and described earlier in this chapter. As such, the guidelines cover the following:

- The number and names of subjects that all universities must teach (i.e., the compulsory common core subjects);
- The number of subjects that each university can self-determine and then provide on a compulsory basis for all students at that university;
- The number of optional subjects that each university can provide (these generally correspond to specified branches of study); and
- The elective subjects the university can offer in order to provide students with choice and greater flexibility in the university's curricula.

The 2006 Organic Law on Education states that the contents of preservice teacher education must ensure that future teachers acquire the teaching skills necessary to deal with the challenges facing not only the education system but also the country. It established that initial teacher education had to adapt by 2010 to the graduate and postgraduate systems of the European Space for Higher Education. Accordingly, today, curricula have to be validated by the National Agency for Quality Assurance and Accreditation or similar agencies in the different autonomous communities, and published in the *Official State Gazette* before they can come into effect. The year 2010 was also set as the date by which the quality assurance agencies and other such agencies were to have verified and accredited all the new degrees for primary school teachers and the Master's degrees for secondary school teachers of all the Spanish universities that intended offering them.

On deciding to introduce a new degree course in teacher education, universities establish a committee with responsibility for preparing a related curriculum. The members of this committee include a person in authority from the corresponding university, several teachers of the common core subjects, each of whom is selected by the Ministry of Education, and (sometimes) a graduate. Once the committee has drafted the curriculum, it must go through the approval process described earlier in this chapter. Only when it has been approved can it come into effect.

Requirements for entry to the teaching profession

As noted earlier, teachers in Spain's state sector are civil servants of the central government or of the different autonomous communities. In order to be appointed to a teaching position in a state primary school, graduates with a teacher certificate[19] have to pass a postgraduate competitive examination designed by each autonomous community, according to national criteria. The selection process has three phases:

1. *The state examination:* This consists of written and oral tasks, designed to assess not only candidates' knowledge about the areas of the curriculum they have to teach

19 Certain other certificate or degree holders are also eligible to take this examination.

in primary school classrooms but also their command of pedagogical and teaching resources.

2. *The competitive phase:* During this phase, candidates are considered on their merits, which relate, among many others, to the marks obtained during academic studies, other qualifications, teaching experience outside the formal system (e.g., as a supply teacher), and participation in or attendance at conferences.
3. *The intern teaching (practice) phase:* Applicants who have successfully traversed the first two phases are required to demonstrate their teaching proficiency in the classroom, which is a course component usually of about six months' duration.

In order to be admitted as a registered secondary school teacher of mathematics, candidates must be university graduates, architects, or engineers. They must also have completed the required teaching course and sat the specified state examination in the area they are going to teach. This examination is similar to the one described for primary teachers, but it includes tests of mathematics knowledge and the teaching of mathematics.

In certain cases, an individual can be appointed to a teaching post in a state educational institution without completing all of the above credentialing requirements. Substitute teachers are one example. This situation occurs when a vacancy cannot be otherwise filled or when there is a need to stand in for a civil servant teacher on leave. The people who typically fill these examinations have taken the above-mentioned competitive state examination but have not obtained a post as a civil-servant teacher. Their appointment is for a limited period of time, and their teaching status can be revoked when their services are no longer required.

References

General Law on Education (LGE). (1970, August 6). *Official State Gazette.* Available online at http://www.mecd.es/mecd/atencion/educacion/hojas/E_SistemaEduc/e-1-1.htm

National Agency for Quality Assurance and Accreditation. (2004). *White paper on the graduate degree in mathematics.* Madrid, Spain: Author. Available online at http://www.aneca.es/var/media/150436/libroblanco_jun05_matematicas.pdf

National Agency for Quality Assurance and Accreditation. (2005). *White paper on the graduate degree in teaching.* Madrid, Spain: Author. Available online at http://www.aneca.es/var/media/150404/libroblanco_jun05_magisterio1.pdf

Organic Law 4/2007 Amending the Organic Law on Universities 6/2001. (2007, April 13). *Official State Gazette.* Available online at http://www.boe.es/boe/dias/2007/04/13/pdfs/A16241-16260.pdf

Organic Law on Education (LOE). (2006, May 4). *Official State Gazette.* Available online at http://www.mec.es/mecd/gabipren/documentos/A17158-17207.pdf

Organic Law on the General Organization of the Education System (LOGSE). (1990, October 4). *Official State Gazette.* Available online at http://www.mec.es/mecd/atencion/educacion/hojas/E_SistemaEduc/e-1-4.htm

Organic Law on University Reform (LRU). (1993, September 1). *Official State Gazette.* Available online at http://www.usal.es/~agptu/legis/LRU.html

Organic Law on Universities (LOU). (2001, December 24). *Official State Gazette.* Available online at http://www.mec.es/mecd/atencion/educacion/hojas/E_SistemaEduc/e-1-2.htm

Organic Law on Quality in Education (LOCE). (2002, December 24). *Official State Gazette.* Available online at http://www.boe.es/boe/dias/2002/12/24/pdfs/A45188-45220.pdf

Organic Law Regulating the Right to Education (LODE). (1985, July 4). *Official State Gazette*. Available online at htttp://www.mec.es/mecd/atencion/educacion/hojas/E_SistemaEduc/e-1-3.htm

Organisation for Economic Co-operation and Development (OECD). (2005). T*eachers matter: Attracting, developing and retaining effective teachers*. Paris, France: OECD.

Organisation for Economic Co-operation and Development (OECD). (2006). *Education at a glance*. Paris, France: Author.

Puelles, M. (1985). *Educación e Ideología en la España contemporánea* [Education and ideology in contemporary Spain]. Barcelona, Spain: Labor.

Ruiz, L. (1998). Análisis de los temarios de las asignaturas troncales y obligatorias de didáctica de la Matemática en la formación de educación infantil y primaria [Analysis of the agendas of the core and compulsory subjects of mathematics teaching in early childhood education and primary schools]. In C. Abraira, & A. Francisco (Eds.), *La formación inicial de los profesores de primaria y secundaria en el área de didáctica de las matemáticas* [The initial training of primary and secondary teachers in the area of mathematics education] (pp. 35–54). Leon, Spain: Faculty of Education, University of León.

Ruiz De Azua, E. (2000). Un primer balance de la educación en España en el siglo XX [An initial assessment of education in Spain in the 20th century]. *Cuadernos de Historia Contemporánea*, *22*, 159–282.

CHAPTER 15:

Switzerland

Editors' Overview

Switzerland's teacher education system has changed in fundamental ways in the last two decades, moving toward integrating teacher education into higher education, a process experienced in other countries long before this. At the same time, the Swiss have reduced, but by no means eliminated, important differences between cantons. In addition, Switzerland remains exceptional in the number of different subjects that future teachers have to study.

Institutions and governance

According to the country report, Swiss teacher training was not only diverse in the early 1990s (before the higher education integration process started) but also, in many respects, "arbitrary." There were virtually no mechanisms for coordinating and harmonizing teacher training from one canton to another. At that time, teacher education took place in 153 different institutes. Under the reform, a limited number of teacher training schools began the transformation into universities of teacher education, a process that is now almost complete.[1]

Future teachers are typically required to qualify for university entrance by gaining the *Matura*, a qualification awarded on the basis of passes in final examinations and students' academic record in the final year of secondary school. Students who do not have this diploma can still gain admission by sitting and passing a special entrance examination.

As a result of this reform, cantonal parliaments have lost some of their power over teacher education while rectors of universities of teacher education, who can now draw on increased institutional autonomy, are playing a more decisive role. The federal government has no role in teacher education whatsoever, except for vocational schools.

Previously, each canton decided whether to recognize the certificates of other cantons. However, the Swiss Conference of Cantonal Ministers of Education (EDK) has agreed that teaching certificates from EDK-approved teacher education institutions are now valid in every canton.

1 In 2004, the older teacher training schools issued 60 percent of the teaching certificates at the preschool and primary school levels, while the universities of teacher education issued 31 percent and the traditional universities 9 percent. Since 2006, however, teacher education for preschool, primary school, and lower-secondary school has been mainly offered at 13 universities of teacher education, and at three of the traditional universities.

Program-types and credentials

Despite cantonal autonomy and variation, the overall structure of Swiss teacher education in the TEDS-M survey (carried out only in German-speaking institutions in Switzerland) is relatively simple. It consists of the following program-types, as portrayed in Exhibit 15.1:

- Teachers of secondary school Grades 7 to 9;
- Teachers of primary school Grades 3 to 6;
- Teachers of primary school Grades 1 to 6;
- Teachers of primary school Grades 1 to 2/3.

Curriculum content, assessment, and organization

Primary teachers teach the core primary subjects as well as music, art, physical education, and other such subjects. Lower-secondary teachers also teach multiple subjects, but they usually choose between a language/history-oriented cluster and a mathematics/science- oriented cluster. Future teachers preparing for primary school generally take six to eight subjects, thus putting more emphasis on a wider range of subjects than countries that concentrate on only a few core subjects. Most primary teacher education includes German, French, English, and/or Italian,[2] mathematics, art, physical education, history, information technology, geography, science, and instrumental instruction. Additional coursework in education is integrated into the program-types from their beginnings.

Secondary teaching candidates generally become qualified to teach three to five subjects. The combination of subjects is mandated in some institutions and is elective in others.[3] The practicum ranges from 2 to 12 weeks, with an average of seven. Some universities add on-the-job training in the social or business sectors or foreign-language study trips to this practicum requirement.

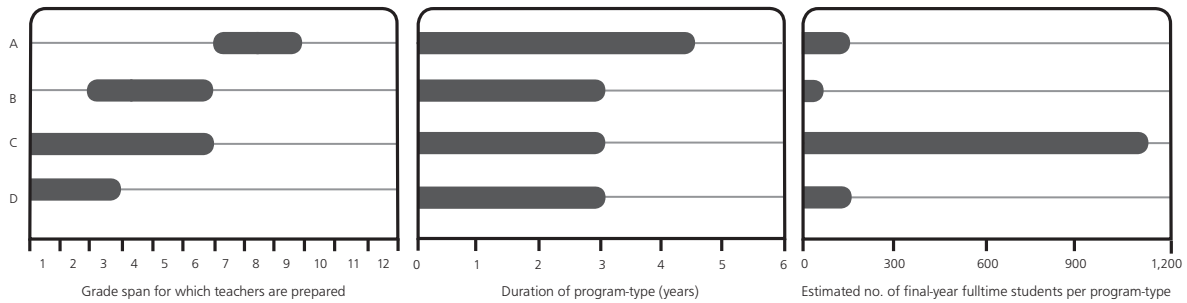
In primary school teacher education, interim and final examinations are handled quite differently by the cantons. Some cantons have no real final examinations. In most cantons, though, examinations for primary future teachers are held for up to 10 subjects. The timing and modalities of these examinations also differ.[4] Success on a teaching test consisting of one or two lessons is required. Likewise, there are major differences in assessment across the universities offering education to lower-secondary future teachers. However, oral and written final examinations for at least three subjects take place almost everywhere. The practicum and a dissertation component of the degree are also assessed.

2 Italian is only required within the Italian-speaking cantons.

3 In either case, this combination is drawn from a comprehensive set of subjects from the humanities and mathematics/natural sciences (mathematics, biology, chemistry, physics and, in rare cases, information technology). Subject-matter content and subject-specific pedagogy are expected to comprise at least 40 percent of the program-type, the education sciences at least 20 percent, and practical training at least 10 percent.

4 They include not only written but also oral examinations, covering the general education and the profession-related parts of the program-type, which means inclusion of at least the mother tongue, one other language, mathematics, pedagogy, psychology, didactics and music, but often also drawing, physical education, history, and the natural sciences.

Exhibit 15.1: Teacher education program-types in Switzerland



Key to program-type

A—Teachers of secondary school Grades 7–9
B—Teachers of primary school Grades 3–6
C—Teachers of primary school Grades 1–6
D—Teachers of primary school Grades 1–2/3

Preparing Teachers of Mathematics in Switzerland

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Part I: Context and Conditions of Teaching as a Career

Historical roots

Before 1992, prior to being merged into higher education, Swiss teacher education was not only diverse but also arbitrary in many respects, with only informal arrangements for inter-cantonal coordination and harmonization. In 1992, Switzerland had 145 different basic teacher education structures and programs taking place in 153 training institutes, with individual institutes offering more than one program (Badertscher, 1993; Lehmann, Criblez, Guldimann, Fuchs, & Périsset-Bagnoud, 2006).

In all cantons, primary teachers received their training at teacher training schools (*Lehrerseminare*), as did teachers of lower-secondary basic-education schools (*Sekundarlehramt für Schultyp mit Grundansprüchen*). Teacher training for lower-secondary schools offering expanded courses (*Sekundarlehramt für Schultyp mit erweiterten Ansprüchen*) took place in universities, from which students graduated with either a humanities or a sciences diploma. Teacher training for the upper-secondary level took place after or in combination with study toward a university diploma (*Lizenziat-Doktorat*).

During the 1980s, nearly all teacher training schools increased the duration of their training programs to five or six years. By the end of that decade, most primary teacher education had been transferred to the tertiary level of education. In the 1990s, during the reform of higher education, teacher training schools were generally either converted into specialized *Matura* schools (*Gymnasien*, upper-secondary level) or transformed into universities of teacher education (*Pädagogische Hochschulen*). Some cantons, however, maintained seminary-type training until the beginning of the 21st century.

The training of future lower-secondary teachers at universities had a special character, with the faculties of subject disciplines (e.g., sciences or arts) offering specially tailored training courses. Coursework focused on the educational sciences, and practical training was specially tailored to these students. In general, the program of studies in the lower-secondary teacher training schools of the universities took six to eight semesters to complete (Badertscher, 1993; Grunder, 2005).

Conditions at the time of TEDS-M

Switzerland, with respect to the recruiting and hiring of teachers, is a country that exhibits many characteristics of position-oriented employment in the public sector. This type of employment relies on a selection process designed to find the most suitable candidate for each open position, whether through external employment or internal promotion. This system is also better than other systems in terms of enabling candidates from across a wide spread of ages to apply for a teaching position.

Cantons are at liberty to decide how many new teachers they hire. They also determine conditions of employment, including salary, number of teaching hours, and type of appointment (Swiss Conference of Cantonal Ministers of Education [EDK], 2001).

Newly certified teachers have no entitlement to a position after completing their training. Also, unlike civil servants, teachers are not guaranteed teaching jobs for life. Instead, in most cantons, they are appointed for a defined term of office of several years. In general, however, their appointment is renewed automatically.

The employer–employee contractual relationship for teachers in primary schools is initially embodied in a written contract lasting for four years, although it is usually extended indefinitely. Only after successfully completing a period of probation are teachers appointed on a more lasting basis, which, under public law, is either for an undefined period or for a four- to six-year period of office; also, the higher the school level, the lower the proportion of permanently employed teachers. In 1995/1996, 78 percent of preschool and primary school teachers were permanently employed. The corresponding figure at the lower-secondary level was 73 percent.[5] These proportions depend on the employment policy of the school authorities (EDK, 2001). The most common level of permanent employment across the cantons is between 50 and 90 percent (EDK, 2001; Landert, 2006). At the primary and lower-secondary levels, just under half of the teachers employed work parttime (46 percent).

Access into teaching from other career paths and teachers moving into other careers and then later returning to teaching are relatively common. Although starting salaries are often attractive, they reach a plateau at a comparatively early point in the career. Promotion is only possible if a teacher applies for a higher position, but the number of higher positions is limited. Personnel selection and management are generally decentralized at the level of schools and the local education authorities.

Coupled with the regulations governing term of office are automatic remuneration increases, as well as special loyalty bonuses and family allowances. Ongoing payments of salary in the event of sickness and redundancy payments are longer and better, respectively, than they are in private industry. Ten cantons,[6] however, have no term-of-office regulations (EDK, 2001), and a further six cantons[7] were in the process of abolishing these regulations just before and at the time of TEDS-M. Only 10 of Switzerland's cantons now have term-of-office regulations.

Teachers' working hours consist of teaching duties, preparation and follow-up of lessons, lesson planning and evaluation, administrative duties, contact with parents, authorities, and other parties, further education and training, teamwork, and additional duties. The weekly teaching load varies from canton to canton. For a fulltime employee, the cantonal classroom teaching time varies between 27 and 33 lessons a week at the primary school level (1,085 hours per year) and between 22 and 31 lessons at the lower-secondary school level (1,056 hours per year). Depending on the canton, a lesson normally lasts between 40 and 50 minutes. At primary level, a year consists of between 35 and 40 school weeks and at lower-secondary level between 36.5 and 40 school weeks. A teacher's compulsory workload can be reduced if he or she is needed to carry out ancillary school-management functions, such as school library, information technology support, and teacher professional development.

5 These percentages were the most recent available.

6 Appenzell Outer-Rhodes, Basel District, Bern, Geneva, Grisons, Neuchâtel, Obwalden, Ticino, Vaud, and Zug.

7 Appenzell Inner-Rhodes, Lucerne, Nidwalden, Schwyz, Solothurn, and Zurich.

In Switzerland, school holidays extend to between 12 and 14 weeks. However, teachers do not have "free time" during these holidays. Depending on the school level, teachers spend an average of 10 to 13 hours per week on school work. Also during these weeks free of teaching duties, teachers are expected to undertake professional development and work on long-term lesson planning. On average, teachers in Switzerland have only about three weeks a year of true vacation (EDK, 2001).

Classroom teaching time is thus not the same as working time. Teachers at primary and lower-secondary levels work approximately 1,860 hours a year (i.e., about 46 hours per week). Teachers spend about one half of their working hours on teaching, one quarter on daily preparation and follow-up, and the remaining quarter on long-term planning and teaching evaluation, administrative duties, contact with parents and authorities, their own professional development, and collaborative work with their colleagues.

As a rule, the teaching certificates and diplomas awarded to lower-secondary teachers enable these teachers to work across all lower-secondary grades. However, because the point at which students transfer from primary to lower-secondary education differs across cantons, the grades included in lower-secondary schools also vary from one canton to another, as does the grade span for which the lower-secondary teaching certificate/diploma is valid (Lehmann et al., 2006).

The most prevalent model of school organization across the cantons is six years of primary school and three years of lower-secondary school.[8] This model applies in 20 cantons. In four other cantons,[9] the model of five primary grades and four lower-secondary grades is currently valid, while the canton of Vaud operates a model that encompasses four years of primary and five years of lower-secondary school. In the canton of Basel City, four years at primary level are followed by three years at what is known as orientation school (*Orientierungsschule*). At the end of these seven years, students are tracked into either a vocational secondary school or an academic secondary school (*Gymnasium*) (Lehmann et al., 2006; Weber, 2006).

A recent draft school concord proposes that the first school levels (kindergarten, or entry level, and primary school) should in future last eight years, and the secondary level three years. If this concord comes into effect, the differences listed above will no longer exist.

In the past, Swiss teaching certificates and diplomas held by teachers at the primary and lower-secondary levels of schooling tended to be valid only in the canton where they were issued, and each canton could decide whether or not to recognize teaching certificates and diplomas from other cantons. However, mutual recognition of these qualifications has since been achieved through intercantonal agreements. Today, in line with the reform of teacher education, all teaching certificates recognized by the Swiss Conference of Cantonal Ministers of Education (EDK) are now valid in every canton.

Once the Commission for Diploma Recognition, which operates under the jurisdiction of the EDK, gives recognition to a certificate or diploma, all cantons must then ensure that all holders of those qualifications have equal access to the job market. The diploma recognition regulations define the minimum requirements required for a degree or a

8 Appenzell Outer-Rhodes, Appenzell Inner-Rhodes, Bern, Fribourg, Geneva, Glarus, Grisons, Jura, Lucerne, Nidwalden, Obwalden, Schaffhausen, Schwyz, Solothurn, St Gallen, Thurgau, Uri, Valais, Zug, and Zurich.

9 Aargau, Basel District, Neuchâtel, and Ticino.

diploma, including the prerequisites for training, the admission criteria, the length of the program, the subjects taught, and examination procedures.

Only in exceptional cases will a school board approve a teacher being transferred from one teaching level to another or from one school to another. As a rule, teachers look for new positions themselves. All open positions are advertised by the cantonal or local authorities, and applications to teach in other municipalities are common. The cantons also determine teachers' salaries through a salary classification system, wherein each teacher is assigned to a point on the salary scale in accordance with his or her qualifications and the school level he or she will teach. Promotions take place incrementally within this wage scale, and occur on the basis of length of preservice and inservice teacher education, the school level being taught or to be taught, and the number of years of service.

The gross salaries for a fulltime position include a residential allowance, a cost of living allowance, a loyalty reward, other allowances, and a 13th month of salary, which is an additional salary paid either at the end of the year or on the half year (EDK, 2001). In 1998, the range of the lowest and the highest annual salaries in Switzerland for primary school teachers were US$55,000 to 69,000 for the first year of service upward to a career maximum of US$83,000 to 108,000. The range for lower-secondary school teachers was US$62,000 to 82,000 for the first year of service and US$88,000 to 123,000 at maximum level.[10] Federal state efforts to save money over recent years have led, in many cases, to reductions in teacher salaries relative to the salaries of other occupations (Carnoy, Brodziak, Luschei, Beteille, & Loyalka, 2009). Some cantons have also introduced qualifications that come with predetermined salary ranges.

Until recently, Swiss primary and secondary schools were subject to few external management controls, and the powers of the school governing body were limited. In addition, the state school supervisory board (*Schulaufsicht*) performed more in an advisory role than a supervisory one. Teachers therefore had extensive autonomy over what they taught and how they taught. This situation is changing under the reform of teacher education and teachers' conditions of employment. Other potential reforms currently under debate include the power of school management boards, evaluation of school quality, and teacher assessment. The tenor of these debates and of the reforms implemented to date have been for school management boards (*Schulleitung*) to have greater control over schools and their teachers. Measures for assessing teacher competency have been a particularly marked feature of this greater control.

Teachers today credit themselves with having greater competence than their colleagues of yesteryear. At the same time they have become increasingly disenchanted with their promotion and development opportunities, the nature of school reforms, the reliability of their conditions of employment and work, their administrative workloads, and the balance between working time and recreation time (Landert & Strittmatter, 2007).

According to Hutmacher, Raymann, and Spichiger-Carlsson (2004), despite the high esteem accorded to teachers and their students in the German-speaking part of Switzerland, the past 10 years have witnessed a marked decrease in teaching as a preferred occupation. For example, the proportion of surveyed parents who said they would advise their son or daughter to enter the teaching profession declined during this period by 23 percent for sons and 19 percent for daughters. In particular, many

10 Exchange rate of July 21, 2009.

parents reported reluctance to encourage their sons to enter teaching. Another trend over this period was the increase in the number of teachers leaving the profession. Findings of this kind point to the need to resolve problems such as worsening teacher working conditions, the declining prestige of the profession, and the absence of career-development opportunities. Not addressing these difficulties signals the likelihood of individual schools, school boards, and the school system as a whole not performing as they should (Lehmann et al., 2006).

In 2005/2006, the cantons reported a total of around 75,100 fulltime equivalent teaching (FTE) positions (including those in the upper-secondary vocational schools). On average across all cantons and school levels, approximately five percent of these posts (or about 3,750 FTEs) were newly filled ones during school year 2005/2006. Around four percent (about 3,000 FTEs) of all registered teaching positions were occupied by teachers holding teaching diplomas that were not specific to the levels at which they were teaching. Around three percent (about 2,250 FTEs) of all registered positions were held by teaching staff who did not have a teaching certificate or a diploma.

Although the staffing situation at this time was relatively balanced, with neither a widespread lack nor an excess of teaching staff across the majority of the cantons, substantial staffing differences were evident in individual cantons and across school levels and school subjects. For example, schools were having trouble staffing special curriculum classes. Teacher shortages were also much more evident in the lower-secondary grades of schools offering basic courses (*Schultyp mit Grundansprüchen*) than they were in the same grades of school types with extended courses (*Schultyp mit erweiterten Ansprüchen*). However, both school types were not finding it easy to attract teachers of mathematics and science. At the other school levels, teacher shortage was limited to just a few cantons. No canton reported a shortage for the primary level. In fact, a clear surplus of teachers could be found at the preschool and primary school levels.

Part II: Organization and Characteristics of Teacher Education

The nationwide political oversight of teacher education (except for vocational college teachers) is exercised through the 28 ministers of the Swiss Conference of Cantonal Ministers of Education (EDK), which assumes the role of a standardization body for such matters as teacher mobility, recognition of certificates and diplomas, cost transparency and accountability, standardization of provision, and adaptation of the structural organization of education. However, at present the EDK's power is "soft power" in that it is delivered through recommendations. The EDK's only real power is in ensuring that recognition of teaching certificates and diplomas accord with the requirements of the intercantonal certificate/diploma agreement.

A recent draft of a new education constitution for Switzerland calls for strengthening the position of the EDK and authorizing it to demand standardization of teacher education provision in certain areas. The Swiss Conference of Rectors of Universities of Teacher Education (SKPH) is also today playing a more significant role in teacher education throughout Switzerland, in terms of coordinating provision across the universities. Their role is one that is likely to strengthen even more in time.

The only responsibility the Swiss federal government has with respect to teacher education is oversight of the training of vocational college teachers. However, should anticipated legislation relating to the universities be enacted, it is likely that the Swiss federal government will soon have a more robust measure of control available in the form of a federal accreditation policy. It is likely, though, that this expanded control will not be truly effective with regard to teacher education until the universities of teacher education receive the same status as the universities of applied sciences and the traditional universities.

Under the overall reform of teacher education that began at the end of the 1990s, only those people who had successfully completed the general qualification for university entrance (the Matura) could now become teachers. Tertiary education was therefore the only route into teacher education. In 2004, the new universities of teacher education issued 31 percent and the traditional universities nine percent of all teaching certificates and diplomas. However, the training institutes still accounted for 60 percent of the 1,159 teaching certificates and diplomas for teachers in preschools and primary schools. The same year saw issuance of 408 teaching certificates and diplomas for teaching at the lower-secondary level.

In 2005/2006, nearly all the traditional forms of teacher training completed their last year of operation. Most of these discontinued courses had been training teachers of kindergarten and primary school children. They produced very few lower-secondary teachers (Lehmann et al., 2006). Since 2006, teacher education for teachers in preschools, primary schools, and lower-secondary schools (with one exception) has been offered primarily at one of the 13 universities of teacher education and at one of the three departments of teacher education at the traditional universities. The universities of teacher education sit under the umbrella of the universities of applied sciences (*Fachhochschule*) (Lehmann et al., 2006).

Notwithstanding these reforms, individual cantons still have the main responsibility for governance of education. As such, teacher education remains basically the responsibility of the cantons, with the parameters of that responsibility determined through cantonal and intercantonal law. As a general rule, the cantonal parliament passes legal guidelines for teacher education at the universities of teacher education as well as for admission to the profession. It also defines the conditions of employment in the universities of teacher education (personnel legislation, working hours, compulsory lessons, salaries, and the like). If several cantons want to share a jurisdiction, their parliaments must pass treaties authorizing cooperation.

However, as teacher education institutions have gained more autonomy and greater integration into higher education, the cantonal parliaments' direct influence on the universities of teacher education has gradually given way during the reforms of the past 10 or so years to indirect control through performance mandates, diploma recognition, rules of admission to the profession, and market-driven employment policy. But despite this decline, the indirect control measures still enable cantonal education policymakers and education administrators to have a good measure of influence over teacher education.

Curriculum and field experience requirements

Cantonal and EDK policy state that universities of teacher education are responsible for empowering all future teachers to educate and teach, counsel and assess, organize and administrate, innovate and develop. At a more specific level, this policy means that by the time future teachers complete their training, they should be able to accomplish the following tasks once in schools:

- Determine and stimulate the development and learning behavior of their students;
- Plan, design, and evaluate instruction;
- Assess their students' learning abilities, subject knowledge, and achievement;
- Develop and realize pedagogical projects;
- Work collaboratively with other teachers, the school management, parents, and local authorities;
- Analyze and reflect on their own teaching practice;
- Work on application-oriented research projects; and
- Plan their own professional development (EDK, 2001, p. 168).

The respective courses of study for preschool, primary, and lower-secondary teachers comprise subject-based training with interdisciplinary components, namely:

- Education as a field of study, with particular emphasis on pedagogy (general didactics, grade-specific and subject-specific didactics, psychology, and teaching children with special educational needs and from diverse cultural backgrounds);
- Teaching practice, covering some 20 to 30 percent of the whole training program and including observation of experienced teachers in their classrooms and planning and teaching lessons to students at the targeted level; and
- A thesis.

Some universities of teacher education give their students opportunity to gain work experience (as part of their practical training) in the social or business sectors or to take foreign-language-learning trips (EDK, 2001). Courses of study can also follow a consecutive model in which the future teacher obtains a subject-related Bachelor's degree before undertaking the profession-oriented phase of the program. There are also opportunities for prospective teachers to participate in European exchange programs, which enable them to complete parts of their program in another country.

Training for prospective teachers of preschool and primary school children lasts at least three years, is equivalent to a Bachelor's degree course of 180 ECTS,[11] and is deemed a professional teaching qualification. Graduates holding this degree are encouraged to continue their studies by working toward a Master's degree.

In nearly all cantons, the curriculum for future primary school teachers includes subjects that correspond to those of the earlier seminary-based courses of study. Thus, the programs typically include German, French, mathematics, drawing, handicrafts, music, physical education, English or Italian, history and political science, information technology, geography, physics, chemistry, biology, and learning a musical instrument. Some cantons also include writing, research methodology, media studies, choir singing,

11 The European Credit Transfer and Accumulation System (ECTS) is a standard for comparing the study attainment and performance of students of higher education across the European Union and other collaborating European countries. One academic year corresponds to 60 ECTS-credits, equivalent to 1,500 to 1,800 hours of study.

youth literature, health education, typewriting, philosophy, ecology, teaching practice, and economics. Profession-related subjects—most often pedagogics, psychology, didactics, and teaching methodology—as well as teaching practice are generally taught to the students from the very beginning of their studies. The time and emphasis allocated to these various subjects vary not only among teacher education institutions but also between programs within an institution (Wegenast, 2006).

Despite the abolition of seminary-based training for primary school teachers, the principle of the "generalist" teacher continues to underpin teacher education for teachers at this level of education in Switzerland. The new degree program-types are therefore continuing to qualify new teachers to teach all subjects at primary school level. According to Lehmann et al. (2006), these subjects can include mother tongue, foreign languages (French and English), mathematics, the natural sciences, humanities and the social sciences, history, geography, biology and physics, religion/Bible studies and ethics, design, music, and sports. However, just which subjects, and how many, are taught in accordance with the proclaimed all-rounder profile differ from institution to institution. Some institutions have already partially departed from the generalist principle by permitting students to drop one or two subjects in order to concentrate in more depth on the others (Lehmann et al., 2006).

Lower-secondary school teachers generally also teach multiple subjects, but with more specialization than their primary school colleagues. Training as an all-round teacher, which is the norm at the primary level, is not required. Choice of subjects can be between, for example, a language/history-oriented cluster and a mathematics/science-oriented cluster. Before the amended certification regulations came into effect in 2005, a secondary school teacher had to be certified in at least two to four and up to a maximum of five subjects. Subject choices included German, French, English, Italian, Rhaeto-Romanic, Spanish, Latin, mathematics, information technology, biology, chemistry, physics, history, geography, art/drawing/technical design, music, religious studies/theology, sport, home economics, and crafts/textile. The regulations also stated that the subject called natural sciences, which amalgamates nature studies, nature and engineering, and the natural sciences, and which formally consists of the content of a maximum of three of the courses relating to biology, chemistry, and physics, could also be counted as a teaching subject.

Today, with much of the teacher reform agenda completed, teacher education for the lower-secondary level lasts five years and culminates in a Master's degree in three to five subjects. This program-type is offered mainly in the universities of teacher education, and only in the general university at Fribourg. The length of training for all secondary school teachers was previously nine semesters, but the teacher education reforms extended the course of study for prospective teachers at the lower-secondary level by half a year.

Nowadays, the Bachelor's–Master's course requires prospective teachers to complete 270 to 300 ECTS credits. (Note that the interim Bachelor's degree does not count as a teaching qualification.) Under the current teacher education regulations, the expectation is that subject-specific and pedagogical training for lower-secondary teachers will comprise at least 40 percent of the complete training program, education sciences training at least 20 percent, and field experience at least 10 percent. As a rule, two fields of study are available. The mathematics/natural sciences program-type includes mathematics, biology, chemistry, physics, and (in exceptional cases) information

technology. Students must study three or four such subjects. Depending on the training institution, the combination of subjects is either compulsory or selected by the student (e.g., mathematics does not always have to be combined with science). In some training institutions, future teachers can combine subjects from the humanities, natural sciences, handicrafts, music, and sports arena. The vocational part generally includes pedagogics, psychology, didactics, teaching methodology, and teaching practice.

In the standing orders governing the recognition of university degrees and diplomas, future teachers of preschools and primary schools and lower-secondary levels must attain 36 to 54 ECTS credits of practical training, while their lower-secondary school peers must obtain at least 48 credits. Future teachers' practice-based training is of two types: school and nonschool placements. School placements emphasize the learning of specific vocational skills through direct hands-on experience in the real working environment of schools. Field experience in lower-secondary schools can take as few as two or as many as 12 weeks, but the average is seven weeks. The aim of the nonschool practical placements, such as work experience in social and business fields, is to build character skills and personal competence and to gain insight into how principles and practice within these sectors can be used in the teaching profession. Nonschool placements typically last from one to three months.

Before implementation of the higher education reforms, teachers' first spell in classrooms after gaining their teaching qualification counted as internship training, but this is no longer the case. The EDK regulations governing recognition of teaching degrees and diplomas do not specify what future teachers should learn during their practical training. Just what the practical training of future teachers should involve has yet to be fully settled.

Staffing requirements

The following information on staffing in the universities of teacher education is drawn from several case studies. The work of staff in these institutions relates primarily to lecturing (on average 63% of total work hours per week) and administrative/technical activities (22%). Some staff members are involved in research and development (8%) and in professional development for inservice teachers (7%). However, the allocation of staff to these areas of activity varies considerably among the universities of teacher education included in the TEDS-M survey.

The EDK guidelines require lecturing staff to hold a university degree/diploma in their specialist area, a didactic qualification in adult education, and (as a rule) a teaching certificate or diploma and teaching experience. However, the qualifications required for those staff involved in research, professional development, and other related services have yet to be defined. In some areas of their programs, the universities of teacher education set higher qualification requirements than those given in the EDK regulations (EDK, 1999a, 1999b; Lehmann et al., 2001).

At present, little attention is being paid to the professional development of lecturers with respect to the academic and research requirements that are a normal part of university-level work. Participation in available professional development opportunities is mostly voluntary. Virtually no university of teacher education has a scheme for recruiting new staff with fresh ideas and for supporting lecturers' academic development. As such, few lecturers are involved in research; their task is instruction. And very few lecturers work fulltime. Nearly all have a small or minimal workload, and tend to be present on their

respective university's campus for only brief periods of time, all of which makes their integration into the academic and research culture of universities even more difficult. Moreover, in individual cases, particularly in the areas of technical didactics and didactics for different grades, the requirement for a university degree is waived as long as the person concerned can provide other evidence of specialist ability.

All staff involved in the practical teaching of future teachers must possess a teaching certificate/diploma and have several years of practical experience. Practical experience is seen as a basic qualification for these teacher educators. In general, the qualifications these staff members require rarely vary across the different levels of teacher education (i.e., preschool, primary, and secondary).

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

As a result of the reform of teacher education in the 1990s, the general qualification for individuals wanting to enroll in an institute offering teacher education for primary school teachers is university entrance (the Matura). There is no specific mathematics requirement for these prospective teachers. However, most teacher institutions also use their own selection or proficiency tests, which may include tests of mathematical knowledge.

Switzerland requires applicants to teacher education programs for secondary teachers of mathematics to have completed a first university degree in mathematics (or an equivalent degree), or to have successfully completed designated mathematics courses at university level. Secondary school teachers may be expected to teach mathematics at both the lower- and upper-secondary levels of the school system. Preparation of future secondary mathematics teachers takes place in faculties of mathematics, which offer specially tailored courses.

Although Switzerland has an open-entry policy to university (every student who has successfully passed the Matura has a legal right to enroll at a university), the academic requirements for graduation from secondary schools are relatively high internationally. Students entering teacher education programs are typically described as high achievers (i.e., the top 20% of their age group). There is a strong demand for teacher education places in Switzerland from abler high school and university graduates. Salaries for beginning teachers are comparable to the salaries of graduates in other professions. Salaries for Swiss teachers are among the highest in the OECD countries (OECD, 2005).

However, as noted earlier in this chapter, Swiss research shows that the attractiveness of the teaching profession has declined markedly in recent years. State efforts to make savings have led to reductions in actual earnings for teachers. Although starting salaries are attractive, they reach a plateau at a comparatively early point in the career. Opportunities for promotion are limited unless teachers successfully apply for the few management positions available and so move out of teaching. In addition, the rate at which teachers are leaving the profession has increased, with factors relating to working conditions, prestige, and career development opportunities in the profession cited as the reasons. Also, as observed earlier, this decline in the status of teaching and in the commensurate quality of teachers has the potential to undermine the efficacy of individual schools, school boards, and the school system as a whole.

Accreditation of teacher education institutions and programs

Quality assurance in teacher education takes place at several levels of the political system, and in different ways via various assessment instruments depending on the content area. As described earlier, the main responsibility for education and culture lies with the cantons, which coordinate their work at the national level through the Swiss Conference of Cantonal Ministers of Education (EDK). The EDK defines standards for the teacher education universities, which are established by cantonal officials. However, the current regional process of accreditation will soon be unified in a federal one. At the time of the TEDS-M survey, Switzerland did not have an external agency with specific responsibility for evaluating the quality of teacher education providers and programs.

Today, teacher education institutes have to undergo an accreditation process that involves national and international experts reviewing their detailed applications for accreditation. The process includes analyses of documents and interviews with members of the institution (managerial and administrative staff, lecturers, students). Federal accreditation ordinances define the standards that programs leading to a teacher qualification must adhere to. These include the number of ECTS credits students must gather in the different subjects of the program.

Teacher education universities are public institutions with rigorous obligations (budgetary, rules of employment, qualification of professors, admittance of students, standards of examinations, and so on). In addition, these universities usually have in place a quality management system, most of them founded on EFQM (European Foundation for Quality Management) principles and practices. A nationwide accreditation process (instead of the recent regional processes) for all universities is in the offing. It will be performed by the Center of Accreditation and Quality Assurance of the Swiss Universities (OAQ), an independent statutory agency that will operate under its own by-laws and have its own budget (see www.oaq.ch).

Requirements for entry to the teaching profession

The EDK's Commission for Diploma Recognition determines which teaching certificates and diplomas it will recognize. Thus, in order for a qualification to come into effect, it must be approved by the EDK (EDK, 2001).The EDK was also the instrument through which the cantons jointly agreed that all holders of a recognized teacher education degree or diploma should have equal access to the job market. In addition to defining the minimum requirements that a degree and a diploma must meet to gain recognition as valid qualifications, the diploma recognition regulations define the prerequisites for training, the criteria governing admission to a program, the length of the program, the subjects to be taught, and the qualifications of those teaching the programs.

References

Badertscher, H. (1993). *Handbuch zur Grundausbildung der Lehrerinnen und Lehrer in der Schweiz. Strukturen, Bedingungen Unterrichtsberechtigungen* [Guide to the basic training of teachers in Switzerland: Regulations governing the structure and conditions of teaching]. Bern, Switzerland: Swiss Conference of Cantonal Ministers of Education (EDK).

Carnoy, M., Brodziak, I., Luschei, T., Beteille, T., & Loyalka, P. (2009). *Teacher Education and Development Study in Mathematics (TEDS-M): Do countries paying teachers higher relative salaries have higher student mathematics achievement?* Amsterdam, The Netherlands: International Association for the Evaluation of Educational Achievement (IEA).

Grunder, H. U. (2005). *Lehrerseminare* [Teaching seminars]. I*n Historisches Lexikon der Schweiz* [Dictionary of Swiss history] (e-publication). Bern, Switzerland: HLS. Retrieved from http://hls-dhs-dss.ch/textes/d/D28711.php?PHPSESSID=da8d29d2567b76eb6b2b34aaf039a27f

Hutmacher, W., Raymann, U., & Spichiger-Carlsson, P. (2004). *Images, statut social et attractivité des professions enseignantes: Programme de recherche UNIVOX* [Images, status, and attractiveness of the teaching profession: Research program UNIVOX]. Zurich and Geneva, Switzerland: GFS Market Research and Faculty of Psychology and Educational Sciences, University of Geneva.

Landert, C. (2006). *Die Arbeitszeit der Lehrperson in der Deutschschweiz: Ergebnisse einer einjährigen Erhebung bei 2'500 Lehrerinnen und Lehrern verschiedener Schulstufen und Kantone* [The work of the teacher in the German-speaking part of Switzerland: Results of a one-year survey of 2,500 teachers across different grade levels and cantons]. Zurich, Switzerland: Swiss Federation of Teachers. Retrieved from http://www.lch.ch/dms-static/d61e184b-a1ad-4c35-8f6c-a153ae85da91/arbeitszeiterhe bung _ 2006.pdf

Landert, C., & Strittmatter, A. (2007). Berufszufriedenheit: Arbeitsbedingungen und unseriöse Reformen nagen an der Substanz [The erosion of job satisfaction through radical reform of working conditions]. *Bildung Schweiz, 1*, 21.

Lehmann, L., Criblez, L., Guldimann, T., Fuchs, W., & Périsset-Bagnoud, D. (2006). *Lehrerinnen- und Lehrerbildung in der Schweiz. Bericht im Rahmen des Bildungsmonitorings Schweiz* [Teachers and teacher education in Switzerland: Findings from monitoring education in Switzerland]. Aarau, Switzerland: Institute for Issues in Education and Research.

Organisation for Economic Co-operation and Development (OECD). (2005). *Teachers matter: Attracting, developing, and retaining effective teachers.* Paris, France: Author.

Swiss Conference of Cantonal Ministers of Education (EDK). (1999a). *Reglement über die Anerkennung von Hochschuldiplomen für Lehrkräfte der Vorschulstufe und der Primarstufe vom 10. Juni 1999.* [Regulations on the recognition of diplomas for teachers of the preschool and primary school levels from 10 June 1999]. Bern, Switzerland: Author.

Swiss Conference of Cantonal Ministers of Education (EDK). (1999b). *Reglement über die Anerkennung von Hochschuldiplomen für Lehrkräfte der Sekundarstufe I vom 26. August 1999.* [Regulations on the recognition of university degrees for lower-secondary teachers from 26 August 1999]. Bern, Switzerland: Author.

Swiss Conference of Cantonal Ministers of Education (EDK). (2001). *Das Schweizerische Bildungswesen* [Swiss education]. Bern, Switzerland: Author. Retrieved from http://www.edk.ch/d/BildungswesenCH/framesets/mainBildungCH_d.html

Weber, H. (2006). Basel-Stadt: Reformdrang stösst auf Widerstand [Basel-City: Urge for reform meets resistance]. *Bildung Schweiz, 6*, 28–29.

Wegenast, K. (2006). LehrerInnenbildung in der Schweiz—wie weiter? Bemerkungen zu einem nach wie vor ungelösten Problem in der vielschichtigen Bildungslandschaft der Schweiz [Teacher education in Switzerland: What next? Comments on a yet unresolved problem within Switzerland's complex educational landscape]. *VSH-Bulletin, 1*(April), 1–5. Retrieved from http://www.ch-hochschullehrer.ethz.ch/pdfs/2006_1_S1_Wegenast.pdf

CHAPTER 16:

Thailand

Editors' Overview

Although Thailand has a comprehensive regulatory framework for teacher education, institutions continue to enjoy considerable curricular and instructional autonomy.

Institutions and governance

In academic year 2007, 46 Thai institutions had mathematics teacher education students. Thirty-seven of these institutions offered a five-year degree, one institution offered only a one-year graduate diploma in the teaching profession, and eight institutions offered both these program-types. The Ministry of Education's Commission on Higher Education oversees Thai universities.[1] The Teachers' Council of Thailand is responsible for accrediting degrees and certificates, subject to guidelines set out by the corresponding professional associations.

Program-types and credentials

Thai basic education follows the 6–3–3 system—six years of primary school followed by three years of lower-secondary school and three years of upper-secondary school. Nine years are compulsory. Universities with a faculty of education are responsible for preparing future teachers for both primary and secondary schools. Future teachers who have earned a Bachelor's degree outside of education must take one additional year, fulltime, in a modified university program-type, which leads to a graduate diploma—the second of the two program-types included in TEDS-M for Thailand. The earlier four-year program-type was changed to five years after the 2007 class graduated. There is no differentiation between preparation of teachers for the lower grades and secondary grades up to Grade 12.

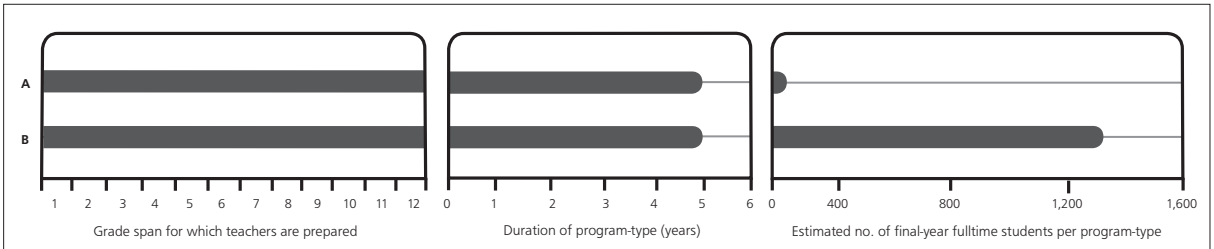
All future teachers within the Thai TEDS-M target population were specializing in mathematics, in line with a recent policy requiring teachers throughout compulsory education to be competent in mathematics. Thus, as Exhibit 16.1 suggests, the two program-types in Thailand differ only in that one is concurrent and one is consecutive.

1 The Bureau of Standards and Evaluation supervises all internal quality assessments at the universities in three domains: standards for graduation, standards for educational management, and standards for developing a knowledgeable society. In addition, the Commission on Higher Education establishes a national framework, standards, and practical routes for the country's universities. That office also provides broad entry prerequisites, structure, total credits, attendance length, registration, evaluation, and graduation standards/requirements. Each institution, in turn, is responsible for specific details.

Curriculum content, assessment, and organization

Most Thai curricula for mathematics teacher education have a core of basic professional courses. The contents of these core courses are extracted from nine areas: language and technology, curriculum development, learning management, psychology, measurement and evaluation, classroom management, educational research, innovation and information technologies, and teacher characteristics. There is also an allowance for special topics and electives. Students must also complete a 180-day practicum during the two semesters of their last year of the five-year concurrent program-type. Students completing the graduate diploma of teaching must undertake a full-year practicum requirement, but there is some variation in how this is implemented.

Exhibit 16.1: Teacher education program-types in Thailand



Key to program-type

A—Graduate Diploma in Teaching, consecutive

B—Bachelor of Education, concurrent

Note: Program-types producing primary generalist teachers existed on paper, but at the time of testing and afterwards had no students. All future teachers in the TEDS-M target population were mathematics specialists. Estimates for the final-year fulltime students per program-type were calculated as the mean of the estimates from the two split-half samples for Program-Types A and B.

Preparing Teachers of Mathematics in Thailand

Precharn Dechsri and Supattra Pativisan

Part I: Context and Conditions of Teaching as a Career

Basic education in Thailand is the responsibility of the Ministry of Education and operates through 175 educational service areas in 76 provinces. Basic education follows the 6–3–3 system, with six years of primary school followed by three years of lower-secondary school and three years of upper-secondary school. In the past, compulsory education was enforced for only the first six years of primary school. Compulsory schooling has now been extended to the first nine years, that is, through to the end of lower-secondary school, as stipulated in the National Education Act 1999. At present, children must begin attending school from the age of about seven and continue on up to the age of 16, unless they have already completed Grade 9 (Office of the Education Council, 2006).

Historical roots

Four major periods of educational reform have been particularly influential in the development of the present-day Thai system of education (Ministry of Education, 1998; Pillay, 2002). From 1868 to 1910, King Chulalongkorn (Rama V), a great visionary reformer, incrementally implemented the country's first education reform. This involved implementation of a Western system of education. Before this time, teaching and learning outside the family took place mainly in temples, with monks as teachers.

The second period of reform began in October 1973 when a political revolution brought about by students rose up against the dictatorial government. This second period of educational reform emphasized equity, unity, and freedom of expression. The third period followed in the decade starting in 1987, during which the government strove to implement changes necessary to help Thailand adapt to globalization and internationalization.

The most recent (fourth) period of educational reform was a result of the Asian economic crisis of 1997. This crisis led first to political reform and then to the drafting of a new Thai constitution. This constitution, as adopted in 1997, called for educational reform and decentralization of power. An outcome was enactment of the National Education Act of 1999, which emphasizes an education system dedicated to the full development of Thai people, based on the principles of lifelong learning and student-centered approaches.

The rationale behind the 1999 educational reform stemmed from the need to improve the country's competitiveness relative to other Asian countries such as China, India, Vietnam, Malaysia, and Singapore. The government and other educational stakeholders judged the Thai education system to be ineffective and its centralized governance and management poor. Another major concern was the lack of access to quality education for many students, especially those in rural areas. While social, cultural, and political problems, such as drugs and juvenile misconduct, also created pressure for educational reform, the economic crisis of 1997 was the main factor. According to Fry (2002), the following economic factors drove the reform:

1. The Thai agriculture sector, which had previously been the main source of Thailand's income, had come to account for only 13 percent of that income by 1997, whereas

the service sector had continued to grow, reaching 47 percent of Thailand's income by this time. Given this change in employment, Thailand was in great need of a workforce suited to that change.

2. Income inequality had become too high, with a Gini coefficient for income distribution in Thailand of 5.21.
3. The Thai economy had become increasingly internationalized, as evidenced by the ratio of the sum of exports and imports compared to total gross domestic product (GDP), which by 1997 exceeded 100 percent.
4. GDP per capita had reached an impressive $6,700 (PPP), reflecting the country's rapid growth economically and materially over previous decades. This development gave Thailand sufficient means to support a quality education system.

Conditions at the time of TEDS-M

Primary schooling in Thailand aims to develop and enhance the quality of students' lives in ways that enable them to serve society at large and to assume their roles and responsibilities as virtuous citizens within a democratic society and a constitutional monarchy. The first six years of primary school provide basic knowledge and necessary daily skills. These years also teach children how to adapt to social change, how to maintain good physical and mental health, how to be effective at work, and how to live a peaceful life. Secondary schooling also aims to improve students' quality of life by providing the relevant fundamental knowledge and skills that students need, on leaving school, to enter occupations with limited education requirements or to go on to further studies. Six years of secondary schooling also enable students to explore their abilities, aptitudes, and interests (Ampra & Thaithae, 2000).

Students who successfully complete secondary schooling and obtain upper-secondary school diplomas are eligible to take entrance examinations for public universities. Private institutions have their own admission processes that may or may not include the use of examinations. However, two public open universities (Ramkhamhaeng University and Sukhothai Thammathirat University) are exceptions. They do not require applicants to sit an entrance examination.

At the undergraduate level, most fields of study leading to a Bachelor's degree involve four years of fulltime study. Most of these programs require students to attain 120 to 150 credits, with a minimum grade point average of 2.0, before they can graduate.

The Commission on Higher Education in the Ministry of Education is the official body governing and overseeing all universities except the physical education colleges and Bunditpatanasilpa institutes. Each university is free to determine its curricula and teaching, quantitatively and qualitatively. As a result, Thailand does not have a national cooperative and coherent plan for these institutions to ensure that they prepare an appropriate number of suitably qualified school teachers.

In general, the nation's comparative rankings in educational, social, and economic development are viewed as important indicators of needed changes (Office of the Education Council, 2004, 2006). The International Institute for Management Development ranked Thailand second of 49 countries (30 OECD members and 19 developing countries) in terms of financial commitment to education (World Economic Forum, 2002). Despite this, Thailand ranked 38th in both academic and general competitiveness, compared to the United States in first place, Singapore in second, and

Indonesia in 49th. In 1999, the Third International Mathematics and Science Study (TIMSS) showed that the performance of Thai students in science and mathematics ranked 27th among the 38 participating countries. These rankings raised suspicions that government spending for education in Thailand was not being used effectively.

It is clear that even though the Thai government has invested a great deal of its budget in education, educational quality has not improved as much as intended. This outcome may be understandable, given that quality usually takes time to show effects, and that various factors continue to stand in the way of quality improvement, such as the social and cultural environment for teaching and learning in schools. In particular, Thai teachers face a number of challenges, some of which are common to teachers elsewhere while some are inherent in the Thai way of life.

- *Economic challenges:* Thailand is shifting from an agricultural and labor-intensive society to a more market-based one with a steadily growing service sector. This trend calls for skillful and well-trained workers who are capable of problem solving. In order to develop a workforce of this caliber, teachers must themselves be well trained and adept in understanding students' needs with respect to these economic changes.
- *Teaching challenges:* Teachers are being called on to adjust their practice from a teacher-centered approach to a more child-centered approach. They accordingly need to teach students to think and analyze by themselves and to learn on their own.
- *Curricular challenges:* Researchers have shown that lower-secondary school students (12 to14 years of age) in Thailand spend less time in science and mathematics classes (167 hours per year) than do their peers in other countries: Austria, 325 hours per year, Australia, 251 hours per year, and South Korea, 204 hours per year (Fry, 2002). Both science and mathematics are subjects vital for almost all modes of life, especially technology development. At present in Thailand, teachers do not have enough time to teach all of the required topics in these areas to a high standard.
- *Information and communication technology (ICT) competency:* An unfortunate fact evident everywhere in Thailand is that a great number of teachers possess little competence in ICT, thus making it difficult to find sufficient ICT teachers. This problem is exacerbated by the rapid advance of ICT and insufficient support for teachers to overcome the difficulties associated with this development. At present, the ratio of computer teachers to the number of students is extremely low at 1:84 in primary schools and 1:53 in lower-secondary and upper-secondary schools.

In pursuit of improvement, Thailand has implemented major changes in how teachers are hired and administered. In the past, teachers in public primary and vocational schools were civil servants and their recruitment was centralized through examination-based selection. This examination was conducted by relevant departments affiliated with the Ministry of Education. These departments gathered information about which schools needed more teachers and in what subject areas, and then sent the selected teachers to where they were most needed throughout the Kingdom of Thailand. Nowadays, educational service area offices are responsible for soliciting applications, conducting selection via examination, and hiring all school teachers at the basic education level (with the exception of teachers in vocational education or in private schools) in their respective service areas.

When individuals enter the public teaching service, they are placed on a scale corresponding to their qualifications and prior experience. There are two scales, one specific to teaching (Teacher 1, Teacher 2, Ajarn 1,[2] Ajarn 2, and Ajarn 3) and one for the civil service as a whole (called the C-classification, from C1 to C9). A teacher is promoted automatically from one level to the next (from C1 to C5) after working the required period of time.

In order to progress from C6 to C7, teachers must be evaluated by their school's board after submitting documentation required by school regulations and policies. An Ajarn 3 teacher wanting to be promoted from C8 to C9 has to submit academic work and be evaluated by the teachers' Civil Service Commission office in his or her area. Those teachers who are promoted to Ajarn 3 at the C8 tier receive a top-up payment of US$329.41 per month, while teachers promoted to Ajarn 3 at the C9 tier earn an additional US$658.82 per month.[3]

In the case of private schools, each school has its own policies and regulations regarding teacher promotion. The Private Teaching Service Commission, which is affiliated with the Ministry of Education, governs private school accreditation, the quality of teaching in these schools, and any matters of public interest relating to these schools.

For highly educated persons in Thailand, teaching is not as attractive a proposition as are other occupations in Thailand. Generally, academically qualified students with high achievement are not interested in becoming teachers. Fry (2002) found that of 1,040 fourth-year university students studying teacher education, only 54 percent had chosen the programs because of their belief that the teaching profession is secure and honorable, despite its low salary. Seven percent of the students indicated that their interest was in teaching science, and nine percent said they would like to teach mathematics.

If unable to secure a teaching position, 93 percent of the students surveyed said they would favor business- or finance-oriented professions (76 percent were interested in the tourist industry) because these occupations are in the private sector and so offer more job opportunities and higher incomes. In addition, 29 percent indicated that if they could re-enter college, they would not choose education. For those who really wanted to be teachers, 28 percent said they would like to teach at university level, 16 percent in secondary schools, and 8 percent in primary schools. Fifty-five percent of teacher education students expected that they would find it difficult to be hired to a teacher position. Hence, 84 percent of these students said they would offer to work initially in a volunteer unpaid position.

According to the Office of the Teacher Civil Service and Educational Personnel Commission (2011), a newly graduated teacher with a Bachelor's degree starts teaching with a salary of US$255 per month, while one with a Master's degree starts at US$285 per month.[4] In contrast, students graduating in fields such as management, engineering, and medical science earn much more. This is one of the main reasons why teaching as a career fails to attract proficient students. Other reasons include the perception that teaching is difficult and that teachers have many responsibilities in school additional to teaching.

2 Thai title specific to teachers.

3 US$1 = 34 Thai baht.

4 US$1 = 34 Thai baht.

Research also shows that only 1.8 percent of all teachers receive double-tier salary increases a year for exceptional performance. Compared to the yearly salary increases of other government officials, yearly increases for teachers, who represent 16.2 percent of the working population, are far fewer because the number of teachers is greater than the number of other government officials and so less compensation is allocated. The majority of teachers do, however, receive their customary one-tier salary increase, irrespective of their teaching performance.

For several decades, Thailand has been noted for success in family planning. Families have therefore become smaller, on average, which in turn has resulted in fewer children starting school. However, the number of new school teachers has not been reduced accordingly, and the result has been an oversupply of teachers. A lack of coherent policies and mutual planning among teacher education institutions has been the main obstacle to providing a more realistic number and quality of graduates. This situation was partially addressed about 15 years ago when the government transformed most teacher colleges into the Rajabhat group of institutes and later into the Rajabhat group of universities; these institutions offer many more degrees and courses than their teachers' college predecessors.

Despite the oversupply of primary generalist teachers, there is a shortage of good mathematics teachers. As discussed above, students who perform well in mathematics are reluctant to choose school teaching as their profession. They normally prefer other more elite professions such as medicine, engineering, mass media, and architecture. The students who are unable to enter their desired faculty apply to teachers' colleges as a last resort. Most of these institutions, which have open admission, therefore set their application deadlines much later than the deadlines set by the universities, which have more limited intakes.

Part II: Organization and Characteristics of Teacher Education

The primary school teachers of recent decades were generally graduates from either universities or teacher colleges throughout the kingdom. Earlier, these two types of institution were under two different ministries (universities under the Ministry of University Affairs and teachers' colleges under the Ministry of Education). This structure ended when the Ministry of University Affairs merged with the Ministry of Education. Other specialized institutions are responsible for vocational education, physical education, and the arts.

Currently, students who wish to become mathematics teachers in school have to complete a five-year Bachelor of Education and major in mathematics, or they need to complete four years of a Bachelor of Science and then spend one more year studying toward a graduate diploma in the teaching profession. After gaining these qualifications, graduates can teach mathematics in schools from Grades 1 to 12. The first cohort of students in the Bachelor of Education program that was extended from four to five years were only in their fourth year of study at the time of the TEDS-M data collection.

Curriculum and field experience requirements

The Commission on Higher Education in the Thai Ministry of Education is responsible for determining the broad, national framework for teacher education. The framework includes entry prerequisites, program structure, total credits, attendance, length, curriculum requirements, and standards for graduation and registration. Universities

have substantial autonomy to develop the details and particulars of teacher education programs within this framework.

Course content and course credits are set at the university level by a university academic committee governed by the university council. Another academic committee, appointed by the responsible department, is responsible for drafting and revising the course content and credits of each subject area. The university academic committee approves matters dealing with existing curricula and then refers them to the university council for official endorsement. For matters involving new curricula, approval must come from both the university council and the Commission on Higher Education.

The current five-year Bachelor of Education program was officially adopted in 2004. In the past, students training to be school teachers spent four years of study in their university's faculty of education, with this period of time including one semester of teaching practice in schools. This four-year program was abolished after the 2007 classes graduated. In addition to these five-year programs, there is a one-year course leading to a teaching certificate for university graduates in other fields, such as science or mathematics. In short, only two types of teacher education programs are offered to future teachers in Thailand: a five-year concurrent program and a one-year consecutive certificate program. The number of students in each program has never been officially documented.

Future teachers of both types are eligible to teach from Grades 1 to 12. In September 2007, the Institute for Promotion of Teaching Science and Technology conducted, in accordance with its participation in the TEDS-M project, a survey to find out the number of future teachers in their highest year of the program in the public universities. The TEDS-M survey provided an unbiased estimate of the total number of teacher education students specializing in mathematics at the time the survey was drawn. The results showed that in academic year 2007/2008, 46 institutions had mathematics teacher education students. Among them were 37 institutions with a five-year degree program, one institution with the one-year graduate diploma in teaching program, and eight institutions with both programs. The total number of fourth-year teacher education students stood at 1,235 in the five-year program and 119 in the one-year graduate diploma program.

The new five-year program is already causing concern. The quality of students exiting secondary schools and entering faculties of education is still considered problematical, and the extension of courses to five years has, according to critics, made matters worse by resulting in a decline in student enrollment. Other programs such as social science, business administration, and mass communication not only take less time to complete (i.e., four years) but are more likely to lead to employment with higher pay.

Each teacher education student is required to undertake field teaching at a certified school. Normally, students take coursework subjects during their first four years and, at the beginning of their fifth year, take up teaching practice in a school for two semesters. The required number of days for teaching practice in a certified school are 90 in the first semester of the fifth year and 90 in the second semester, assuming 18 weeks a semester and five working days a week. The teaching practice provides additional experiences such as school and class observations, and work with real teachers in classrooms. In addition, before beginning their professional teaching experience in the last year of the program, future teachers can take practice-oriented courses, such as micro-teaching, during each semester.

Staffing requirements

The Commission on Higher Education attached to the Ministry of Education is the national body in charge of specifying instructor (teacher educator) qualifications and modes of operation in teacher education programs. Instructors in tertiary institutes must possess qualifications relevant to their teaching subjects, and each teacher education program must have at least five instructors with a Master's degree, or two assistant professors. Instructors with principal responsibility for one program are not allowed to have the same responsibility for another. Additional norms that the institutions must adhere to include the following:

- Assigning instructors to teach in the areas of specialization or most experience;
- Keeping the teaching load of an instructor to no more than 12 hours a week and no more than two subjects per semester;
- Requiring instructors to provide a teaching outline for each subject and at least one textbook for each subject;
- Ensuring that instructors provide their students with regular feedback on test results and other forms of student assessment;
- Requiring instructors to engage in self-assessments and their students to provide assessments of their instructors;
- Supporting instructors to participate in conferences and seminars at least twice a year;
- Expecting instructors to complete one research project and write a professional paper once a year; and
- Providing instructors with further education (professional development) in areas of need either within Thailand or abroad.

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

The bodies that oversee quality assurance of teacher education programs in Thailand are:

1. The university councils, responsible within the university for approving curricula and students' graduation;
2. The Commission on Higher Education, responsible for policy, planning, regulating, and evaluating the provision of higher education; and
3. The Teachers' Council of Thailand, responsible for accrediting degrees and certificates and, in the case of professional diplomas, following guidelines set down by corresponding professional associations.

The official body in charge of the entrance admission system for the 19 public universities with limited numbers of places is the Ministry of Education's Commission on Higher Education. Entrance examinations are held simultaneously nationwide, with the same examination paper for each subject area. Applicants must have a high school diploma. The entrance admission system is operated through a number of committees, namely examination content, proctoring, grading, and reporting. Those Grade 12 students who fail the entrance admission examination or have other reasons for not studying in the public university can apply to study in a Rajabhat or private university.

In general, each university decides on the standards it will use to determine student entry to its teacher education programs. Thailand does not have a centralized means of controlling entry standards across all universities. Each institution therefore also specifies its own number of entry places, depending on the availability of staff members, classrooms, materials and tools; consideration is also made of students' needs should they decide to pursue higher degrees.

Accreditation of teacher education institutions and programs

Thailand requires universities to meet requirements for internal and external quality assurance. Each university is responsible for demonstrating that internal quality-assessment procedures are in place. These evaluations must encompass three domains:

1. Standards for graduates;
2. Standards for educational management; and
3. Standards for creating and developing a learned and knowledgeable society.

Once the institution has completed its internal quality-assurance evaluation, it must release a self-assessment report into the public domain and have external bodies independently assess the institution's findings.

Thailand's External Quality Evaluation System is the responsibility of the Office for National Education Standards and Quality Assessment (ONESQA), a public organization. All institutions offering teacher education programs must submit to an assessment by this office every five years. In assessing the programs, considerable care is taken to safeguard the three principles of academic freedom, institutional autonomy, and accountability. ONESQA assessments focus on the following aspects of each program:

- Philosophy, objectives, and working plans;
- Teaching and learning;
- Student development activities;
- Research;
- Academic services to society;
- Arts and cultural preservation;
- Management;
- Finances and budgets; and
- Quality-assurance systems and mechanisms.

ONESQA's assessment procedures consist of document evaluation, interviews with executives, staff, and students, school visits, and follow-up visits. During its first cycle of evaluations from 2001 to 2005, ONESQA assessed 260 institutions. During its second assessment cycle from 2006 to 2010, ONESQA conducted assessments at both the institutional level and the program level, with the results reported as follows: pass, conditionally pass, and fail.

Requirements for entry to the teaching profession

Graduates wishing to take up a teaching position must hold the Teacher Profession License issued by the Teachers Council of Thailand (Siribunnapithak, 2006). There are two routes to obtaining this license.

1. Graduates who hold a Bachelor of Education from a certified institution or those who hold a Bachelor's degree in different fields with a teaching certificate showing no fewer than 24 credits of a teacher education program are automatically entitled to a Teacher Profession License.
2. Graduates holding a Bachelor of Education from an institution in Thailand before the current Education Act was in force or those holding a Bachelor of Education from countries not certified by the Teachers Council of Thailand must pass an assessment covering knowledge and ability in accordance with regulations and procedures laid out by the Teachers Council of Thailand, before being granted a Teacher Profession License.

References

Ampra, K., & Thaithae, C. (2000). Curriculum planning, development and reform in Thailand. In Central Board of Secondary Education (Ed.), *Final report of the sub-regional course, organized by the International Bureau of Education and the Indian Ministry of Human Resources Development, New Delhi* (pp. 126–130). Paris, France: UNESCO.

Fry, G. W. (2002). *Synthesis report: From crisis to opportunity: The challenges of educational reform in Thailand* (report to ONEC and ADB as part of TA 3585-THA). Bangkok, Thailand: Asian Development Bank.

Ministry of Education. (1998). *History of Thai education*. Bangkok, Thailand. Retrieved from http://www.moe.go.th/English/e-hist01.htm

Office of the Education Council. (2004). *Education in Thailand 2004*. Bangkok, Thailand: Amarin Printing and Publishing.

Office of the Education Council. (2006). *Education in Thailand 2005/2006*. Bangkok, Thailand: Amarin Printing and Publishing.

Office of the Teacher Civil Service and Educational Personnel Commission. (2001). Bangkok, Thailand: Author. *Tables of teachers' salaries*. Retrieved from http://rtc.ac.th/www_km/07/0723/TableSalary%202554.pdf

Pillay, H. (2002). *Education sector reform: Teacher development for quality learning* (report to ONEC and ADB as part of TA 3885-THA). Bangkok, Thailand: Asian Development Bank.

Siribunnapithak, P. (2006). *Summary report: The qualifications of the teaching force and the quality of the teaching job*. Bangkok, Thailand: Faculty of Education, Chulalongkorn University.

World Economic Forum. (2002). *The global comprehensiveness report 2001–2002*. New York, NY, Oxford, UK: Oxford University Press.

CHAPTER 17:

United States of America (USA)

Editors' Overview

The United States has gradually shifted from local control toward centralization of the teacher licensure or certification policy at the state level and, to a lesser extent, the national level. At the same time, teacher education program-types, licensure requirements, and program accreditation requirements for primary-school and lower-secondary mathematics teaching have continued to vary significantly both within and across states.

Institutions and governance

In the United States, more than 1,300 public and private colleges and universities as well as school districts, state agencies, and private organizations offer teacher education for future primary and secondary teachers. All states require teacher education institutions to obtain state approval for what they offer, but approval standards vary across states.

Program-types and credentials

In the federal No Child Left Behind legislation, the "highly qualified" teacher requirement mandates teachers to demonstrate knowledge of the subjects they are assigned to teach but does not impose specific national curriculum requirements.[1]

Exhibit 17.1 does not attempt to portray all the variations in levels of certification offered by universities and colleges in the 50 American states. Instead, it gives an overview of the six main program-types—primary, lower-secondary, and secondary, each of which is offered in both a concurrent and a consecutive version. Note, however, that the grade spans overlap: teachers in grades generally identified with primary school can thus be prepared in a lower-secondary program-type, and teachers in grades usually identified with lower-secondary can be prepared in either a lower-secondary or a lower-secondary plus upper-secondary program-type. The content that these prospective teachers at any of these grade levels can study therefore varies considerably.

Aside from the mandatory completion of upper-secondary school, teacher education applicants in the United States have to comply with the additional and varying requirements set by both teacher preparation institutions and the states. These include, for example, minimum grade point average, previous course requirements, scores on university entrance examinations (SAT/ACT), and, in some cases, state licensure test scores.

1 Instead, primary candidates can demonstrate knowledge of mathematics (and other subjects) by completing a Bachelor's degree and passing tests of subject-matter knowledge and teaching skills in mathematics, reading/language arts, and writing. Secondary mathematics teaching candidates can demonstrate subject-matter knowledge by passing a subject-matter examination, majoring in mathematics as an undergraduate, earning a graduate degree in mathematics, completing the coursework equivalent to an undergraduate degree, and/or holding advanced board certification from the National Board for Professional Teaching Standards (NBPTS) or the American Board for Certification of Teacher Excellence (ABCTE).

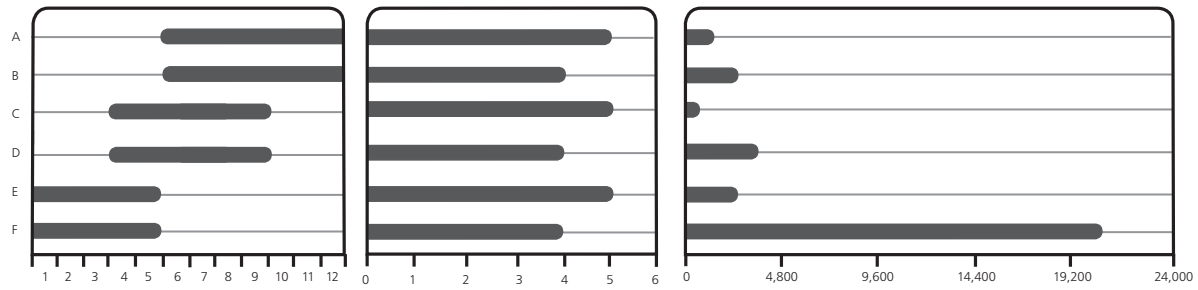
In addition to the more traditional program-types in higher education, alternate routes to licensure have grown significantly. States have differentially defined these routes in order to meet the demand for teachers in specific high-need subject-matter areas or high-need locations. Alternate routes provide professional training to individuals who have been hired as the official teacher of record in a classroom and who therefore fall outside the scope of TEDS-M. Since 1998/1999, the number of teachers licensed through alternate routes has climbed steadily: in 2004/2005, approximately 50,000 teachers (about 33% of all teachers hired that year) entered through such routes. Local school districts, intermediate school districts, state agencies, private organizations, and institutions of higher education offered these options.

Curriculum content, assessment, and organization

In general, the primary and lower-secondary program-types differ substantially from the program-types offering secondary mathematics preparation. The latter are specialist program-types that primarily emphasize coursework in mathematics, mathematics pedagogy (methods), and some additional education courses (e.g., special education, social foundations of education, multicultural education). Primary school and middle-grade program-types prepare generalists and include pedagogy (methods) courses for language, arts, social studies, and science (as well as mathematics), along with education courses. They offer fewer courses in mathematics content than do program-types that prepare teachers for up to Grade 12.

Program-type requirements vary in other respects as well. Some states provide general guidelines, while others mandate specific requirements concerning liberal arts courses, subject-matter courses, and pedagogy courses. Teacher preparation programs, program-types, and states also vary with regard to requirements for practicum experience. As of 2007/2008, 39 of the 50 states required 5 to 18 weeks of student teaching, 38 states required candidates to pass tests of basic literacy and numeracy, and 41 mandated that candidates pass tests of content knowledge. Three states did not require candidates to pass either type of test.

Exhibit 17.1: Teacher education program-types in the United States



Key to program-type

A—Secondary, consecutive
B—Secondary, concurrent
C—Primary and secondary, consecutive
D—Primary and secondary, concurrent
E—Primary, consecutive
F—Primary, concurrent

Note: The enrollments in the graphs are for public institutions only. Because of limited funding, the sample of future teachers was drawn from all public colleges and universities with teacher-education programs. The sample represented just over 60% of the total production of both future primary and future secondary teachers from all types of colleges and universities. Exclusions included (a) private institutions of teacher education and (b) alternate routes of preservice education conducted outside institutions of higher education. The different grade spans in this exhibit reflect the fact that grade spans are regulated by the certification requirements of each state. Some United States program-types at primary level qualify future teachers for kindergarten, but because kindergarten was outside the scope of TEDS-M, no distinction was made between K–Grade 5 and Grades 1 to 5 programs, for example. Estimates for final-year fulltime students per program-type were calculated as the mean of the estimates from the two split-half samples for Program Type C.

Preparing Teachers of Mathematics in the United States of America

Peter Youngs and Erin Grogan

Historical roots

By the 1840s, the majority of teachers in the United States received their teaching license from local officials. Receipt of the license was based on the candidate's performance on an examination that focused on his or her character and/or subject-matter knowledge. Over time, this practice faced growing opposition from those who argued that states, in order to raise educational standards, had to centralize control by introducing state licensure requirements (Sedlak, 1989). By the 1860s, many states required candidates to pass examinations "in the subjects usually taught in the primary grades … [including] orthography, reading, writing, grammar, geography, and arithmetic" (Angus, 2001, p. 8). Over the last third of the 19th century, states increasingly standardized examination content across their jurisdictions.

As the demand for teachers grew, so did normal schools—teacher education institutions that provided a high school education (or the first two years of college) for prospective teachers. In the second half of the 19th century, some states moved away from direct assessments of teacher candidate knowledge and integrity. By 1897, "twenty-eight states certified teachers based on graduation from a normal school" (Angus, 2001, p. 5). Simultaneously, other states continued to require normal school graduates to pass state or county examinations.

At this time, wide variation existed among states in terms of jurisdiction over teacher preparation and what teachers were supposed to know. For instance, the rapid growth of US cities during the mid-1800s led to teacher shortages in urban primary schools. City high schools or normal schools, controlled by local school boards, often issued teaching licenses. Urban boards of education controlled "the supply of teachers for the city schools by raising and lowering entrance requirements, by issuing certificates only to those who had received their training in those schools, and even by suspending the training programs during brief periods of oversupply" (Angus, 2001, p. 6). Because rural schools also struggled to find teachers, several Midwestern state legislatures created "teacher institutes." County superintendents generally ran these state-subsidized institutes, expectations were minimal, and students sat county teacher-licensing examinations at the conclusion of a given institute (Angus, 2001).

During the first third of the 20th century, state departments of education grew rapidly, and normal schools evolved into teachers' colleges (Labaree, 1998). A consensus about what constituted teacher preparation emerged within the educational establishment (Angus, 2001; Ravitch, 2000). Competition arose among universities and normal schools as to who would prepare teachers. While most Eastern normal schools ceded responsibility for preparing secondary teachers to universities, normal schools in the Midwest remained the dominant institution for preparing primary and secondary teachers.

Angus (2001) argues that during the first decades of the 20th century, most teacher colleges and universities supported three trends: an increase in formal teacher education requirements, a decline in the use of examinations, and an increase in the number of teaching specializations (and requisite licenses). By 1937, 28 out of 48 states had

abolished examinations, relying instead exclusively on graduation from a professional teacher preparation program for licensure (Wilson & Youngs, 2005).

According to Angus (2001), the opposition of the education establishment (i.e., administrators and faculty in teachers' colleges and normal schools) was a primary reason for the reduced reliance on examinations. These individuals criticized such examinations, viewing them "as a 'back door' into teaching through which people with inferior training and talents 'infiltrated' the profession" (Angus, 2001, p. 19).

Gradually, views of what constituted professional knowledge expanded. Preparation came to include courses such as history of education, educational psychology, teaching methods, and assessment. By the 1930s, states also began specifying requirements for liberal education, although, in 1930, 27 states still had no academic requirements for high school teachers other than graduation from a recognized college.

Post Second World War America witnessed a severe drop in teacher supply (Angus, 2001; Sedlak & Schlossman, 1986). Despite this shortage, 23 states increased requirements for primary teacher licensure between 1943 and 1953 to a minimum of a four-year college degree. This was an era in which strong concerns about the quality of teacher preparation were being voiced. In 1946, the National Education Association (a national professional organization of teachers) created the National Commission on Teacher Education and Professional Standards (TEPS). TEPS leaders criticized existing university and teachers' college preparation programs. They advocated giving teachers greater input into teacher preparation and requirements for entry to the profession.

In response to criticism of teacher preparation, several agencies with a stake in education created the National Council for the Accreditation of Teacher Education (NCATE) in 1954 as the main national agency in the United States for accrediting preparation programs. Although the organization initially was seen as a way to give K–12 teachers and university faculty more voice in teacher education policy and practice, Angus (2001) claims that the teacher education establishment gradually took over the governing body through several reorganizations that marginalized teachers. By 1959, 17 states were using NCATE accreditation. By 1961, NCATE had approved 342 of the then 1,100 teacher education programs nationwide.

Ongoing criticism of teacher quality and teacher education (e.g., Conant, 1963; Flesch, 1955), in combination with the increased militancy of teachers and the push for unionization in the 1960s, seriously undercut the efforts by TEPS to promote standards and standards boards, and to control entry to the profession. However, efforts to professionalize teaching reemerged in the 1980s and 1990s, especially during discussions concerning the National Board for Professional Teaching Standards (NBPTS) and The Holmes Group of prominent reform-minded deans in leading schools of education. NBPTS (Porter, Youngs, & Odden, 2001) was successful in developing high-level standards and performance-based assessments designed to recognize highly accomplished teachers. During the 1980s and 1990s, The Holmes Group (1986, 1990, 1995) strongly promoted changes in preparation coursework and clinical student teaching placements, overall degree and certification requirements, and the transformation of regular schools into professional development schools.

However, also by the 1980s and 1990s, the American public had an even deeper suspicion of teacher quality and were demanding more accountability. The outcome of these demands is evident in the reemergence of mandatory basic skills and entry-level teacher tests. By academic year 2001/2002, 37 states required teaching candidates to pass basic skills tests in order to earn a teaching license, 33 states required them

to pass tests of subject-matter knowledge, and 26 states required them to pass tests of pedagogical knowledge (Youngs, Odden, & Porter, 2003). In addition, there was a significant shift toward a "hands-on" federal role in defining teacher quality, including teacher preparation requirements (Ramirez, 2003).

While the Clinton administration (1993 to 2000) largely supported the teacher professionalism agenda, when Congress reauthorized Title II of the Higher Education Act in October of 1998, it sought to hold higher education institutions accountable for teacher education by requiring them to report their passing rates on state licensure examinations. Critics of Title II reauthorization questioned whether teacher quality could be assessed by examinations, since schools of education had little or no control over the subject matter that ordinarily was taught in other departments (Wilson & Youngs, 2005).

In 2002, the federal government passed the No Child Left Behind (NCLB) Act. It called for "highly qualified teachers" (HQTs) in classrooms by 2005/2006. HQTs were to demonstrate strong subject-matter knowledge and pass a licensure examination. The Bush administration's belief that traditional teacher education and licensure were obstacles for promising candidates was reflected in the government's withdrawal of financial support for NBPTS in favor of making a commitment (five million dollars in 2002) to the newly created American Board for Certification of Teacher Excellence (ABCTE). ABCTE was designed to ease entry into teaching by allowing candidates with an appropriate undergraduate degree to take a licensure examination and so bypass teacher preparation programs in universities and colleges (Metzger, 2004).

Conditions at the time of TEDS-M

In the United States, teaching is generally considered a position-based occupation, one in which jurisdictions (i.e., school districts) compete for teachers. In comparison with career-based systems, position-based occupations offer more open access to the profession for candidates best qualified for positions and is a more market-based approach to recruitment and compensation (OECD, 2005). Teacher recruitment and hiring practices vary widely in the United States, and the recent growth of alternative licensure programs has contributed to teaching's status as a position-based occupation. However, many regulations governing teacher careers remain, and most school districts have regulated career progression.

Teaching applicants in most public school districts in the United States must meet some common criteria. Seventy-seven percent of districts require full standard state licensure, 66 percent require graduation from a state-approved teacher preparation program, 64 percent a passing score on a state test of basic skills, 63 percent a college major or minor in the subject, and 58 percent a passing score on a state test of subject knowledge.

While national data pertaining to 2003/2004 suggest that some common selection practices were (and presumably still are) being employed across the nation, research from individual states provides more details on teacher recruitment and hiring. For example, Liu (2002) found both centralized district-based and decentralized school-based hiring systems in New Jersey, while Liu and Johnson (2006) found relatively decentralized processes in California, Michigan, Florida, and Massachusetts. Their research also suggested that the teacher hiring process in these states was often rushed and did not always provide opportunities for individual schools and employees to make well-founded judgments about candidates before deciding on whom to hire. Additionally, in some locations, teacher hiring was commonly completed after the

school year began. Late hiring may be particularly problematic in urban areas, where the process and hiring timeline frequently results in the loss of highly qualified candidates to neighboring suburban districts (Liu, Rosenstein, Swan, & Khalil, 2008).

Virtually all public school districts in the United States (93 percent) have a teacher salary schedule. In such locations, the average yearly base salary for a beginning public school teacher with a Bachelor's degree in 2003/2004 was $29,100, while the average salary at the highest step on the schedule was $53,900. Fewer private schools (only 61%) were using a teacher salary schedule at this time. Beginning private school teachers with a Bachelor's degree were making, on average, $23,300, while teachers at the highest step on the salary schedule were earning an average salary of $39,300.

As an additional benefit, 97 percent of public school districts in 2003/2004 were offering teachers general medical insurance, and almost 91 percent were providing retirement plans. Only 75 percent of private schools were offering general medical insurance, and 60 percent were offering retirement plans. Other incentives, such as compensation for obtaining advanced certification through the National Board for Professional Teaching Standards (NBPTS) or recruitment bonuses for teachers in hard-to-staff schools or subjects were infrequent.

In terms of specialization, United States teaching candidates earning primary teaching licenses are prepared to teach mathematics, language arts (reading and writing), science, and social studies to students in Grades K (kindergarten) through 6 or Grades 1 to 8. Candidates earning a secondary mathematics teaching license are prepared to teach mathematics to students in Grades 6 to 12, and candidates earning a middle grades license are prepared to teach mathematics, language arts, science, and social studies to students in Grades 5 to 8. In addition, many university-based programs and alternative pathways into teaching (e.g., Teach For America, New York City Teaching Fellows Program) specifically focus on training candidates to teach in certain school contexts or with certain student populations (e.g., urban, high-poverty, and rural; students with limited English proficiency).

More generally, however, primary and lower-secondary school mathematics teachers are licensed to teach in a wide variety of contexts that differ with regard to such factors as students' socioeconomic status, race/ethnicity, urbanicity, special needs, and English proficiency, as well as school size, school governance (e.g., charter schools versus traditional public schools), and the role of teacher unions and teacher labor contracts. While few states make distinctions among teaching licenses with regard to the urbanicity of school settings, many encourage candidates at all levels to earn a dual license or an endorsement in areas such as special education and bilingual education.

Teachers' working conditions vary greatly across the nation. Some teachers, particularly those in high-poverty or low-resource schools, face difficult working conditions such as large classes, lack of instructional materials, limited access to technology, long work hours, long commutes, and remote locations. Research indicates that some of these working conditions are associated with high levels of teacher turnover. Loeb, Darling-Hammond, and Luczak (2005), for example, found that high levels of teacher turnover were strongly influenced by poor working conditions and low salaries, as well as by student characteristics.

The United States rarely experiences teacher shortages at the primary school level, given the high annual graduation rates of primary future teachers. However, shortages of secondary mathematics teachers in school districts are frequent. In particular, prior to 2005/2006, many lower-secondary mathematics teachers were not licensed to teach

mathematics. Using data from the 1993/1994 Schools and Staffing Survey, Ingersoll (1999) reported that approximately one-third of all secondary school mathematics teachers had neither a major or minor in mathematics, nor a secondary-school mathematics education, nor study in related disciplines.

Several possible explanations have been provided for the high percentage of teachers teaching "out of field," including shortcomings in US teacher preparation, the role of teacher union contracts, and teacher shortages. Ingersoll (2008), having provided evidence that these explanations account for some of the high rate of out-of-field teaching, argued that principals' decisions regarding teaching assignments also contribute to this phenomenon.

Mobility for teachers is made possible by agreements among the states. The National Association of State Directors of Teacher Education and Certification (NASDTEC) facilitates the movement of educators across states and across other jurisdictions that are members of NASDTEC and have signed the NASDTEC Interstate Agreement. This agreement makes it possible for an educator who has completed an approved preparation program or who holds a teaching license in one jurisdiction to earn a license in another state or jurisdiction. The interstate agreement is actually a series of agreements that mandate a "receiving" state to issue some form of authorization allowing the inbound license holder to legally teach or provide services in the receiving state, provided the license issued by the "sending" state is acceptable under the agreement. This authorization may be limited in time by the receiving state. In addition, the receiving state may impose additional requirements that the educator has to meet before he or she can be fully qualified in that state (NASDTEC, 2009).

The NCES's Baccalaureate and Beyond (B&B) Study of over one million 1992/1993 Bachelor's degree recipients can be used to assess the competiveness of teaching with other professions. About 19 percent of those surveyed were K–12 teachers. The teacher education major was considered a "career-oriented" major, and so was grouped with other career-oriented majors such as engineering and business (Anderson & Carroll, 2008).[2]

When compared to the salaries of other career-oriented graduates, teachers' salaries lagged behind. In 2003, teachers earned an average of $43,800, as compared to salary ranges of between $59,300 and $74,900 for graduates who had earned a career-oriented degree in engineering, computer science, health, or business. The teachers had also started out with the lowest entry-level salary of the career-oriented group: $26,600 compared to the average of $32,700. While most other career-oriented degree holders earned more than graduates with "academic-oriented" majors (i.e., arts and humanities), teachers actually earned less than graduates from the academic-oriented group.

In 1994 (around the time of their first postgraduate employment experience), B&B study participants were asked to indicate whether or not their job had "definite career potential." Of all the career-oriented graduates, K–12 teachers were the least likely to agree with this statement (56% of teachers, compared to 61% of all career-oriented majors). By 2003, teachers were the group most likely to consider their current work a career; 94 percent of educators affirmed this belief, compared to 90 percent of all other occupational groups. This increase may have reflected attrition in 1994 among the teachers who considered that their job did not have strong career potential.

2 All subsequent B&B data are taken from Anderson and Carroll's report (2008).

Despite the apparent belief that they had settled into their careers, teachers expressed less satisfaction than the average expressed by all occupational groups with regard to pay, benefits, and opportunities for promotion. While mean satisfaction with pay across groups was 66 percent, only 55 percent of teachers were satisfied. Mean satisfaction with benefits was 75 percent, compared to 63 percent of teachers. Teachers were only slightly below the mean satisfaction levels in terms of opportunity for advancement: the cross-occupation mean was 65.3 percent, compared to 64.5 percent for teachers. Teachers appeared to be more satisfied with their job security than individuals in other groups: 86 percent of teachers were satisfied with their job security, compared with the mean of 81 percent.

Part II: Organization and Characteristics of Teacher Education

In the United States, the following types of organization provide teacher education for primary and secondary teaching candidates: colleges, universities, school districts, state agencies, and private organizations. More than 1,300 public and private colleges and universities offer teacher education programs; the number of school districts, state agencies, and private organizations offering preparation programs is unknown.

Colleges and universities generally offer one or more of the following types of preparation program: early primary (e.g., Grades pre-K through 3), primary (e.g., Grades K through 6 or Grades 1 through 8), secondary mathematics (e.g., Grades 6 to 12), and middle grades (e.g., Grades 5 through 8). Colleges and universities generally additionally offer one or more of the following types of degree program: Bachelor's (four years of study), Master's (one to two years), post-Baccalaureate (one to two years), and Bachelor's degree plus one year of dedicated teacher preparation (five years).

The number of teaching candidates graduating each year from college- or university-based programs ranges from 25 or fewer in small liberal arts colleges and elite universities to several hundred or nearly 1,000 in a few large public institutions. In general, highly selective colleges and universities prepare fewer teachers while less selective institutions generally educate hundreds of teaching candidates annually. However, several selective and highly selective research universities prepare 100 or more teaching candidates each year.

Most primary and lower-secondary future teachers of mathematics in the United States enroll for 30 months (30 months = 4 years = 8 semesters x 15 weeks = 120 weeks) in a college or university to complete the first phase of a concurrent program or the first two phases of a consecutive program. In general, the minimal credential or qualification required for entry into such programs is completion of upper-secondary school. Many teacher preparation institutions and states set additional requirements that applicants must meet, such as minimum grade point average, previous course requirements, SAT/ACT scores, and, in some cases, state licensure test scores. At the end of the first phase, primary and lower-secondary mathematics candidates typically earn a Bachelor's degree.

The TEDS-M sampling frame for the United States included only future teachers from public institutions of higher education (IHEs). While public IHEs make up about 30 percent of all teacher preparation institutions in the United States, they produce about 50 to 60 percent of all new teachers in the nation annually.

The estimated total primary teaching candidate population in the United States in 2007[3] included 7,749 candidates from first-tier PhD-granting institutions (9.3% of all primary candidates in 2007), 13,554 candidates from second-tier PhD-granting institutions (16.2% percent of all primary candidates), 23,733 candidates from MA-granting institutions (28.4% percent of all primary candidates), and 2,877 candidates from BA-granting institutions (3.4% of all primary candidates). In combination, these IHEs produced an estimated 57.4 percent of all new primary teaching candidates in 2007.

The estimated total secondary prospective teacher population in the United States in 2007 included 2,392 candidates from first-tier PhD-granting institutions (8.5% of all secondary candidates in 2007), 3,730 candidates from second-tier PhD-granting institutions (13.2% of all secondary candidates), 5,811 candidates from MA-granting institutions (20.5% of all secondary candidates), and 803 candidates from BA-granting institutions (3.9% of all secondary candidates). In combination, these IHEs produced an estimated 45.0 percent of all new secondary teaching candidates in 2007.

Curriculum and field experience requirements

In general, US teacher education programs for the primary and middle grades differ significantly from the secondary mathematics programs. The former programs include pedagogy courses for language arts, social studies, and science (as well as mathematics), other education courses, and courses in mathematics (but fewer such courses than those in the secondary mathematics programs). The secondary programs primarily emphasize coursework in mathematics and in mathematics teaching pedagogy (methods), along with some additional education courses (e.g., special education, social foundations of education, multicultural education). However, even within the same state, the structure of primary, middle-grade, and secondary mathematics preparation programs can vary according to state policies or individual institution decisions.

In the US, the states are responsible for establishing content guidelines in their teacher preparation programs. In most cases, one or more of the following state agencies is involved in setting guidelines: state legislature, state education agency, state board of education, and professional standards board. States vary in the degree to which their guidelines consist of detailed requirements. Some states set general guidelines concerning subject-matter courses, pedagogy courses, general liberal arts courses, and student teaching experiences. At the same time, other states have more specific coursework and student teaching experience requirements.

The United States has no national requirements concerning practicum and field experiences for primary and lower-secondary mathematics candidates. Teacher preparation programs and states also vary with regard to the features of and requirements for practicums. As of 2007/2008, 39 of 50 states required 5 to 18 weeks of supervised student teaching, while 11 states did not require student teaching. Some institutions, however, required students to carry out student teaching beyond those set by the states ("Quality counts," 2008).

3 These estimates are for the total population of 2007 teaching candidates in the United States produced by public IHEs. They were calculated by the US TEDS-M researchers using data from the previous four to five years. This approach was necessary because no singe data source contained complete production estimates for any single year. Combining the data across years was intended to produce more stable production estimates, which were needed to serve as the measure of size in the sampling frame.

Programs within states also typically vary with regard to such aspects of student teaching as program oversight of the selection of the cooperating teacher (the teacher mentoring the future teacher in the classroom), cooperating teacher experience requirements, stability of cooperating teachers' participation, contact between program faculty and field supervisors, number of required supervisory observations, explicit links between coursework and field experience, and number of courses requiring field experiences (Grossman, Hammerness, McDonald, & Ronfeldt, 2008).

As noted in the TEDS-M route questionnaire (USA TEDS-M National Research Center, 2008), the degree of difficulty that teacher education programs have in finding where their students can complete the practicum or the student teaching component of their preparation also varies greatly.

Staffing requirements

In general, faculty members in those institutions in the United States that prepare primary and secondary mathematics teachers are required to have earned a PhD in education, mathematics, or a related field. It is important to note that many colleges and universities employ graduate students, practicing teachers and school administrators, retired teachers and administrators, and others as university course instructors and supervisors of student teachers. There is some disagreement among US scholars regarding not only the effectiveness of engaging graduate students and practicing K–12 educators in teacher education programs but also the feasibility of requiring all teacher education personnel in colleges and universities to have doctorates (Cochran-Smith & Zeichner, 2005; Goodlad, 1990).

Part III: Quality-Assurance Arrangements

Entry standards and selection methods

In the United States, individual teacher preparation programs and pathways play the primary role in determining the total number of university places available for teacher education students. When a state, or districts within a state, faces teacher shortages in particular areas (e.g., secondary mathematics, secondary science, special education, bilingual education), various state agencies or district personnel typically work with universities and other organizations that prepare teachers to add new preparation programs or to increase the number of available places for teaching candidates.

A second response on the part of some states when they face teacher shortages is to establish alternate routes to licensure. According to Feistritzer and Haar (2008), teacher shortages are the main factor explaining the growth of alternate route programs over the past 10 years. Finally, states sometimes lower the requirements for gaining entry into the profession (e.g., perhaps by lowering their cut scores for passing teacher licensure tests).

Within universities, the total number of places available for teacher education students is based on a wide range of factors, and the number and the importance of these factors vary across different types of institutions. On the one hand, many universities, especially less selective public and private ones, view teacher preparation as an important source of income, and attempt to maximize the number of places available for teaching candidates, regardless of the demand for teachers in their jurisdictions or states (Goodlad, 1990; Levine, 2006). On the other hand, as previously noted, many selective universities and liberal arts colleges either do not offer teacher preparation at all or provide only a limited number of places for teaching candidates. The reasons

for this situation include the low prestige associated with teacher preparation in the United States, reward systems for faculty in research institutions and liberal arts colleges that favor scholarship and grants, and lack of interest on the part of students in many of these institutions (Goodlad, 1990). Finally, in both the selective and less selective institutions that train teachers, the number of available spaces is often shaped by the availability of qualified instructors to offer required courses, the availability of student teaching placements, and student interest.

With regard to alternative-route programs, the availability of places for teaching candidates usually depends on a similar set of factors: degree of interest on the part of candidates, availability of qualified instructors, and availability of student teaching or fulltime teaching placements. However, even though alternative-route programs exist to respond to market demands to fill teacher vacancies, they vary substantially from one another and are influenced to a large extent by the institutional contexts in which they are located and the teaching contexts for which they prepare candidates (Halladay, 2008).

The requirements for entry into primary generalist and lower-secondary mathematics teacher education programs vary across states. Variance is evident in terms of whether states mandate candidates to attain a minimum grade point average, attain minimum scores on the SAT/ACT, attain minimum scores on basic skills tests, or attain minimum scores on state tests of mathematics content knowledge.

With respect to the mathematical knowledge of high school graduates, 20 states were, as of 2008, requiring high school graduates to complete four years of "rigorous" mathematics (Achieve, 2008). In most of these states, these requirements stipulate that, in order to graduate, high school students must complete algebra I and II, geometry, and a fourth mathematics course such as trigonometry or probability and statistics.

Teaching candidates who pursue primary education with licensure in mathematics tend to have lower SAT scores than the average college graduate. However, teaching candidates in subject-specific content areas such as mathematics who pursue secondary education licensure come from the pool of candidates with SAT scores that are average or are higher than those of other college graduates (Gitomer, Latham, & Ziomek, 1999).

Accreditation of teacher education institutions and programs

For many years, teacher education programs in the United States were primarily created and offered by universities. Over the past two decades, however, many states in the US have developed alternate licensure (AL) programs themselves or passed legislation enabling school districts, intermediate educational agencies, private organizations, or other entities to offer teacher education programs. All states require teacher education providers to obtain state approval for their programs, but approval standards tend to vary across states. For example, states differ with regard to whether programs must include substantial formal coursework in the subject areas candidates plan to teach. As of 2007/2008, 26 of the 50 states required programs to offer such coursework.

The content and character of state accreditation also varies. Some states do paper or online reviews of program curricula; others use teams of professionals to conduct onsite reviews. Some states have performance or competency-based processes that require programs to demonstrate how they ensure prospective teachers have acquired necessary knowledge and skills; others examine program outcomes, graduation, job placement, and teacher retention rates.

Except for Canada, the United States is the only country in the world with a tradition whereby agencies can set themselves up to provide accreditation services independently of government. Unlike the situation for other professions in the United States, such as architecture, medicine and law, *national* preparation-program accreditation is not required in teacher education. Of the approximately 1,300 teacher education institutions in the United States, more than half are accredited at the regional or state levels. As of 2007/2008, just under 40 percent of preparation institutions had been accredited by the two national organizations—the National Council for the Accreditation of Teacher Education (NCATE) and the Teacher Education Accreditation Council (TEAC).

Both of these agencies are governed by independent boards. NCATE's executive board, for example, has 30 members. They include, among others, six teacher representatives, six teacher education representatives, six representatives of specialized professional associations, and six state or local policymakers. TEAC's executive board has 20 members. They include nine representatives of universities, three teacher representatives, and two foundation staff members, as well as two individuals with backgrounds related to liberal arts colleges, a state education agency official, and a senior staff member from a teacher professional association.

Only five states (Alaska, Arkansas, Maryland, New Jersey, and North Carolina) require teacher education programs to secure national accreditation by NCATE or TEAC. Many other states allow programs to obtain either state or national accreditation. In more than 40 states, teacher education programs can obtain national accreditation in addition to state approval. In some states, programs can substitute national accreditation for state accreditation.

In the late 1990s, NCATE implemented performance-based accreditation, and it now requires programs to provide evidence that program graduates have acquired relevant subject-matter knowledge and teaching skills, and that they can teach competently. In particular, NCATE expects colleges and universities to show in their institutional reports that they assess candidate competence before admission, during the course of the preparation program (including field-based and clinical experiences), and before completion of the program or before recommendation for licensure. In addition, for each program area (e.g., secondary mathematics, secondary English, primary education), programs must indicate how candidate assessments relate to the program standards in that area, and they must document evidence of the validity and reliability of these assessments.

As of 2007/2008, NCATE had approved national standards for approximately 20 program areas (e.g., primary education, mathematics, English/language arts). These standards documents were developed by various professional associations, such as the National Council of Teachers of Mathematics (NCTM), the National Council of Teachers of English (NCTE), and the like. In line with these standards, institutions preparing future teachers of lower-secondary school mathematics are required to provide evidence, during program assessments, that candidates can demonstrate the knowledge and skills represented in the 15 NCTM standards. Institutions must therefore include the findings of assessments designed to evaluate candidate content knowledge in mathematics, candidate ability to plan instruction and teach in classrooms, and candidate effect on student learning. They must also provide findings from licensure or other content-based assessments, and from optional additional assessments that address NCTM standards.

More specifically with respect to mathematics, the 15 NCTM standards require programs that address future teachers' dispositions toward mathematical processes and mathematics learning and future teachers' problem-solving, reasoning, proof, mathematical communication, mathematical connections, and mathematical representation skills. The standards furthermore require teacher candidates to be proficient in the areas of technology, mathematics pedagogy, and number and operations, to have acquired different perspectives on algebra, and to have knowledge of geometries, calculus, discrete mathematics, measurement, and data analysis, statistics, and probability. While the reports from programs preparing primary teachers need to contain similar content, they have to address only 13 rather than 15 of the NCTM standards (the two exempted standards are knowledge of calculus and discrete mathematics).

Each institution seeking accreditation from TEAC for one or more preparation programs must first document the program's requirements, the faculty's qualifications, and the program's capacity. It must then collect information about candidate assessments and rubrics, evidence pertaining to candidate performance on the assessments, and evidence of the validity and reliability of the assessments. Based on these materials, program faculty then formulate a set of claims that address TEAC's program standards (described above) and write an inquiry brief that comprehensively describes the program, its outcomes, and its resources. On completion of the inquiry brief, a team of auditors visits the program to verify, on site, that the evidence supplied supports the brief's claims.

Requirements for entry to the teaching profession

In the United States, states are responsible for determining teacher licensure requirements and granting teaching licenses. As of 2005/2006, more than 40 states had professional standards boards that were involved in some way in developing teacher licensure requirements. The majority of these boards (i.e., those in 28 states) were advisory in that their recommendations were considered by another state agency with rule-making authority. In 11 states, these boards were autonomous (i.e., their decisions were final). In the three states (Maryland, Texas, and Vermont) that were semi-autonomous with respect to teacher licensure policies, board decisions were final unless another agency (typically the state board of education) overruled their decisions (Loeb & Miller, 2006).

In the United States, the state agencies referred to above are responsible for developing or adopting teaching standards, setting licensure requirements regarding coursework and clinical student teaching experiences, determining whether to create or adopt licensure tests, and determining when candidates have met the state's licensure requirements. Over the past 10 to 15 years, nearly all states have adopted or revised teaching standards delineating the general knowledge and skills that candidates should demonstrate in order to earn a license. Most states have also adopted or revised specific standards for primary school candidates and secondary school mathematics candidates.

In many cases, state teaching standards reflect teaching-standards documents developed by the Interstate New Teacher Assessment and Support Consortium (INTASC), the National Board for Professional Teaching Standards (NBPTS), and professional associations such as NCTM. In Connecticut, for example, the secondary mathematics standards address teachers' knowledge of mathematics content and teachers' ability to pose mathematics tasks, engage students in mathematics discourse, create an intellectual

learning environment, and analyze their mathematics teaching and the learning of their students (Connecticut State Department of Education, 1999). As of 2007/2008, 26 states required teaching candidates to complete substantial coursework in the subject area(s) they planned to teach, and 39 states required candidates to complete from 5 to 18 weeks of student teaching ("Quality counts," 2008).

States also vary significantly in the licensure tests they employ to ensure that future teachers can demonstrate relevant teaching knowledge and skills. As of 2007/2008, 38 states required candidates to pass tests of basic literacy and numeracy skills, 41 states mandated that future teachers needed to pass tests of content knowledge, and three states did not require candidates to pass either type of test.

Within states, preparation programs often vary in the number of mathematics courses and mathematics methods courses they require primary and lower-secondary mathematics teaching candidates to complete (National Council on Teacher Quality, 2008). For example, in a study of programs preparing primary candidates to teach in New York City, Grossman et al. (2008) reported substantial variation among programs in terms of the number of mathematics methods courses that candidates were required to complete.

In a small number of states and a growing number of programs, future teachers are also required to complete portfolios or document their ability to meet program or state teaching standards. In California, for example, all teaching candidates in university-based programs must complete a performance assessment that features lesson plans, videotapes of instruction, work samples, and analyses of their teaching in the field and their students' learning (see, for example, Pecheone & Chung, 2007).

In some states, state agencies grant candidates a professional teaching license when (a) the candidates provide evidence that they have earned passing scores on required licensure tests, and (b) their preparation program provides evidence that they (the candidates) have met state requirements regarding coursework, student teaching, or other aspects of preparation. Most states, however, employ multiple-stage licensure systems in which future teachers are required to meet additional requirements after earning an initial license and entering teaching. As of 2005/2006, these additional requirements included passing a state performance assessment (17 states) or a local district performance assessment (15 states), completing a minimum number of semester hours of coursework (12 states), or earning a Master's degree (12 states) (Loeb & Miller, 2006).

Connecticut and Ohio provide two examples of state performance assessments. In Connecticut, second-year teachers in most content areas have been required, as of 2007/2008, to successfully complete a content-specific portfolio in order to earn a professional teaching license. Teachers have to include several entries in their portfolios that are integrated around a unit of instruction. These entries have to include a description of teaching context, a set of lesson plans, two videotapes of instruction during the unit, samples of student work, and written reflections. As part of their portfolio work, the second-year teachers each has to focus on two students during the unit and write about how he or she would modify his or her instructional practices and assessments to address the students' needs.

Each portfolio is scored independently by two trained assessors who teach in the same content area as the candidate they are evaluating. Portfolios are scored on a 0 to 4 scale, and there are three passing levels: advanced (Level 4), proficient (Level 3), and basic

(Level 2). The two nonpassing levels are below basic (Level 1) and incomplete (Level 0). Those candidates who receive passing scores on their portfolios earn a professional license (provided they meet other requirements). On average, assessors take three to four hours to score a portfolio.

In Ohio, each first-year teacher has been required as of 2007/2008 to successfully complete Praxis III, developed by Educational Testing Service (ETS), a process that involves being interviewed and observed by a trained assessor. ETS requires Ohio and other states using Praxis III in pursuit of licensure decisions to administer the assessment at least twice during each candidate's first year of teaching (Youngs et al., 2003).

Federal legislation contains additional licensure requirements. The No Child Left Behind Act mandates that teachers demonstrate knowledge of the subjects that they are assigned to teach. This provision under the Act does not consist of national curricular requirements for future teachers of primary or lower-secondary mathematics. Instead, primary candidates can demonstrate knowledge of mathematics (and other subjects) by completing a Bachelor's degree and passing tests of subject-matter knowledge and teaching skills in mathematics, reading/language arts, and writing. Secondary mathematics teaching candidates can demonstrate subject-matter knowledge by passing a subject-matter examination, majoring in mathematics as an undergraduate, earning a graduate degree in mathematics, completing coursework equivalent to an undergraduate degree, or holding advanced certification from the NBPTS or the ABCTE.

References

Achieve. (2008). *State college- and career-ready high school graduation requirements.* Washington, DC: Author. Retrieved from http://www.achieve.org/files/College&Career ReadyGradReqTable.pdf

Anderson, S., & Carroll, C. D. (2008). *Teacher career choices: Timing of teacher careers among 1992–1993 Bachelor's degree recipient*s. Washington, DC: United States Department of Education, National Center for Education Statistics.

Angus, D. L. (2001). *Professionalism and the public good: A brief history of teacher certification.* Washington, DC: The Fordham Foundation.

Cochran-Smith, M., & Zeichner, K. (Eds.). (2005). *Studying teacher education: The report of the AERA Panel on Research and Teacher Educatio*n. Washington, DC: American Educational Research Association.

Conant, J. B. (1963). *The education of American teachers.* New York, NY: McGraw-Hill.

Connecticut State Department of Education. (1999). *Connecticut's common core of teaching.* Hartford, CT: Division of Teaching and Learning, Bureau of Curriculum and Teacher Standards, Connecticut State Department of Education.

Feistritzer, C. E., & Haar, C. K. (2008). *Alternate routes to teaching.* Upper Saddle River, NJ: Pearson/Merrill/Prentice Hall.

Flesch, R. F. (1955). *Why Johnny can't read—and what you can do about it.* New York, NY: Harper.

Gitomer, D. H., Latham, A. S., & Ziomek, R. (1999). *The academic quality of prospective teachers: The impact of admissions and licensure testing.* Princeton, NJ: Educational Testing Service.

Goodlad, J. (1990). *Teachers for our nation's schools.* San Francisco, CA: Jossey Bass.

Grossman, P., Hammerness, K. M., McDonald, M., & Ronfeldt, M. (2008). Constructing coherence: Structural predictors of perceptions of coherence in NYC teacher education programs. *Journal of Teacher Education*, *59*(4), 273–287.

Halladay, P. (2008). *Career changers: An investigation of nontraditional entrants into teaching.* Unpublished doctoral dissertation, Michigan State University, East Lansing, MI.

Ingersoll, R. M. (1999). The problem of underqualified teachers in American secondary schools. *Educational Researcher*, *28*(2), 26–37.

Ingersoll, R. M. (2008). *Misdiagnosing the teacher quality problem.* Paper presented at the Center for Research in Education Opportunity conference on "Understanding Teacher Effects on Educational Outcomes," South Bend, IN, University of Notre Dame.

Labaree, D. (1998). *How to succeed in school without really learning.* New Haven, CT: Yale University Press.

Levine, A. (2006). *Educating school teachers.* Washington, DC: The Education Schools Project.

Liu, E. (2002). *New teachers' experiences of hiring in New Jersey* (Harvard Graduate School of Education Project on the Next Generation of Teachers). Paper presented at the annual meeting of the American Educational Research Association, New Orleans, April 22, 2008. Retrieved from http//www.gse.harvard.edu/~ngt/Liu_AERA2002.pdf

Liu, E., & Johnson, S. M. (2006). New teachers' experiences of hiring: Late, rushed, and information-poor. *Educational Administration Quarterly*, *42*(3), 324–360.

Liu, E., Rosenstein, J., Swan, A., & Khalil, D. (2008). When districts encounter teacher shortages: The challenge of recruiting and retaining mathematics teachers in urban districts. *Leadership and Policy in Schools*, *7*, 296–323.

Loeb, S., Darling-Hammond, L., & Luczak, J. (2005). How teaching conditions predict teacher turnover in California Schools. *Peabody Journal of Education*, *80*(3), 44–70.

Loeb, S., & Miller, L. C. (2006). *A review of state teacher policies: What are they, what are their effects, and what are their implications for school finance?* Stanford, CA: Institute for Research on Education Policy and Practice, School of Education, Stanford University.

Metzger, S. (2004). *Teacher qualifications historical timeline.* Unpublished manuscript, Michigan State University, East Lansing, MI.

National Association of State Directors of Teacher Education and Certification (NASDTEC). (2009). *NASDTEC interstate agreement.* Washington, DC: Retrieved from http://www.nasdtec.org/agreement.tpl

National Council on Teacher Quality. (2008). *No common denominator: The preparation of elementary teachers in mathematics by America's education schools.* Washington, DC: Author.

Organisation for Economic Co-operation and Development (OECD). (2005). *Teachers matter: Attracting, developing, and retaining effective teachers.* Paris, France: Author.

Pecheone, R. L., & Chung, R. R. (2007). *Technical report of the Performance Assessment for California Teachers (PACT): Summary of validity and reliability studies for the 2003–04 pilot year.* Retrieved from http://www.pacttpa.org/policy/PACT percent20Technical percent20Report_March07.pdf

Porter, A. C., Youngs, P., & Odden, A. (2001). Advances in teacher assessment and their uses. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 259–297). New York, NY: Macmillan.

Quality counts 2008: Tapping into teaching—unlocking the key to student success. (2008, January 10). *Education Week.* Available online at http://www.edweek.org/ew/toc/2008/01/10/index.html

Ramirez, H. (2003). *The shift from hands-off: The federal role in supporting and defining teacher quality.* Presentation at the American Enterprise Institute Conference, "A Qualified Teacher in Every Classroom: Appraising Old Answers and New Ideas," Washington, DC, American Enterprise Institute.

Ravitch, D. (2000). *Left back: A century of failed school reforms.* New York, NY: Simon & Schuster.

Sedlak, M. (1989). "Let us go and buy a school master:" Historical perspectives on the hiring of teachers in the United States, 1750–1980. In D. Warren (Ed.), *American teachers: Histories of a profession at work* (pp. 257–290). New York, NY: Macmillan.

Sedlak, M., & Schlossman, S. L. (1986). *Who will teach? Historical perspectives on the changing appeal of teaching as a profession*. Santa Monica, CA: RAND.

The Holmes Group. (1986). *Tomorrow's teachers: A report of The Holmes Group*. East Lansing, MI: Author.

The Holmes Group. (1990). *Tomorrow's schools: Principles for the design of professional development*. East Lansing, MI: Author.

The Holmes Group. (1995). *Tomorrow's schools of education: A report of The Holmes Group*. East Lansing, MI: Author.

USA TEDS-M National Research Center. (2008). *TEDS-M 2008 route questionnaire*. East Lansing, MI: Author.

Wilson, S. M., & Youngs, P. (2005). Research on accountability processes in teacher education. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA Panel on Research and Teacher Education* (pp. 591–643). Washington, DC: American Educational Research Association.

Youngs, P., Odden, A., & Porter, A. C. (2003). State policy related to teacher licensure. *Educational Policy*, *17*(2), 217–236.

APPENDIX:

LISTINGS OF ORGANIZATIONS AND INDIVIDUALS RESPONSIBLE FOR TEDS-M

TEDS-M Joint Management Committee

- MSU: Maria Teresa Tatto (chair), Sharon Senk, John Schwille
- ACER: Lawrence Ingvarson, Ray Peck, Glenn Rowley
- IEA: Hans Wagemaker, Barbara Malak (*ex-officio*)
- DPC: Dirk Hastedt (*ex-officio*), Ralph Carstens (*ex-officio*), Falk Brese (*ex-officio*), and Sabine Meinck (*ex-officio*)
- Statistics Canada: Jean Dumais (*ex-officio*)

The International Study Center at Michigan State University (TEDS-M Lead Institution)

- Maria Teresa Tatto, TEDS-M executive director and principal investigator
- Sharon L. Senk and John Schwille, co-directors and co-principal investigators
- Kiril Bankov, University of Sofia, senior research coordinator for mathematics and mathematics pedagogy knowledge
- Michael Rodriguez, University of Minnesota, senior research coordinator for statistics, measurement, and psychometrics
- Martin Carnoy, Stanford University, senior research coordinator for the cost study
- Yukiko Maeda, research associate for statistics, measurement, and psychometrics
- Soo-yong Byun, research associate for statistics and data analysis
- Mustafa Demir, Todd Drummond, Richard Holdgreve-Resendez, Nils Kauffman, Wangjun Kim, Patrick Leahy, Yang Lu, Sungworn Ngudgratoke, Irini Papaieronymou, Eduardo Rodrigues, and Tian Song, research assistants
- Inese Berzina-Pitcher, consortium coordinator
- Ann Pitchford, administrative assistant

The Australian Council for Educational Research (ACER)

- Lawrence Ingvarson, co-director
- Ray Peck, co-director, primary mathematics
- Glenn Rowley, co-director, statistics and measurement

International Association for the Evaluation of Educational Achievement (IEA)

- Hans Wagemaker, executive director
- Barbara Malak, manager membership relations
- Juriaan Hartenberg, financial manager

IEA Data Processing and Research Center (IEA DPC)

- Dirk Hastedt, co-director
- Falk Brese, project coordinator
- Ralph Carstens, project coordinator
- Sabine Meinck, sampling methodologist/coordinator

TEDS-M International Sampling Referee

- Jean Dumais, Statistics Canada

TEDS-M International Sampling Adjudicator

- Marc Joncas, Statistics Canada

TEDS-M National Research Coordinators (NRCs)

Country	Name	Affiliation
Botswana	Thabo Jeff Mzwinila Tuelo Martin Keitumetse	Tlokweng College of Education
Canada	Pierre Brochu	Council of Ministers of Education, Canada, Pan-Canadian Assessment Program
Chile	Beatrice Avalos	Ministry of Education, Chile, Unit of Curriculum Evaluation
Chinese Taipei	Feng-Jui Hsieh Pi-Jen Lin	National Taiwan Normal University, Department of Mathematics National Hsinchu University of Education, Department of Applied Mathematics
Georgia	Maia Miminoshvili Tamar Bokuchava	National Assesment and Examination Center
Germany	Sigrid Blömeke	Humboldt University of Berlin, Faculty of Arts IV
Malaysia	Mohd Mustamam Abd. Karim Rajendran Nagappan	Universiti Pendidikan Sultan Idris
Norway	Liv Grønmo	University of Oslo, Department of Teacher Education and School Development
Oman	Zuwaina Al-maskari	Ministry of Education, Math Curriculum Department
Philippines	Ester Ogena Evangeline Golla	Science Education Institute, Department of Science and Technology
Poland	Michał Sitek	Polish Academy of Sciences, Institute of Philosophy and Sociology
Russian Federation	Galina Kovaleva	Russian Academy of Education, Center for Evaluating the Quality of Education, Institute for Content of Methods of Learning,
Singapore	Khoon Yoong Wong	Nanyang Technological University, National Institute of Education
Spain	Luis Rico Pedro Gomez	University of Granada
Switzerland	Fritz Oser Horst Biedermann	University of Fribourg
Thailand	Precharn Dechsri Supattra Pativisan	The Institute for the Promotion of Teaching Science and Technology
United States	William Schmidt	Michigan State University

TEDS-M Expert Panels and Meetings

Specialist Advisory/Expert Panel Meetings for TEDS-M, November 2002

Meeting	Participants	Country/Affiliation
Special IEA advisory meeting on approval of TEDS-M Study, Brussels, Belgium November 4–5, 2002	Fernand Rochette	
	Belgium (Flemish)	
	Liselotte Van De Perre	Belgium (Flemish)
	Ann Van Driessche	Belgium (Flemish)
	Marcel Crahay	Belgium (French)
	Julien Nicaise	Belgium (French)
	Per Fibæk Laursen	Denmark
	Bjarne Wahlgren	Denmark
	Gerard Bonnet	France
	Catharine Regneir	France
	Ranier Lehmann	Germany
	Georgia K. Polydores	Greece
	Bruno Losito	Italy
	Ryo Watanabe	Japan
	Andris Kangro	Latvia
	Jean-Claude Fandel	Luxembourg
	Jean-Paul Reeff	Luxembourg
	Seamus Hegarty	UK
	Arlette Delhaxe	Eurydice
	Barbara Malak-Minkiewicz	IEA Secretariat
	Maria Teresa Tatto	MSU

Specialist Advisory/Expert Panel Meetings for TEDS-M, June 2003

Meeting	Participants	Country/Affiliation
IEA TEDS-M expert panel meeting, Amsterdam, The Netherlands, June 16–21, 2003	Peter Fensham	Australia
	Kiril Bankov	Bulgaria
	Martial Dembele	Burkina Faso and Québec-Canada
	Beatrice Avalos	Chile
	Per Fibæk Laursen	Denmark
	Sigrid Blömeke	Germany
	Frederick Leung	Hong Kong SAR
	Losito Bruno	Italy
	Ciaran Sugrue	Ireland
	Lee Chong-Jae	Korea
	Loyiso Jita	South Africa
	Marilyn Leask	UK
	Christopher Day	UK
	Michael Eraut	UK
	Drew Gitomer	USA
	Susanna Loeb	USA
	Lynn Paine	USA
	David Plank	USA
	Paul Sally	USA
	William Schmidt	USA
	Adrian Beavis	IEA-TEDS-M ACER
	Lawrence Ingvarson	IEA-TEDS-M ACER
	Jack Schwille	IEA-TEDS-M MSU
	Maria Teresa Tatto	IEA-TEDS-M MSU

Specialist Advisory/Expert Panel Meeting for TEDS-M, December 2003

Meeting	Participants	Country/Affiliation
IEA TEDS expert panel meeting, Hamburg, Germany, December 1–5, 2003	Peter Fensham	Australia
	Kiril Bankov	Bulgaria
	Beatrice Avalos	Chile
	Per Fibæ Laursen	Denmark
	Sigrid Blömeke	Germany
	Frederick Leung	Hong Kong
	Ciaran Sugrue	Ireland
	Bruno Losito	Italy
	Tenoch Cedillo Avalos	Mexico
	Marcela Santillan-Nieto	Mexico
	Loyiso C. Jita	South Africa
	Marilyn Leask	UK
	Angelo Collins	USA
	Lynn Paine	USA
	Hans Wagemaker	IEA
	Pierre Foy	IEA DPC
	Dirk Hastedt	IEA DPC
	Lawrence Ingvarson	IEA-TEDS-M ACER
	Jack Schwille	IEA-TEDS-M MSU
	Maria Teresa Tatto	IEA-TEDS-M MSU

Specialist Advisory/Expert Panel Meetings for TEDS-M, June 2006

Meeting	Participants	University
Expert panel for review of TEDS-M items and data from field trial East Lansing, Michigan, USA June, 2006	Edward Aboufadel	Grand Valley State University
	Sandra Crespo	MSU
	Glenda Lappan	MSU
	Vince Melfi	MSU
	Jeanne Wald	MSU
	Rebecca Walker	Grand Valley State University

Specialist Advisory/Expert Panel Meetings for TEDS-M, September 2006

Meeting	Participants	University
Expert panel for review of primary TEDS-M items for mathematics content knowledge and mathematics pedagogy content knowledge, Melbourne, Australia September 18, 2006	Doug Clarke	Australian Catholic University
	Peter Sullivan	Monash University
	Kaye Stacey	Melbourne University
	Gaye Williams	Deakin University
	Barb Clarke	Monash University
	Ann Roche	Australian Catholic University
	Ray Peck	IEA TEDS-M ACER
	Lawrence Ingvarson	IEA TEDS-M ACER

Specialist Advisory/Expert Panel Meetings for TEDS-M, September 2006

Meeting	Participants	Country/Affiliation
Expert panel for review of TEDS-M test items and questionnaires, Grand Rapids, Michigan, USA September 29–30, 2006	Kiril Bankov	Bulgaria
	Jarmila Novotna	Czech Republic
	Paul Conway	Ireland
	Ruhama Even	Israel
	Kyungmee Park	Korea
	Maarten Dolk	Netherlands
	Ingrid Munck	Sweden
	Hyacinth Evans	West Indies
	Lynn Paine	IEA-TEDS-M MSU
	Sharon Senk	IEA-TEDS-M MSU
	Jack Schwille	IEA-TEDS-M MSU
	Maria Teresa Tatto	IEA-TEDS-M MSU

Specialist Advisory/Expert Panel Meetings for TEDS-M, June and July 2009

Meeting	Participants	University
TEDS-M Mathematics and Mathematics Pedagogy Scale Anchoring Workshops in East Lansing, MI.	*Mathematicians Primary*	
	Anna Bargagliotti	University of Memphis
	Hyman Bass	MSU
	Michael Frazier	University of Tennessee
	Mathematicians Lower Secondary	
	Roger Howe	Yale University
	Cathy Kessel	Independent consultant
	Alejandro Uribe	University of Michigan
	Jeanne Wald	MSU
	Mathematics Educators—Primary	
	Lillie Albert	MSU
	Sandra Crespo	MSU
	Cynthia Langrall	Illinois State University
	Edward Silver	University of Michigan
	Alejandra Sorto	Texas State University
	Rebecca Walker	Grand Valley State University
	Mathematics Educators—Lower-Secondary	
	Jennifer Bay Williams	University of Louisville
	Jeremy Kilpatrick	University of Georgia
	Glenda Lappan	MSU
	Xuihui Li	California State University
	Sharon McCrone	University of New Hampshire
	Rheta Rubenstein	University of Michigan
	Denisse Thompson	University of South Florida

Note: The objective of these workshops was to develop descriptions of the characteristics of persons whose scores on the mathematics and mathematics pedagogy tests placed them at various locations on the scales.

During the 55 years of its activities, IEA has conducted over 30 comparative research studies focusing on educational policies, practices, and outcomes in various school subjects in more than 80 countries around the world. The Teacher Education and Development Study (TEDS-M), the first IEA project to address tertiary education, examines the preparation of future teachers of mathematics in primary and secondary schools. The study collected data from representative samples of future teachers and their educators in 17 countries.

The study's key research questions focused on the relationships between teacher education policies, institutional practices, and the mathematics and pedagogy knowledge of future teachers at the end of their preservice education. Data were gathered from approximately 22,000 future teachers from 750 programs in about 500 teacher education institutions. Teaching staff within these programs were also surveyed. They included close to 5,000 mathematicians, mathematics educators, and general pedagogy educators.

Information about the policies guiding the recruitment, selection, preparation (including characteristics of institutions involved in this process), and certification of mathematics teachers was collected from each participating country through country case study reports. Guidelines for case studies issued by the TEDS-M international study center asked also about the influence of countries' distinctive political, historical, and cultural contexts on policy and practice relating to the education of mathematics teachers. The reports presented in this TEDS-M encyclopedia were written primarily by experts from universities or research institutions connected with their respective ministries of education.

The encyclopedia chapters show that despite some commonalities, teacher education systems differ in many ways in terms of their characteristics and how they organize teacher education. These differences concern the number and size as well as the nature of teacher education institutions (public versus private, universities versus self-standing colleges) and the types of teacher education programs (built around grade span and/or teaching specialization). Differences also exist in teacher selectivity and status. For example, a shortage of candidates for this profession results not only in standards of admission to preservice programs being lowered but also influences certification practices. In some of the countries, the majority of future teacher educators have doctoral degrees in the subject they are teaching (mathematics and/or mathematics pedagogy), but this is not universal.

In combination with the TEDS-M international and policy reports, the TEDS-M encyclopedia is a useful resource for policy development and further research on teacher education. The TEDS-M publications are complemented by the TEDS-M technical report and the international database (together with a user guide), which offer opportunity for secondary analysis of collected data.