DOCUMENT RESUME

ED 419 824		TM 028 399
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TITLE	Cross-National Achievement Comparisons of Upper-Secondary Students: A Swiss Perspective.	
PUB DATE	1998-04-00	
NOTE	15p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Diego, CA, April 13-17, 1998). Research supported by a grant from the Swiss National Science Foundation.	
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)	
EDRS PRICE	MF01/PC01 Plus Postage.	
DESCRIPTORS	College Preparation; Comparative Analysis; Cross Cultural Studies; Foreign Countries; Government Role; *International Education; *Mathematics Achievement; Mathematics Tests; *Sampling; Science Education; *Secondary Education; *Vocational Education	
IDENTIFIERS	*Switzerland; *Third International Mathematics and Science Study	

ABSTRACT

This paper shows how the Third International Mathematics and Science Study (TIMSS) can be carried out in a country with a very complicated upper-secondary educational system. The difficulties are not linked to the measurement of achievement, since the international project provides a common achievement scale. The challenge lies in the design of the sample, which has to reflect the structure of the educational system. Before the Swiss design is presented, a description of the Swiss educational system is given, followed by some national results and a short comparison with the United States. In Switzerland, a country with 3 principal languages, the 26 cantons make many of their own laws and enjoy a great deal of autonomy in local education. There is greater unity at the upper secondary level than at the lower levels, because the upper secondary level is governed by some federal regulations. It is divided into two major types of education, the Maturitatsschule (gymnasium), which is a university preparation school, and vocational training schools. There are two other minor types of upper-secondary education, teacher training and general education schools. Gymnasiums, entrance to which is governed by a rigorous selection process, offer five types of academic programs. The TIMSS sample design was not well-suited to Switzerland, where the population needed to be stratified according to programs of study, and where drawing random samples from schools was not suitable for practical limitations on testing time. The stratification process is described. Results from the TIMSS in Switzerland confirm how important it is to take account of different achievement levels among classes, since 66% of the variation in mathematics and science literacy achievement was inter-class variation, while only 34% was intra-class variation. The need to stratify vocational training was also confirmed. Although there are many problems in comparing achievement of Swiss and U.S. students, some comments can be made about the higher achievement of Swiss students. It appears that Swiss schools succeed in upholding implicit performance standards and communicating them directly to their students. Reasons for this assumption are discussed. The TIMSS shows that it is possible to design a sample that reflects the complicated structure of the Swiss educational system. In addition, TIMSS results support the high level of achievement of the Swiss vocational schools. (Contains 2 figures and 11 references.) (SLD)

Cross-National Achievement Comparisons of Upper-Secondary Students:

A Swiss Perspective[1]

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Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, April 1998

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[1] The research reported in this article was supported by a grant from the Swiss National Science Foundation (No 4033-035819) and is an integral part of the 'Third International Mathematics and Science Study (TIMSS). TIMSS and various national supplements form a project called 'School, Achievement and Personality' within National Research Program 33. The project is a collaborative effort involving the following institutions: Amt für Bildungsforschung des Kantons Bern (direction of project); Institut romand de recherches et de documentation pédagogiques, Neuchâtel; Ufficio studi e ricerche, Bellinzona; Universität Zürich, Päd. Institut, Fachbereich Päd. Psychologie/Didaktik; Universität Bern, Höheres Lehramt.

1. Overview

This paper will show how TIMSS can be carried out in a country with a very complicated upper-secondary educational system. The difficulties with the national project are not linked to the measurement of achievement, since the international project provides a common achievement scale. The challenge lies in the design of the sample, which has to reflect the structure of the education system. Before the Swiss design is presented, a description of the Swiss educational system is given, followed by some national results and a short comparison with the U.S. The results are discussed in relation to the current debate on standards and national achievement tests.

2. The Swiss Educational System[2]

Switzerland is a small country in central-western Europe with a population of about 7 million. It has three principal language regions, in which German, French and Italian are the official languages. These regions differ greatly in size.[3] Like the United States, Switzerland has a federal system of government. It is subdivided into 26 cantons, whose populations range from approximately 15,000 to over 1 million. Despite their small size, the cantons make many of their own laws and enjoy a great deal of autonomy in numerous areas, one of which is education. The compulsory school enrolment age, for example, is either 6 or 7 years, depending on the canton. Primary school may last for 4, 5, or 6 years, also depending on the canton. Lower secondary school, which continues until grade 9, is divided into 2, 3, or 4 different tracks, with children grouped according to academic achievement. However, some cantons have comprehensive schools where students are separated only in two or three individual subjects, based on achievement in a particular subject. Each canton has its own obligatory curriculum for all primary and lower secondary schools within its borders.

More than 80% of all young people continue schooling in upper secondary education. This level exhibits greater unity across cantonal borders, as it is governed by some general federal regulations. It is divided into two major types: the *Maturitätsschule* (gymnasium) and vocational training schools. Between these two types are two other minor types which comprise about 3% of the in-school population: teacher training schools, and general education schools, which prepare students for certain non-university professions, e.g. in paramedical and social fields.

The gymnasiums are designed to prepare students for university. The school leaving certificate from a gymnasium grants access to all universities and federal institutes of technology in Switzerland. Gymnasiums offer five academic programs: Type A (emphasis on Greek and Latin); Type B (Latin and modern languages); Type C (mathematics and science); Type D (modern languages); and Type E (economics). Entrance to gymnasium is governed by a rigorous selection process. Only about 18% of the top academic achievers among Swiss students attend gymnasiums and complete the program of study successfully.

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[2] Parts of this section correspond to the description of the Swiss educational system in Mullis et al. (1998, p. A-25).

[3] Percentage of school-leavers at upper secondary level: about 70% in German-speaking Switzerland, 25% in French-speaking Switzerland, and 5% in Italian-speaking Switzerland. If not differently specified, information about the population is based on the Swiss sampling frame for TIMSS.

Vocational training usually takes the form of an apprenticeship, consisting of two basic elements: practical training on the job (3.5 to 4 days per week) and instruction in a vocational school (1 to 1.5 days per week). Instruction at vocational schools is partly general (e.g. mother tongue, civics), and partly focused specifically on a particular field (e.g. electronics for TV and radio repair staff, etc.). Vocational training is regulated by federal law and provides a recognized program of instruction of two to four years' duration in each of about 300 different vocations. It is by far the largest educational sector in Switzerland. Approximately 75% of the school-leavers complete vocational training. The dual system of on-the-job training and instruction in a vocational school is typical in German-speaking countries.

Although the cantons play a less central role in the upper secondary system than at the lower secondary level, there are still important differences among cantons. Depending on the canton, the period of schooling needed to earn a school leaving certificate at a gymnasium may be 12, 12 ½, or 13 years. The percentage of students who receive school leaving certificates from a gymnasium ranges between 7 and 31%.[4]

One common feature of education at the upper secondary level in both Switzerland and the USA is the wide variety of and differences in curricula. However, it is the differences between systems in the two countries that are most remarkable. When a Swiss student decides to enroll in a particular apprenticeship or program of study at a gymnasium, his educational path is largely determined for the next several years. He or she will have virtually no flexibility; freedom of choice is restricted to a few subjects that constitute a very modest portion of his or her overall vocational training program or academic curriculum. The same group of students or apprentices receives joint instruction in almost all subjects (except for on-the-job vocational training). The curriculum in a particular area is organized for the entire period of training or study, with directives about the topics to be studied in each year. The number of lessons per week can vary greatly from one grade to another. The advantage of this fixed pattern of different paths of training and education lies in the fact that it ensures systematic treatment of certain topics and subjects and leads to a school leaving certificate with well defined possibilities for a future career. The school leaver is thus qualified for employment in a specific vocation (in the case of vocational training), or university entrance (in the case of gymnasium students). One major disadvantage of this system is the great difficulty of changing to another program of study in the event of dissatisfaction with one's original choice (owing to structural rigidity).

The situation is different in the USA, where students can devise their own curriculum based on personal interests, future aspirations, or ability. Of course, if they intend to go to university, they must choose a set of courses which prepares them accordingly. But the single course is the definitive unit of instruction. A course usually involves several lessons per week throughout one academic year. Mathematics, for example, is specifically subdivided, so that topics can be reasonably handled in a particular course (e.g. calculus or pre-calculus). A student receives thorough training in mathematics, for example, only if he or she takes a recommended combination of such courses. The advantages of this form of curricular organization are its great lack of structural rigidity (allowing a chance to change

[4] Including cantonal school-leaving-certificates; source: Federal Statistical Office (1996). *Maturitäten*. Bern, p. 13.

one's course of study), and its high degree of individual choice. One possible disadvantage is the lack of clarity about the role of a particular course or topic in the overall program of study. Nor is it always clear what a high school education qualifies a student for (Hamilton & Hurrelmann, 1993, Hamilton, 1990).

3. Sampling in a highly differentiated system

Swiss adaptation of the sampling design

TIMSS defined the student population at upper secondary school as "all students in the final year of secondary school" (Mullis et al., 1998, p. B-12). All such students were given a test in mathematics and science literacy. Two sub-populations were tested: students who had taken advanced mathematics, and students who had taken physics. Additional tests for these sub-populations involved deeper knowledge of mathematics and physics that clearly exceeded mathematics and science literacy. It is difficult to determine sub-populations of this sort in an educational system such as that of the USA, as students are free to decide during the course of their education whether they would like to specialize further in a particular subject. In Switzerland, on the other hand, this is a simple and straightforward matter: one has only to determine which programs of study need to be considered. Since TIMSS does not give a precise definition of the sub-populations for advanced physics and mathematics, there is some choice in deciding which programs of study to include in the advanced test. In order to ensure that Swiss students were tested in a comprehensive fashion comparable to that in other countries, all Swiss students at public gymnasiums in Switzerland were included in the specialized testing – not just those who were enrolled in the Type C program (mathematics and natural sciences).

TIMSS proposed a two-stage sample design, where the first stage involved sampling of schools and the second a random sample of 40 students in each selected school (Mullis et al. 1998, p. B-18). While definition of the student population was especially easy in Switzerland, this sample design was not well-suited to the Swiss school structure for two reasons. First, different programs of study are a main feature of the Swiss educational system at the upper secondary level. In our national analysis we wanted to report on these different programs with guaranteed precision. We therefore had to stratify the population according to programs of study.[5] But most schools offer more than one program. In order to assign each primary sampling unit to one and only one stratum, we had to define "all students in a particular program of study within one school" as the sampling unit instead of the whole school.[6] Fortunately, the number of students pursuing a particular program of study can be derived from national statistics for each single school. It was therefore possible to establish a corresponding sampling frame.

[5] Strata are sub-populations which are treated individually in sampling. If similar sampling units are combined into strata, there will be less variation within the strata and statistics (mean values, etc.) will be more precise. Explicit strata (domains) generate statistics with defined accuracy if the random sample is expanded accordingly. Systematic classification of units can be used to construct many implicit strata which serve exclusively to control variation (e.g. Kish, 1965).

[6] Originally we designed a procedure which would allow for classes including a mixture of students with different programs of study in the vocational schools. But this mixture was not as important as expected, so that it can be neglected in calculating sampling weights.

Second, drawing random samples within schools is not suitable. Since the classes are together nearly all the time, it is much more practical to test whole classes. In the case of vocational training, which involves more than two-thirds of the population, any strategy other than sampling of entire classes is practically impossible, since students are at school only about one day per week. With random sampling, therefore, testing would last for a whole week. For this reason, we sampled one entire class for each primary sampling unit at the second stage.

The need to sample whole classes is another reason to use "program of study within a school" and not the whole school as the primary sampling unit. Classes are constituted on the basis of the program of study, and it can be expected that within a school great differences in performance will be evident, for instance, between classes preparing for a demanding technical profession and classes preparing for entrance into a basic trade such as that of a butcher. The program of study therefore had to be controlled to get an efficient sample. This can be done by using the proposed definition of the primary sampling unit and by forming implicit strata based on the program of study afterwards.

Stratification

In the Swiss part of TIMSS we wanted to describe mathematics and science achievement in the relevant segments of the educational system. These are defined by program of study and language region. In what follows, we shall describe how we defined strata to reflect these variables. Concerning program of study, the basic division is given by the two major types of upper secondary education, gymnasiums and vocational training schools, mentioned above. The third type, teacher training, is a form of vocational training which also allows access to many fields of study at university level. In a national context, it is worthwhile to know how favorably this track compares with education at a gymnasium. It was therefore also included as a separate stratum.[7] All other programs of general education that terminate at the end of the upper secondary level were combined into a fourth stratum which has minimal representation in the sample, since reporting on this group is of no interest.

Further subdivision took place within the two major types of secondary education. In gymnasiums we expected clearly higher achievement in the mathematical and scientific program. Since it was of interest to verify this, we defined an explicit stratum for this mathematical and scientific program of study (Type C), and another one for all other programs in gymnasiums.

We designed three different explicit strata for vocational training. To some extent vocational training has the reputation of a second-class education. Several countries in the TIMSS study, for example, did not even include vocational training in the study. It would therefore be of great interest to see whether achievement levels attained in vocational training programs are comparable to those in academically-oriented programs that lead to university study. To investigate this possibility, we created a separate explicit stratum consisting of nine selected technical vocations for which we can expect high achievement in mathematics and science.

[7] This stratum includes some gymnasiums which are recognized on a cantonal level only and which often prepare students for teacher training at tertiary level.

Training in commercial vocations leading to a commercial degree, accounting for 19% of the total, constituted such a large portion of all apprenticeships that a further explicit stratum was created in this area. Without much expansion of the sample it was possible to report separately on the level of achievement in this important vocation. The remaining programs of vocational training are combined in a stratum called "Other Vocations".

With all this differentiation based on type of education, we ended up with seven strata defined by program of study (see Table 1). But in a national study it is obvious that the language regions will have to be represented in such a way that reliable conclusions can be drawn from all of them. Furthermore, three cantons also wanted an expanded sample, primarily in the part of the study concerned with general education. Therefore, besides subdivision according to program of study, the sample also had to be independently classified into six regions or cantons. This resulted in the matrix illustrated in Table 1. For sampling purposes each cell of the matrix corresponds to an explicit stratum. But the sample in each cell only had to be big enough so that reporting was possible for the programs of study irrespective of the regions, on one hand, and for the regions (irrespective of the programs of study) on the other hand.

Table 1: Structure of the Swiss TIMSS Sample in the Final Year of Secondary School (Number of students tested per stratum)

Programs of study	Cantons and Regions						Total
	Canton of Baselland	Canton of Bern	Canton of Solothurn	German Speaking	French Speaking	Italian Speaking	
Gymnasium, Math./Science Type	137	182	81	319	331	198	1248
Gymnasium, Other Types	418	324	238	392	324	234	1930
Teacher Training	36	288	53	315	72	39	803
Other Types of General Education	114	118					*232
Selected Technical Vocations				293	78	23	394
Commercial Vocations				396	129	148	673
Other Vocations				432	179	183	794
Total	816	794	372	2075	1152	865	6074

* "Other Types of General Education" has not been completely classified by regions.
In vocational programs cantons are not separated from their language region.
344 additional students were tested (e.g. from classes with girls only).

Classification of vocational programs

For the definition of our explicit and implicit strata, it was crucial to make a classification of the many programs of vocational training which reflected the achievement in mathematics and science that could be expected from students in these programs. No such classification previously existed. In order to create such a ranking, we proceeded in two stages. The first stage involved classification of the 60 most common vocations. These account for 87% of the student population in vocational schools. In order to rank these vocations, we combined different types of information.

- Five experts on vocational training assessed these 60 vocations according to achievement in mathematics and natural sciences expected from practitioners of a certain vocation.

- The percentage of all apprentices coming from schools with higher requirements at the lower secondary level was determined for all vocations.
- Additional information in the form of the mean IQ was obtained for apprentices in 33 vocations (Stadelmann, 1990, p.70).
- We had access to a seven-part evaluation of the intellectual demands in 42 vocations determined by vocational counsellors (Schallberger, 1982).

The correlation between these different measures was satisfactory ($.56 < r < .86$), with only one expert making a clearly different assessment; consequently, his evaluation was not taken into account in determining the overall score. The overall score was determined by adding standardized individual scores. Reliability (Cronbach's alpha) was .95 for the 12 vocations for which all data were available. Vocations were ranked by this overall score. Finally, slight reclassifications were made: small shifts allowed clustering of vocations in specific sectors (e.g. health care, agriculture).
In the second stage the remaining, less common vocations were incorporated into the ranking of the more common vocations, based on percentage of students from schools with higher requirements at the lower secondary level, duration of apprenticeship, and, for the 40 next most common vocations, the assessment of a single expert.

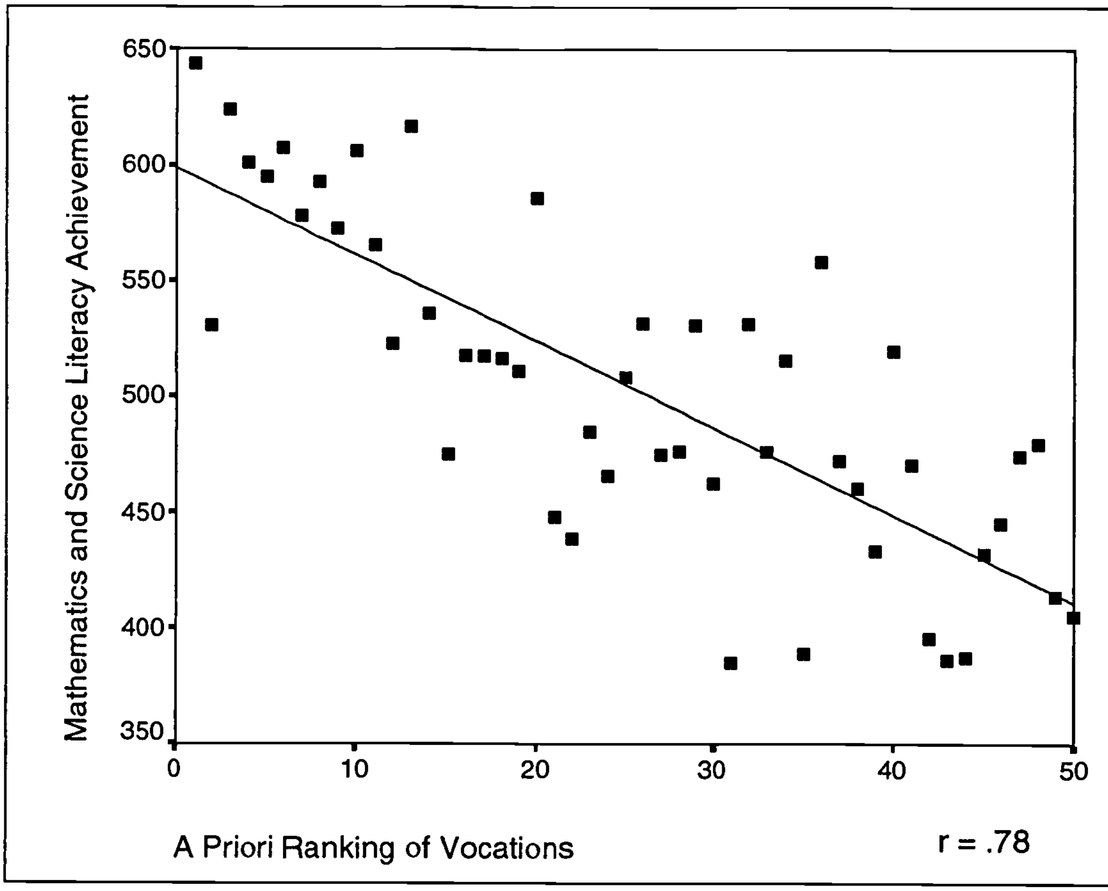
4. Results

Structure of sample and mathematics and science literacy

The results of TIMSS in Switzerland confirm how important it is to take account of different achievement levels among classes: 66% of the variation in mathematics and science literacy achievement was inter-class variation, while only 34% was intra-class.[8] The need to stratify vocational training was also confirmed. Within this sub-population, 60% of the variation in achievement was still inter-class variation. The linear relationship between literacy achievement and vocational ranking at the class level was $r=-.69$; it therefore explains 48% of the variation among classes. The validity of vocational ranking can best be illustrated by aggregating at the level of individual vocations. Figure 1 shows the relationship between the mean mathematics and science literacy achievement for each vocation in the sample and the a priori ranking of that vocation by expected achievement. At this level the correlation is $r=-.78$. The ranking of vocations made it possible to describe 61% of the variation in achievement between vocations. It thus appears that this ranking is highly valid.

[8] Calculation based on one plausible value, with weighted estimation and classes treated as a random factor.

Figure 1: Means of Mathematics and Science Literacy Achievement per Vocational Program of Study and A Priori Ranking by expected achievement

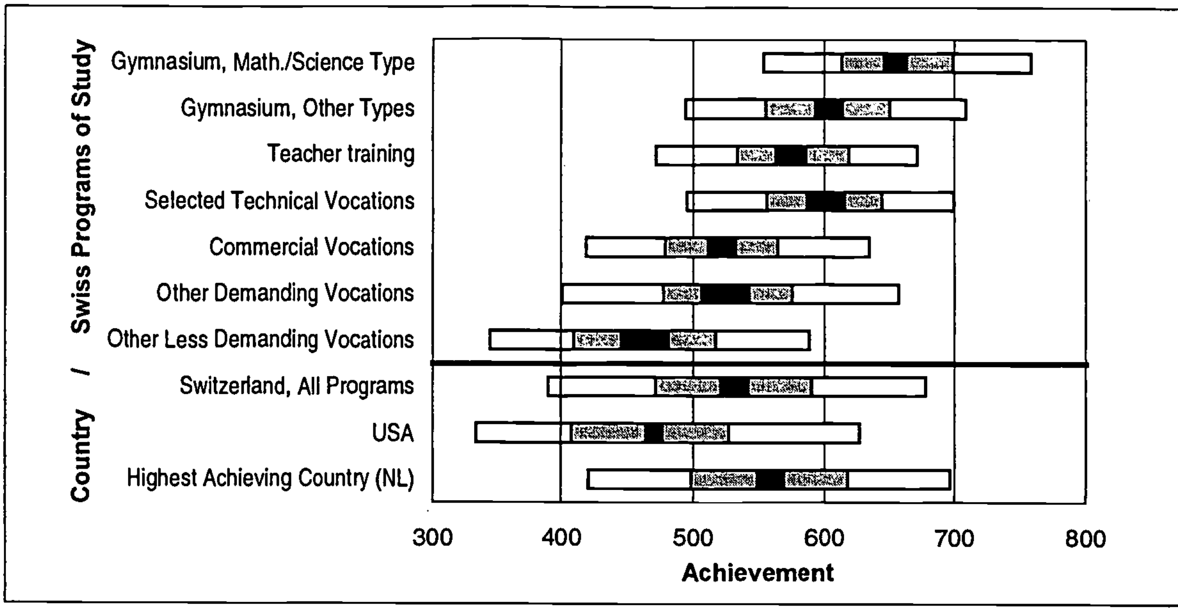


Mathematics and Science Literacy in different strata

Figure 2 shows results on the literacy achievement test for different programs of study. In order to classify variability between strata, achievement results for the USA and for the top-ranking country are also included. As expected, Type C gymnasium students, who specialize in mathematics and natural sciences, achieved by far the best results. The results for different types of vocational training are of particular interest. Students in the category for selected technical vocations achieved results that were just as good as those attained by gymnasium students not specializing in mathematics and natural sciences, and significantly better than those for students in teacher training programs. Students in the commercial vocations showed much poorer results than those in the category for selected technical vocations.

Students in the remaining vocations constitute as much as 52% of the overall population. In order to present more information about this large portion of the population, we divided it in half based on vocational ranking according to *expected* achievement (see Figure 1). The group with the higher expected level of achievement attained approximately the same results as students in commercial training programs. It is not surprising that the group of students from less demanding vocations did less well. What is surprising, however, is the fact that the mean for this stratum is not significantly lower than the overall mean for the United States.

Figure 2: Mathematics and Science Literacy Achievement by Program of Study



Switzerland performed well in mathematics and science literacy on an international comparative basis. Only two of twenty-one countries in the study did significantly better. This was not to be automatically expected, as most young people in Switzerland take vocational training and therefore attend school only one or two days per week. Moreover, their education is heavily oriented towards future employment in a particular field. Mathematics and natural sciences are frequently not studied. This played no great role in the literacy test, however, as the basic knowledge being tested here is largely attained during the period of compulsory schooling. For this reason it should not be assumed that Switzerland enjoyed any particular advantage just because the Swiss students tested were older than those in most other countries – 1.7 years older, for instance, than students in the USA. But remaining in school for a longer period also gives most Swiss students an education that qualifies them for a particular vocation. The same cannot be said for a high school diploma in the USA (Buttlar, 1992, p. 98).

Advanced Mathematics and Physics

The countries participating in TIMSS had considerable freedom in defining what students they regard as being enrolled in advanced mathematics and physics courses and therefore eligible for the advanced achievement test. Indeed, definitions varied considerably, including everything from only a true elite to a broad group of students. TIMSS therefore determined for each country what percentage of the whole age cohort at the school-leaving age was tested. We can only compare mean achievements of countries by taking this percentage into account. This can be illustrated for Switzerland and USA. Both countries administered the test to 14% of the school-leaving age cohort. Switzerland attained very good results in mathematics. Of 16 countries, only France had a significantly higher mean. In physics, Switzerland ranked within a cluster of countries with average means. The achievements of the United States were fairly low; no country had significantly poorer results in mathematics or physics (see Mullis et al., 1998, for details).

The United States determined the mean for a more specialized group of students, too. In mathematics, students with advanced placement calculus instruction, who represent about 5 percent of the U.S. school-leaving age cohort, were included. This group of students scored 71 points higher than the whole U.S. sample and ranked above the international mean (U.S. department of education, p.39 ff.). 70 points are an important gain, since the international achievement scale is defined to have a standard deviation of 100 points.

A corresponding comparison for Switzerland can be made by using only the mathematical and scientific program of study (Type C gymnasium). This group represents about 4% of the school-leaving age cohort. Its mean mathematics achievement was about 70 points higher than the whole Swiss sample (Ramseier et al., in preparation) and higher than any country mean reported by TIMSS.

Virtually the same is true for physics. In the U.S., twelfth graders with advanced placement in physics represent about 1 percent of the age cohort and attained a mean which is 51 points higher than that for the whole U.S. sample (U.S. department of education, p. 46 ff.). For Switzerland, we must again consider the Type C gymnasium program The mean achievement for this group is about 80 points higher than the overall Swiss mean (Ramseier et al., in preparation).

It is not astonishing that the mean achievement of Type C gymnasium students is clearly higher than the mean of gymnasium students from other programs. First, students with a high interest in mathematics and science will choose this program of study. Second, Type C students get about twice as much mathematics and physics instruction as students in other types of gymnasium education.[9]

In comparing the United States and Switzerland, we should take into account that the mean age of the Swiss sample (advanced tests) is about 1.5 years higher than in the U.S. sample. In contrast to the literacy test, this age difference is probably relevant in the advanced achievement tests, since in this case the topics tested are taught in the last years of high school, and half of the Swiss gymnasium population attends school for 13 years.

6 Conclusions

Comparing Switzerland and the United States

Perhaps it is not appropriate to compare Switzerland – a small country – and the USA, with all its diversity and internal variability. It may be more appropriate to compare Switzerland with a single American state on the East Coast, say Massachusetts, than with the entire USA. Differences in achievement might then not be as great. But at the same time, Switzerland – with three major national languages and a foreign student population of approximately 22%[10] – is not exactly the exemplary homogeneous model that one might assume.

[9] As an example we take the Kirchenfeld Gymnasium in Berne. On average during the last four years of study, Type C students have 6.8 mathematics lessons per week and 2.8 physics lessons. Type A/B students have 3.0 mathematics lessons and 1.5 physics lessons.

[10] Percentage within compulsory education. Source: Federal Statistical Office (1996). *Schülerinnen, Schüler und Studierende 1995/96*. Bern, p. 24.

It is obviously a very complex undertaking to explain differences in achievement between two countries with reference to differences in another characteristic of these countries. This would make it necessary to show an established linkage between this characteristic and achievement levels that is valid for many educational systems, to control for confounding factors, and so on. This will not be our concern here. We cannot explain differences in achievement. But we can discuss the surprisingly great differences in achievement between the USA and Switzerland in light of the current debate over performance standards.

High public standards and objective assessment: Necessary conditions for high achievement?

The USA is not satisfied with its international performance ratings. President Clinton even used his State of the Union Address in 1997 to issue a "Call to Action for American Education in the 21st Century". An important component of his initiative is the increased setting of clear performance standards and systematic monitoring of the extent to which they are observed. Setting high standards and testing to determine whether they have been achieved seems to be the main current approach to educational reform. A prominent example is the New Standards Project. In this project many states and major school districts "have joined together to produce a system of examinations and assessments based on a shared set of high achievement standards" (Resnick et al., 1995, p. 439). The United States already has a well established system of objective achievement testing for measuring educational progress at the national level (e.g. Jones, 1996) and for use in admission to college (e.g. SAT). The new trend is to link this to curriculum and to find more valid methods of testing.

Resnick et al. (1995) analyzed the educational systems of France and the Netherlands, two countries with high performance in mathematics, to see how they define standards and what makes them successful. In a comment on this analysis, Louis and Versloot (1996, p. 253) stress factors other than the "centralized standards that are reinforced in all schools and that have tough consequences for teachers and students", especially the protracted process to obtain national consensus about any concrete topic like the content of an examination in the Netherlands. A similar analysis of Switzerland would reveal that binding public standards and objective nationwide assessment are lacking, especially at the gymnasium level. It appears that Swiss schools succeed in upholding implicit performance standards and communicating them efficiently to their students. Typical features of the Swiss system which may contribute to this are

- The school-leaving examination is a high stakes exam. A prominent example is the school-leaving certificate from a gymnasium, which makes university entrance possible. In the USA, by contrast, students often must take university entrance exams which do not reflect their specific curriculum at high school (e.g. Resnick et al., 1995).
- The school-leaving exams for gymnasium students are usually designed and evaluated within each school. Only a very general curriculum and the presence of an outside expert from a university ensure a broader perspective. For more than half of the subjects there is no final examination, but the assessment made by the teacher in a subject during the last year is decisive. Internally designed school-leaving exams and assessments by the teacher guarantee that overall evaluation is closely linked to the school's curriculum. This makes it worthwhile for students to apply themselves diligently while in school.

- All teachers at gymnasium have a university degree (equivalent to the master's degree in the U.S.) in the subject they teach. Teachers consider themselves experts in their fields and accordingly set high standards for their students.
- Students are involved in a program of study with a systematic overall structure that applies to all years of school at a particular level of education.
- Assessments made at the end of the primary and lower secondary levels are already high stakes assessments since they determine which subsequent programs of study are accessible to a student (with all the danger of making nearly irreversible decisions too early).
- Curricula for the vocational programs of study are jointly designed by employers, trade unions, and educational experts. These programs are tailored to the structure of the national economy, ensuring that apprentices will be well qualified to practice a particular vocation.

The Swiss example shows that a fairly satisfying achievement level can be reached without a detailed national curriculum, without public standards, and without an elaborated system of objective assessment. Of course, this does not mean that these are not important factors. In a country like the U.S., with a "passion for testing and measurement" (Resnick et al., 1995, p. 439), it may be important not to forget other factors. Defining standards is a social process. Perhaps intensive interaction between all the persons and groups involved in defining standards is in itself important and creates a common understanding. This may be more important than the resulting public standards.

What can Switzerland learn from TIMSS?

TIMSS shows that it is possible to design a sample which reflects the complicated structure of the Swiss educational system. One important result is that in many vocational programs of study the level of mathematics and science literacy was as high as it was for gymnasium students. The vocational part of the Swiss educational system deserves greater public recognition.

Seen in terms of international comparison, there is not too much need for action with regard to achievement levels in the Swiss educational system. It is more important to realize that the educational systems of many countries are less rigid than the Swiss system. They offer more individual choice to students, giving them a better chance to change their course of study. The following current trends in Switzerland should be continued:

- Further relaxation of the boundaries between vocational and general education
- Greater access to qualified tertiary education based on vocational training at the upper secondary level
- Replacement of the five predefined programs of study within gymnasium by a system which allows the student free choice of a combination of subjects on which to focus.

In a country like Switzerland, with no tradition in large-scale assessment, strengthening objective assessments of achievement at the system level is important to evaluate parts of the educational system and to identify sources of inequality, for instance, in access to higher education.

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