

Professional Development for Secondary Career and Technical Education: Implications for Change

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FOREWORD

After a quarter century of education reform, the essential role of the teacher is receiving the attention it deserves. Standards have been raised, testing has been mandated, principals have gained increased autonomy, schedules have been revised, computers have become widely available. None of these changes has as much impact as ensuring that teachers have the skills and knowledge to identify their students' learning needs and the ability to deliver instruction that responds to those needs. In this paper, the implications of this statement for the professional development of secondary-level career and technical education (CTE) teachers are examined and the evidence upon which it is based is cited.

Secondary-level CTE is in transition. From its origin as a part of public education until the last decades of the twentieth century, its primary objective was to prepare students for entry-level positions in occupations requiring specialized skills. Beginning in the 1980s, secondary CTE broadened its purpose to include the enhancement of academic skills and preparation for an array of occupations within defined occupational clusters. This broader purpose creates a need for secondary CTE instructors who can respond to these wider and more diverse expectations. This paper presents what its writers judge to be the types of skills and knowledge that secondary CTE teachers require.

Many individuals contributed to the planning and writing of this paper, and they decided it would not be feasible to list them all as co-authors. Instead, they chose to have this paper cited as a collective effort of the National Research Center for Career and Technical Education (NRCCTE) and to have their work acknowledged in this Foreword. The authors were Morgan Lewis, Heather Boggs Sass, Sandra Pritz, Richard Joerger, Laura Overman, Patricia Kelley, and John Foster. Heather Boggs Sass, the lead author for the sections developed by the Southern Regional Education Board (SREB), has asked me to indicate that her sections draw upon work done for SREB by Belinda McCharen and Richard Lynch, consultants for the Alternative Certification Teacher Induction Project, which is funded by the NRCCTE. She was also assisted by the following members of the SREB Staff: Leslie Carson, Pam Fails, Renee Murray, and Alice Presson, as well as University of Louisville graduate students Lisa-Anne Ferris, George Richardson, and Yi-Juin Pan, whose work was guided by the Center's Associate Director, Donna Pearson. The final draft benefited from the careful editing of Kirsten Sundell.

I wish to thank all of my colleagues for their efforts. I am sure this paper will guide the NRCCTE as we plan our new initiatives, and I trust it will also be of use to the broader CTE community. As is the case with all of our publications, the views expressed are those of the writers and not necessarily those of the NRCCTE or its sponsor, the Office of Vocational and Adult Education (OVAE), U.S. Department of Education.

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Executive Summary

Secondary-level career and technical education (CTE) is broadening its purpose from preparation for entry-level jobs to preparation for both employment and postsecondary education. This expanded purpose requires teachers who have a wider range of skills and knowledge than has been true in the past. This report examines the influences that are creating the context in which professional development for secondary CTE operates, the kinds of learning opportunities that secondary CTE teachers need to respond to this context, and the projects that the National Research Center for Career and Technical Education (NRCCTE) is conducting that are addressing the needs identified. Our focus is on professional development for teachers in the classroom, both those who enter the profession through traditional teacher preparation programs and those who are alternatively certified.

The context for professional development for secondary CTE teachers arises from the interaction of many factors, four of which are examined in Chapter 2: (1) the stages that teachers typically go through from the time they enter the classroom until they leave the profession; (2) standards that have been established for (a) what teachers should know and be able to do and (b) how professional development should be structured and delivered; (3) technological innovations that cause new occupations to emerge and others to become obsolete; and (4) the decline in the number of institutions offering four-year teacher education programs in CTE.

The influences identified in Chapter 2 interact to create a need for secondary CTE teachers who have the instructional and assessment skills and knowledge that are discussed in Chapter 3. To meet the expanded expectations of what secondary CTE should accomplish will require increased emphasis on the integration of academic and technical content using research-based instructional strategies. Three strategies that are especially applicable to CTE are project-based instruction, problem-based instruction, and cooperative learning. CTE instructors should also be able to plan standards-based instruction. That is, they should design their instruction so that their students are prepared to the levels specified in applicable academic, technical, and industry standards. CTE teachers and administrators should be able to analyze data from technical assessments in ways that assist them in modifying instruction and initiating other types of program improvement, such as curriculum revision and professional development. In addition to all of these skills, CTE teachers should be able to manage classrooms that are becoming increasingly diverse as students with a wide range of aspirations and abilities choose to take CTE courses.

The NRCCTE has five current projects that address some of the professional development needs discussed in Chapter 3. These projects are summarized in Chapter 4. The first of these is Math-in-CTE Technical Assistance. From its inception through the date of this report, this project has assisted 17 states, regional consortia, and large school districts to implement the Math-in-CTE model for enhancing instruction in the mathematics that is naturally embedded in CTE curriculum. The second examines methods of increasing the literacy skills of CTE students. The third project, conducted by NOCTI (National Occupational Competency Testing Institute), a member of the NRCCTE consortium, addresses the use of technical assessment data. In this project, CTE teachers and administrators were surveyed and asked if they use the results from technical skills assessments to improve instruction and programs. If they do, they were asked

how they learned to use these data. The survey results are being used to design a professional development package that will be piloted, revised, and tested for effectiveness. The fourth project, conducted by the Academy for Educational Development (AED) in cooperation with the National Association of State Director of Career Education Consortium (NASDCTEc), assisted selected states as they developed workplans to improve the enrollment and retention of students in CTE programs that are nontraditional for their gender. AED is monitoring and providing ongoing assistance in the implementation of these workplans. The fifth project is directed at improving the preparation of alternatively certified teachers. The High Schools That Work (HSTW) Consortium of the Southern Regional Education Board (SREB) is developing four modules for an induction program. These modules involve professional development activities and support through a mentor in the teacher's school, coaching from a professional development instructor, guidance from the teacher's principal, and engagement through an electronic community of practice. Two modules have been field tested through an iterative research process that will be used with the remaining two. When all four modules have been completed, they will be further tested for feasibility and effectiveness.

We conclude Chapter 4 by raising three questions that should be asked to guide the planning and delivery of all professional development provided to secondary CTE teachers:

1. What do teachers most need to learn to prepare students for both employment and further education?
2. How can professional development experiences be structured to incorporate the characteristics that the literature identifies as essential to effective professional development?
3. Are adequate resources available to provide the professional development that is needed?

The NRCCTE's projects address only a fraction of the professional development needs of secondary CTE teachers. The improvement of pedagogic skills and updating of technical knowledge require an ongoing effort that must be shouldered by education, business, industry, government, and teachers, themselves. Through collaborative activities, all stakeholders can work to help teachers develop the skills and knowledge needed to prepare students to compete in a satisfying and productive manner within the increasingly competitive global workplace.

Chapter 1

Professional Development for a Field in Transition

This report addresses the professional development needs of secondary level career and technical education (CTE) teachers. Much more is being asked of CTE teachers today than was the case in the past. Society's expectations for what CTE at the secondary level should accomplish have undergone a major expansion. From its origins until the last decades of the twentieth century, occupationally specific courses at the secondary level focused primarily on preparing students for entry-level employment that required specialized training below that typically acquired in four-year baccalaureate programs. In the 1980s, pressures mounted for all of education to improve. These pressures resulted from rapid rates of technological and economic change, especially a concern with maintaining the competitiveness of the American economy in a global marketplace (National Commission on Excellence in Education, 1983). As these pressures mounted, it became clear that for many occupations, high school preparation was insufficient.

The initial attempts to broaden CTE to include preparation for postsecondary education primarily took the form of Tech Prep. The core of Tech Prep is an articulation agreement that explicitly linked instruction at the high school and postsecondary levels and enabled students to earn postsecondary credit for courses studied in high school (Parnell, 1985). In 1990, this broadening received federal endorsement and financial support through the inclusion of a Tech Prep title in the reauthorization of the Carl D. Perkins Vocational and Applied Technology Act (P.L. 101-392).¹ Tech Prep was followed by career pathways, which are designed to link secondary and postsecondary education in 16 career clusters (industry/occupational groupings) in order to provide structure and guidance concerning the skills and knowledge that students must acquire to prepare for employment at various levels within the clusters.

This broadening of CTE was not a federal mandate imposed on reluctant educators; it had, and continues to have, wide support within the field. The most visible signal of this support occurred in December 1989 when the primary professional association of CTE educators changed its name from the American Vocational Association to the Association for Career and Technical Education (ACTE). Members of the association voted for this change in part to overcome negative perceptions that had come to be linked with vocational education, but also to indicate that the renamed field was expanding beyond its focus on preparing students for employment following high school. In 2006, the renamed association published a position paper that presented the rationale and recommendations for an expanded vision of CTE: *Reinventing the American High School for the 21st Century* (ACTE, 2006). This paper set forth the following three purposes for CTE at the secondary school level:

- Support students in the acquisition of rigorous core knowledge, skills, habits and attitudes needed for success in postsecondary education and the high-skilled workplace;

¹ This was the second act to carry the name of Carl D. Perkins, a member of the House of Representatives, who had consistently supported vocational education during his years in Congress. This act is typically referred to as Perkins II, and the current legislation, which continues to carry his name, is referred to as Perkins IV.

- Engage students in specific career-related learning experiences that equip them to make well-informed decisions about further education and training and employment opportunities; and,
- Prepare students who may choose to enter the workforce directly after high school with levels of skill and knowledge in a particular career area that will be valued in the marketplace. (ACTE, 2006, p.1)

It should be noted that preparation for employment following high school is still one of the three purposes of secondary CTE. The collective judgment of CTE educators, as reflected in this paper, continues to see a need for occupational preparation for those students who choose not to continue their education after high school graduation.

The same year ACTE's position paper was published, 2006, the reauthorization of the Perkins legislation required all recipients of its funds to offer at least one program of study (POS). Such a program must:

incorporate secondary and postsecondary elements [that] include coherent and rigorous content aligned with challenging academic standards and relevant career and technical content in a coordinated, nonduplicative progression of courses . . . [that] adequately prepare students to succeed in postsecondary education, and . . . lead to an industry-recognized credential or certificate at the postsecondary level, or an associate or baccalaureate degree. (Sec. 122(c)(1)(A))

This language is quoted directly from the legislation. It codifies and encapsulates the expanded and raised expectations for secondary-level CTE to which the field must respond.

Such expectations have compounded the challenges of preparing CTE teachers for the classroom. This report examines an array of issues that professional development in CTE must address and the ways in which the field is responding. Zirkle, Martin, and McCaslin (2007) described the certification/licensure requirements for secondary CTE teachers established by the 50 states. CTE teachers enter the classroom from two different pathways: traditional and alternative certification. The traditional pathway includes teachers of agriculture, business, family and consumer science, and marketing, almost all of whom have completed a four-year baccalaureate program that prepared them to teach in these fields.² The alternative certification pathway includes teachers in other occupational areas, such as the trades, health, and culinary arts, which alternatively certified teachers entered after having acquired several years of experience in the occupations they teach. Alternatively certified teachers may or may not have baccalaureate degrees, but they typically have had little or no preparation in pedagogy. Those who have not completed a four-year teacher education program earn alternative certification by completing a series of courses designed to teach the essential skills needed to plan, deliver, and evaluate instruction.

All states offer alternative routes to certification, and it is estimated that between 20% and 33% of all new teachers enter the teaching field through alternative pathways (Feistritzer, 2007; U.S.

² Technology education is often thought of as part of CTE, but its goals are those of general education and not preparation for specific occupations.

Department of Education, 2006; Walsh & Jacobs, 2007). Ruhland and Bremer (2003) found the percentage was similar for CTE teachers, about 28%. In a study of 12,000 CTE teachers at High Schools That Work (HSTW) sites in 30 states, however, Bottoms and McNally (2005) found that as many as 75% entered teaching through an alternative route. In light of the economic downturn that began in 2008, the number of prospective teachers seeking alternative licensure may continue to rise (Grossman, 2009). Those who have lost jobs in business and industry may choose to become CTE teachers, entering a field where workforce experience is highly valued. Participants in alternative certification routes are attracted by incentives including inexpensive and brief preparation and the assurance of stable employment that is relatively immune to recessionary downturns (Johnson, Birkeland, & Peske, 2005).

Focus of the Report

In this report, we focus on the professional development that CTE teachers need to respond to the demands of preparing young people for careers that will inevitably be affected by as-yet unforeseen economic and technological changes. Our dual purpose is (a) to explore the current state of professional development in CTE within the context of the contemporary high school and (b) to identify what CTE teachers should know and be able to do. We agree with the National Staff Development Council that professional learning is a more apt label for “activities that increase teachers’ knowledge and change their instructional practice in ways that support student learning” (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009, p. 1); however, we do not focus on the whole range of such activities. When we refer to professional development in this report, it is to structured experiences designed to enhance the knowledge and skills of secondary CTE teachers who are already in the classroom or who have been hired to enter the classroom. We limit the report in this way for reasons of feasibility and focus. The topic of preservice preparation in a four-year program involves most of the same issues as preservice preparation for general education. The voluminous literature on this topic has been thoroughly synthesized in *Preparing Teachers for a Changing World*, edited by Darling-Hammond and Bransford (2005).

We further limit our discussion to the secondary level because it is at this level that change is occurring most rapidly. Unlike the postsecondary level, the secondary level emphasizes (a) the preparation of young people for opportunities requiring different levels of preparation within defined career clusters and (b) using CTE to reinforce academic skills. In contrast, the goal of the postsecondary instructor is to prepare students for employment at the technician level in specific occupations. Postsecondary instructors do not have to deal explicitly with either career exploration or academics. Students who enroll in postsecondary occupational courses are assumed to have made commitments to the career areas they are studying. In addition, community colleges require entering students to take placement tests that determine if they are prepared for college-level courses. Students with academic deficiencies must successfully complete developmental courses before they can enroll in their desired technical courses. Low completion rates in postsecondary CTE programs suggest that the assumptions of a career commitment and the efficacy of development courses both warrant closer examination (Bottoms & Young, 2008b; Bragg et al., 2002; Grubb, 1989), a topic for a different report. We focus here on the professional development provided to secondary-level CTE teachers who are in the

classroom, both those who have entered the profession through a traditional teacher preparation programs and those who are alternatively certified.

To structure our report, we draw upon a conceptual framework for CTE developed by Rojewski (2002, 2009), which we present schematically in Figure 1.1. In the figure, CTE is represented by the oval in the center, and the arrows represent major forces in the environment that affect the field.

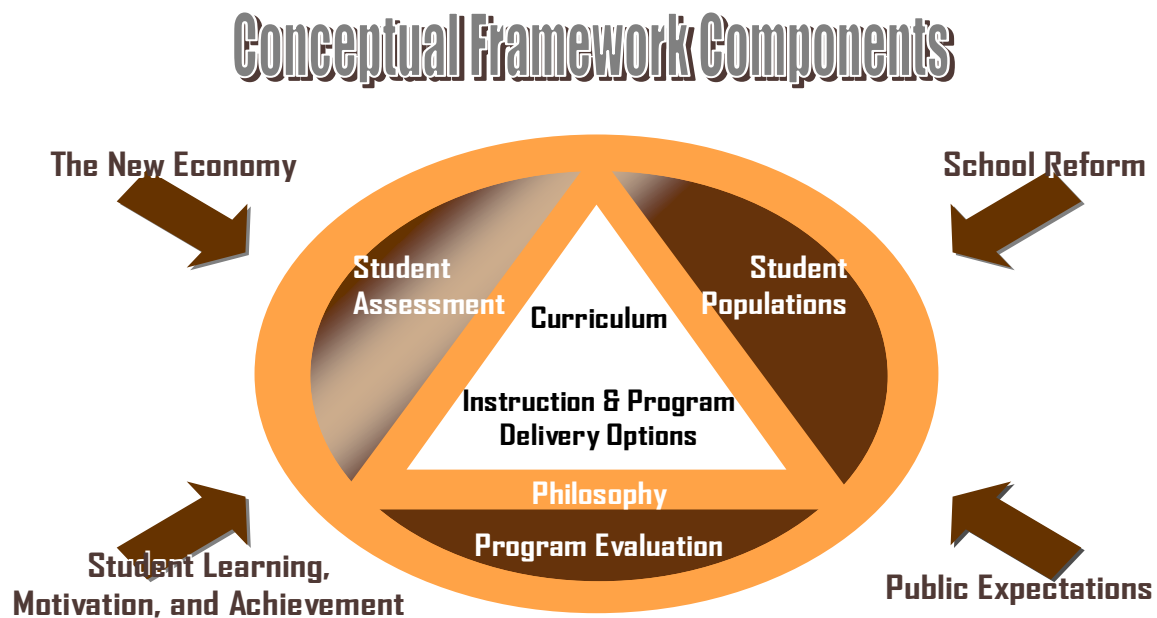


FIGURE 1.1. Rojewski’s (2002, 2009) conceptual framework for CTE. Reproduced from Rojewski (2009) with permission.

Three of the influences identified by Rojewski are the new economy, school reform, and public expectations. It can be argued that the new economy is the force driving both public expectations and school reform. The link between education and the economy was made most forcefully in *A Nation at Risk*, the report of the National Commission on Excellence in Education (1983). The basic argument of this report was that the quality of American education had declined and this decline was directly linked to the nation’s poor economic conditions at the time. The report referred to a “rising tide of mediocrity that threatens our very future as a Nation and a people” (p. 5). No data or analysis supported this assertion, and although many (e.g., Berliner & Biddle, 1995) have refuted its premise, the report’s impact continues to this day.

The validity of its charges may be challenged, but there is no question that *A Nation at Risk* launched a series of reforms aimed at improving the performance of American students. Its lasting impact implies that it focused widely shared concerns about America’s competitiveness in a global economy. The decline of manufacturing, the rise of service industries, and the replacement of workers by machines combined with rapid rates of technological innovation have

created a demand for workers prepared to continually learn and adapt. Such workers must have a strong foundation in what were referred to in the 1990s as SCANS skills (Secretary's Commission on Achieving Necessary Skills, 1991), now being called "21st Century Skills" (Partnership for 21st Century Skills, 2008). Both SCANS and 21st Century Skills stress the need for a solid academic base enhanced by those skills needed for success in a workplace that places a premium on flexibility, critical thinking, problem-solving, teamwork, and the use of information. A consensus has emerged, as reflected in Perkins IV and *Reinventing the American High School for the 21st Century* (ACTE, 2006), that secondary CTE must assume part of the responsibility for providing such a foundation.

If schools are to prepare students with this array of skills, teachers must be prepared to teach them. Both *No Child Left Behind* (P.L. 107-110, NCLB) and Perkins IV rely heavily upon professional development to provide this preparation. NCLB requires every classroom to have a "highly qualified teacher." Subsequent interpretations have limited this requirement to those who teach core academic subjects. However, with increasing pressure on CTE to contribute to academic achievement, all CTE teachers, both traditionally and alternatively certified, may be required to meet the "highly qualified" definition. Reflecting this push, HSTW, the largest school reform initiative targeting CTE, published *Actions States Can Take to Place a Highly Qualified Career/Technical Teacher in Each Classroom* (Bottoms & McNally, 2005). This publication recommends that all CTE teachers be required "to earn a bachelor's degree within five years of beginning to teach from a state-approved career/technical teacher preparation program" (p. 5).

The current federal CTE legislation, Perkins IV, makes 14 references to professional development. What the law requires reflects many of the characteristics of effective professional development articulated in the report of the National Staff Development Council (Wei et al., 2009). Perkins IV specifies that each state plan must describe how professional development will:

- Promote the integration of coherent and rigorous academic content standards with CTE curricula, including opportunities for appropriate academic and CTE teachers to jointly develop and implement curricula and pedagogical strategies
- Increase the percentage of teachers that meet certification and licensing requirements
- Be of high quality, sustained, intensive, focused on instruction, and increase the academic knowledge and understanding of industry standards of CTE teachers
- Encourage applied learning and contribute to the academic and career and technical knowledge of students
- Provide the knowledge and skills needed to work with and improve instruction for special populations
- Assist in accessing and utilizing data including occupational information, student achievement data, and data from assessments
- Promote integration with professional development carried out under NCLB and the Higher Education Act (Perkins IV, Sec. 122(c)(2)(A) to (G))

Section 124(b) of Perkins IV lists nine ways in which the funds reserved for state leadership activities are to be used. Professional development is the third item listed, but 40% of the language in this section addresses this activity. Much of the language repeats and elaborates the

requirements listed above. With regard to the requirement for high-quality, sustained, intensive professional development, Section 124(b)(3)(B) adds the phrase, “and are not 1-day or short-term workshops or conferences.” Three additional topics required for state leadership funds that are not mentioned above include effective practices to improve parental and community involvement (A)(iii); helping teachers to improve student achievement to meet state adjusted levels of performance (C); and ensuring that CTE teachers stay current with the needs, expectations, and methods of industry (D)(i).³

Rojewski’s (2002, 2009) conceptual framework provides some boundaries for our report, but given the breadth of the field of professional development, the topics we include represent only a small proportion of the total, and our discussion of each is limited. Virtually every topic discussed has an extensive literature base; we cited only what we deemed the most relevant sources. Our discussion is thus selective, not exhaustive. Further, we addressed only those elements of Rojewski’s framework that we judged to have the most direct influence upon what CTE teachers should know and be able to do. We concentrated mainly on the triangle within the oval; within that triangle, we primarily addressed instruction and program delivery options.

Overview of Current Practices

Although teaching effectiveness is difficult to define and measure, research supports the conventional wisdom that good teachers have a positive impact upon student achievement (Darling-Hammond, 1997, 1999, 2000; National Commission on Teaching and America’s Future, 1996; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Marzano, Pickering, and Pollock (2001) conducted a meta-analysis spanning decades of research and concluded that after family factors, teachers have the single greatest influence upon student achievement. If secondary CTE teachers are to respond to the expectations placed upon them, they too must be continuous learners, acquire the ability to evaluate and adopt approaches to improve student academic achievement, and keep up to date with technical content of their occupational areas while supporting the career exploration and development of their students.

The most direct approach to influencing career-long professional learning occurs through professional development, a term, concept, and/or process that has several elements. For this report, we define *professional development* as follows:

Professional development involves comprehensive, sustained, and systemic learning experiences that are based on identified needs of teachers and result in improved instructional effectiveness and increased student achievement and performance outcomes.

Under this definition, examples of professional development include such activities as web-based seminars, online training, summer workshops, college courses, and school-level workshops, as well as those that are inherently more sustained, such as mentoring/coaching and study/support groups. The means of delivery is less important than the structure and goals the activity is designed to achieve. To meet our definition, activities need to be conducted purposefully with

³ Each of the paragraph references in this sentence are from Section 124(b)(3) of Perkins IV.

attention to adult learning and teacher development and designed to produce positive change in teacher practice.

The literature indicates that professional development usually deviates widely from our definition. Ruhland and Bremer (2002) put it this way: “Current professional development opportunities are often unfocused, fragmented, low-intensity activities that lead to no significant changes in teaching practices” (p. 21). Traditional professional development can be characterized as formal education activities featuring experts who speak on a “hot” topic or involving a series of trainer-conducted workshops (Corcoran, 1995). Teachers, at best, leave these didactic sessions with some practical tips and useful materials. However, there is seldom any follow-up; subsequent sessions may address completely different topics. Corcoran noted that more in-depth opportunities—such as summer conferences or summer workshops—may be offered to a limited number of teachers, especially for those working in categorical programs like CTE, when funding is available. Special programs are often provided by state or regional agencies.

Table 1.1 summarizes the assumptions identified by Fine (1994) that appear to underlie traditional professional development and contrasts them with what Fine derived from a review of research on best practices. Fine noted that assumptions about traditional practice are largely implicit, inferred from observations on how professional development is usually delivered, rather than explicitly stated. Surveys of nationally representative samples of teachers (Birman, Desimone, Porter & Garet; 2000; Hezel Associates, 2006) imply that most professional development is of the traditional type. Wei and her colleagues (2009) analyzed teacher questionnaire data from the federal Schools and Staffing Surveys from 1999-2000 and 2003-2004 conducted by the National Center for Education Statistics. They found that 59% of those surveyed found content-related learning opportunities useful or very useful. The percentage giving these ratings dropped to 43% on uses of computers for instruction and to 27% on student discipline/classroom management. The rating from the two surveys remained consistent across states and school contexts, with a few exceptions.

Findings from a survey of 205 K-12 classroom teachers in two suburban New York districts shed light on differences between teachers who experienced ineffective professional development and those with more effective experiences (Lowden, 2006). Lowden’s description of ineffective professional development has many parallels with Fine’s assumptions about traditional practice. Such practices are generally unfocused and fragmented, not aligned with school improvement and the teacher evaluation process, offered after school, presented in a didactic format, and/or with the content decided upon by teachers only. In such cases, teachers did not feel the professional development they received changed their attitudes and beliefs about teaching and learning. By contrast, those who had participated in more effective experiences reported experiencing such changes.

The assumptions Fine lists as underlying best practices are supported by the report of the National Staff Development Council (Wei et al., 2009) and evidence reviewed by Yoon et al. (2007). In order to develop as professional educators, teachers need systematic and focused professional learning activities and programs. Such activities must be intensive, on-going, connected to practice, and delivered in learning communities that have sufficient duration to lead to changes in teaching practices and improved student learning

Table 1.1

Assumptions Underlying Traditional Professional Development and Assumptions Derived from Research on Best Practices

Traditional	Best Practices
Periodic inservice days are sufficient to introduce teachers to new ideas and to improve practice	Ongoing professional development is required if it is to result in significant change
Professional development should improve and remediate individual teaching practice	School change is the result of both individual <i>and</i> organizational development
The goal of professional development is to transfer knowledge and discrete skills from "experts" to teachers	The goal of professional development is to support the inquiry into and study of teaching and learning
The most effective way for teachers to learn is for them to listen to a speaker	Teachers learn as a result of training, practice, and feedback, as well as individual reflection and group inquiry into their practice
Professional development is more of a luxury than an essential element of a district's educational program	Professional development is essential to school development
"Pull-out" training at the district level is the most effective delivery mode	Professional development should be primarily school- focused and embedded in the job

Source: Fine (1994, p. 2).

Yoon et al. (2007) reported that professional learning activities that ranged from 30-100 hours and were delivered over a 6- to 12-month period resulted in a positive significant effect on student scores. The students of teachers who averaged 49 hours of professional development increased their achievement scores by an average of 21 percentile points. This finding was derived from nine studies that met the What Works Clearinghouse (WWC; 2010) evidence standards. A total of over 1,300 studies were identified as addressing the effect of professional development on student achievement, but only nine met WWC evidence standards. All nine were based on studies of elementary students.

Professional learning activities should include instruction and experiential strategies addressing how to teach new subject matter (Garet, Porter, Desimone, Birman, & Yoon, 2001). When activities included such experiences, classroom teaching practices were more effective and increases in student achievement occurred (Cohen & Hill, 2001; Desimone, Porter, Garet, Yoon, & Birman, 2002; Knapp, 2003; Stone, Alfeld, Pearson, Lewis, & Jensen, 2006).

Teacher practice and student outcomes are also improved when professional learning activities emphasize content known to be difficult for students to learn (Blank, de las Alas, & Smith, 2007; Carpenter, Feneman, Peterson, Chiang, & Loef, 1989; Cohen & Hill, 2001; Lieberman & Wood, 2001; Merek & Methven, 1991; Stone et al., 2006). Research indicates that professional learning activities should be aligned with larger reform efforts within the school (Cohen & Hill, 2001; Elmore & Burney, 1997; Garet et al., 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007;

Supovitz, Mayer, & Kahle, 2000). Teachers experience a greater impact and are more apt to apply what they learn when they see connections between professional development activities and local assessment practices, curricula, or other topics of local concern.

For professional learning to be effective, strong working relationships must exist among teachers. When time is available and relationships are created, the benefits include more consistency in instruction, deeper teacher knowledge, and an increased willingness to try new teaching approaches and to share practices (Joyce & Calhoun, 1996; Louis, Marks, & Kruse, 1996; McLaughlin & Talbert, 2001; Newman & Wehlage, 1997; Perez, et al., 2007; Stone, Alfeld, & Pearson, 2008).

Quality professional development has many features, each of which may differ somewhat depending on the provider. Drawing upon years of experience and reflection upon key elements of effective professional development activities, the American Federation of Teachers (2002) recommended that professional development should:

- deepen and broaden knowledge of content;
- provide a strong foundation in the pedagogy of particular disciplines;
- provide knowledge about the teaching and learning processes;
- be rooted in and reflect the best available research;
- be aligned with the standards and curriculum teachers use;
- contribute to measurable improvement in student achievement;
- be intellectually engaging and address the complexity of teaching;
- provide sufficient time, support and resources to enable teachers to master new content and pedagogy and to integrate this knowledge and skill into their practice;
- be designed by teachers in cooperation with experts in the field;
- take a variety of forms; and
- be job-embedded and site specific. (pp. 11-12)

Perkins IV reflects the importance that policymakers place on professional development and their expectation for how it should be delivered to CTE educators. New technology, research findings, policy changes, the economy, demographic shifts, teacher certification requirements, and a variety of mandates affect the daily practice and effectiveness of all teachers. These external factors, as well as changes in their own experience and competence, create a need for professional development opportunities that will improve knowledge and skills related to the many facets of the CTE teaching profession.

Organization of the Report

In the following chapters, we examine what we judge to be major topics that must be addressed in order to provide effective professional development to secondary level CTE teachers who are already in the classroom. These topics emerge from economic and technological trends that are pressing the entire educational enterprise to teach students the skills they will need to continually adapt to future economic and technological changes. The educational reforms launched by the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983) have

largely been driven by the prevailing opinion that American workers must be innovative problem-solvers if they are to compete with their lower wage counterparts from other countries. Education has been charged to teach the skills that such workers will need.

In Chapter 2, we discuss the influences that interact to create the context in which professional development in secondary CTE is delivered. The most basic of these influences is the evolution teachers undergo from the time they first enter the classroom until they leave the profession. Their changing needs during this journey are the foundation that should underlie all professional development. We present the standards adopted by three national boards and councils concerning the skills and knowledge that teachers should have and the ways in which professional development should be planned and delivered. Additional influences discussed include the changes in technical skills required by new technologies and innovations in the workplace. Such changes create the need for teachers who have acquired these skills; this need is often met through alternative certification. We conclude the chapter with a discussion of the decline in the number of higher education institutions offering teacher preparation in CTE. This decline has increased the demand for alternatively certified teachers but reduced the capacity of the field to provide the professional development they require.

In Chapter 3, we discuss the knowledge and skills that secondary CTE teachers need to prepare students to enter and succeed in their careers. CTE teachers are asked to (a) engage and retain students and prepare them for transition to further learning in postsecondary education or the workplace by using research-based instructional strategies to integrate career, academic, and technical skills that meet industry standards, (b) partner with business and industry, and (c) use data to guide the improvement of their programs. When presented all in one sentence, such expectations may sound unrealistic, but they are not. CTE teachers are being pressed to do all of these things while simultaneously acquainting students with all aspects of the industries they are studying, fostering leadership and citizenship skills, and managing classrooms with students from varied backgrounds.

Chapter 4 describes current NRCCTE projects that are responding to four of the professional development needs discussed in Chapter 3: integration of academic and technical skills, use of assessment data to guide instruction and program improvement, diverse classrooms (with a focus on students taking courses not traditional for their gender), and alternative certification. The chapter concludes with three questions that should be asked of all professional development provided to secondary CTE teachers.

Chapter 2

The Context for Professional Development in Career and Technical Education

This chapter examines four broad influences that affect the context to which professional development in CTE must respond. Professional development attempts to increase and enhance the knowledge and skills of teachers. Consequently, we begin our discussion with an overview of the many dimensions that underlie a teacher's development as an educator and individual. The first section of this chapter discusses models that delineate the stages that teachers go through as they enter and progress in the profession. In the second section, we review two sets of national standards that have been established for teaching and one for the delivery of professional development. Each of these sets has a somewhat different emphasis, but there is much similarity between them regarding expectations for effective teaching and how best to develop the skills and knowledge required to meet these expectations.

In the third section, we turn to changes in the technical skills needed by CTE teachers and their implications for alternative certification. As the number of skilled workers recruited to become teachers increases, so does the need for professional development. We end this chapter with a review of trends in CTE teacher education programs that provide the preparation for virtually all CTE teachers, both those who follow a traditional four-year baccalaureate route and those who obtain alternative certification. The evidence indicates that the number of such programs is declining and raises doubts about the capacity of the field to meet the demand for qualified CTE teachers.

Teacher Development and Learning

Learning to teach is a developmental, career-long process. Sprinthall, Reiman, and Thies-Sprinthall (1996) noted personal and professional dimensions that evolve at differing rates. Bee (1987) and Bee and Bjorklund (2000) provided a summary of many different models of adult development that affect the daily experiences and views of teachers. All adults experience changes in their physical health, cognitive abilities, family roles, work roles, interpersonal relationships, personality, systems of meaning, and major life tasks. In addition to changes at the individual level, the development of teachers as professionals is affected by state and local contexts, performance appraisals, professional development experiences, preconceptions about teaching, testing, teaching standards, professional growth plans, teaching experiences, and other educators, including mentors (Reiman & Thies-Sprinthall, 1998). Each of these elements contributes in varying degrees to the focus, concerns, and change in teachers' professional lives. Professional development activities that respond to these evolving dimensions will optimize the knowledge and skill development of CTE teachers.

Models of Teacher Development

Reiman and Thies-Sprinthall (1998) proposed that teachers proceed through five stages throughout their career. The experiences of early-career teachers, also known as beginning teachers, are characterized by survival and discovery events during the *novice* stage. Within the

advanced beginner stage, teachers consolidate skills and move on to the integration of new ideas into effective teaching practices. Teachers in the *competent* stage practice the mastery of some instructional techniques and content. After achieving and maintaining a sense of stability, teachers progress to the *proficient* stage in which they are more analytical about teaching. Extended analyses and deliberations result in additional changes in their beliefs and practices. Due to their advanced levels of competence, *expert* teachers are able to be quite flexible and fluid in their approaches to teaching. The Reiman-Thies-Sprinthall model is a more detailed elaboration of the concerns-based adoption model (Fuller, 1969), which places teaching concerns in the categories of *self*, *task*, and *impact* during different periods of teacher development.

Occupational progression is also represented in career development phase models. A number of models of teacher development have been proposed to explain how teachers evolve given the influence of personal, professional, and organizational factors (e.g., Fessler & Christenson, 1992; Steffy, Wolfe, Pasch, & Enz, 2000). Odell and Huling (2000) have identified four stages that teachers progress through during their careers: preservice, induction, inservice, and renewal—each with its own characteristic experiences and challenges. Huberman, Grounauer, and Marti (1993) constructed a framework, summarized in Figure 2.1, that reflects common patterns of transition throughout the teaching career cycle. Acknowledging that the relationship between years of teaching experience and phases of teacher life cycle varies by individual, they stated:

While we have not set forth a linear or monolithic model of the career cycle (i.e. all teachers traversing each phase in succession) we have evoked *central tendencies* general junctures notably with respect to the leitmotifs or different phases in the ordering of these phases. (p. 12)

There are many changes in the lives of secondary CTE teachers as their careers evolve, and our focus is primarily upon the first two phases shown in Figure 2.1: career entry and stabilization. In the following chapters, we discuss what we consider the essential knowledge and skills that new teachers need in order to experience sufficient success and satisfaction and continue in the profession. The national standards, to which we now turn, specify the types of knowledge and skills that are needed and how professional development should be delivered to respond to teachers' evolving needs.

National Standards for Teaching and Professional Development

National standards have become a hallmark of education reform partly due to the belief that if educators can set forth a common set of expectations, the task of meeting these expectations will be straightforward. There is an implicit hope that agreement on and promulgation of such standards will encourage higher achievement, especially if the standards are set at high levels. Standards are not only a primary policy for improving student performance; they also have been developed for teachers and professional development. This section reviews three different sets of national standards, two that define what effective teachers should know and be able to do and one for the structure and delivery of professional development. These include the National Board for Professional Teaching Standards (NBPTS)

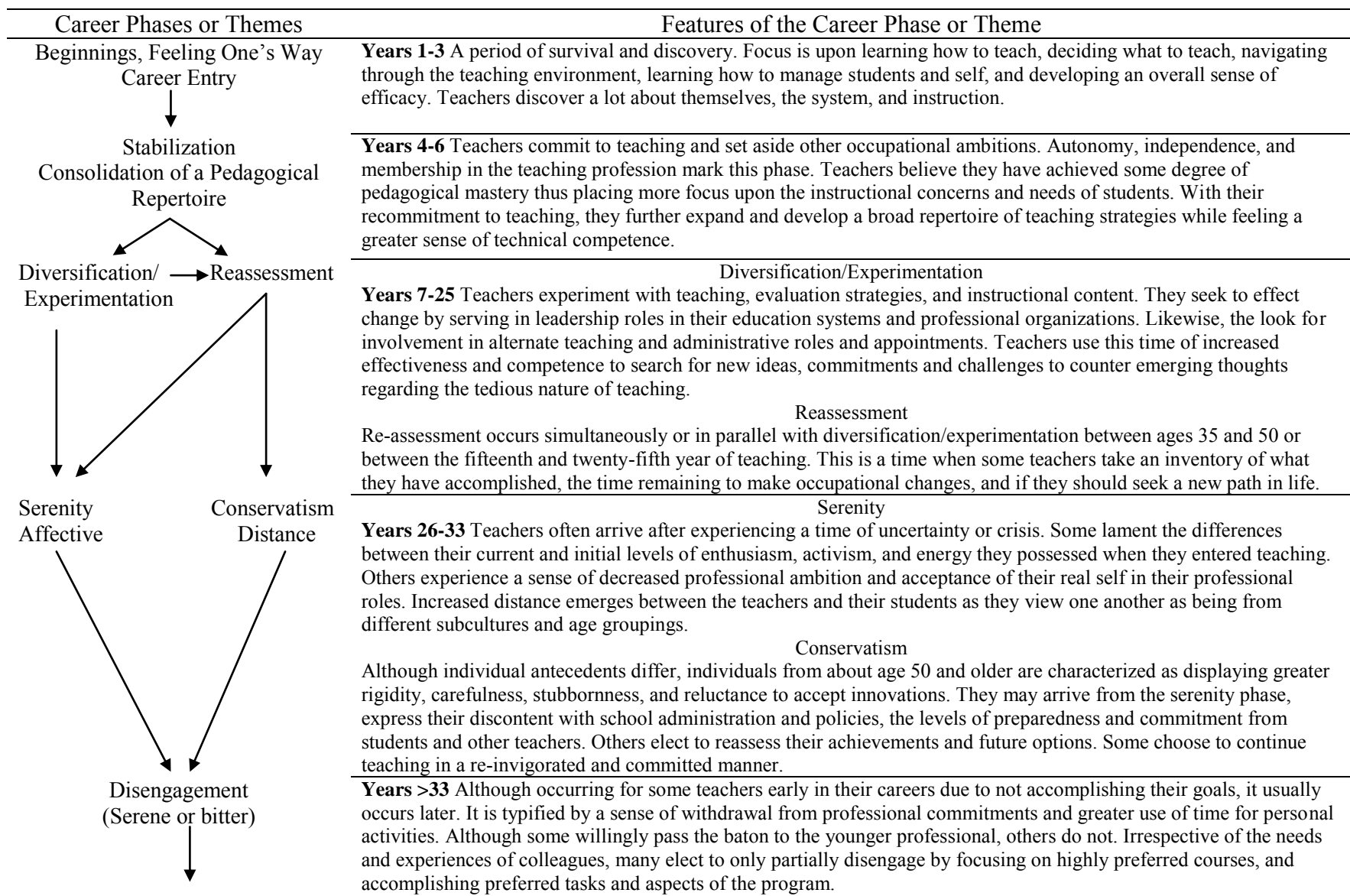


Figure 2.1. Huberman's model of the sequences of the teacher's career life cycle. *Source:* This figure is adapted from Huberman (1989) and Huberman et al. (1993).

for advanced teachers; the model standards for beginning teachers from the Interstate New Teacher Assessment and Support Consortium (INTASC), Council of Chief State School Officers; and the National Staff Development Council Standards (NSDCS) for the professional development of teachers at all stages.

As with much else in the current educational climate, the roots of the current education standards movement in the United States can be traced to *A Nation at Risk* (National Commission on Excellence in Education, 1983). Two of the five major recommendations raised in the report were to:

- Adopt more rigorous and measurable standards and higher expectations
- Improve the preparation of teachers and make the profession more rewarding and respected

The first of these recommendations was to be applied to students, but in the succeeding years, it has been extended into every segment of education. The standards movement has been bolstered by a series of education reports and summits, and the concept of standards for students has been embedded in education-related legislation at all levels, notably for CTE in Perkins IV, which references nationally recognized skill standards and industry-recognized standards.

The application of standards for teachers has varied across states (Zirkle et al., 2007). In some states, standards have driven teacher preparation and certification; in others, they have received little attention. Yet the intent mentioned in *A Nation at Risk*—to improve the preparation of teachers and make the profession more rewarding and respected—has led to the implementation of standards for teachers as a way to clarify expectations of what accomplished teachers should know and be able to do. We present these standards in detail because they shape the target for professional development of all teachers—including secondary CTE teachers—and as such should be reflected in professional development.

National Board for Professional Teaching Standards

The NBPTS describes itself as an independent, nonprofit, nonpartisan, and nongovernmental organization. It was formed in 1987 to advance the quality of teaching and learning by developing professional standards for accomplished teaching, creating a voluntary system to certify teachers who meet those standards, and integrating certified teachers into educational reform efforts. It is governed by a 63-member board of directors, a majority of whom are teachers. Committed to basic reform in education, NBPTS recognizes that teaching is at the heart of education and, further, that the single most important action the nation can take to improve schools is to strengthen teaching (NBPTS, 1997).

The NBPTS' system of teacher certification differs from state-level teacher licensing and certification because it is a voluntary process that allows experienced teachers to demonstrate advanced teaching skills according to national standards, rather than minimum licensing requirements that vary from state to state. The experience of working to gain the certification is itself seen as deep professional development. Five Core Propositions form the foundation of the

standards for National Board Certified Teachers (NBCTs), who are certified through demonstration of the standards in one of 25 areas.

Proposition 1: Teachers are committed to students and their learning.

Proposition 2: Teachers know the subjects they teach and how to teach those subjects to students.

Proposition 3: Teachers are responsible for managing and monitoring student learning.

Proposition 4: Teachers think systematically about their practice and learn from experience.

Proposition 5: Teachers are members of learning communities. (NBPTS, 1997, pp. vi-vii)

NBPTS provides a system for identifying, recognizing, and rewarding accomplished teachers. In addition, it contributes to the way the profession organizes itself for continued growth and professional development by capitalizing on the expertise of accomplished teachers to provide role models for others. Considerable research has been conducted about the impact of this system. According to a NBPTS report (2007) of this research:

Overall, the studies show promising, but in some cases mixed, results regarding the impact of National Board Certification on student achievement as measured by standardized tests. The research is consistently positive about the influence of National Board Certification on teacher practice and morale, professional development, and areas of school improvement—such as leadership development, teacher mentoring, monitoring student performance, team-building, and curriculum development—that are critical to raising student achievement. (p. 4)

To create each set of standards for the 25 certificate areas, the NBPTS Board of Directors appoints a standards committee to (a) develop standards that reflect the Five Core Propositions, (b) identify specific knowledge, skills, and attitudes that support accomplished practice within a holistic approach to teaching, (c) illustrate how a teacher’s professional judgment is reflected in action, and (d) describe how the standards come to life in different settings.

The CTE certificate area is designed for teachers who teach career and technical subjects to students ages 11-18+ and who know industry-specific subject matter. Candidates must select one of eight specialty area clusters that best identifies their teaching situation: agriculture and environmental science; arts and communications; business, marketing, information management, and entrepreneurship; family and consumer sciences; health services; human services; manufacturing and engineering technology; and technology education. Thirteen standards have been organized into four categories around the effect of teacher actions on student learning. The standards listed below are from the NBPTS publication, *Career and Technical Education Standards* (1997).¹ The pages where the standards appear in this publication are indicated in parentheses:

¹ This publication was originally titled *Vocational Education Standards*. It was renamed in 2000 at the request of the committee that developed the standards. The name change followed the decision of the American Vocational Association to change its name to the Association for Career and Technical Education (ACTE).

Creating a Productive Learning Environment

- I. Knowledge of students (including how they learn best): Accomplished career and technical education teachers are dedicated to advancing the learning and well-being of all students. They personalize their instruction and apply knowledge of human development to best understand and meet their students' needs. (p. 9)
- II. *Knowledge of subject matter (including ways that students learn workplace skills and integration with other disciplines and eight broad economic sectors):* Accomplished career and technical education teachers command a core body of general career and technical education knowledge about the world of work in general and the skills and processes that cut across industries, industry-specific knowledge, and a base of general academic knowledge. They draw on this knowledge to establish curricular goals, design instruction, facilitate student learning, and assess student progress. (p. 13)
- III. *Learning environment (including classroom management and teaching methods):* Accomplished career and technical education teachers efficiently manage their classroom and create an environment that fosters democratic values, risk taking, and a love of learning. In this environment, students develop knowledge, skills, and confidence through contextualized learning activities, independent and collaborative laboratory work, and simulated workplace experiences. (p. 31)
- IV. *Diversity:* Accomplished career and technical education teachers create an environment where equal treatment, fairness, and respect for diversity are modeled, taught, and practiced by all. They take steps to ensure quality career and technical education learning opportunities for all students. (p. 35)

Advancing Student Learning

- V. *Advanced knowledge of CTE subject matter:* Accomplished career and technical education teachers foster experiential, conceptual, and performance-based student learning of career and technical education subject matter and create important, engaging activities for students that draw upon an extensive repertoire of methods, strategies, and resources. Their practice is also marked by their ability to integrate career and technical education and academic disciplines productively. (p. 39)
- VI. *Assessment (variety of purposes, variety of methods; progress, feedback):* Accomplished career and technical education teachers utilize a variety of assessment methods to obtain useful information about student learning and development, to assist students in reflecting on their own progress, and to refine their teaching. (p. 45)

Helping Students Transition to Workplace and Adult Roles

- VII. *Workplace readiness:* Accomplished career and technical education teachers develop student career decision-making and employability skills by creating opportunities for students to gain understanding of workplace cultures and expectations. (p. 49)

VIII. *Managing and balancing multiple life roles:* Accomplished career and technical education teachers develop in students an understanding of the competing demands and responsibilities that are part of the world of work, and guide students as they being to balance those roles in their own lives. (p. 53)

IX. *Social development:* Accomplished career and technical education teachers develop in students self-awareness, confidence, character, leadership, and sound personal, social, and civic values and ethics. (p. 57)

Improving Education through Professional Development and Outreach

X. *Reflective practice:* Accomplished career and technical education teachers regularly analyze, evaluate, and strengthen the effectiveness and quality of their practice through life-long learning. (p. 61)

XI. *Collaborative partnerships:* Accomplished career and technical education teachers work with colleagues, the community, business and industry, and postsecondary institutions to extend and enrich the learning opportunities available to students and to ease school to work transitions. (p. 65)

XII. *Contribution to the education profession:* Accomplished career and technical education teachers work with colleagues and the larger educational community both to improve schools and to advance knowledge and practice in their field. (p. 69)

XIII. *Family and community partnerships:* Accomplished career and technical education teachers work with families and communities to achieve common goals for the education of all students. (p. 73)

The standards represent agreement among contributing professionals about the critical aspects of the teaching practice that characterize advanced teachers and what distinguishes them from those just beginning in the field. It is noticeable that the NBPST standards are focused on what accomplished teachers *do* with their knowledge, described with action verbs. The next set of standards is designed differently, as it is for beginning teachers, and the focus tends to be, although not exclusively, on what teachers *understand*.

Interstate New Teacher Assessment and Support Consortium

The website for the Council of Chief State School Officers (CCSSO) states:

The Interstate New Teacher Assessment and Support Consortium (INTASC) is a consortium of state education agencies and national educational organizations dedicated to the reform of the preparation, licensing, and on-going professional development of teachers. Created in 1987, INTASC's primary constituency is state education agencies responsible for teacher licensing, program approval, and professional development. Its work is guided by one basic premise: An effective teacher must be able to integrate

content knowledge with the specific strengths and needs of students to assure that *all* students learn and perform at high levels...INTASC's role is one of consensus building among the states, and not decision making...The INTASC standards are ~~model~~" standards and intended to be a RESOURCE that all states can use to develop their own state standards. INTASC encourages states to take the model standards and discuss and debate them among their own stakeholders to come up with their own. (CCSSO, 2010)

The INTASC standards address a common core of teaching knowledge and skills intended to help all students learn 21st century knowledge and skills. These standards were developed with reference to the advanced certification standards of the NBPTS and in response to the five major propositions that guide the National Board's work. However, INTASC's 10 principles are not organized within each of the NBPTS propositions because the developers considered many abilities to be interwoven and cross-cutting. Each principle is further explained by the related knowledge, dispositions, and performances considered essential for all teachers regardless of their specialty area. The principles listed below are from the publication *Model Standards for Beginning Teacher Licensing, Assessment and Development: A Resource for State Dialogue* (INTASC, 1992). The pages on which the principles appear are indicated in parentheses.

Principle 1: The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students. (p. 14)

Principle 2: The teacher understands how children learn and develop, and can provide learning opportunities that support their intellectual, social, and personal development. (p. 16)

Principle 3: The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners. (p. 18)

Principle 4: The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills. (p. 20)

Principle 5: The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation. (p. 22)

Principle 6: The teacher uses knowledge of effective verbal, nonverbal, and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom. (p. 25)

Principle 7: The teacher plans instruction based upon knowledge of subject matter, students, the community, and curriculum goals. (p. 27)

Principle 8: The teacher understands and uses formal and informal assessment strategies to evaluate and ensure the continuous intellectual, social, and physical development of the learner. (p. 29)

Principle 9: The teacher is a reflective practitioner who continually evaluates the effects of his/her choices and actions on others (students, parents, and other professionals in the learning community) and who actively seeks out opportunities to grow professionally. (p. 31)

Principle 10: The teacher fosters relationships with school colleagues, parents, and agencies in the larger community to support students' learning and well-being. (p. 33)

Since the standards were issued in 1992, the focus of the consortium's continuing work has been in translation of the core standards into model licensing standards in various academic disciplines. The area of career and technical education is not among those addressed as a discipline. The INTASC effort is moving toward a coherent approach to educating and licensing teachers based upon consensus among the states and within the profession of what constitutes professional teaching. As noted above, some states have already adopted the standards for these purposes.

National Staff Development Council Standards

The National Staff Development Council (NSDC) describes itself as ~~the~~ only education association working solely to increase student achievement through more effective professional development. NSDC's community of educational leaders is committed to professional learning that is standards-based, sustained, job-embedded, practical, and linked directly to student achievement."² In addition to the national organization, more than 35 state and provincial affiliates provide services and programs that connect staff developers within individual states or provinces or regions.

NSDC's purpose statement connects professional development and student learning: The organization exists to ensure that ~~every~~ educator engages in effective professional learning every day so every student achieves." This purpose statement emphasizes that all educators have a responsibility to learn in order to improve student performance. NSDC's belief statements follow:

- Every student learns when every educator engages in effective professional learning.
- Schools' most complex problems are best solved by educators collaborating and learning together.
- Remarkable professional learning begins with ambitious goals for students.
- Professional learning decisions are strengthened by diversity.
- Sustainable learning cultures require skillful leadership.
- Student learning increases when educators reflect on professional practice and student progress.

The Council's definition of professional development, as with the definition adopted for this report, makes a direct link with activities that improve student achievement: To the NSDC,

² This and the following quotations in this section are from various pages on the NSDC website at <http://www.nsd.org>.

professional development is —a comprehensive, substantiated, and intensive approach to improving teachers’ and principals’ effectiveness in raising student achievement.” Professional development fosters collective responsibility for improved student performance and must be comprised of professional learning that: (a) is aligned with rigorous state student academic achievement standards as well as related local educational agency and school improvement goals; (b) is conducted among educators at the school and facilitated by well-prepared school principals and/or school-based professional development coaches, mentors, master teachers, or other teacher leaders; and (c) primarily occurs several times per week among established teams of teachers, principals, and other instructional staff members in which teams of educators engage in a continuous cycle of improvement.

The standards presented below are stated as staff development standards rather than teacher performance standards and involve context, process, and content standards. The key term is given in parentheses; each is linked to a rationale and annotated bibliography on the NSDC website.

Context Standards

Staff development that improves the learning of all students:

- Organizes adults into learning communities whose goals are aligned with those of the school and district. (Learning communities)
- Requires skillful school and district leaders who guide continuous instructional improvement. (Leadership)
- Requires resources to support adult learning and collaboration. (Resources)

Process Standards

Staff development that improves the learning of all students:

- Uses disaggregated student data to determine adult learning priorities, monitor progress, and help sustain continuous improvement. (Data-driven)
- Uses multiple sources of information to guide improvement and demonstrate its impact. (Evaluation)
- Prepares educators to apply research to decision making. (Research-based)
- Uses learning strategies appropriate to the intended goal. (Designs and strategies)
- Applies knowledge about human learning and change. (Learning)
- Provides educators with the knowledge and skills to collaborate. (Collaboration skills)

Content Standards

Staff development that improves the learning of all students:

- Prepares educators to understand and appreciate all students; create safe, orderly and supportive learning environments; and hold high expectations for their academic achievement. (Equity)
- Deepens educators’ content knowledge, provides them with research-based instructional strategies to assist students in meeting rigorous academic standards, and prepares them to use various types of classroom assessments appropriately. (Quality teaching)

- Provides educators with knowledge and skills to involve families and other stakeholders appropriately. (Family involvement)

Although structured with different premises, all three sets of standards have many similarities. Consistent themes in each include knowledge of subject matter and human development; use of a variety of instructional strategies to meet the diverse needs of students; use of data that includes on-going formal and informal assessment; and collaboration with colleagues, parents, and community. The NBPTS and INTASC also stress continual reflection to analyze and improve practice. In the collective judgment of the authors of this paper, all three sets of standards have been created with thoughtful input from numerous leaders in education, have been accepted in the broad field of education, and should be reflected in all professional development provided in CTE.

Technical Knowledge and Skills Needed by CTE Teachers

The content of CTE is continually changing. As new technologies become commercially viable, new occupations emerge, the requirements of existing occupations change, and obsolete occupations decline and disappear. CTE teachers must remain abreast of those changes and adjust their own knowledge, skills, and curricula accordingly. Two examples of such needs at a macro level include reacting to new and evolving occupations and reacting to changes in approaches to and new trends in occupations, such as the growing focus on green occupations.

New, Emerging and Evolving Occupations

The Bureau of Labor Statistics of the U.S. Department of Labor conducts research about changing occupations. Drawing upon the discussion in a methodology report from the National Center for O*NET Development (2006), we shall use the following definitions:

- *A new occupation* includes duties that have developed recently and are not included in a current occupational classification. No predictions are available about the field's growth rate. Retinal angiography, a subfield of biomedical photography, is an example.
- *An emerging occupation* has been recognized in small numbers but continues to grow. For example, search engine optimization (SEO) is established enough to have its own professional association and trade group.
- *An evolving occupation* includes tasks that are changing significantly. For example, database administrators are often expected to assume IT security duties, and a new job title would be database security engineer.

New occupations tend to arise from technological advances, legislation and regulations, and changing demographics. These may be spurred by needs created by natural disasters, war and terrorism, and global competition. New and emerging occupations are increasingly multidisciplinary, meaning that they require diverse skills from more than one area of study. Nevertheless, such occupations may be very specialized; good examples are those that have spun off the 2003 completion of the Human Genome Project, including genetic counseling, organ transplantation, drug development, computational biology, and biomedical engineering. With the advent of globalization, occupations also now have an international component (Jones, 2008).

Thomas Friedman's best-selling books, *The World is Flat* (2005) and *Hot, Flat, and Crowded* (2008), have raised public awareness of how globalization has changed the stakes in terms of training U.S. workers for new job opportunities. U.S. workers now find themselves in competition with others around the globe who can do many technical jobs at lower wage levels. Unless they have been trained to higher standards and can do a superior job, American workers may not be able to compete. This fact places a higher burden on the preparation of teachers who must not only learn the required material themselves, but must also help students progress to higher levels.

New technologies continue to emerge in the workplace, just as they always have, both in products and services and also in processes. Just-in-time supply chain analysis is a far cry from taking manual inventory in a warehouse. The National Academies Committee on Prospering in the Global Economy of the 21st Century (2005) cited studies showing that, even before the advent of information technology, as much as 85% of U.S. per capita income growth was due to technological change. The National Academies urged that continued economic growth and leadership will depend on the country's ability to maximize its knowledge-based resources, especially in science and technology, and foster new and revitalized industries and innovation. Their recommendations, however, focus on recruiting and educating K-12 science and mathematics teachers and providing a variety of types of professional development —to upgrade the skills and state-of-the-art knowledge” of practicing teachers in these disciplines. With the myriad continuing education opportunities available, however, teachers complain that it is hard to know which will be worthwhile. CTE and CTE educators are not mentioned in the National Academies report, despite the many CTE-related occupations that support the technology-based innovations they hoped to spur. The National Governors Association (NGA) Center for Best Practices (2007) did recognize that CTE programs, such as computer networking and pre-engineering, are being created to prepare students for careers involving science and technology.

As these new technologies are gradually proven and become established in business and industry, there is generally a lag before they are recognized as important enough to initiate new programs and be included in existing CTE programs. The new knowledge and skills inherent in these technologies must be identified, and teachers of the related programs must have some way to master them before incorporating them in existing programs or generating new ones. This means that teachers who are not newly recruited from occupations using new technologies are always in catch-up mode with regard to industry advances.

For several years, the Association for Professional Development in CTE (APDCTE), an affiliate of ACTE, has surveyed the national population of state directors of CTE or the individuals in their organizations responsible for the coordination of professional development activities for career and technical educators (Pivnichny, Wichowski, & Heberly, 2007, 2008; Wichowski & Heberly, 2004, 2006). Their survey instrument contains 49 topical statements describing possible priorities in CTE and allows space for write-in items. Respondents are directed to identify up to 10 items representing priorities in their individual state. The number of times “CTE Teacher Technical Skill Updating” was identified as a priority for professional development ranked 5th, below 10th, and 9th, respectively, in the first three years of survey administration. In 2008, this topic jumped to 4th place. The NGA's Center for Best Practices (2007) identified the relative lack

of connections between state education and economic systems as a problem that makes the response of education to the emergence of new industries —slow onexistent.” It also cited the misalignment of state high school academic standards with both college and workplace demands

One of the ways in which CTE educators can upgrade their knowledge and skills in emerging or evolving occupations is to engage in externships, a term coined to describe a work-based experience at a relevant business. The School-to-Work Opportunities Act of 1994 (P.L. 103-239) provided funding to states for local partnerships, with business and industry as a required partner, to develop a comprehensive school-to-work system. Among the activities allowed were teacher externships, which were intended to give CTE teachers the opportunity to stay current with technology and to network with other professionals in the industry. Although the act has expired and research has found wide variance in implementation of its provisions (Hughes, Bailey, & Mechur, 2001), externships remain as one means of upgrading CTE content knowledge.

Green Occupations

Increasing concern about the environment has led to the emergence of green occupations. A simple definition of a green occupation is that any occupation that focuses primarily on environmentally responsible products or services can be considered “green” (Career Solutions, 2009). And yet behind the obvious environmentalism message are strong economic and national security factors: the need for renewable resources, reduction of U.S. dependence on foreign oil, a focus on less expensive alternatives to meet increasing energy demands, job creation, and a means of addressing climate change and other environmental challenges. One of the campaign proposals of President Obama was to spend \$150 billion over 10 years in addressing these needs (Obama, 2008). The stimulus bill alone appears to contain four million new green jobs (Penn, 2009). Green occupations fit into the categories of new, emerging, and evolving occupations discussed earlier, and many of their roots reside in manufacturing. Three important sectors affected are:

- *Energy conservation and generation:* biomass fuels, solar-thermal and geothermal technologies, wave-power technologies, wind-turbines, photovoltaic energy, lithium-ion batteries, and upgrading the electric grid, all for powering industry, homes, and vehicles.
- *Environmental conservation:* reduction of pollution, preservation of natural resources, and reconstituting waste.
- *Construction:* sustainable building and landscaping, Forest Stewardship Council (FSC)-certified lumber and wood panels, water-efficient plumbing fixtures and fittings, floor coverings, and concrete from recycled materials.

However, occupations in every sector and industry are likely to be affected by efforts to reuse, renew, and recycle. For example, green fashion designers utilize recycled fabrics and renewable fibers such as hemp and organic cotton (Career Solutions, 2009).

The disciplines inherent in the green occupations call for even more convergence of academic and technical skill instruction. Almost all green technologies involve the so-called STEM disciplines of science, technology, engineering, and mathematics. It is no coincidence that

Project Lead the Way,³ a structured program in pre-engineering, engineering technology, and biomedical science at both the middle and high school levels, also provides a teacher training program with ongoing support. Instructors are trained in a teaching approach that involves students in team problem-solving activities like those used in college and industry, with hands-on daily experience in problem-solving skills, electronics, robotics, and manufacturing processes.

Community colleges are establishing programs to address the skill needs of green occupations because business and industry are clamoring for workers; high schools are also creating courses on renewable technologies. For example, Whitmore Lake High School in Michigan has a new class called Green Tech, which is in demand among both top students and those who struggle, according to one of its teachers. Even so, the topic of renewable energy is not yet in state standards, and it is challenging for teachers to find necessary materials (Cavanaugh, 2009), much less be skilled in teaching from them.

Despite a lack of standards and the difficulties in obtaining content, innovative CTE professionals have always tried to maintain programs that are on the cutting edge. One such school system is Virginia Beach Public Schools, which not only received a grant for installation of offshore wind turbines, but also instituted a systemwide end-of-program assessment on sustainability. Konopnicki (2009) reported that this school system has added sustainability—environmental, economic, and social—to its list of 21st Century Skills (Partnership for 21st Century Skills, 2008). Even if other high schools do not institute new programs as the Virginia Beach system has, they can provide the relevant foundations in electronics, electro-mechanics, instrumentation, power distribution, welding, machine tools, and industrial maintenance in programs designed to articulate with postsecondary programs in many sustainability-related fields.

Availability of Teacher Education

Over the past two decades, the number of CTE teacher education programs in colleges and universities has declined, and entry requirements for the remaining programs have increased. These trends are contributing to a decline in the number of CTE teachers entering the profession from four-year programs. These trends also mean that there is less institutional capacity to provide the courses required for alternative certification, even as the numbers seeking such certification rise.

The decline in CTE teacher education programs was documented by surveys conducted in 1989 and 2000. Lynch (1990) contacted 98 institutions he identified as offering teacher education programs in four or more traditional subject areas of what was then called “vocational education.” Eleven years after Lynch’s study, Bruening and his associates (2001a, 2001b) collected the same types of data. Instead of using institutions as the primary sampling unit, however, Bruening et al. defined their population as 673 individual teacher educators with administrative responsibilities at 385 institutions.

³ See <http://www.pltw.org>.

Differences in their sampling units and response rates make comparisons across the two surveys prone to misinterpretation. Even with these problems, however, the results leave little doubt that the number of programs preparing CTE teachers declined sharply from 1989 to 2000. Table 2.1 indicates the number of programs in traditional subject areas. The bases for the percentages are the 78 institutions that responded to Lynch in 1989 and the 164 that responded to Bruening et al. in 2000.

Table 2.1
Number of Teacher Preparation Programs by Subject Areas in 1989 and 2000

Subject Area	1989 (Lynch)		2000 (Bruening et al., 2001a, 2001b)	
	<i>N</i>	A (%)	<i>N</i>	B (%)
Agriculture	41	52.6	67	40.9
Family-consumer science	59	75.6	61	27.9
Technology	58	74.4	28	12.8
Business	54	69.2	24	11.0
Trade and industry	58	74.4	18	8.2
Marketing	37	47.4	12	5.5
Health	15	19.2	5	2.3
Total	322		215	

Note. A = Percentage of 78 institutions that offered four or more programs reporting that they offered programs in this subject area. B = Percentage of 164 institutions that offered one or more programs reporting that they offered programs in this subject area.

Bruening et al. (2001a, 2001b) had more than double the number of responding institutions as Lynch, and 49 of these respondents also participated in the Lynch study.⁴ Despite this overlap and Bruening’s larger total, the number of programs reported in 2000 declined by one-third from the number reported in 1989. An example of the potential for misinterpretation is the apparent increase in the number of agriculture programs. A simple comparison of the two surveys indicates that these programs increased by almost the same percentage as total programs declined, but such a conclusion is unwarranted. Lynch’s sample included only institutions offering programs in four or more subject areas, and Bruening et al. may have included institutions that offered preparation only in agriculture.

Both of the reports discuss the effects on CTE teacher education of the educational reforms that started with the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983). In 1990, Lynch identified the greatest change as a tightening of the requirements to enter teacher preparation programs. This tightening took the form of requiring higher grade point averages or higher minimum scores on tests of basic skills. An impact of the reform movement that occurred after the Lynch study was the emergence of instruction on the integration of academic and occupational content as a significant component of the teacher preparation curriculum. Integration was hardly mentioned in the 1989 survey, but in 2000, the institutions responding offered an average of six credits, two regular courses, on this topic.

⁴ This figure was calculated by comparing lists of the responding institutions presented in the appendices of the reports.

Searches of the ERIC and Google databases conducted on February 15, 2010, attempted to find more recent information on the status of CTE teacher preparation programs in colleges and universities, but no studies using nationally representative samples were found. To our knowledge, the Bruening et al. surveys are the most recent. Even though the Lynch and Bruening et al. studies did not survey the same populations, there was considerable overlap in their responding institutions and the lower number of program reported in 2000 indicates that the number of CTE teacher education programs declined during the 1990s. Anecdotal reports suggest that this decline has continued since 2000. If, as Bottoms and McNally (2005) have recommended, the *No Child Left Behind* requirements for highly qualified teachers were applied to CTE teachers, it seems unlikely that the declining numbers of teacher education programs would be able to provide all the preparation required. Alternative methods of enabling CTE teachers to meet the “highly qualified” criteria are needed.

Summary

In this chapter, we discussed the major influences that we see as creating the environment in which CTE operates. We began with a review of the evolution that teachers undergo from the time they enter the classroom until they leave the profession. The models that describe this process differ somewhat in detail, but they typically describe a journey toward increasing competence and confidence. Professional development plays a critical role in this journey. We presented three sets of national standards that have been adopted for the performance of teachers and the delivery of professional development. We also discussed how change in occupations, largely driven by technological innovation, affects the content of CTE, and as a result, the skills CTE teachers need. We concluded the chapter by examining trends in teacher education programs. These programs play a key role in the delivery of professional development, and their numbers are decreasing.

Chapter 3

Responding to the Expanded Mission of Secondary Career and Technical Education

In this chapter, we address topics essential for secondary career-technical education (CTE) teachers to respond to the broadened expectations of what they should accomplish. Rojewski's (2002, 2009) framework, introduced in Chapter 1, identified integration of academic and technical knowledge as critical to reform efforts in CTE. Integration lies at the core of the expanded concept of secondary CTE, and it may be the area in which CTE teachers need the most support. CTE teachers need to learn how to use the relevance of their occupational curriculum to teach and reinforce academics that their students may not have fully understood in traditional academic classrooms. We discuss the challenges of integration and focus on three instructional strategies that have a natural fit with the CTE curriculum: project-based learning, problem-based learning, and cooperative learning.

The establishment of explicit standards for what students should learn and high-stakes tests to determine if these standards have been met has become a—some would argue *the*—dominant policy for improving student achievement (Madaus, Russell, & Higgins, 2009; Phelps, 2009). Perkins IV requires that programs of study “include coherent and rigorous content aligned with challenging academic standards” (Sec. 122(c)(A)(ii)). CTE has its own form of high-stakes testing. Performance indicators in Perkins IV state that CTE programs shall be evaluated by the extent to which their students meet the academic proficiency standards established under NCLB and “career and technical skill proficiencies including student achievement on technical assessments, that are aligned with industry-standards, if available and appropriate” (Sec. 113(b)(2)(A)(ii)). There is much more to assessment, however, than these accountability measures. In this chapter, we discuss other types of assessment and how they may be used in the classroom, in addition to how assessment results may be used to guide program improvement. We describe how several schools have used the results of standardized technical assessments as part of a continuous improvement process to guide modifications in curriculum, instruction, and professional development.

We conclude the chapter with a topic that, although not directly related to instruction or assessment, has a pervasive influence on everything that happens in the classroom: the management of diverse classrooms—these are referred to as *student populations* in Rojewski's framework (2002, 2009). Although critical to all teachers, classroom management is generally one of the greatest concerns of new teachers, especially the alternatively certified (Darling-Hammond, Chung, & Frelow, 2002; Melnick & Meister, 2008). High among these concerns is the ability to accommodate the wide range of student abilities.

Integration of Academic and Technical Knowledge and Skills

The shift in the mission of CTE at the secondary level from preparing students for entry-level work to preparing students for further learning and the workplace significantly broadens the nature and content of CTE curriculum and creates challenges for the professional development of

CTE teachers. Fundamentally, teachers must understand their content in order to teach it effectively:

Accomplished CTE educators command a core body of knowledge about the world of work in general and the skills and processes that cut across industries, industry-specific knowledge, and a base of general academic knowledge. National standards state that CTE teachers should be able to draw on this knowledge to establish curricular goals, design instruction, facilitate student learning, and assess student progress. (NBPTS, 1997, p. 13)

When the focus of CTE was on preparing students for entry-level work, teachers needed competence in the knowledge and skills essential for that work. Preparing students for further learning and the workplace, however, broadens the content to include academic knowledge and skills, particularly those needed for college readiness, as well as an understanding of comprehensive workplace readiness skills that cross all industries.

The most significant change in content for CTE teachers is the need to integrate academic knowledge and skills in ways that improve academic achievement. Perkins IV requires schools to develop CTE programs with challenging academic and technical standards and instruction that integrates academics with technical knowledge and skills. This policy context reflects the needs of the modern workplace. A survey of human resources professionals indicated that “~~at~~ too many young people are inadequately prepared to be successful in the workplace. At the high school level, well over one-half of new entrants lack sufficient levels of the most important skills—oral and written communications, professionalism/work ethic and critical thinking/problem solving” (Conference Board, 2006, p. 7).

In addition to the Perkins IV mandate, CTE teachers are also being asked to help students meet academic proficiency standards on state-mandated tests used to measure individual and schoolwide achievement. Because these tests are often tied to whether schools meet Adequate Yearly Progress (AYP), as defined in NCLB, all teachers, including CTE teachers, are focused on student performance. CTE teachers are expected to integrate grade-level academic standards in their courses in ways that help students meet these performance goals. Fulfilling this need will be a major factor in the future of CTE at the secondary level (Daggett, 2003; Kazis, 2005).

High school CTE programs are expected to provide a relevant context for applying academic knowledge and skills, thereby increasing student motivation to learn challenging content and persist to graduation and further learning beyond high school (Bottoms & Young, 2008a). The integration of academic and CTE content is not a new phenomenon in CTE education. A wide variety of approaches have been used in the past, such as identifying and making explicit the academic content relevant to the CTE content; contextualizing the teaching of academic content through the use of real-world CTE applications; and using cross-curricular thematic projects and organizational changes like career academies. In the face of increasing graduation requirements, the integration of academic and CTE content can also be achieved through the earning of academic credit through CTE coursework. This includes (a) hybrid courses that offer fully integrated academic and CTE content so that the course counts for both academic and elective CTE credit on a student’s high school transcript or (b) a CTE course that meets the academic credit requirements for graduation. When one considers the breadth of these approaches and the

depth of understanding of the academic content needed to implement them, integration clearly represents a major challenge for CTE teachers.

Little research has investigated the impact on academic achievement of integrated academic and technical content in CTE courses (Kazis, 2005). However, surveys conducted by SREB of students participating in HSTW and Technology Centers That Work provide some evidence. These surveys found that CTE students experiencing an intensive emphasis on integrated academic content and skills in their CTE courses met college- and career-readiness goals at a much higher rate than those who experienced low or moderate emphasis on academic integration (Bottoms & Young, 2008a). Additional evidence comes from the Math-in-CTE study, a random assignment experiment conducted by the NRCCTE (Stone et al., 2006). This study found that CTE students who were taught lessons with integrated mathematics outscored those in the control group on two tests of mathematics achievement by 8% and 9%. These gains were achieved with an average of only 20 hours of instruction delivered over the course of the 2004-2005 school year.

Improving students' college and career readiness places significant pressure on CTE teachers to integrate academics that will improve student achievement. Surveys of teachers' professional development needs consistently reflect this pressure. A HSTW survey indicated that 51% of CTE teachers felt a need for professional development in using methods to integrate reading, writing, and communication skills into CTE content, and 45% said they needed assistance to integrate mathematics into the curriculum (Bottoms & McNally, 2005). Similarly, a survey of state directors placed integration of academics with CTE as the second highest professional development priority among 49 possible topics (Wichowski & Heberly, 2006).

Meeting the demand for professional development in integrating rigorous academics presents many challenges. The National Center for Education Statistics (NCES, 2000) has reported that CTE teachers are eight times more likely than their academic counterparts to lack academic training in the form of a bachelor's degree or specific subject knowledge. Survey findings in the HSTW network indicate that nearly one-third of CTE teachers who have been teaching for five or fewer years do not have a bachelor's degree (Bottoms & McNally, 2005). Even if CTE teachers have a postsecondary degree, they often come to teaching straight from the workplace; most have been out of school for a longer period than other new entrants into the profession. Additionally, their postsecondary focus of study may have required fewer academic courses (Cramer, 2004). Participants in CTE teacher training programs typically scored lower on Praxis basic reading and writing tests than did those preparing to be elementary school teachers (Cramer, 2004). Those who employ CTE teachers express the concern that few are fully competent in integrating challenging academic and technical standards into their content areas to meet the intent of Perkins IV legislation (Bottoms & McNally, 2005).

The demands of the new mission of CTE require that CTE teachers possess sufficient understanding of the academic knowledge and skills that are necessary for college readiness as well as those necessary to enter and succeed in a career field. The Math-in-CTE study (Stone et al., 2006) employed a particular approach to professional development that could improve teachers' capacity to integrate higher-level academics into CTE content. The experimental teachers in the study worked with mathematics teachers to develop lesson plans that integrated

mathematics, beginning with the CTE curriculum. This approach enabled the CTE teachers to learn the mathematics they were to teach in a nonthreatening manner.

Integrating rigorous academics is challenging because integration, by its nature, is a complex task that requires ongoing professional development and support. Hoachlander (1999) identified reasons for this complexity. Integration can result in a loss of focus if the objective is not clear. Teachers need a clear understanding of the standards and how to use them to focus their integration efforts. Integrating academic and CTE curricula depends on more than simply identifying work-related applications of academic knowledge and skill. It also involves ensuring the use of a variety of research-based instructional strategies, particularly project- and problem-based learning and cooperative learning, that are engaging to all students. These strategies are well-suited to the nature of the content in CTE, but require a high level of expertise and support to implement.

Constructing a rich, cumulative, integrated curriculum that simultaneously helps students improve their academic skills and apply them in a coherently defined domain of the workplace demands time, expertise, and resources that are beyond the reach of most teachers. Herein lies the challenge of fully integrating high-level academics and CTE: Teachers must have an on-going, job-embedded set of professional development experiences that provide time, facilitate collaboration, and support trying out, refining, and improving these practices.

Workplace Readiness Skills

In addition to the increased demand for integrating challenging academic content, the new mission of CTE broadens content to include a comprehensive approach to workplace readiness skills. Workplace readiness includes an essential common core of general knowledge about the workplace and skills that all employers expect of their employees. These skills are represented as a fundamental component of the States' Career Clusters Initiative (2009), which organized occupations into groups of occupations with commonalities. At the foundation level of each career cluster are the workplace readiness knowledge and skills necessary for success in any career pathway in the cluster. The general categories for these skills are common across all clusters and include the following:

- Knowledge and skills in related academics
- Communications
- Problem solving and critical thinking
- Information technology applications
- Safety, health, and environmental
- Leadership and teamwork
- Ethics and legal responsibilities
- Employability and career development
- Technical skills

Many states have adopted the career clusters model. CTE teachers are expected to successfully integrate knowledge and skills at the cluster level into secondary CTE courses within their programs so that even occupation-specific programs have a broader scope.

A similar emerging framework for workplace readiness skills is the 21st Century Skills Standards (Partnership for 21st Century Skills, 2008), which were developed in an attempt to focus K-12 educators on the most important skills students need to learn to meet the demands of modern life. Working with educators, employers, and government officials, a set of standards were identified within several categories. Life and career skills focus on competence related to flexibility, initiative, social skills, productivity, and leadership. Learning and innovation skills include creativity, critical thinking, communication, and collaboration. Information, media, and technology skills focus on information and media literacy. The standards also outline core subjects and interdisciplinary themes of civic literacy, global awareness, and financial literacy. Teaching 21st Century Skills requires a variety of strategies such as problem-based learning and cooperative learning. The Partnership for 21st Century Skills encourages states to launch initiatives to adopt and implement these skills in their K-12 school system; 13 states have begun to do so. CTE teachers need an understanding of these skills, how they fit within their curricula, and the contribution their classes can make to ensure that all students possess them.

College Readiness Standards

Another of the demands related to the integration of academics and CTE is the nature of the academic knowledge and skills necessary to meet the new mission of preparing all students for college and career readiness. ACT (2006) reported that only one-half of high school graduates possess the reading and writing skills needed to succeed in postsecondary education or the workplace. More secondary students are completing a standard high school curriculum, but the percentage of 12th-grade students who are proficient in reading dropped from 40% to 35% from 1992 to 2005 (NCES, 2007). Furthermore, although over half of all high school graduates continue their studies in postsecondary institutions, 28% must enroll in at least one remedial course as a freshman college student (NCES, 2004). Studies conducted by the NRCCTE (Bragg et al., 2002; Castellano et al., 2007) found much higher rates of enrollment in postsecondary remediation courses among students who had concentrated in CTE while in high school. To boost student achievement and ensure a successful transition to postsecondary education, ACT and others have developed college readiness standards on which secondary educators can base assignments and assessments with the goal of helping students be better prepared for further learning.

Examples of such standards are the college and career readiness indicators in English established by SREB (Murray & Bottoms, 2008). SREB convened expert panels of teachers and developers of curricula and national tests who analyzed major curriculum documents, including the ACT College-Readiness Standards and national content standards, and identified and established a set of indicators. Sample learning activities and assessments were developed for each indicator. In order to meet the demands of the new mission of CTE, teachers will need professional development in indicators like these and assistance in how to use them to create intellectually challenging assignments and assessments that integrate academic and CTE content with the goal of college readiness.

Industry Standards

Stakeholders at all levels and types of education are being asked to raise standards, align instruction and curriculum to those higher standards, and hold students to higher standards on assessments. In *Rising Above the Gathering Storm* (2005), the National Academies Committee on Prospering in the Global Economy of the 21st Century called for high-quality teaching and the use of world-class curricula, standards, and assessment. The National Assessment of Vocational Education (NAVE) recommended a strategy of raising occupational and technical skills in high schools through required standards (Silverberg, Warner, Fong, & Goodwin, 2004). In an issue brief, the NGA Center for Best Practices (2007) recommended a new CTE that prepares students for college and careers and asked states to reorient their CTE programs to include “the skills employers demand in state standards, assessment, and accountability systems” (p. 6). CTE teachers are expected to plan instruction that aligns what is taught and expected of students with industry standards. Further, they are expected to stay abreast of changes in these dynamic standards and continually revise their curricula.

Advisory committees are a hallmark of a solid relationship between a technical program and the employer community, and a number of states require evidence of such relationships as a criterion for program approval. Advisory committee member volunteers include, among others, representatives from local business and industry, labor, and community agencies. Because of their working knowledge of the requirements of specific occupations, such representatives provide valuable advice and assistance. Although not all local committees are attuned to the national standards for their industry areas (where such standards exist), they still provide an excellent starting point for aligning instruction with prevailing practices in the workplace.

One avenue of access that has received recent attention is the use of up-to-date labor market information (LMI) provided by a variety of state, federal, and local agencies and organizations. LMI can help program planners design and redesign effective CTE programs to prepare students for in-demand occupations and careers; it typically includes information about current skill requirements derived from business and industry. CTE program planners can use such LMI to ensure that they develop occupational standards that reflect changing socioeconomic demands (Brown, 2003).

Industry associations, generally national in scope, are another source for teachers to stay abreast of industry standards. In conjunction with their roles as certifying bodies, these associations often have established standards for the skill sets that are meaningful for their industry. Experts within the industry develop and validate the standards that specify tasks and the level at which they should be performed, based on critical knowledge and skills. An example of such an industry association is the National Institute for Metalworking Skills (NIMS), the national developer of precision manufacturing skill standards and competency assessments. NIMS certifies individual skills against standards and accredits programs that meet its quality requirements. NIMS stakeholders represent over 6,000 American companies. Another prominent example is the Manufacturing Skill Standards Council (MSSC) standards, training, testing, and credentialing system for the foundational skills of all manufacturing production workers—the

MSSC-Certified Production Technician (CPT)—which is being used across the United States and results in an industry-recognized, nationally portable credential.¹

The certifications and licensures offered by such associations are tied explicitly to industry standards and thus are recognized and valued by employers. Certifications and licensures are meaningful to employees seeking upgrades, new applicants seeking positions, and students. Industry certifications and licensures are becoming important components of CTE programs and gaining importance in the business world as evidence of skill attainment. Thousands of certifications and licensures are available, and more are introduced each year, even though Bartlett (2004) found, in researching the automotive service and information technology industries, that employers found a two-year community or technical college degree more important than certification or licensures. Earning a certification or licensure has many benefits. It gives students a sense of accomplishment and a valued professional credential, and it helps make them more employable, perhaps with higher starting salaries (Foster & Pritz, 2006). Teachers whose students are working toward certification or licensure must themselves be cognizant of how the standards for these credentials are reflected in their program curriculum.

Some companies may have their own certifications and/or licensures or they may be involved with providing experts to set the standards for industry associations. Both usually depend on an independent testing agency to provide an agreed-upon assessment as a means of ensuring industry-relevant competency. Such assessments must be developed so that they closely reflect the standards; that is, they must have content validity. Many professional assessment organizations specialize in carefully facilitating these processes for industry. These organizations follow a well-researched process to ensure that performance on the assessment is closely tied to performance in the field. The same process is used for the development of standards-based CTE assessments. Assessment organizations are also responsible for updating the standards on which their assessments are founded in order to keep abreast of changes in the field (Foster & Pritz, 2006).

Once knowledgeable of what the current standards are and how their students' assessments are tied to them, educators must continually revise their curricula to match them. This is a challenge, and teachers often need assistance in managing the process.

Research-Based Instructional Strategies

Research underlying effective instructional practices and the growing recognition of teachers' capacity to affect student learning have raised expectations for all teachers. In CTE this means that teachers deliver engaging instruction that integrates rigorous academic material with CTE content around intellectually demanding authentic projects and activities (Bottoms & McNally, 2005; Hunt & Carroll, 2003; Medrich, 2005). As CTE is challenged to prepare students for a workplace that demands collaboration, communication, critical thinking, and research skills, the instructional strategies used in CTE classrooms must provide powerful learning experiences that mirror those workplace challenges. Research-based instructional strategies such as project- and

¹ The certification system of NIMS is described on its website, <http://www.nims-skills.org>, and that of MSSC on <http://www.msscusa.org>.

problem-based learning and cooperative learning have the potential to provide those power learning experiences. When well implemented, these strategies have significant benefits for students (Darling-Hammond et al., 2008)

Project-based learning is an instructional model that organizes learning around projects—complex tasks based on challenging problems or questions. This model engages students in decision-making, design, problem-solving, or investigative activities that provide opportunities for students to direct their own learning and that result in a product or presentation (Thomas, Mergendoller, & Michaelson, 1999). Projects vary in duration and scope, but recent definitions recognize that good projects are standards-focused and engage students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks (Buck Institute for Education, 2007).

As an essential instructional strategy for CTE teachers, project-based learning brings authentic, motivating contexts to teaching career-related competencies. Typical CTE projects involve developing or implementing a plan to meet a local business need; workplace simulations such as designing, assembling, testing, or evaluating a product; or operating a school-based business (Bottoms, Pucel, & Phillips, 1997). Projects can be used simulate workplace conditions in the CTE classroom or to frame learning in real-world work settings by requiring a series of steps and providing opportunities to make judgments and decisions when unexpected events occur. Projects teach students to resolve problems and build essential problem-solving skills needed for the workplace.

Research on the effectiveness of project-based learning is complicated by the varying nature and extent of its implementation. Projects vary widely in duration, depth of content, and the degree to which they are student-directed. Teachers who do not use projects cite a variety of reasons for not doing so, including lack of time, resources, and technology. In spite of these limitations, Thomas' (2000) comprehensive review of relevant research found evidence that project-based learning enhances the quality of student learning when compared with other instructional methods. Project-based learning has the potential to help students not only learn subject matter content, but also develop the ability to put that content to use in real-life situations to solve problems and make decisions. These features make this model a desirable CTE instructional strategy because students are solving problems and completing projects similar to those they will face as they enter and advance in the workplace.

Problem-based learning is closely related to project-based learning in that both involve complex tasks that engage students in planning, gathering and evaluating information, analyzing situations, and developing solutions. The difference between the two lies in the specific aspects of delivery. Problem-based learning begins with a problem that requires students to hypothesize possible solutions (Delisle, 1997). Once the problem is defined, students access, analyze, and use data and information from different sources, revise initial hypotheses as needed, and develop and justify solutions according to evidence and reasoning (Barrows, 1986; Gallagher, Stepien, Sher, & Workman, 1995). Although project-based learning can begin with a problem, the problem does not necessarily drive learning as it does in problem-based learning.

Problem-based learning is both rigorous and relevant, engaging students in a highly participatory learning experience driven by authentic situations. Student motivation can be enhanced by an interest in the problem. Through active engagement in the learning process, students can take responsibility for their own learning and are better able to define topics, access resources, and evaluate the validity of those resources (Krynock & Robb, 1996). In a quasi-experimental study conducted by Sungur and Tekkaya (2006), one classroom was taught with teacher-centered, textbook-oriented traditional instruction and the other with problem-based learning. The students who received problem-based learning had higher levels of critical thinking, metacognition, and effort than students taught with traditional methods. The biggest impact, however, was observed on students' ability to self-regulate their learning by actively sustaining their thoughts, behaviors, and emotions to reach their goals. Other studies have shown problem-based learning to improve critical thinking, communication, mutual respect, teamwork, and interpersonal skills (Achilles & Hoover, 1996; Gordon, Rogers, Comfort, Gavula & McGee, 2001; McBroom & McBroom, 2001; Sage, 1996; Savoie & Hughes, 2004; West, 1992).

Problem-based learning has significant potential to teach the kind of skills that CTE students will need to succeed in further learning and the workplace. If real workplace problems, questions, or scenarios drive student learning, students are much more likely to reap the benefits of this strategy—problem-solving, higher-order thinking skills, and the ability to regulate their own learning throughout life. Given the nature of CTE content, it is likely that most, if not all, units of study may be planned with a driving project or problem.

Another research-based instructional strategy well-suited to the content and goals of CTE is cooperative learning. According to Abrami, Chambers, Poulsen, and Chambers (2004) and Laverie (2006), evidence suggests that cooperative learning promotes student achievement and the development of social and interpersonal skills. Johnson, Johnson, and Smith (2006) synthesized over 375 studies on the effect of cooperative, competitive, and individualistic efforts on student achievement and productivity. They found that students in cooperative learning settings performed better than students in either competitive or individualistic settings. They concluded that in comparison to individualistic or competitive learning, cooperative learning produced more high-level reasoning, more frequent generation of solutions, and greater transfer of learning from one situation to another. In addition, Ramsden (2003) has reported that students who experience teaching that allows them more control learn more and enjoy learning more.

Cooperative learning is a particularly important strategy for CTE teachers. Sutphin and Newsom-Stewart (1995) found that students enrolled in agricultural education identified activity-centered learning, opportunities for work experience, and the development of teamwork and life skills as reasons for enrolling in that CTE course. Given the popularity of Facebook and other forms of social networking among today's youth, it is evident that many students gravitate to active learning that engages them socially as well as intellectually. The effect of cooperative learning may be enhanced when it is used along with project- or problem-based learning. Roger Johnson of the Cooperative Learning Institute has stated that cooperative learning is a process for doing things in classrooms—raising achievement, building self-esteem, encouraging positive attitudes, and building acceptance of differences in diverse classrooms—whereas project-based learning is a good content home for building cooperative team relationships (personal communication, February 12, 2009). Cooperative learning can also influence classroom management in a positive

way. The classroom environment is more productive and positive when students are concerned about each others' behavior and learning. Peers can be one of the most important influences on each others' success.

Implementing cooperative learning presents unique challenges for both teachers and students in planning, design, and implementation (Hutchinson, 2007). Estimates of how many teachers use cooperative learning vary widely—from 10% to 93%—with the highest usage reported at the elementary level (Antil, Jenkins, Wayne, & Valdasz, 1998). To add to this complexity, there are at least three types of cooperative learning groups (Johnson, Johnson, & Smith, 2006):

- Informal cooperative groups are organized for tasks that last from a few minutes to one period in length. They are used during direct instruction to help students focus on what they are to learn or ensure that students are cognitively processing the content being taught.
- Formal cooperative groups are designed to last from one class period to several weeks. The groups are structured to complete an assignment or course requirement and to ensure that all students are actively involved and accountable for the work that is produced.
- Base cooperative groups are assigned for long periods of time to provide support, help, and encouragement for academic progress. These groups are designed to promote positive, long-term supportive relationships among learners.

Effective cooperative learning requires consideration of the goals of instruction and choice of the type of group to use. All three types are useful in different ways. For example, informal groups improve direct teaching by interspersing short, active student conversations and reviews of the material being delivered. Formal cooperative groups ensure that students who are working together on a project make accountable contributions to the ongoing work and final performance.

Research-based instructional strategies such as project- or problem-based learning and cooperative learning require significant expertise on the part of CTE teachers if they are to be fully implemented and their benefits fully realized. Expertise in these strategies requires not only professional development experiences that explain and model the strategies, but ongoing follow-up and support to ensure that they become a standard part of CTE teachers' instructional repertoires.

Standards-Based Instructional Planning

Many states and school systems across the United States have identified standards that outline what students need to know and be able to do as a result of their education. Few educational policies fail to mention the need to ensure that *all* students achieve these standards (Lefkowitz & Miller, 2005). Perkins IV requires states and local school districts to develop challenging academic and technical standards for their CTE programs. At the 2005 National Education Summit on High Schools, participating governors called for expanding options and support for students to achieve higher standards, and several states responded by creating policies for increasing rigor by undertaking efforts to align high school standards to college readiness standards (Achieve, Inc. & NGA, 2005). In an issue brief (2007), the NGA Center for Best Practices called for a new CTE that prepares students for college and careers and asked states to

reorient their CTE programs to include ~~the~~ skills employers demand in state standards, assessment, and accountability systems” (p. 1).

CTE teachers perceive the need for standards-based instructional planning and alignment, reflecting their awareness of educational policies and trends. The 2002 HSTW survey found that 54% of teachers with five years or less of teaching experience expressed a need for professional development in aligning course standards to national academic and skill standards; 52% indicated a need for professional development in preparing a syllabus for teaching to standards (Bottoms & McNally, 2005). This need may be particularly pressing among alternatively certified teachers. Heath-Camp and Camp (1990a) found that alternatively certified teachers knew nothing about their curriculum and needed orientation, help, and time to learn its scope and how to prepare lessons. In a separate study, few new CTE teachers even received curriculum guides that would indicate the standards they needed to teach (Camp & Heath-Camp, 1992). Unfortunately, beginning CTE teachers entering teaching from business and industry tended to be unfamiliar with the process of lesson planning (Heath-Camp & Camp, 1990b) and found aligning their lessons to standards to be a particularly difficult task. This situation may have improved over the two decades since the Camps published their research, but more recent studies on this topic could not be located.

Standards-based instruction focuses on students achieving specified knowledge and skills. Although the first step of identifying which standards to teach seems relatively easy if state and national standards are used as a reference, this step is much more complex for CTE teachers. First, there are several types of standards to be used in instructional design: career-technical standards, which usually include industry skill standards or state-validated lists of competencies and tasks related to specific occupations; academic skills from state standards that support college and career-readiness and can be contextually aligned to the CTE content; and workplace readiness knowledge and skills that cross all career areas, such as teamwork, leadership, and workplace ethics and behavior.

Once CTE teachers establish instructional goals from standards, they are responsible for developing instructional plans, which include the learning activities necessary to help students achieve the standards and the assessment strategies necessary to document that achievement. The importance of coherent instructional plans is well documented in the research literature. Students learn better when instruction is logically sequenced (Armento, 1977; Smith & Sanders, 1981). An accomplished CTE teacher ~~fosters~~ experiential, conceptual, and performance-based student learning of career and technical subject matter and creates important, engaging activities for students that draw upon an extensive repertoire of methods, strategies, and resources” (NBPTS, 1997, p. 39).

Standards-based instructional planning usually involves ~~chunking~~ “chunking” similar learning goals into units and then into daily lessons. An instructional unit includes a logical sequence of learning activities that will lead to students achieving the instructional goal and an assessment that provides evidence of the learning that is achieved. Each learning activity has a purpose in the unit as a whole and a reasonable time frame in which to be taught. The learning activities in the unit should be selected so as to be suitable for the students’ learning needs. Unit design also involves selecting appropriate materials and resources to support the learning goal.

The concept of backwards design is based on beginning with the end—or in this case, the standards, in mind. Backwards design suggests a planning sequence in which the first step following the identification of learning goals is to develop the assessment that will be used to determine whether those learning goals have been achieved (Wiggins & McTighe, 1998). Once the acceptable evidence has been determined for the assessment, learning experiences and instruction are planned. This design concept has been detailed in a wide variety of formats, including SREB's *Planning for Improved Student Achievement: Ten Steps for Planning and Writing Standards-Based Units* (2007).

In addition to planning units of instruction, secondary CTE teachers are usually required to plan a course syllabus, which communicates standards-based course expectations to students and parents. Planning at the course level can increase the quality of CTE programs (Bottoms, Pucel, & Phillips, 1997). In SREB's *Designing Challenging Vocational Courses: A Guide to Preparing a Syllabus* (Bottoms et al., 1997), instructors are encouraged to decide what knowledge, understandings, and skills are needed for the career field; set high standards; use projects as a focus for learning; establish their role as a facilitator of learning; and assess continuously. The steps in the syllabus design process are to:

- Describe the course
- Clarify the instructional philosophy
- Determine major course goals
- Select and put into sequence major course projects
- Develop project outlines
- Decide on an instructional delivery plan
- Develop an assessment plan for the course

In anticipation of the need to communicate standards-based instructional plans to other teachers as part of the effort to integrate academic and technical content, CTE teachers also use a process called curriculum mapping. Curriculum maps are based on the school calendar and outline essential knowledge and skills to be examined, processes and skills to be emphasized, and products and performances that are the assessment of the learning (Jacobs, 1997). Curriculum maps allow teachers to record the time it takes to teach particular content and to analyze those time frames in reference to other units of study and the whole curriculum of a course. The unique contribution of curriculum maps as a standards-based instructional tool for CTE teachers is that they provide a visual sequence of what is taught and when it is taught so that this information can be shared with other teachers. Such information is central to the process of identifying points in the curriculum where integration opportunities exist.

Assessment Strategies

Assessment is the process of collecting, analyzing, and interpreting information to determine the degree to which students are becoming competent in meeting standards. CTE teachers use a variety of assessment methods in the classroom to determine how well students are meeting CTE and academic standards, as well as their progress in becoming competent in a myriad of

workplace readiness skills that will ensure their success. These methods can be used for both summative assessment—judging the success of the learning process at its completion, and formative—beginning at the onset and continuing throughout the learning episode, providing feedback to students to help them correct misconceptions, understand mistakes, and reinforce progress (Cruickshank, Jenkins, & Metcalf, 2009).

The ultimate goal of formative assessment is to assess *for* learning (Stiggins, 2005) in contrast with the assessment *of* learning accomplished through summative methods (Wilén, Hutchison, & Bosse, 2008). For the beginning CTE teachers, classroom assessment may seem like one of the simplest issues they face, but the way in which students are assessed, particularly the way in which students receive feedback during the learning process, is one of the most powerful tools for shaping student learning (Bangert-Drowns, Kulik, & Kulik, 1991; Bangert-Downs, Kulik, Kulik, & Morgan, 1991; Crooks, 1988; Fuchs, 1986; Kuger & DeNisi, 1996; Marzano, 2006; Natriello, 1987). By consistently adhering to certain basic principles and carrying out related formative assessment practices as a matter of routine and within and across classrooms, various researchers claim student achievement gains of one-half to two standard deviations on high-stakes tests with the largest gains being made by low achievers (Stiggins, 2005).

According to Stiggins (2007), assessment for learning begins when teachers share achievement targets with students in student-friendly language, often with examples of exemplary student work. The students' role is to understand what success looks like and use feedback from myriad assessments to discover where they are now in relation to where they want to be and how to do better next time. Stiggins (2005) has proposed these principles of assessment for learning:

- Aligning learning goals with assessment methods and knowing achievement targets before instruction begins.
- Informing students about these targets and the nature of the assessments that will be used to measure them.
- Using a variety of assessment methods that accurately reflect student achievement.
- Involving students in the assessment process.
- Providing frequent feedback to learners that gives students a clear picture of their progress on learning goals and encourages them to improve.
- Modifying instruction based on assessments. (pp. 325-326)

To these principles might be added *analyzing and interpreting assessment data* in response to the requirement in the 2006 reauthorization of the Perkins legislation. Due to the variety of knowledge and skills included in the CTE, academic, and workplace readiness standards that are part of CTE programs, teachers must be prepared to use a wide variety of assessments tools both in formative and summative assessment. Examples of these tools are presented in Table 3.1.

Section 113 in Perkins IV contains clear language that supports the use of state and local assessments for measuring “student attainment of challenging academic content standards and student academic achievement.” As mentioned previously, the legislation also calls for the use of assessments that measure “student attainment of career and technical skill proficiencies,

Table 3.1
Examples of Teacher-Developed Assessment Strategies

<i>Paper and Pencil tests—Measurement of Knowledge and Understanding</i>	<i>Authentic or Performance Tests—Measurements of Application of Skills</i>
<i>Multiple choice</i> – uses a stem which presents a problem or asks a question with 4-5 alternative responses	<i>Checklists</i> – written instrument that lists the specific elements deemed necessary for desirable performance, product, or presentation; teacher checks if each element is present
<i>True-false</i> – presents statement which asks students to identify it as true or false	<i>Rating scales</i> – lists the specific elements required of a product, performance, or presentation, but allows teacher to make a judgment of its quality
<i>Completion</i> – presents items that require students to supply missing words from a statement or write a short phrase that answers a question posed in a stem	<i>Rubrics</i> – illustrates with detail and description the various elements required for performance, product, or presentation
<i>Matching</i> – presents a list of stems, often called descriptors, in the left column and a list (usually longer) of alternatives in the right column	<i>Portfolios</i> – a collection of samples of student work that demonstrates accomplishment and achievement; may include video or audio tapes to illustrate
<i>Essay</i> – stem, question, or statements that require written response which can range from a few sentences or paragraphs to several pages	<i>Other authentic tasks</i> – depending on objectives and expectations, an interesting array of “other” assessments have been reported: field interviews, work samples, student peer or self written evaluations, observational notes, competitions, employment-based assessments

including student achievement on technical assessments, that are aligned with industry recognized standards, if available and appropriate.” Bottoms and McNally (2005) reported a 2002 survey of CTE teachers in HSTW schools with five years or less of teaching experience that asked about five topics related to classroom assessment. A similar survey was conducted in 2008 that asked about three of the five topics. The results of the two surveys are presented in Table 3.2.

In 2002, over half of the respondents—HSTW teachers with five years or less of experience—said they needed professional development on each of the five topics. In 2008, with a new group of teachers with the same amount of experience, the percentages were significantly lower for the three topics that were surveyed in both years, with the largest drop in the percentage that reported they needed professional development on using performance assessment. Although the percentage of teachers dropped on the three topics included in both surveys, about half of the HSTW teachers with five years of experience or less still reported they needed professional development with regard to assessment issues.

Table 3.2

Percentage of CTE Teachers with Five Years or Less Experience Indicating Need for Professional Development on the Use of Assessment

<i>Topics for Which Professional Development Is Needed</i>	2002 (%)	2008 (%)
Developing rubrics in academic content areas	51	47 ^b
Using performance assessment	54	44 ^b
Using multiple forms of assessment to determine students' progress	55	*
Using student portfolios	55	52 ^a
Having students assess and revise their work to meet standards	56	*
<i>Base Numbers for Percentages</i>	2,587	2,536

Source: For 2002 data, Bottoms and McNally, 2005; for 2008 data, special analysis by HSTW. ^a Difference significant at $p < .05$; ^b Difference significant at $p < .01$. *This item was not included in the 2008 survey.

Third-Party Technical Skills Assessment

The Section 113 language from Perkins IV concerning “student achievement on technical assessments, that are aligned with industry recognized standards” [(b)(2)(A)(ii)] is especially meaningful with regard to what are termed “third-party assessments.” The general concept, widely applied across global business and industry, is that if the assessor is external to what is being tested, bias is less likely and a more objective outcome is achieved. In education terms, a third-party assessment is not teacher-developed, but is provided by an independent agency external to the classroom or school. Further, for psychometric integrity, the items on the assessment need to be *secure*; that is, totally unknown in advance by the test taker (Anderson, 1999). By keeping items secure, the value of the scores increases for individuals who are asked to apply their knowledge in an unfamiliar setting. In addition, keeping items secure has value when making comparisons across groups as all groups throughout the tested population enter the testing at an equal disadvantage. The concept of having test takers exposed to similar information, with no one having with an advantage over another, is included in *Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999).

The assessments referred to in the legislation would be taken by most CTE concentrators at the end of senior year as they approach completion of their programs, but the knowledge (cognitive) component can also be administered as a pretest at any grade level after the students have attained skills in the program. If used in a pre-post sequence, the advantage is that pretest scores, especially if broken down into the specific skills of an occupation, can inform the teacher about specific areas of strength and weakness. For example, knowing that a student or group of students has a weakness in converting blueprint-based information into working drawings can be a powerful guide to individualizing instruction and making adjustments in instruction. Pre-post gains can be charted longitudinally as a measure of overall program effectiveness. Data that demonstrate advances in technical knowledge and skills from pre- to posttest can be used to identify and reinforce instructional strengths.

Research from the NRCCTE (Castellano, Harrison, & Schneider, 2008) indicated that:

Few states have crosswalked their academic standards onto programs, and similarly small numbers of states use technical skill assessments to measure student technical proficiency gained from CTE course taking. We assume that the number of states responding to these mandates will grow, but incentives might need to be provided to motivate states to move away from approaches undertaken before the details of Perkins IV were known. (p. 58)

The U.S. Department of Education, Office of Vocational and Adult Education (OVAE), has supported national discussions about Perkins performance indicators through its Next Steps Work Group, a voluntary information-sharing network. This group has identified and shared gold, silver, and bronze (GSB) indicators of technical skill achievement at its Data Quality Institutes. An unpublished draft document for review purposes of the group describes the gold level in this way:

Gold: Any external, third-party assessment that objectively measures student attainment of industry-recognized skills, appropriate to the educational level of CTE concentrators.

Acceptable assessments may include:

- National/international credentialing or certification exams (e.g., ASE [Automotive Service Excellence] certification)
- State credentialing or licensing exams (e.g., cosmetology)
- Industry-developed exams for occupations/specialties (e.g., Certified Executive Chef)
- Third-party exams measuring technical skills (e.g., NOCTI)
- State-developed exams, tied to industry standards—either a series of end-of-course exams or a single end-of-program exam (e.g., including homegrown or VTECS model)
- Foundation-level exam developed by national industry groups (e.g., Health Care)
- State secondary exam, matched to postsecondary entry—but only if technical skills are measured (U. S. Department of Education, Office of Vocational and Adult Education, 2007, pp. 3-4)

OVAE negotiates separate benchmarks with each state and works to encourage continual improvement over the duration of Perkins IV. By the final year of a state's five-year plan (2012-2013), the goal is for all states to be using this gold approach. Recognizing that states are not all equipped to meet this standard right away, the silver and bronze levels, which are less rigorous, are interim approaches that states may employ on an increasingly limited basis over the course of their five-year plan.

The Perkins IV legislation specifies not only that standards-based technical assessments in CTE be administered, but also that each state implementation plan must describe how professional development will assist in using data in general, and student achievement data from assessments in particular. The philosophy behind Perkins IV is that (a) independent third-party assessments that quantify accomplishments and identify areas for improvement are needed to strengthen programs and meet today's demands, and (b) considerable professional development is needed before educators understand how that type of assessment is different from their typical classroom assessments and why it is necessary to move toward this goal.

Using Data to Guide Program Improvement and Instruction

The term *data-driven decision making* is occurring with increasing frequency in education, most often with reference to policy decisions related to reporting requirements and accountability. Deserving at least equal attention, according to Boudett, Murnane, City, and Moody (2005), is the ability of teachers and administrators to use student assessment results to determine student skills and instructor effectiveness and then use the results together to improve overall instruction. Despite the apparent value of such an approach, little research has been reported on this topic, and very little appears in the literature about CTE educators' use of technical assessment data, particularly as it relates to program and instructional decisions. Few citations were found in a literature search on the implementation of data-driven decision making with regard to test data. The one citation most directly applicable is a white paper that NOCTI commissioned, *Using Standardized Test Data to Improve Instruction in Career-Technical Education*, which discussed the value of standards-based testing and how students, teachers, schools, and states could use the data as a part of improvement efforts (Kister, 2002).

With an increasing emphasis on the use of standardized tests for reporting on school, teacher, and student achievement, there is a risk that the true purpose of testing—program improvement and student learning—will be lost or buried under the need to use testing results for reporting and rating purposes. An understanding of assessment data, including their interpretation and uses, can encourage teachers who have used data for classroom improvement to continue to do so, and help those who have not used them see the value in using test data for classroom improvement beyond mere reporting. The more teachers understand the process and function of assessment, the more they are likely to see it as a tool rather than a threat (Cromey, 2000), and the more they can recognize and raise informed objections to assessment's misuse.

Although there has been little research on the use of data-driven decision making in schools, the research that does exist indicates that it can have a positive impact on student achievement and provide other benefits to schools (Dembosky, Pane, Barney, & Christina, 2005). Gordon (1998) found that CTE educators saw the value of assessment information, although standardized testing was judged of less importance than other types of testing, such as informal observations, classroom performance assessments, or portfolios.

In Chapter 2, the Association for Professional Development in CTE surveys were discussed in connection with technical skill updating. In the 2007 survey, "Student Data for Decision Making" was rated eighth out of 49 topics about which professional development is needed and sought (Pivnichny et al., 2007). This was the first year that respondents' choices placed this topic in the top 10 priorities overall, which may indicate that the emphasis on data-driven decision making is making an impression on educators and that there is a need to respond with suitable professional development.

Although many teachers and schools lack the skills necessary to make effective use of data, some school administrators have embraced the process to learn how to do so and have implemented positive changes as a result. As part of a series of case studies conducted by NOCTI, the practices of several individual schools in a variety of states were reviewed. One such site in the High Desert District of Oregon used assessment data to make curricular changes. In this district,

end-of-year assessment data have exposed lower-than-the-norm scores in blueprint reading, and teachers have been tasked with developing instructional strategies to raise these scores. In addition, community college instructors have been involved with secondary teachers in designing instructional enhancements in this area. This district experienced a doubling of its professional development budget to enable it to respond to the interest in learning how to analyze and review end-of-program technical assessment data.

Although the High Desert District is relatively new (three years) to the utilization of assessment data as a path to improvement, staff and administration now speak a common language throughout the region. Staff and administration also demonstrate a greater understanding of the relationship between standards, assessment data, and program improvement. In addition to the doubling of its professional development resources, the district's collaboration with community colleges has resulted in a full articulation program now in place with the Oregon Institute of Technology. This site has increased its credibility by providing objective evidence on the performance of its students and has been finding more uses for technical assessment data each year.²

Another site, Reading Muhlenberg Career and Technology Center (RMCTC), located in Reading, Pennsylvania, tracks a variety of data, including technical and academic assessments and industry certifications, and uses these data to review program trends, adjust curriculum, and work to increase the number of industry certifications awarded. In addition, RMCTC now has two coaches to help teachers with academic integration skills in literacy and numeracy. The RMCTC Director indicated that the school is more data-rich and results-oriented than a few years ago.

Professional development of teachers can also be driven by continuous improvements efforts; such efforts can be motivated and worked on cooperatively at the school level, with school-level results, but they also result in program-level improvements. National professional development standards were discussed in Chapter 2; however, other types of standards are embodied in the criteria of international or state award programs.

International external quality systems are exemplified by ISO-9001. In May 2007, the International Organization for Standardization (ISO) published updated guidelines to facilitate the implementation of quality management systems in education organizations. If education organizations work on individual elements of improvement but find it difficult to achieve the synergy needed to implement a successful continuous improvement effort, "implementation of a quality management system (QMS) for the educational organization can create the required synergies" (de Arrascaeta Farrando, 2007, p. 16).

Erie County Technical School (ECTS), located in Erie, Pennsylvania, and serving 11 school districts, exemplifies how continuous improvement can be linked to ISO-9001 standards by the use of technical assessment data. Administrators and staff have collaboratively been able to —dfl

² This information and the other examples of local use of data were provided in a personal communication, February 20, 2009, from C. Hodes, a Senior Consultant to NOCTI, who contacted administrators in schools known to use data for instructional purposes. These contacts were made as part of the NRCCTE-NOCTI project *Professional Development for Educators on the Use of Assessment Data*.

down” to find “root causes” of curricular issues impeding program improvement. There is a solid understanding of the relationship between standards, assessment data, and program improvement. ECTS teachers also maintain a program-level alignment to CIP (Classification of Instructional Programs) codes to ensure that the curriculum will reflect nationally accepted content. Due in part to the analysis of end-of-program technical assessment data and the collective work of a team of 14 educators, ECTS was among the first schools in Pennsylvania to achieve the ISO-9001.

Continuous improvement efforts benchmarked to award criteria are another spur to professional development. An example is the state-level Virginia Governor’s Exemplary Standards Award program. The purpose of this program is to raise the rigor and quality of CTE programs across the state. This is a two-step process: program instructors first work with business advisory groups and postsecondary faculty to validate their attainment of rigorous standards, then apply for the Governor's designation. This is a continuous quality improvement process engaging K-12 and higher education, the business community, and state, regional, and local officials. The opportunity to earn this distinction creates an incentive for programs to meet high academic standards and improve other measures of program quality, strengthen their partnerships and alignment with postsecondary education and industry, and demonstrate relevant and positive outcomes.

All CTE programs are eligible to seek exemplary status. Criteria for the awards ensure that all programs earning exemplary status will raise the STEM literacy of participating students through rigorous academic and programmatic standards. In determining an exemplary program, evaluation criteria include program excellence, educational significance, evidence of effectiveness and success, and replicability/usefulness to others; these standards were adopted originally from the National Dissemination Center for Career and Technical Education (NDCCTE) at The Ohio State University. Exemplary programs are identified through documented nominations followed by site visits. Programs earning this distinction form a growing network of exemplary programs to share best practices with each other and other programs striving for the designation (description adapted from Virginia Career Education Foundation, 2009).

One of the awardees is the Virginia Beach City Public Schools (VBCPS), which consists of 11 secondary schools and two career centers. VBCPS has adopted Virginia Governor’s CTE Exemplary Standards as the operational standards for all district programs. Teachers and administrators focus on trend data from end-of-program assessment as they plan for school improvement. These data support the effectiveness of CTE. The facts on student success, documented by assessment data, are used to justify equipment and resource purchases. VBCPS educators also discuss end-of-program data with their business and industry advisory members. Leadership at VBCPS wants to use solid, reliable data to help their teachers succeed. According to state reports, over 96% of CTE students make a successful transition upon graduation to the workplace, higher education, or the military.

These examples illustrate the variety of ways in which professional development can be instigated and integrated through standards-based continuous improvement programs. It is clear that the use of data-driven decision making in education is here to stay. The basic school

improvement strategy in NCLB is based on using student achievement data to assess AYP. NCLB and the Perkins IV both rely heavily on professional development to achieve their goals. The Perkins IV legislation specifies that standards-based technical assessments in CTE must be administered and that each state implementation plan must describe how professional development will, among other charges, assist in accessing and utilizing data including occupational information, student achievement data, and data from assessments. In addition, OVAE negotiates separate benchmarks with each state to encourage ongoing improvement over the duration of the Perkins IV legislation.

If the spirit and not just the letter of both Perkins IV and NCLB are to be adhered to, it is critical that student achievement data are not simply gathered and reported, but also used to inform instruction and make classroom-based improvements that should ultimately lead to higher student achievement. These favorable outcomes depend on educators receiving effective professional development to acquire skills in using and interpreting data from, for example, standardized technical assessments in CTE. As they integrate the use of data into determining, implementing, and evaluating the effectiveness of instruction, efforts at improvement will be more effectively targeted toward the specific needs of their own students, programs, and schools, resulting in a more focused use of resources. As instructional improvements become more targeted and effective at this grass-roots level, it is anticipated that student achievement will improve. Better prepared students entering higher education and the workforce should contribute to long-term gains in workforce quality, productivity, and global competitiveness, goals of the CTE field and our nation as a whole.

Management of Diverse Classrooms

No matter how well teachers are prepared technically and pedagogically, classroom management is crucial to student learning, and new teachers worry more than experienced teachers about the effectiveness of their classroom management skills (Clements, 1985; Melnick & Meister, 2008). Furthermore, teachers who come to the profession through alternative licensing feel even less prepared than their traditionally prepared peers for the core tasks of teaching, such as meeting the needs of diverse learners and constructing a positive learning environment (Darling-Hammond et al., 2002). Such teachers also have greater concerns about their ability to manage the classroom and motivate students (Wayman, Foster, Mantle-Bromley, & Wilson, 2003). Assisting new teachers in this area is crucial as research has consistently cited that a lack of classroom control leads to higher levels of teacher stress and burnout (Blase, 1996; Borg, Riding, & Falzon, 1991; Brouwers & Tomic, 2000; Friedman, 1995; Keiper & Busselle, 1996). Stress and burnout due to poor classroom management skills may result in teachers leaving the teaching profession altogether (Ingersoll, 2001; Ingersoll & Perda, 2009).

Classroom management when accommodating students with special needs presents a particular challenge. In two nationally representative surveys analyzed by Wei et al. (2009), teachers were asked to indicate their agreement level with the statement “I am given the support that I need to teach students with special needs.” Only 36% of all teachers across the states agreed with this statement. In addition, when the teachers were asked to choose their top priority for additional professional development, teaching students with special needs ranked third out of eight topics.

The expressed need for support in working with a diverse group of students with special needs is important, as a growing number of students (12% to 22%) in school have mental, emotional, or behavioral disorders (Adelman & Taylor, 2002). As Marzano and Marzano (2003) discussed, although classroom teachers are not expected to be experts in addressing severe emotional or behavioral problems, they can develop a repertoire of effective classroom management techniques to better meet some of their students' needs. Researchers point out that the most effective classroom managers do not treat all students the same, but instead tailor their strategies to the different needs of their students. By contrast, ineffective classroom managers are not as sensitive to diverse needs and use more of a one-size-fits-all approach (Brophy & McCaslin, 1992).

CTE has always served students with a wide range of abilities, and the broadening of programs to provide preparation for both employment and postsecondary education may attract an even more diverse mix. Kerka (2000) observed that “opportunities for challenging careers and good salaries are changing the demographics of today’s CTE students” (p. 1). Research shows that students who are considered to be at risk or disadvantaged, as well as students with disabilities, have greater success when they are enrolled in technology education, Tech Prep, school-to-career, and other career-focused programs (Brown, 2000; Cardon, 2000; Harvey, 2001; Kerka, 2000). They are less likely to drop out and more likely to be employed, have paid competitive jobs, and work fulltime after high school (Cobb, Halloran, Simon, Norman, & Bourexis, 1999; Colley & Jamison, 1998). With this record of success, students with special needs are often placed in CTE classes (Mahadevan & Peterson, 2009). Qualitative studies reviewed by Eisenmann (2000) imply that the integration of academic and vocational curricula promoted meaningful engagement and inclusion of students with disabilities by increasing persistence, academic achievement, and postsecondary engagement. According to ACTE’s past president, Colleen Keffeler (2008):

CTE provides special needs learners with the opportunity to showcase their talents and abilities. Project-based learning, application of academics to real-world situations, and the opportunity to work with a variety of learners provide not only career-specific skills, but the soft skills so necessary for success in today's work environment... It does not matter if a student is special needs, gifted, or general education—CTE teaches all learners the knowledge and skills necessary to compete in a global economy. (p. 6)

Gray and Walter (2001) pointed out that students with special needs generate almost half of all CTE credits. In some CTE programs, students with special needs are the majority. Not unlike new teachers in general (Rochkind et al., 2008), CTE teachers indicate feeling inadequately prepared to work with special needs students (Cotton, 1994, 1999; Custer & Panagos, 1996). Ruhland and Bremer’s (2002) study of the professional development needs of beginning CTE teachers reported a lack of sufficient preparation and hands-on experience in working with students with special needs. When asked how professional development for beginning teachers might be improved, respondents identified working with students with special needs as a useful content area, with an emphasis on practical, in-depth preservice training, including more and earlier opportunities for classroom experience. Teachers expressed the need for personal support, whether in the form of a mentor or a peer support group, as well as the availability of classroom

observation opportunities and workshops on many topics. Teachers also wanted time to be provided so they could take advantage of these experiences.

Although all teachers can benefit from professional development in accommodating diverse needs, this is especially important for CTE teachers who enter the field through alternate routes and have not had preservice training in classroom management through internships or student teaching opportunities. Joerger and Bremer (2001) suggested teacher induction programs as one answer to retaining and further developing the skills, satisfaction, and experience of beginning CTE teachers. Teacher induction provides support and guidance for beginning educators (Smith & Ingersoll, 2004). Induction programs are distinct from both preservice training, defined as preparation received before employment, and in-service opportunities, which provide periodic upgrading and training during employment. Induction programs assist teachers as they move from “novice” to “established.” Among the assistance particularly important for alternatively certified CTE teachers at the beginning of their first year of teaching, Joerger and Bremer listed the following:

- A mentor in the same or related instructional area and a support group
- Access to a variety of workshops when needed
- A continuous orientation program that addresses all aspects of teaching
- A handbook for first-year teachers that includes a list of resources and supplies
- A help hotline for new and beginning teachers (p. 12)

Specific efforts are being made to support teachers’ work with CTE students with special needs at the Career and Technical Special Populations Training and Resource Education Center (CTSP Center), a collaborative effort between the Family Development and Resource Management unit of Texas A&M AgriLife Extension Service and The Texas Education Agency. The CTSP Center provides CTE teachers and other educators with access to resources for improving their knowledge regarding the education of students who have special needs. These resources include a newsletter, books, curriculum materials, videos, and online courses for teachers, parents, and education professionals throughout Texas and the nation.

It is clear that effective classroom management is critical to student learning and success. It is just as clear that most new CTE teachers, especially those with alternative certification, do not feel competent in their classroom management skills; nor do they feel adequate in their ability to support students with special needs. Although the research shows that new CTE teachers express a need and desire for professional development in these areas, little has been written about how best to provide them with such experiences. To explore the issue of classroom management among alternatively certified teachers, searches were performed using Google and ERIC. These searches yielded few hits. An ERIC search made on February 9, 2010, used a number of combinations of search words. A search for “alternative certification” yielded about 370 sources, of which 179 were journal articles; 100 of these 179 were in peer-reviewed journals. If “classroom management” or “career and technical education” were included with “alternative certification,” the results were greatly reduced. An ERIC search for “alternative certification” and “classroom management” yielded 15 sources, 4 of which were journal articles; 2 of the 4 journals were peer-reviewed. Even fewer were found when “career and technical education” was added to the “alternative certification” search. Although a far greater number of sources were

found when using Google to search for “alternative certification,” this number was greatly reduced when adding either “classroom management” or “career and technical education.” Several additional searches using various combinations of key terms yielded the same outcome. Such database searches underscore the need for more research in how to best support new CTE teachers in classroom management skills through professional development opportunities.

Summary

This chapter examined how professional development for secondary CTE teachers can improve instruction and assessment. The emphasis on academic integration has become pervasive in secondary CTE, and Perkins IV has added additional pressure to integrate academic and technical content. As secondary programs attempt to prepare students for both college- and career-readiness, they must include more rigorous academic content than has been the case in the past. Project-based, problem-based, and cooperative learning are well-suited to CTE and provide opportunities for academic integration, but teachers need to be trained in the methods required for their application. They also need preparation in the use of educational standards for instructional planning. Such standards define the skills and knowledge that students should acquire, and Perkins IV requires that programs of study be aligned with such standards. Closely linked with standards are assessment and the use of data from assessments for program improvement. Data-driven decision making is becoming more prevalent, but educators continue to struggle with how to do it. Despite their difficulties, there are districts in which the use of data has had significant impact on curriculum and instruction. We presented brief sketches of how such districts have used assessment data to guide programs. The final topic examined in this chapter is the management of diverse classrooms. The range of students enrolling in secondary CTE is wide and teachers, especially those with alternative certification, need preparation in responding to this diversity.

Chapter 4

Professional Development Initiatives of the National Research Center for Career and Technical Education

Chapter 3 discussed the kinds of skills and knowledge needed by teachers to respond to the broadened expectations for secondary CTE. Although all of the topics discussed are important, the NRCCTE can respond to only some of them. In this chapter, we discuss those needs to which the NRCCTE is currently responding through research, professional development, and technical assistance projects. The topics of these projects are the integration of academic and technical skills and knowledge, the use of assessment information to guide program improvement, increasing enrollment of nontraditional students, and alternative certification. We wish we could report that there are projects directed to all of the needs discussed in this report, but resource constraints make that impossible.

Integration of Academic and Technical Skills and Knowledge

In our judgment, the principal challenge facing secondary CTE is how to use its content and pedagogy to improve the academic skills of CTE students. Many of the students who choose CTE are deficient in academic skills, and CTE can present academics in ways the typical academic classroom cannot. By explicitly teaching the academic content inherent in occupational settings, CTE teachers can demonstrate the practical utility of that content and engage students who might otherwise be bored or intimidated by academic subjects.¹

In advancing the improvement of academic skills as a priority, we are not asking CTE teachers to shift their primary focus away from teaching technical skills. If they did so, they would lose the interest of those students who most need what they offer. We do ask CTE instructors to partner with academic teachers to examine their CTE curriculum to find the academics that are inherent in occupational tasks. Once this content is found, we ask that the teachers work together to develop lessons that teach both the applications of the academics and the general principles that underlie those applications. An example from health occupations may help explain what we propose.

When treating patients who have been severely burned, medical professionals use what is referred to as the “rule of nines.” The main parts of the body—the head, upper and lower front and back torso, each arm, and front and back of each leg—each represent roughly 9% of the total surface area of the body. To estimate the amount of body surface that is burned, the extent of burns on each of these body parts is observed and added together. A patient with extensive burns on the front of one leg would be estimated to have burns on 9% of his or her body; burns on all of one leg, front and back, 18%; and so on. These estimates are used to determine the amount of fluid replacement that is necessary and whether the patient should be transferred to a facility that specializes in the treatment of burns.

¹ For a synthesis of the research on how occupational context can contribute to motivation to learn, see Chapter 7 of *Fostering High School Students’ Motivation to Learn* (National Research Council and the Institute of Medicine, 2004).

In a typical health occupations class, the rule of nines is taught largely as explained above with no attempt to examine the mathematics that were used to develop the rule. As discussed in Chapter 3, Stone et al. (2008) reported on the Math-in-CTE study conducted by the NRCCTE. In this study, health and mathematics teachers worked together to develop a lesson plan that taught the geometry that underlies the rule of nine. In this lesson, the head was considered to be a sphere, the arms and legs were cylinders, and the torso was a set of rectangles. After relating the body to geometric shapes, the lesson plan introduced the formulas for calculating the surface area of each of these shapes and had students practice applying them.

In the Math-in-CTE study, several lessons of this type were developed for health and four other occupational areas, for an average of about 10 lessons per occupational area. The effectiveness of the lessons was tested in an experimental design that randomly assigned half of the CTE teachers who volunteered for the study to the experimental group and half to the control. CTE teachers in the experimental group worked with math partners to identify embedded math in the CTE curriculum and develop lessons to teach that math. Once lessons were developed and critiqued, the CTE teachers taught them to their students. This was not team teaching. The CTE teachers needed to understand the math with sufficient depth to explain it to their students, and the CTE teachers' participation in the development of the lessons taught them the math they needed. This was a major change in teaching practice that required extensive professional development and ongoing support to implement.

On two standardized tests of mathematics, Accuplacer and TerraNova, the students who were taught the math-enhanced lessons scored 8% and 9% higher, respectively, than students of the control group teachers.² On average, across the five occupational areas, teaching the math-enhanced lessons took only 20 hours, or 11% of a year-long (180-day) one-hour class. These 20 hours were not entirely spent on mathematics; occupational content was also taught that grounded the mathematics in relevant occupational tasks.

The 20 hours spent in direct instruction, however, represented only the proverbial tip of the iceberg. The CTE experimental teachers who participated in the study spent 80 hours in professional development with their math partners, working together to identify the math embedded in the CTE curricula and develop lesson plans to teach it. To provide a common approach across lessons and occupational areas, all lesson plans were developed following a common template that specified seven elements to be addressed. Most important, teachers were given time to develop, critique, revise, and practice the lesson plans with their fellow teachers. The actual development of the lessons was not a "take home, do on your own" assignment. The time provided encouraged teamwork that led to the emergence of communities of practice (Wenger, 1998) among the teachers in each of the occupational areas.

A recurring theme in the literature on professional development is the need for teachers to work together in learning communities (Carpenter et al., 2004; Fullan, 2007; Giles & Hargreaves, 2006; Hargreaves & Goodson, 2006; Newmann & Associates, 1996). The primary goal of

² These percentage differences reflect effect sizes on Accuplacer of .42 and on TerraNova of .55. An effect size is a measure of the difference between the average scores of two groups in comparison to the overall variation of the scores in the groups.

learning communities is to improve student learning. In a true community, teachers assume joint responsibility for this goal and work together to develop ways to achieve it (Hord, 2004). This involves defining the needs and problems of students, identifying and drawing upon resources to respond to these needs, and fashioning and testing approaches to improve learning. Obviously, teachers need administrative support to function in this manner.

Most discussion of learning communities assumes that they will be developed within a school with the principal playing a key role by supporting the community and providing leadership. The communities in the Math-in-CTE study were not school-based, and the teachers who volunteered to participate were drawn from many schools. However, as they worked together to identify embedded math and develop lessons, communities of practice emerged. Wenger (1998) has developed the most complete theory of communities of practice, which he defines as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger, 2009). The teachers who participated in the Math-in-CTE study shared a concern for improving the math skills of their students; their interactions helped them learn how to do this better. Further, their interactions were fostered by the time and structure offered by the study; these factors led to the development of communities of practice.

The findings from the Math-in-CTE study, conducted from 2003 through 2005, provided a sound scientific base for the delivery of technical assistance and professional development. Analyses of these findings led to the formulation of five principles that guide the services offered by the Math-in-CTE technical assistance:

1. Develop and sustain a community of practice among the teachers.
2. Begin with the CTE curriculum and not the math curriculum.
3. Understand that math is an essential workplace skill.
4. Maximize the math in the CTE curriculum.
5. Recognize that CTE teachers are teachers of math-in-CTE, and not math teachers
(Stone et al., 2006, p. 69)

The NRCCTE provides technical assistance on the implementation of the Math-in-CTE model on a cost-recovery basis at the request of states, regional consortia, and large school districts. The overall goal of the technical assistance is two-fold: (a) to build the capacity of state leadership to implement and sustain curriculum integration, and (b) to concurrently provide the kind of high-quality, extended teacher professional development that was conducted in the original research study. The NRCCTE facilitators who leads site implementations all have either participated in the original study or gained extensive experience with Math-in-CTE implementation through long-term training and participation in the NRCCTE’s technical assistance services.

Developing the ability of CTE teachers to implement the Math-in-CTE model in their classrooms requires a minimum of 10 professional development days—five days in the summer before school begins, two in the late fall, two in the early spring, and one at the end of the year. During this extended time, CTE instructors work with math teacher partners to develop curriculum maps, develop and revise math-enhanced lessons, and practice teaching lessons in front of their peers. In this way, the Math-in-CTE model meets the mandate of Perkins IV legislation to

provide professional development that is high-quality, sustained, intensive, and leads to increases in academic knowledge.

From the completion of the research study to the writing of this report, the NRCCTE has provided technical assistance on the Math-in-CTE model to 17 states or large school districts. A total of 145 administrators, 504 CTE teachers, and 464 math teachers have participated. It is estimated that more than 10,000 students have been directly impacted by this technical assistance. The student total is a conservative estimate in that it does not include students in math classes taught by math-teacher partners or students in classes taught by CTE teachers who did not participate in the technical assistance.

During the 2009-2010 school year, the NRCCTE offered three levels of technical assistance: introductory presentations, Jump-Start workshops (which provide an in-depth look at key elements of the model), and full implementation of the Math-in-CTE model. The NRCCTE is also conducting activities to support curriculum integration efforts, such as the development and refinement of professional development handbooks and materials, ongoing evaluation at technical assistance sites, and development of web-based strategies to sustain and support communities of practice.

The NRCCTE is also conducting a second project on the integration of academic and technical instruction that involves the literacy skills of CTE students. The objective of this project, titled *Authentic Literacy Applications in CTE: Helping All Students Learn*, is to test and refine effective reading program models and cognitive strategies to improve reading comprehension skills. Disciplinary literacy strategies represent a group of cognitive strategies—including self-questioning, monitoring comprehension, and summarizing information—to improve reading comprehension related to CTE. The research attempts to determine teacher practices that cultivate active, engaged, and proficient readers in secondary CTE disciplines.

During the first year of the project, focus groups were conducted with CTE teachers from various locations in the state of New York to determine the types of literacy problems their students encountered and how they were responding to them. The results from these focus groups led to the selection of two models for enhancing literacy skills, the ALS and the MAX Teaching Framework.³ In the second year of the study, a randomized trial pilot test was conducted with 48 teachers and their 1,313 students assigned to experimental or control groups. The pilot test involved 2.5 months of experimental treatment with pre- and posttesting. Analyses of the Gates-MacGinitie Reading Test (MacGinitie, MacGinitie, Maria, Dreyer, & Hughes, 2006), a standardized measure of vocabulary and comprehension, found statistically significant gains for students who received the interventions.

The results from the pilot test were sufficiently positive that a full-year randomized trial of the two models is being conducted during the 2009-2010 school year with a total of 101 teachers from New York and South Carolina. If this full-year test finds that the interventions produced meaningful increases in the reading skills of CTE students, the NRCCTE will explore ways of

³ ALS is the acronym for Adolescent Literacy Support (The Education Alliance, 2008). The MAX acronym is derived from Motivation, Acquisition, eXtension (Forget, 2004).

disseminating these models; this may include offering technical assistance similar to that being conducted for Math-in-CTE.

Assessment Data for Program Improvement

Perkins IV accountability requirements for technical skills assessment signaled an urgent need for professional development on using assessment data for secondary CTE educators. This past year, supported by the NRCCTE, NOCTI conducted survey research as a means of gathering the information required to respond to this need. This descriptive survey study investigated how secondary CTE educators, both administrators and teachers, use technical assessment data to improve program curricula and identify individual and group instructional needs. Of particular interest were how CTE educators have learned to make use of the data; what specific types of professional development they have received, if any; their perception of the effectiveness of this training; and what types of professional development they would consider most effective for the future. Findings from the survey are being combined with insights gleaned from the literature and will be made available nationally. These survey results represent the basis for the creation of professional development that can be provided in response to technical assistance requests from states.

The principal research strategy was survey research with a purposeful sample of five states: Illinois, Missouri, Oklahoma, Pennsylvania, and Virginia. One of the main criteria for selection of these states, beyond their having relevant types of CTE delivery systems, was that data could be obtained efficiently because NOCTI staff have working relationships with educators at several levels in these states. It has been the experience of NOCTI staff that the likelihood of obtaining quality responses is enhanced when there are existing relationships. This also meant that considerable time and resources could be saved over the alternative of selecting a random sample and then having to search out the most appropriate respondents.

Within each state, representative samples of secondary CTE centers and comprehensive high school CTE programs were randomly selected. Center directors and CTE coordinators at comprehensive high schools were sent questionnaires to complete themselves and also distribute to all CTE instructors in four selected program areas: business education, construction, health science, and manufacturing. In addition to the survey, a variety of interviews, or small case studies, were conducted with individual schools. These case studies addressed how the schools were using assessment data to make instructional improvements and the results of such data use that educators have observed. Some of the results from these case studies were summarized in Chapter 3 of this report.

During Year 3 of the NRCCTE (August 2009-July 2010), NOCTI staff have focused on designing a professional development package for CTE educators on the topic of using technical assessment data to make instructional improvements within the school environment. The experience and research findings of the NRCCTE's other professional development projects are also being incorporated in this package. This development and initial trials will be conducted with a small sample of pilot schools. In NRCCTE Year 4, the finalized product will be piloted with a more controlled efficacy study. During Year 5, the plan is to have a finished product that

the NRCCTE can use to provide technical assistance to states that need professional development on this topic for their CTE teachers.

Increasing Enrollment of Nontraditional Students

Chapter 3 discussed how the increasing diversity of students in secondary CTE has intensified the need for skills in classroom management. One source of this diversity is increased enrollment of students in occupational areas that are not traditional for their gender (e.g., males in health occupations, females in construction trades). Section 113 of Perkins IV, the accountability section of the legislation, requires CTE programs at both the secondary and postsecondary levels to be evaluated by the extent to which students participate in and complete programs that lead to employment in nontraditional fields. Because these are indicators of programs effectiveness, increasing the enrollment and completion of nontraditional students are high on the priority list of CTE administrators.

The Academy for Educational Development (AED) conducts the NRCCTE's Technical Assistance (TA) Academy in conjunction with the National Association of State Directors of Career Technical Education Consortium (NASDCTEc) and MPR Associates, Inc. The goal of the TA Academy is to provide technical assistance on issues of high priority to CTE state directors; during the first year of the NRCCTE, the TA Academy focused on nontraditional CTE program participation and completion.

The resources available to the TA Academy project are not sufficient to allow AED to provide technical assistance to all 50 states. Consequently, a request for proposals process was used to select those who would receive assistance. For the first TA Academy, proposals were received from four states: Alabama, Georgia, Minnesota, and Pennsylvania, and the District of Columbia; all five were judged acceptable. Each of these states assembled teams of five to eight members who took part in the first annual TA Academy, which was held June 26-27, 2008.

Prior to the actual meeting, the states submitted information summarizing their current efforts with regard to nontraditional students. At the meeting, national experts made presentations and facilitators worked with state teams to develop workplans for improving data and outcomes for nontraditional students. These experts and facilitators were drawn largely from recommendations provided by Mimi Lufkin, Chief Executive Officer of the National Alliance for Partnerships in Equity. Each state team prepared a workplan that outlined objectives, activities, responsible parties, timelines, and outcomes. The purpose of the workplan was to provide a detailed guide to the specific work to be undertaken by the state over the next year. These workplans were used by the state teams as they reformed their state initiatives for nontraditional students.

Following the first meeting, the focus of follow-up activity has been on monitoring and supporting state progress on the further development and implementation of their workplans. At the Fall 2008 NASDCTEc conference, AED met with three of the state liaisons to review progress and offer suggestions. As of the end of June 2009, updates on state plan implementation have been provided by three of the five states that participated in the first TA Academy. AED is continuing to monitor state implementation of these plans.

Alternative Certification

Another of the NRCCTE projects is being conducted to respond to the rapid increase in the number of secondary CTE teachers with alternative certification. The decline in the number of institutions offering traditional, four-year teacher education programs has contributed to the need for alternatively certified teachers. This decline not only reduces the number of four-year graduates, it also means there is less capacity to provide the courses required for alternative certification. The situation is further exacerbated by a theme raised in preceding chapters: The professional development needs of alternatively certified CTE teachers are more acute than those of teachers who have completed traditional, four-year programs. Capacity is declining while need is increasing.

The NRCCTE is responding to the need for improvement in alternative certification through a project being conducted by one of its partner organizations, the HSTW Consortium of SREB. This project is designed to develop an induction model for new CTE teachers pursuing an alternative route to certification that will increase their competence, self-efficacy, and retention. The model includes a series of professional development activities as well as support through a mentor in the teacher's school, coaching from a professional development instructor, guidance of the teacher's principal, and engagement through an electronic community of practice. The professional development is specifically designed to prepare new CTE teachers to plan, deliver, and assess engaging instruction that (1) integrates academic content, especially in reading and math; (2) ties to technical concepts and standards in the teacher's subject area; (3) connects with the students' interests, talents, aspirations, and broader program of study; (4) helps students see how coursework is tied to all aspects of their industry; and (5) equips students with essential 21st-century skills.

In the first year of the project, HSTW commissioned four concept papers that served to frame the content for the professional development modules: instructional planning, instructional strategies, classroom assessment, and classroom management. These papers were written by curriculum consultants and reviewed by expert panel members representing teachers, state leaders, teacher educators, and content experts. Working with an instructional designer, HSTW staff drafted facilitators' and participants' guides with learning activities and resources for the Instructional Planning and the Instructional Strategies Modules. These were also reviewed by the expert panel members and others from the field.

The first and second modules on instructional planning and instructional strategies were field-tested using an iterative research process specifically developed for this purpose. The field tests occurred in three six-hour days of training (June 3-5, 2009 and October 14-16, 2009) at the Meridian Technology Center in Stillwater, Oklahoma. Training was offered to groups of 20 and 12 CTE teachers, respectively. State CTE staff, teacher educators, and local CTE administrators observed the process. The field test was conducted in order to generate insights about how to revise modules as well as to improve the design of the overall induction model. The findings from the test are being summarized to inform further revisions of the module.

As the project continues, SREB will use the iterative research process to field test the two remaining professional development modules and analyze the data from the tests to refine materials. When the modules are completed, there will be a field test of the full induction model, including both professional development and support elements. The final field test of the model will be conducted by state leaders to yield information on the feasibility of implementation. Following revisions based on the data from the field tests, the fully developed set of materials and processes for the induction model will be ready to be implemented to scale for empirical testing. The concept papers and field test results will be published and technical assistance offered to states, districts, and community colleges on the use of the materials to shape or improve their own programs.

Concluding Thoughts

In Chapter 1, we introduced Rojewski's (2002, 2009) conceptual framework to focus our discussion. In this report, we have given the most attention to instruction and program delivery options, the components of the framework for which teachers have the primary responsibility. The content that teachers deliver, however, is strongly influenced by forces outside the field. The forces that Rojewski identified are school reform, public expectations, the new economy, and student learning, motivation, and achievement. We have suggested that public expectations and school reform are strongly driven by the new economy, which has placed a premium on high-level skills, adaptability, and innovation. These expanded expectations of what secondary-level CTE should accomplish were the primary determinants of the topics addressed in this report.

Our focus has been on teachers already in the classroom, not preservice teacher education. Even if traditional, four-year teacher education programs were to equip their students with all the knowledge and skills discussed, new entrants from these programs would represent only a fraction of the total number of teachers. In addition, the proportion of CTE teachers entering the profession through alternative certification has been increasing; most observers (e.g., Bottoms & McNally, 2005; Gray & Walter, 2001) expect that this trend will continue. If secondary CTE is to prepare its students for both postsecondary education and employment, the existing teaching force must be equipped to carry out this expanded mission.

When discussing the knowledge and skills that CTE teachers need, we frequently have noted the complexity of the topics and the need for extensive professional development and support. We have cited the report of the NSDC (Wei et al., 2009) several times because it presents the current consensus on the characteristics of effective professional development. Those characteristics were included in the definition of professional development we adopted for this report: comprehensive, sustained, systemic, and based on identified needs of teachers.

Providing professional development of the type recommended by the NSDC to secondary CTE teachers is further complicated by the diversity of the field. In Chapter 2, our description of the standards established for CTE by the NBPTS indicated that a teacher must select one of eight specialty cluster areas in which to seek board certification. Each of these clusters covers a variety of occupations. Manufacturing and engineering, for example, includes occupations such as carpentry, masonry, plumbing, electronics, auto technology, and welding. Given the complexity

of the skills and knowledge discussed in this report and the diversity of CTE content areas, we conclude the report with three questions that providers of professional development to secondary CTE teachers should consider when designing what they plan to offer:

1. What do the teachers most need to learn to prepare students for both employment and further education?
2. How can professional development experiences be structured so as to incorporate the characteristics that the literature identifies as essential to effective professional development?
3. Are adequate resources available to provide the professional development that is needed?

The answers to these questions will vary, of course, according to the circumstances in which the professional development is to be delivered. That being said, our judgment is that, in most cases, the answer to the first question will include the integration of academic and technical content. Academic deficiencies, as reflected in the percentages of CTE students who must take developmental or remedial courses, are major barriers to success at the postsecondary level (Bailey, Jeong, & Cho, 2008; Bragg et al., 2002; Castellano et al., 2007). For many CTE students, the occupational context has the potential to provide the motivation to learn, a quality the typical academic class lacks. If the academic skills of CTE students are to be improved, however, CTE teachers cannot accomplish this on their own. Collaboration with academic teachers will be necessary.

The reference to collaboration reflects our thinking about the answer to the second question. An essential component of professional development is a structure that encourages learning communities—communities of practice—to develop among teachers. Such communities require scheduled time for teachers to work together to identify and respond to the learning needs of their students. Unfortunately, the diverse occupational areas in CTE compound the difficulties of developing such communities, because most secondary schools have only one or two teachers for each area. For the Math-in-CTE study, the NRCCTE brought teachers in the same occupational areas together from many different schools to form communities of practice. This approach is also being used in the NRCCTE's technical assistance on the Math-in-CTE model.

If it is not possible for districts to come together for professional development, we would still recommend efforts to develop learning communities made up of academic and CTE teachers from different occupational areas. The NRCCTE has no direct experience with such communities, but we do have anecdotal evidence from an individual who served as a facilitator to one of the occupational areas in the Math-in-CTE study (personal communication, M. Kisner, October 23, 2009). Dr. Kisner presented the Math-in-CTE model to statewide meetings in her state and was asked by some schools to provide assistance in implementing it. The schools she worked with created small clusters of CTE teachers from different occupational areas to work with mathematics teachers. The CTE teachers, with the math teachers' assistance, were able to develop lessons that enhanced the mathematics instruction in their courses. Another possibility is that such learning communities could be electronic, connecting teachers from the same content

area who are separated geographically, but who could come together to share resources, ideas, and teaching plans through a common website or scheduled online seminars or webinars.

Dr. Kisner stressed a factor that is frequently noted in the literature on professional learning communities: the importance of administrative support. Teachers were far more receptive to the Math-in-CTE model in those schools in which the model had strong endorsement from superintendents and principals. In one such school, after seeing the results of CTE teachers working with math teachers, the principal provided time for English teachers to work with CTE teachers to improve the writing skills of students.

Whatever approach is attempted, providing time for teachers to work together will present a major problem for most schools. Wei et al. (2009) reported that teachers in the United States spend much more time in direct instruction than their counterparts in other nations that are members of the Organization for Economic Cooperation and Development. The 1996 report of the National Commission on Teaching and America's Future indicated that in most European and Asian nations, 15 to 20 hours of the average teacher's work week is spent out of the classroom on such tasks as planning lessons, grading papers, and meeting with colleagues, students, and parents. In the United States, teachers typically have three to five hours for lesson planning, and this time is usually spent independently, not working with colleagues.

Even if time is found for teachers to work together, they will need additional support if communities of practice are to emerge. There must be a focus for these communities, and the teachers will need assistance from facilitators in identifying the problems they want to address; seeking information on potential approaches to the problems; designing and testing approaches; and evaluating the results of their tests. If a true community focused on improving instruction and increasing learning emerges, the need for facilitators should decrease, but not the need for time for teachers to work together.

Major changes are needed to move professional development in the direction that research indicates is most effective, and these changes have financial implications. The cost of effective professional development may be the greatest barrier to its implementation. Providing time for teachers to work together is essential, but time may also be the most costly aspect of professional development. The improvement of pedagogic skills and the updating of technical knowledge require ongoing effort that must be shouldered by education, business, industry, government, and teachers themselves. Through such collaborative activities, all stakeholders can work to help teachers develop the skills and knowledge needed to prepare students to compete in a satisfying and productive manner within an increasingly competitive global workplace.

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