The Journal of Vocational Education Research

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EDITORIAL POLICY The *Journal of Vocational Education Research (JVER)* publishes refereed articles that examine research and research-related topics in career and technical education, preparation for work, and the workplace. The JVER Editorial Board is committed to publishing scholarly work that represents a variety of conceptual and methodological bases. Submission of manuscripts representing the following styles is encouraged: (a) empirically-based manuscripts that report results of original research, either quantitative or qualitative, (b) reviews or synthesis of empirical or theoretical literature, (c) essays derived from original historical or philosophical research, (d) reviews of recently published books, and (e) rejoinders to articles recently published in the *JVER*. Page costs are not typically assessed. However, if a manuscript is accepted, authors will be asked either to supply camera-ready tables and figures, or pay for the costs incurred in preparing complex tables and figures for publication.

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The *Journal of Vocational Education Research (JVER)* is published three times a year in April, August, and December and is an official publication of the American Vocational Education Research Association (*AVERA*). *AVERA* was organized in 1966 to (a) stimulate research and development activities related to vocational education, (b) stimulate the development of training programs designed to prepare persons for vocational education research, (c) foster a cooperative effort in research and development activities with the total program of vocational education, other areas of education and other disciplines, and (d) facilitate the dissemination of research findings and diffusion of knowledge.

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Editorial Note

J. W. Rojewski
University of Georgia

Loyal readers of the *Journal of Vocational Education Research* (*JVER*) are, no doubt, aware of the interruption we have experienced in publication of the journal. As Interim Editor, I am happy to report that the problems experienced in 2002, resulting in substantial publication delay, have been successfully resolved. In fact, you should receive the three back issues comprising Volume 27 in relatively quick succession over the next several months. The three issues slated for publication in 2003 (Volume 28) are already in various stages of preparation. We—the *AVERA* Executive Board and *JVER* Editorial Board—fully expect to be on schedule by the end of this calendar year.

Timely publication was not the only aspect of JVER that was negatively affected during this past year. A number of authors experienced problems with the review process, primarily not receiving timely feedback on manuscript reviews. With the publication of this issue, communication has been made with all affected authors and arrangements have been made to complete the review process in a timely fashion. We all realize that it will take some time to repair the negative impact delays in the review process and in publication have caused, but are confident that the corrective actions taken will fully resolve these concerns.

Despite this bad news, the future of the journal looks very bright. Dr. Joe Kotrlik, a professor at Louisiana State University, has stepped into the role of Editor. Although just starting, he has already demonstrated his competence, commitment to the journal, and ability to manage the various demands placed on a journal editor. Please consider submitting manuscripts of your recent research to the *JVER* and Dr. Kotrlik for possible publication. Information for mailing manuscripts can be found on the back inside cover of this issue.

In other important news, the *JVER* Editorial Board voted (in 2001) to reduce the number of issues published per volume series from four to three per year. This reduction will occur with the publication of Volume 27 (2002). The primary reason for this decision was the significant drop in the number of unsolicited manuscripts received for review by the journal over the past five years. Other professional journals—e.g., the Journal of Career and Technical Education, and the Journal of Industrial Teacher Education—have experienced similar drops in manuscript subscription. This problem is important enough that the *AVERA* Executive Board recommended initial discussions with these journals about the possibility of merger. There are both advantages and disadvantages to merging journals from different organizations. No action, other than discussion has been taken at this time.

I encourage all readers to voice their opinions to a member of the *AVERA* Executive Board or the JVER Editorial Board. Hopefully, a report will be presented for discussion during the annual meeting of the ACTE scheduled for Orlando in 2003

Finally, this issue of the *JVER* presents six papers commissioned by the National Dissemination Center for Career and Technical Education and presented at the 2002 National Career and Technical Education Institute in Scottsdale, Arizona. I think readers will find the set of papers interesting and thought-provoking during this time of educational reform. During his tenure as JVER Editor, Dr. Jim Stone initially posed the idea for this special issue and initiated the efforts to gather and edit the manuscripts. N. L. McCaslin provides an introduction to the special issue.

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Renaissance in Career and Technical Teacher Education

Papers from the 2002 National Career and Technical Teacher Education Institute

Introduction to Special Issue

N. L. McCaslin
The Ohio State University

The attention being devoted to teacher quality and how to produce quality teachers is probably as high as it has ever been. The debates have been intense and offered new ways of thinking about how teachers are certified, how teachers are prepared, and what new educational policies are needed at the local, state, and national levels. These new policies have ranged from requiring all teachers to have a baccalaureate degree in the subject they plan to rewarding teachers with large increases in salary if they meet the requirements of the National Board for Professional Teaching Standards. In career and technical teacher preparation, there have always been numerous avenues to certification. However, improving the quality of teachers and teacher preparation is no simple task.

The papers in this issue of *JVER* were developed for the 2002 National Career and Technical Teacher Education Institute conducted in Scottsdale, Arizona and sponsored by the National Dissemination Center for Career and Technical Education through funding they received from the U.S. Department of Education, Office of Vocational and Adult Education. The theme of the Institute was, *A Call for Renaissance in Career and Technical Teacher Education,* and was the first time that those interested in career and technical teacher education had been brought together for several years. Individuals from colleges and universities, community colleges, K-12 schools, regional education agencies, state education agencies, national organizations, state teaching certification/licensing agencies, labor groups, business and industry, community organizations, and educational consultants were invited. A total of 154 individuals from 36 states attended.

The National Dissemination Center for Career and Technical Education is a Consortium of five major universities serving as the primary partners: University of Minnesota, The Ohio State University, University of Illinois, Oregon State University, and The Pennsylvania State University. These universities represent some of this nation's premier providers of career and technical instructor, administrator, and counselor education—both initial and continuing preparation. The Consortium also draws upon the experience of a high-profile national Advisory Council of leading experts, a number of leading internationally recognized consultants, and a number of collaborating institutions, agencies, and organizations.

Five commissioned papers were developed to provide the basis for the 2002 National Career and Technical Teacher Education Institute. Each of the five university partners in the National Dissemination Center for Career and Technical Education were asked to identify an individual or individuals to prepare one of these papers for the National Career and Technical Teacher Education Institute. The Pennsylvania State University was asked to develop a paper on a conceptual framework for career and technical education. Jay W. Rojewski from the University of Georgia was selected to prepare the paper. The University of Minnesota identified Arthur M. Harkins to prepare a paper dealing with career and technical education and the future. The Ohio Sate University named N. L. McCaslin and Darrell Parks to prepare a paper that overviewed career and technical teacher education. The preparation and certification of postsecondary career and technical teachers was assigned to the University of Illinois and was developed by James E. Bartlett, II. Finally, Oregon State University was asked to develop a paper on the use of a virtual teacher-training center to prepare career and technical teachers. Sylvia M. Twomey was asked to prepare the paper. An *Information Synthesis* paper developed for the National Dissemination Center for Career and Technical Education by Ken Gray and Richard A. Walter of The Pennsylvania State University, *Reforming Career and Technical Education Teacher Licensure and Preparation: A Public Policy Synthesis,* was also used as a basic document for the Institute.

Rojewski's paper, *Preparing the Workforce of Tomorrow: A Conceptual Framework for Career and Technical Education,* examines issues connected to the development of a conceptual framework for career and technical education in the United States. He begins by clarifying what a conceptual framework is and how it should be developed. Next, he discusses issues and views that have influenced career and technical education throughout its history. The paper also discusses differing philosophic positions, education reform efforts, workforce needs, and external issues facing career and technical education. Rojewski also identifies the components of a conceptual framework—purpose, theories, models, teacher education, curriculum, delivery options, clientele, student assessment, and program evaluation—and ties them to past, current, and future perspectives. The paper concludes with implications for teacher preparation.

Harkins paper, *The Future of Career and Technical Education in a Continuous Innovation Society*, presents a future for career and technical education that mirrors the last 20 years of software- and technology-driven changes in the workforce. He argues that all levels of American education must undergo a software supported experiential mission shift to prepare, support, and evolve flexible, high-performance knowledge workers for a continuous innovation society. Harkins then compares five learning approaches—earlier industrial training, generalized mass education, information-to-knowledge transition, cybernetic supports, and performance/innovation base learning for continuous innovation society. He also argues that jobs are the logical and appropriate jobs for automation, and thus

elimination. Therefore, Harkins concludes that career and technical education is appropriate and preferred for leading an educational mission shift to prepare knowledge workers. The author concludes his paper by discussing the promises and threats of distributed competence, implication of distributed competence for career and technical education, and new directions for career and technical education.

Teacher Education in Career and Technical Education: Background and Recommended Changes for the New Millennium, by McCaslin and Parks begins by stating that little is known about what makes a good career and technical education teacher and how that teacher contributes to academic and technical achievement. They also that indicate that an inadequate knowledge base is available regarding what the career and technical education teacher does in the classroom and what constitutes an effective career and technical education program. Next, they identify forces impacting career and technical education from society and/or the economy and significantly impact the student, the school, and the community: career development, higher academic achievement, assessment and accountability, diverse clientele, and technology. McCaslin and Parks also provide an historical overview of teacher education, career and technical education, and career and technical teacher education. They also indicate that career and technical teacher education is impacted by four major factors—approaches to teaching and learning, infrastructure, teacher licensure and standards, and innovative programs. A conceptual framework for career presented and tied to the major factors previously identified. The paper concludes with policy recommendations that should be considered at the federal, state, and local levels, and by business and industry, to improve the quality of career and technical teacher education.

Bartlett begins his paper, *Preparing, Licensing, and Certifying Postsecondary Career and Technical Educators,* by providing a definition of words often interchanged in usage on this topic—accreditation, career clusters, certification, licensure, and national board for Professional Teaching Standards. In his synthesis of available literature, Bartlett indicated that licensure and certification procedures differ widely from state to state. He also states that postsecondary career and technical education teachers must be knowledgeable in both their technical area as well as in teaching and learning for both pedagogy and adrogogy. Additionally, the author indicated that postsecondary career and technical education teachers enter their profession from a variety of points and with different education levels. Bartlett also found that the majority of postsecondary career and technical educators do not have certification requirements. The paper presents arguments for and against licensure and certification, multiple paths for preparing licensure and certification, emphasizes the need for continuous learning, and concludes with a call for research to examine postsecondary career and technical education preparation, licensures, and certifications.

Twomey's paper was entitled, *The Virtual Teacher Trainer Center: A One-Year Program to Transform Subject-Matter Experts into Licensed Career and Technical*

Education Teachers. She indicates that there is going to be an impending shortage of career and technical education teachers. Twomey suggests a Virtual Teacher Training Center, such as the one at Oregon State University, based on two major foundations: a flexible, dynamic reconfigurable teacher education program, and use of Internet technology to deliver the program. The courses in the model are designed around students and learning; curriculum, instruction and assessment; school, community and professional cultures; and improving practice. She also presents detailed descriptions and content outlines for the courses in the Virtual Teacher Training Center. The paper's conclusion asks the reader to re-think their beliefs about what it takes to prepare teachers by looking forward, offering continuing professional development, and using technology to broaden access to teacher education.

The Information Synthesis paper by Gray and Walters was entitled, *Reforming Career and Technical Education Teacher Licensure and Preparation: A Public Policy Synthesis*. Gray and Walters indicate that almost one-fifth of all credits accumulated by public high school students are in career and technical education. They also indicate that there are well over 100,000 career and technical education teachers in our nation's middle and high schools. Gray and Walters also posit that career and technical teacher licensure/preparation reforms are part of and therefore influenced by the national teacher quality movement. They further indicate that although the national teacher quality movement is a powerful influence on career and technical teacher licensure/preparation reform, there are some unique factors internal to career and technical education that are prompting change as well as policy implementation constraints. Gray and Walter recommend that all career and technical education licensure be reduced to two types: Traditional/Tech Prep, and a more general Education through Occupations, Work/Family/Community/ Technology, and Tech Prep. The paper concludes with recommendations for both types of licensure programs, recommendations for the reform of teacher preparation program, and recommendations for implementation recommendations.

I am pleased that the Editorial Board for the *Journal of Vocational Education Research* has selected these papers for inclusion in this issue. As I indicated earlier, improving the quality of teachers and teacher preparation is no simple task Hopefully, these papers will help to stimulate this important discussion, improve the quality of our teachers and our teacher preparation programs, and result in a renaissance in career and technical teacher education that will result in the preparation of secondary and postsecondary students that have both the academic and technical skills to succeed in the new millennium.

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Preparing the Workforce of Tomorrow: A Conceptual Framework for Career and Technical Education

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Abstract

A viable conceptual framework for career and technical education (CTE) or any other enterprise should represent consensus among its members concerning the scope, mission, and methods reflective of the profession. Such a framework should be dynamic, subject to frequent debate and ongoing refinement. This paper, then, provides information to stimulate the debate about the present and future of CTE using the development of a conceptual framework as the vehicle for organizing and presenting critical issues. First, the parameters of a conceptual framework are clarified, e.g., what should a conceptual framework entail? Who should develop it? How should it be used? Next, the historical record is briefly reviewed to establish a context for discussion, as well as outline the traditional positions adopted by professionals toward the scope and mission CTE. Current and projected issues affecting both secondary and postsecondary CTE are examined. A tentative conceptual framework is advanced, and implications of the proposed framework for CTE teacher preparation programs are discussed.

Increasing complexity in all facets of work, family, and community life coupled with persistent calls for educational reform over the past several decades present numerous challenges to professionals in career and technical education. The need to revise or eliminate outdated curriculum and develop new programs to meet emerging work or family trends is a seemingly endless occurrence. But, what drives the changes and modifications made to career and technical programs? Even more basic, what is the essential purpose of career and technical programs in an increasingly global economy requiring highly skilled and highly educated workers? Is career and technical education, as Prosser, Snedden and others argued nearly a century ago, solely a means for preparing young people for specific types of work, or as Dewey posited a means of academic education for living in a democratic society? Do purposes differ at secondary and postsecondary levels? Where is career and technical education headed in the foreseeable future?

Answers to these questions, and many more, depend on any number of possible factors not the least of which are the underlying philosophies, implicit assumptions, and "common vision" held by those responsible for career and technical education. Presumably, this information can be collected and

coherently presented in a conceptual framework for career and technical education.

So then, "What is a conceptual framework and what should one look like for career and technical education?" In this article, I attempt to articulate "a" (rather than "the") conceptual framework for career and technical education based on the extant literature, current state of education reform, and projections of future direction for the economy, work–family–community demands, and career and technical education. Because of differing views about the nature of the field, we must recognize that for a conceptual framework to be effective and useful in (a) explaining the general purposes of career and technical education, (b) reflecting the underlying beliefs and perspectives of its constituents, and (c) shaping current activity and future direction, it cannot be developed in a vacuum. Many people and organizations must be involved to provide a comprehensive view of career and technical education and its applications in classrooms, boardrooms, living rooms, and factory floors. Therefore, this framework should be viewed as an initial point of departure for discussion and debate rather than as an arrival at the final destination.

In Search of a Conceptual Framework

Miller (1996) explained that a conceptual framework contains (a) *principles* or "generalizations that state preferred practices and serve as guidelines for program and curriculum construction, selection of instructional practices, and policy development," and (b) *philosophy* which "makes assumptions and speculations about the nature of human activity and the nature of the world….Ultimately, philosophy becomes a conceptual framework for synthesis and evaluation because it helps vocational educators decide what should be and what should be different" (p. xiii).

A conceptual framework should accomplish several things: (a) Establish the parameters of a profession by delineating its mission and current practices, (b) account for historical events to allow understanding of how we got to where we are, (c) establish the philosophical underpinnings of the field and underscore the relationships between philosophy and practice, and (d) provide a forum for understanding needed or actual directions of the field. A conceptual framework does not necessarily solve all problems or answer all questions present in a profession, but it should provide a schema for establishing the critical issues and allowing for solutions, either conforming the problem to the framework or vice versa (or perhaps both). Frameworks should be fairly stable but have the capacity to change over time and adapt to external factors.

The need for a conceptual framework has never been greater, given the state of the workplace and our society, and the demands being placed on

workers and citizens for technical and higher-order thinking skills. Lewis (1998) posits that two related forces shape policy, discourse, and curriculum in vocational education: "(1) a global economy in which economic competitiveness is presumed to be linked with work force readiness, and (2) the changing nature of skill, work, and jobs, wrought largely by the impact of technology and by high-performance work organizations" (p. 13). Any conceptual framework of vocational education (career and technical education)[1] must contend with these influences.

Historical Traditions and Views Toward Vocational Education

Nearly every contemporary work that examines the nature, scope, and possibilities associated with career and technical education pays a fair amount of attention to the historical roots and subsequent development of vocational education. This particular work is no different. Why? A sense of history can foster an appreciation for the origins of the field, contribute to an understand of how and why program purposes and missions have changed over ensuing decades in reaction to political and economic concerns, define the current status of the field, and encourage the consideration of possible directions for the future.

> Without historical insight, vocational educational policymakers fail to gain insights into the relationship between schooling and work that the past may provide. As a result, vocational educational leaders may devote great energy to reinventing a pedagogy incapable of addressing the demands of democracy and the needs of an evolving economy….Historical consciousness can help vocational educators recognize the inherent problems in particular assumptions or particular ways of operating and facilitate the development of pragmatic alternatives. (Kincheloe, 1999, p. 93)

Two of the most important influences that have shaped vocational education, both at its inception and now, are federal legislation and philosophies about the nature of vocational education.

Role of Federal legislation in the nature and scope of career and technical education. Career and technical education programs in the U.S. exist because of federal legislation. In fact, since the beginning of federal support for public vocational education as mandated by the Smith-Hughes Act of 1917 (PL 64-347), the federal government has been a predominant influence in determining the scope and direction of secondary, and to a lesser extent postsecondary, vocational and technical training.

A primary force that led to passage of the Smith-Hughes Act was economic, seen in the growing need to prepare young people for jobs created as a result of

the industrial revolution. As originally envisioned, vocational education was viewed as a sequence of courses and experiences that were designed to prepare individuals for paid and unpaid entry-level employment requiring less than a baccalaureate degree (Sarkees-Wircenski & Scott, 1995). The Smith-Hughes Act established vocational education as a separate and distinct "system" of education that included separate state boards of vocational education, funding, areas and methods of study, teacher preparation programs and certification, and professional and student organizations. Unfortunately, the legislation "contributed to the isolation of vocational education from other parts of the comprehensive high school curriculum and established a division between practical and theoretical instruction in U.S. public schools" (Hayward & Benson, 1993, p. 3).

Vocational education, as implemented through the Smith-Hughes Act, emphasized job-specific skills to the exclusion of the traditional academic curriculum. This particular focus was championed by Charles Prosser and David Snedden who advocated an *essentialist* approach toward vocational education, firmly grounded in meeting the needs of business and industry. Prosser believed that the purpose of public education in a democratic society was not for individual fulfillment but to prepare its citizens to serve society and meet the labor needs of business and industry. John Dewey, a pragmatist and progressive educator, disagreed with Prosser, arguing that education should be designed to meet the needs of individuals and prepare people for life in a democratic society. Prosser's views emerged in the Smith-Hughes Act and remained the dominant philosophic position until the 1960s.

Through a series of reauthorizations to the Smith-Hughes Act, from the 1920s through 1950s, new vocational-specific areas were added. The passage of the Vocational Education Act of 1963 (PL 88-210) signified a major change in federal policy and direction for career and technical education, from an exclusive focus on job preparation to a shared purpose of meeting economic demands that also included a social component. The dual themes of responding to *economic* demands for a trained workforce with marketable skills and *social* concerns for making vocational programs accessible to all students including individuals with special needs were firmly embedded in the Carl D. Perkins Vocational Education Act of 1984 (PL 98-524).

The two most recent reauthorizations of the 1984 Perkins legislation have made dramatic shifts in the direction of federal vocational education policy. "Both of these pieces of federal legislation are essentially grounded in school reform and the mandate to use federal funds to improve student performance and achievement" (Lynch, 2000, p. 10). Thus, while economic and social concerns were still prominent themes, a third broad theme—*academics*—emerged with passage of the Carl D. Perkins Vocational and Applied

Technology Education Act of 1990 (PL 101–392, also called *Perkins II*). While the commitment to special populations remained strong, it was tempered somewhat by the high level of publicity and effort devoted to increasing academic standards in vocational programs. Some educators believed this change in emphasis has signaled one of "the most significant policy shifts in the history of federal involvement in vocational-technical education. For the first time, emphasis was placed on academic, as well as occupational skills" (Hayward & Benson, 1993, p. 3).

The most recent incarnation of the Carl D. Perkins Vocational and Technical Education Act (PL 105-332) was signed into law in 1998. *Perkins III* continues to emphasize improving academic achievement, and preparing young people for postsecondary education and work. The law also reaffirms the commitment to integrate academic and vocational education, serve special populations, tech prep (extensive articulation between secondary and postsecondary programs), accountability, and expand the use of technology. New initiatives enacted through Perkins III include the need to negotiate core performance indicators. Core performance indicators include things such as student attainment of identified academic and vocational proficiencies (state standards); attainment of a high school diploma or postsecondary credential; placement in postsecondary education, the military, or employment; and student participation in and completion of nontraditional training and employment programs (Lynch, 2000).

Philosophic perspectives of career and technical education. While the world has changed considerably from the early 1900s to the present in terms of work, family, and community, the basic philosophical arguments for and against various forms of vocational education have remained relatively the same. Two historical figures, Charles Prosser and John Dewey, have come to represent opposing positions on the nature of vocational education. Prosser's views on social efficiency, while lacking the qualities of a formal philosophic system (Miller & Gregson, 1999), posited that the major goal of school was not individual fulfillment but meeting the country's labor needs. A bulwark of social efficiency was the preparation of a well-trained, compliant workforce. To accomplish this goal efficiently, vocational education was organized and rigidly sequenced, an emphasis was placed on hands-on instruction delivered by people with extensive business-related experience, and program funding and administration occurred via a system that was physically and conceptually separate and distinct from academic education. While strongly supported by a majority of vocational education proponents at the time, Prosser's approach to vocational preparation has been criticized in recent years for being class-based and tracking certain segments of society—based on race, class, and gender—

into second-class occupations and second-class citizenship (Lewis, 1998). Hyslop-Margison (2000) proclaimed that career and technical educators "must recognize that preparing students to fill lower strata occupational roles by providing them with instrumental skills and presenting the existing social paradigm as ahistorical, legitimates the class stratification and social inequality inherent in the present economic structure" (p. 28).

In sharp contrast, Dewey believed that the principle goal of public education was to meet individual needs for personal fulfillment and preparation for life. This required that all students receive vocational education, be taught how to solve problems, and have individual differences equalized.

> Dewey rejected the image of students as passive individuals controlled by market economy forces and existentially limited by inherently proscribed intellectual capacities. In his view, students were active pursuers and constructors of knowledge, living and working in a world of dynamic social being. (Hyslop-Margison, 2000, p. 25)

Dewey's work is recognized as a significant part of the philosophy known as pragmatism. In the last several decades, pragmatism has been identified as the predominant philosophy of CTE (Miller, 1996). Change and the reaction to it are significant features of pragmatic philosophy. "Change, after all, is among the greatest of philosophic certainties for the pragmatist. To accept and even embrace change is necessary for recognition as a philosophic pragmatist, either as an individual or as a field of practice" (Miller & Gregson, 1999, p. 27). Pragmatic education prepares students to solve problems caused by change in a logical and rational manner through open-mindedness to alternative solutions and a willingness to experiment. The desired outcomes for pragmatic education are knowledgeable citizens who are vocationally adaptable and self-sufficient, participate in a democratic society, and view learning and reacting to change as lifelong processes (Lerwick, 1979). A number of current educational reform efforts such as applied academics, contextualized teaching and learning, integrated curriculum, and authentic assessment reflect Dewey's notion of pragmatism.

Miller and Gregson (1999) cogently argued that a proactive stance to change, in the profession and society, best reflects contemporary thinking in career and technical education and should be adopted. This position, known as reconstructionism, emphasizes the role of career and technical education in contributing solutions to problems such as discrimination in hiring, the class ceiling experienced by women and members of minority groups, poor working conditions, or the lack of viable job advancement opportunities. "The reconstructionist strand of pragmatism is explicit in that one of the purposes of vocational education should be to transform places of work into more

democratic learning organizations rather than perpetuating existing workplace practices" (p. 30).

Impact of Educational Reform Efforts, 1980s–1990s

Since the publication of the report *A Nation at Risk* (National Commission on Excellence in Education, 1983) dozens of public and private studies, commissions, and task forces have convened for the purpose of reforming public education. Underlying most calls for reform is an assumption that the direction of causality for problems found in the economy, labor market, and workplace "runs a complex but direct path—from ineffective schools to increased social problems, loss of international competitive advantage, and high unemployment of youth" (Hartley, Mantle-Bromley, & Cobb, 1996, p. 24). Schied (1999) explained that "recent calls for radical reform of vocational education rest on the spurious notion that the previous decade's economic decline was solely based on a failing educational system, thus, neatly avoiding corporate culpability in the U.S. economic decline" (p. xiii). Readers should interpret reform efforts using this critical perspective since the influence of external "stakeholders" has had substantial effect on current and projected educational reform efforts. Several of the more prominent and influential efforts are briefly examined.

The first wave of education reform seen in the 1980s started out with an exclusive focus on academic skills but gradually recognized that vocational preparation was essential if the U.S. was to be competitive in a technologically advanced global workplace. Around 1990 a second wave of educational reform emerged even as vocational education was in the midst of redefinition and establishing new directions. This phase of reform emphasized workplace basics, thrust into the spotlight with release of several high profile reports including *America's Choice* and the *SCANS Report*.

Overall, a number of consistent themes emerge from the myriad educational reform reports and initiatives advanced over the past several decades. Prominent themes include the integration of academic and vocational education; emphasis on developing general (transferable) work skills rather than focusing on narrow, job-specific work skills; articulation between secondary and postsecondary vocational programs; adjustments in programs to accommodate changing workforce demographics; preparation for a changing workplace that requires fairly high-level academic skills; familiarity and use of high technology; higher order thinking skills including decision-making and problem-solving; and interpersonal skills that facilitate working in teams. To this list of prominent themes, Hartley and colleagues (1996) identified basic skills they deemed necessary for success in the modern workplace, "learning to learn; (b) reading, writing, and mathematics; (c) communication; (d) problem solving; (e) personal/career development; (f) interpersonal skills; (g) organizational effectiveness; (h) technology; (i) science;

and (j) family" (p. 39). These topics must be incorporated in any conceptual framework that reflects contemporary career and technical education.

Notions of the "New Economy"

Since the inception of public career and technical education in the early 1900s, economic developments have had major influences on the content and direction of curricula at secondary and postsecondary levels. Until recently, those developments have been gradual, fairly steady, and for the most part, predictable. However, over the past decade or so most economists and labor analysts have identified a *new economy* emerging in the U.S. and around the world (often referred to as globalization). While specifics about the new economy are sometimes in dispute, peoples' (e.g., Carnevale, 1991; International Labor Organization, 2001; Irons, 1997; Reich, 2000; U.S. Department of Labor, 2000) understanding of the emerging economy and expectations for the foreseeable future includes at least some of the following list of *core* characteristics.

- Manufacturers, spurred by advances in technology, maintain an accelerated level of growth in productivity. To stay viable, businesses are in a continual production mode. However, the emerging system of production is shifting away from high-volume mass production to high value production, from standardization to customization.
- Globalization of business markets results in substantial increases in competition for labor and goods. Competition is particularly keen for highly skilled workers, though not exclusively in computer and technology-related areas. The largest labor needs are for persons with innovative and creative methods for (a) producing new products and services, or (b) promoting and marketing these new goods and services to consumers.
- Information handling—e.g., storage, transfer, production—continue to increase in importance in the new economy. Low overhead costs require workers to be able to manipulate data and provide customized, rather than mass-produced, information and services.
- Business management practices are undergoing extensive restructuring and can be characterized by (a) continued downsizing, (b) a premium placed on personnel who can manage knowledge as opposed to people, and (c) an increasing reliance on outsourcing for most work. "Managers will become brokers/facilitators; there will be more technical specialists, more lateral entry, and shorter, flatter career ladders. Instead of the old-style division of labor into discrete tasks, job functions will converge, and work teams will consist of individuals who alternate expert, brokering, and leadership roles. Rewards will be based more on the performance of teams and networks" (Kerka, 1993).

- Fierce competition will affect both for-profit and not-for-profit institutions resulting in pressure to be innovative and to do it all better, faster, cheaper, and continuously. Restructuring will occur frequently in order to achieve the greatest efficiency and productivity.

What does all of this mean? Hawke (2000) observed that "the very essence of work has undergone a massive transition within the last decade and, for vocational education, this is having major implications" (p. 1). Robert Reich (2000), former U.S. Secretary of Labor, predicted that both work and family life will be affected by changes in the economic structure into the foreseeable future. To remain competitive, new enterprises must "continuously cut costs, lease almost everything they need, find the lowest-cost suppliers, push down wages of routine workers, and flatten all hierarchies into fast-changing contractual networks" (p. 6). The decentralization of decision-making and re-organization of work structures around semi-autonomous, task-oriented teams will be the norm.

Many of the implicit rules that have governed employment during the latter half of the 20th century—e.g., employees who expect steady work with predictably rising wages, (i.e., full-time, permanent, and for life), a clearly defined employer–worker relationship, and a clear separation between work and family—will no longer be in sync with the emerging reality of work (Hawke, 2000). Instead, Reich (2000) foresees the end of steady work, the necessity of continuous effort regardless of tenure or seniority status, and widening inequality in wages paid to top and lower-level workers. The new economy will require that workers possess a broad set of abilities that include both technical and interpersonal/communication skills. Higher order thinking skills such as decision making and problem solving, as well as flexibility, creative thinking, conflict resolution, managing information and resources, and the capacity for reflection will also be expected from workers of the future (Carnevale, 1991; Secretary Commission on Achieving Necessary Skills [SCANS], 1991).

Career and technical education stands poised to affect positive change in terms of support, preparation, and guidance in the areas of people's lives likely to be affected by changes in the new economy. However, to be relevant professionals must critically examine and modernize their underlying assumptions about the world of work and family life, and be willing to reconcile "the way we've always done things" with emerging directions of the economy and needs of the workforce as described in this section. To do otherwise, it seems, is to quickly relegate the profession to a footnote in the history of public education in the U.S.

Components of a Conceptual Framework

Past conceptual frameworks. Pratzner (1985) framed his discussion of the current (and emerging or alternative) paradigm in vocational education around six

primary components: subject matter, beliefs in theories and models, values, methods and instruments, exemplars, and social matrices. The traditional paradigm, as Pratzner calls it, reflects an enterprise that serves the interests of employers, provides decontextualized instruction for specialized entry-level jobs, values job placement and earnings, follows a rigid, prescribed curriculum, uses norm-referenced and standardized tests to assess student learning, and has a considerable support network of professional associations and clubs.

More recently, Copa and Plihal (1996) challenged existing paradigms in vocational education, arguing for substantial change in career and technical education at both secondary and postsecondary levels. The authors believed that drastic changes occurring in all segments of society necessitated dramatic action. Rather than perpetuate the present form of career and technical education—"a collection of separate fields, each with a unique history and varying interrelationships over time" (p. 97)—they suggested a broad field approach to curriculum integration where career and technical education is offered to students as a comprehensive subject for learning about work, family, and community roles and responsibilities. A *broad field of study* curriculum for career and technical education teacher education would emphasize the "study of work, family, and community as a composite of vocational roles and responsibilities. . . . Next, the course of study could become more specialized as teacher education candidates elect a specialization" (p. 109) and sub-specializations in areas such as (a) human development, (b) the family, (c) technology and technological change, or (d) distribution of power and authority encountered in families, at work, and in the community.

A major advantage of the approach advanced by Copa and Plihal (1996) is that "the separate fields structure does not respond well to the changing nature of work, family, and community responsibilities. . .[and] more importantly, the separate fields structure fails to recognize the growing importance of the interaction among work, family, and community responsibilities and interests" (p. 103). A major drawback to acceptance of Copa and Phlihal's proposal is that career and technical education would need to be totally reconceptualized with the likelihood that firmly established (entrenched ?) traditions, organizations, and structures would give way to new ones built on the principles of one broad field of study. While these changes could provide career and technical education with a focus needed to address emerging issues related to work, family, and community, it is doubtful that a wholesale change will occur.

Grubb (1997) advocated a shift from job-specific vocational preparation to a more generic, academic-based approach similar to Dewey's notion of education through occupations. Four general practices framed Grubb's idea of the *new vocationalism*. First, he maintained that the purpose of secondary occupational curricula should be more general in nature rather than job specific. This change

would allow students to pursue several possible career options simultaneously rather than being required to choose between college or vocational curriculum tracks. Second, in terms of curriculum, traditional academic content would be integrated into occupational courses while occupational applications and examples would be integrated in academic courses. Third, education through occupations would require a different school (institutional) structure designed to encourage curriculum integration such as the use of career academies or school-within-a school designs using career clusters as organizing themes. Fourth, several other elements included (a) the availability of various work-based learning activities such as job shadowing and short-term internships, school-based enterprises, cooperative education, and placements governed by occupational licenses or certificates of mastery, (b) a hierarchical connection of educational and training opportunities in secondary programs and between secondary and postsecondary programs (i.e., tech prep), and (c) use of applied teaching methods and team-teaching strategies that are more contextualized, more integrated, student-centered, active (or constructivist), and project- or activity-based.

Lynch (2000) describes a "new vision" for career and technical education that supports emerging aspects of the new vocationalism. Four major themes were proposed, including to (a) infuse career planning and development activities throughout the education process; (b) embed career and technical education reform within the broad context of general education reform; (c) develop *contemporary* programs based on the needs of business and industry, and (d) institute a K-14 education model where all students are prepared for postsecondary education. Six components are also outlined in Lynch's framework emphasizing both student achievement and school reorganization. They are to (a) organize programs around major fields of study; (b) use contextual teaching and learning; (c) infuse work-based learning contributing to mastery of industry standards; (d) use authentic assessment, (e) increase use of career academies, and (f) implement successful models of tech prep.

A proposed contemporary framework. With the exception of the several frameworks presented here, few descriptive frameworks for career and technical education exist. However, much if not all of the information needed to develop a coherent perspective of the field, both present and near future, is available through various sources such as legislation, descriptions of the work place and work force, research, opinion and everyday practice. Construction of the framework presented here has capitalized on this information in an effort to synthesize and reflect current streams of thought and practice rather than devise a *new* vision designed to take career and technical education into the next millennium. The conceptual framework for career and technical education I propose is offered as a graphic illustration of the relationship of major components that shape the field (see Figure

1). While relationships between various components are given, the major function of the diagram is to serve as a starting point for discussion about the conceptual underpinnings of the field.

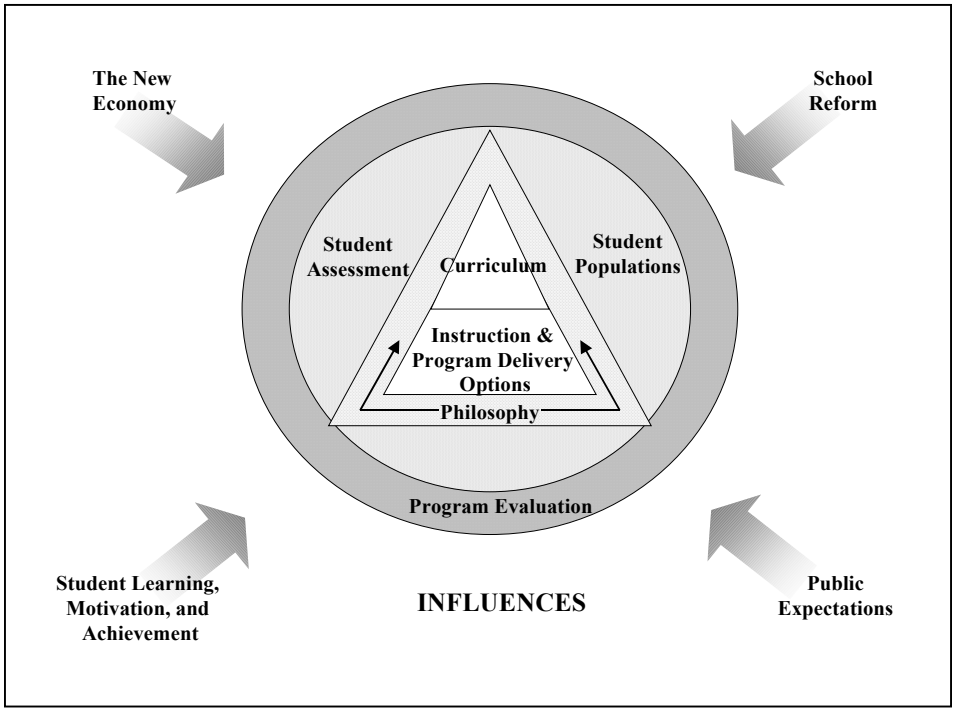

FIGURE 1. *Conceptual framework for career and technical education*

Major components of career and technical education are represented by five categories: curriculum, instruction and delivery options, student assessment, clientele, and program evaluation (accountability). Philosophy, whether implicit or explicit, provides the motivation and impetus for actual practice and affects all areas. The influence of internal and external forces on the field such as the new or emergent economy, educational reform initiatives, student learning, and the expectations of society for career and technical education are recognized.

Current (and Future) State of Career and Technical Education

Curriculum. Curriculum reflects the state of the field; what is considered important, what is being taught (content or conceptual structure), and how it is taught (process; Lewis, 1999). Discussions surrounding required curriculum

components have shifted debate from a narrowly defined set of academic abilities toward a broader set of academic or general competencies, technical and job specific skills, interpersonal abilities, and behavioral traits, including motivation. Perkins III places strongest emphasis on three core curriculum issues that are representative of the new vocationalism: (a) *integration* of academic and career and technical education, (b) *articulation* of secondary and postsecondary programs, and (c) *connections* between school and the world of work.

Results of school reform initiatives, legislation, and changes in the workplace provide the ideal platform to consider moving, at least some, of career and technical education to a common core called *workforce education*. If the field eventually moves toward workforce education as "the unifying conceptual framework for vocational education [it] will inevitably mean a need to redefine vocational education standards independent of content areas" (Hartley et al., 1996, p. 45). Kincheloe (1999) described a "pedagogy of work" which consisted of a common core of knowledge about the world of work based on a critical perspective including an examination of the social, economic, historical, and philosophical foundations of work such as the nature of work and the economy, the social impact of technology, the power of cultural representations, and the ethics of business and industry.

Educational reform efforts have, undoubtedly, influenced the shape of career and technical education curriculum. While not uniform, the new curriculum is likely to be contextually-based and grounded on the need for students to demonstrate mastery of rigorous industry standards, high academic standards and related general education knowledge, technology, and general employment competencies (Lynch, 2000).

> A persistent challenge faced by career and technical educators revolves around the question of whether programs should be occupation specific, stressing depth of preparation, or have a broad-based or occupational cluster orientation that stresses breadth of preparation. In this regard, both ETO [employment through occupations] and traditional/tech prep advocates agree that the objective should be breadth not depth. (Gray, 1999, p. 165)

Career and technical teacher education programs should be guided by the overall mission(s) and standards established by the field (see Table 1).

Instruction/delivery options. Biggs, Hinton, and Duncan (1996) asserted that major changes in the educational infrastructure are necessary to support and build a quality work-preparation system for the 21st century. And, a number of contemporary teaching innovations have emerged or assumed a greater role in career and technical education including tech prep, integrated curriculum, cognitive- and work-based apprenticeship, career academies, school-based

enterprises, and cooperative education. Table 2 provides a summary of these approaches to teaching and learning. Each approach requires new methods of pedagogy to accommodate teachers' emerging roles as collaborators, facilitators of learning and as lifelong learners; familiarity with the workplace; and ability to make school settings reflect workplace environments (Naylor, 1997).

Student assessment. The emphasis of many educational reform initiatives on higher order thinking skills such as problem-solving, critical thinking, reasoning, and so forth, and expressed dissatisfaction with conventional testing approaches demands that different approaches to assessing student learning be implemented (Johnson & Wentling, 1996). Most educators refer to this new form of student evaluation as authentic, or performance-based, assessment. Authentic assessment has three fundamental goals: reforming curriculum and instruction; improving teacher morale and performance; and strengthening student commitment and capacity for self-monitoring (Inger, 1993). At its core, authentic assessment is a reaction to the deficiencies perceived in traditional approaches to testing. It requires students to demonstrate their grasp of knowledge and skills by creating a response to questions or a product that demonstrates understanding (Wiggins, 1990). This type of assessment reflects the complexities of everyday life and a belief that learning is actively constructed knowledge influenced by context (Kerka, 1995).

A variety of options are available to for conducting authentic assessments including portfolios; exhibitions; checklists; simulations; essays; demonstrations or performances; interviews; oral presentations; observations; and, self-assessment. Rubrics, scoring devices that specify performance expectations and various levels of performance, are used to establish benchmarks for documenting progress and provide a framework for ensuring consistency (Kerka, 1995).

Clientele. While the historic roots for vocational education were in providing job-specific training to working class (noncollege-bound) youth, the contemporary world of work requires few of the manual job skills required a century ago. Today, ample evidence shows the work skills required in the 21st century include higher-order thinking skills (reasoning, decision-making, problem-solving), flexibility, interpersonal skills, and technological literacy. Not only are cognitive skills in demand, but many jobs now require some type of postsecondary education (less than a baccalaureate degree) for entry-level.

TABLE 1
Considerations for developing a curriculum component of a CTE framework

Four schools of thought on high school CTE curriculum[a]	Employment through occupation	CTE is modality for teaching traditional academic content; integration of academic and vocational education
	Employment-bound	Instruction on broad career clusters along with specialized skills
	Educationally disadvantaged	Extensive job training to enter labor market upon graduation
	Tech prep models	Non-duplicative, sequenced, and articulated secondary and postsecondary programs integrating academic with career and technical education
Components of ~~secondary~~ CTE curriculum	Common core (workforce education)	Study of work, family, and community as a composite of vocational roles.
	Job-specific/content area specialties	Focused on traditional vocational subject areas
	New vocationalism	Broad array of integrated academic (inc., thinking skills and personal qualities) and general (*SCANS*) competencies, technical and job specific skills, interpersonal abilities, and behavioral traits, including motivation
Implications for CTE teacher preparation programs	Curriculum components	Assessment Curriculum framework (general education, common core and specialized work force education, and work preparation; knowledge of learner, pedagogy, instructional technology, and professional education; and occupational and educational clinical experiences) Standards of knowledge and practice Principles of career and technical education Philosophical foundations

[a]The major issues used here are adapted from Lynch (2000).

TABLE 2
Contemporary approaches to teaching and learning in CTE

Approach	Characteristics	Strengths	Challenges
Tech prep	•Articulation agreement(s) between secondary & postsecondary institutions •"2+2" design (2 yrs secondary plus 2 yrs postsecondary leading to degree or certificate) •Common academic core: math, science, technology, & communications	•Combines academic rigor & applied instruction •Option to continue to baccalaureate level ("2+2+2" design) •Appropriate for most career areas	•Resistance to career-oriented concepts •Securing support from stakeholders •Limited resources (funding) •Uncertainty of postsecondary curriculum reform •Need for teacher training •Addition of work-based learning •Assessment of programs & students
Integrated vocational–academic curriculum	•Modifications of academic & vocational philosophies •Applied focus in learning activities •Balance theory w/ application •Coordination between teachers & counselors	•Uses CTE settings to apply & reinforce academics •Life-relevant education •Didactic instruction replaced by activity-based instruction & problem-solving •Appropriate for all students	•Requires organizational change in schools •Requires interdepartmental cooperation & collaboration •Design & implementation takes time •Need to assess benefits for all students •Administrative & community support
School-based enterprises	•Students produce goods or services for sale to customers	•Students apply academic knowledge to work •Instructors maintain control of instructional activity	•Focus can shift to production rather than instruction •Lack of understanding about how learning occurs in the workplace

(*table continues*)

TABLE 2 (*continued*)

Approach	Characteristics	Strengths	Challenges
Career academies	•School-within-a-school •Career field focus rather than specific job preparation •Integrated academic–vocational content •Includes necessary work skills •Employer involvement	•Career focus may keep high-risk students in school	•Scheduling conflicts •Requires involvement of business/ industry •Requires collaboration & cooperation between academics & career-technical educators & limited instructional resources
Work-based youth apprenticeship	•Work experience & learning in industry •Linkage between secondary & postsecondary education •Collaboration among groups •Modeling, scaffolding, fading, coaching	•Creates a learning situation that emphasizes skills & knowledge required in the workplace	••Requires significant employer participation, workplaces are transformed •Potential conflict between employers' & students' needs •Requires collaboration & cooperation between schools and employers
Cooperative education	•Traditional CTE programs •Written training agreements specify what students will learn and employer's responsibilities	•Students have part-time jobs •Work-based learning •Use as a screening device for new employees	•Lack of coordination between students' school & work experiences •Use as a screening device by employers for new employees

Sources. Table structure and some content from Biggs et al. (1996). Additional content from Kincheloe (1999).

Given this scenario, many professionals are asking, "Whom should CTE serve?" Has the clientele for career and technical education shifted away from work-bound youth to those adolescents who don't attend a four-year college or university but receive some type of postsecondary education at a technical or community college? Should secondary career and technical education be charged with providing job-specific training to students not attending some form of postsecondary education? At present, few answers exist.

Currently, career and technical education programs serve several primary functions ranging from integrated academics instruction to tech prep to job preparation for employment-bound and educationally disadvantaged youth. These diverse goals aim to achieve very different ends and are often at odds with one another. Lynch (2000) suggests that upwards of one-third of all secondary students enrolled in career and technical education programs are not college-bound. Another 8-12 percent of students are identified as being educationally disadvantaged. Both of these groups require job-specific preparation to transition from school to adult life. However, recent trends to promote articulated secondary-postsecondary programs may overlook this substantial proportion of program enrollees. And, when services are available, they are often relatively low, entry-level job skills that offer limited job entry or advancement opportunities.

A number of unanswered questions remain for the field to tackle as ongoing reform efforts of career and technical education curriculum occur. How will current and future reform initiatives and subsequent changes to career and technical education programs affect students with special needs? How do raised academic standards and the increasing need to attend some type of postsecondary education affect special populations and work-bound youth? Should there be a high school career and technical education option that focuses solely on job-specific training? If so, can a program based at the secondary level provide high-skills/high-wage jobs?

Program evaluation. Accountability has become a hallmark of educational reform initiatives and has not escaped reform efforts in career and technical education. Perkins III legislation requires that states develop evaluation systems to assess four core indicators of student performance including academic and vocational achievement, program completion, successful transition from school to postsecondary education and/or employment, and accessibility and equity. Although program evaluation is mandated, criticisms exist about the criteria and methodology used to collect data, and the usefulness of evaluation results (Halasz, 1989). Indeed, collecting data to respond to these federal mandates can pose considerable challenges. Gray (1999) notes that traditional outcome assessment measures—job and college placement rates—still dominate the criteria used to

evaluate the effectiveness of career and technical education programs.

Practitioners also face substantial challenges in determining what state and local evaluation criteria (indicators) will be used, the specific data needed to reflect these criteria, methods of collecting it, and how to use it once collected. Some of the questions that require attention include: How is program *quality* defined? How should student outcomes or learning be measured? How will students enrolled in career and technical education course or programs be classified? What approach will be used to measure instructional practice? How will teacher quality be defined and measured?

Given current mandates and future projections, a conceptual framework in career and technical education must include performance indicators that examine legislative mandates and underlying philosophy, as well as specific outcomes, practices, and inputs. Halasz (1989) indicated that school culture and stakeholders' needs must also be considered. "A variety of information should be collected (personal, instructional, institutional, societal, and so on) from multiple sources (teachers, students, administrators, parents) using multiple methods (survey, interview, participant observation, historical, archival)" (¶ 9). One challenge to CTE teacher educators is to provide emerging teachers with the knowledge required to develop, implement, and maintain appropriate accountability systems.

Summary, Conclusions, and Future Steps

Most career and technical teacher educators acknowledge the need to revisit the basic assumptions, conceptual framework, and syllabi of existing pre-service programs. Indeed, the entire profession must be willing and able to engage in ongoing examination of issues that contribute to a dynamic and relevant conceptual framework, e.g., philosophy, workplace demands, and skill requirements. The field's best thinking must be integrated into teacher preparation programs and, subsequently, into secondary and postsecondary classrooms comprised of a diverse clientele within the context of an increasingly sophisticated work place characterized by a global economy where success is directly tied to work force readiness, the rapidly changing nature of jobs and required work skills, and increasing role of technology in the performance of work tasks (Lewis, 1997).

But, what exactly should teacher preparation programs prepare emerging teachers to do? Table 3 summarizes the main components of conceptual frameworks for career and technical education—past, present, and future. Historically, the conceptual framework of career and technical education has revolved around specific job training, clear distinctions between academic and vocational education, and preparing adolescents to transition from school directly to work. Curriculum and instructional approaches relied heavily on an essentialist philosophy where students were viewed as products and taught in ways that

reflected the industries they were being prepared to enter.

In sharp contrast, the emerging conceptual framework reflects efforts at local, state, and national levels "to broaden vocational education—integrating the curriculum more closely with rigorous academics, improving articulation to postsecondary education (two-year and four-year), and stressing long-term preparation for productive careers that will be subject to increasing technological change and economic reorganization" (Hoachlander, 1998, ¶ 1). Secondary career and technical education programs will continue a trend that focuses less on specific training for immediate entry-level employment upon graduation. Rather, secondary programs will provide more general knowledge about the workforce, offer career awareness and exploration activities in specified career clusters, nurture higher-order thinking skills development, and support students in making initial decisions about their career goals and plan postsecondary activities necessary to achieve those goals. Postsecondary education, on the other hand, will remain in the best position to prepare students for specific jobs.

Implications for CTE Teacher Education and Teacher Education Programs

What then are the implications of the proposed conceptual framework for career and technical teacher education programs? In a word, they are substantial. While myriad other arrangements or contextual structures can address the question of specific content to include or exclude teacher education programs, a relatively simple, straightforward approach focuses on the types of instructional content needed in three areas: general workforce education, content area specialties, and professional teaching development. These areas are broad enough to incorporate issues recognized as integral to the emerging vocationalism (see Table 4).

General workforce education. Aspects of teacher preparation curricula that focus on general workforce education assume that a substantial portion of the knowledge and experiences that define career and technical education cross specialty area boundaries. A common core of knowledge about the world of work is assumed stressing topics like the function of work and family life in society; economics and systems of production and distribution; cultural aspects of work, the family, and society; development and application of higher-order thinking skills, employability skills, and job seeking skills. The nature and underlying assumptions of general workplace education topics suggest an integrative approach to instruction where students from all vocational specialty areas are grouped together for classes. This approach should not only help emerging career and technical educators understand the need for a broad-based curriculum focus, but also nurture a sense of professional commonality and shared purpose.

Content area specialty. The clustering concept adopted by the U.S. Department of Education, the National Board for Professional Teaching Standards ([NBPTS],

2001) and others reflects an ongoing effort "to organize the economy into coherent sectors that will facilitate the development and implementation of

TABLE 3
Illustrations of conceptual frameworks for career and technical education from past, current, and future perspectives

Components	Career and technical education		
	Past	Current	Emerging
Purpose, theory, and models	•Social efficiency (Snedden, Prosser) •Essentialism; scientific method •Serves employers' interests •Job training & preparation for less than a baccalaureate degree	•Pragmatism •Some aspects of progressivism •Preparation for work and post-secondary education & training	•Pragmatism w/ reconstructivist strand •Progressivism •Critical perspective •Preparation for work and post-secondary education & training
Teacher education	•Work experience & job expertise paramount •Focus on job skills preparation •Teacher-directed instruction	•College education focusing on general & specific labor market preparation •Focus on academic & vocational skills instruction •Emphasis on contextualized & facilitated learning	•College education focusing on common core, specialized content area(s), & integrated academics. •Comprehensive approach to learning using occupations as modality •Emphasis on contextualized & facilitated learning
Curriculum	•Narrow focus on entry-level, job specific skills •Separate vocational content areas •Separation of academic & vocational education •Rigid prescribed curricula	•Four curricular strands: -Education through occupations -Integration of academics & vocational education -Job-specific, entry-level training -Tech prep •Dual enrollment	•Multiple options •Common core of workforce education regardless of postsecondary plans •Integrated academic—vocational curriculums •Career clusters direct instruction

(table continues)

TABLE 3 (*continued*)

Components	Career and technical education		
	Past	Current	Emerging
Delivery options	•Behaviorism •Applied academics •Cooperative education	•Cognitive learning theory •Tech prep •Career academies •Work-based apprenticeships	•Multiple options available •Democratic ideals reflected in instructional content & process •Separation between school & work less distinct.
Clientele	•Alternative track for less-academically able students •Increasing emphasis on special populations (peaking in 1984)	•Different programs & purposes for different student groups •*Moderated* emphasis on special populations tempered with phrases like "*all* students" & renewed use of quality standards •Multiple constituency groups	•Multiple constituency groups •Inclusion of all students with continuum of outcomes available
Student assessment	•Standardized & norm-referenced testing	•Standardized testing •Industry-based skill standards •Emergence of alternative	•Standardized testing •Established alternatives to assessment •Criterion-referenced testing
Program evaluation	•Quality based on business and industry standards •Job analysis	•State plans following guidelines established in federal career & technical education legislation	•Quality based on a variety of factors inc., dropout retention, graduation rates, & job placement •Occupational analysis

Note. Information for past components column adapted from Pratzner (1985).

TABLE 4
Possible curricula components in CTE teacher preparation programs

General workforce education	Content area specialty	Professional teaching sequence
Foundations and philosophy of CTE (inc., changing nature of workplace, new economy)	Entrepreneurship (as a general concept regardless of occupational cluster area)	Contextualized teaching and learning
Communication/interpersonal skills necessary in workplace	Knowledge associated with career clusters[a]	Tech prep
Communication, interpersonal, and leadership skills required when dealing with constituencies (e.g., parents, colleagues, business leaders)	•Agriculture and environmental sciences	Integration of academic and vocational education
CTE teacher as change agent in school and community (e.g., advocacy, public relations, etc.)	•Arts and communications	Work-based learning (e.g., apprenticeship, cooperative education)
Higher-order thinking skills such as problem-solving and decision-making	•Business, marketing, information management, and entrepreneurship	Articulation of secondary–postsecondary, school–business instructional arrangements
School-to-work transition issues for ALL students	•Family/consumer sciences	Student assessment (formal, informal, and alternative assessment methods) and program evaluation
Balancing work and family life	•Health services	Working with diverse student populations
Employability skills (workforce readiness)	•Human services	Professional development (notion of lifelong learning)
Acquiring a sense of social justice regarding the effects of work on individuals and in society	•Manufacture technology	Classroom management
	•Engineering technology	
	•Technology education	

[a]Adapted from the National Board of Professional Teaching Standards (2001). While a useful, other taxonomies have been proposed. The National Skill Standards Board proposes 15 large economic sectors (Hoachlander, 1998). The U.S. Department of Education has established 16 career cluster models designed to introduce students to occupations in a broad industry area.

a national skills standards system" (p. 4). Regardless of the specific structuring system used, some form of content area specialization will, in all likelihood, persist for career and technical education. While maintaining some aspect of "traditional" vocational education, emerging teachers will increasingly be exposed to something

other "than business as usual."

Teacher preparation curricula need to equip preservice teachers with the tools and experiences necessary to integrate academic and vocational education, prepare students for entry into the workforce, and support the successful transition of students from high school to two-year or four-year postsecondary education. Regardless of the specific curricula and structure of teacher preparation programs, all must satisfy three essential requirements: They must prepare emerging educators to (a) address the long-term prospects of students not just entry-level jobs, (b) encourage high levels of academic proficiency and mastery of sophisticated work-based knowledge and skill, and (c) preserve the full range of postsecondary options for program participants (Hoachlander, 1998). No small task.

Professional teaching sequence. Career and technical educators must be able to incorporate an array of possible teaching strategies in classroom, laboratory, and work-based settings. Traditional teaching approaches will need to be supplemented with greater emphases on emerging pedagogical approaches like integrating of academic and vocational education, tech prep, and contextualized teaching and learning forums. Knowledge about the diversity of students and school settings will continue to be a critical element in adequate teacher preparation and will need to expand in scope. Attention will also need to be paid to assessment issues, most notably high stakes testing and accountability issues related to school reform efforts. Ramsey, Bodilly, Statsz, and Eden (1994) wrote that "teachers also need to be trained in the use of teaching techniques that support activity-based learning, including hands-on experiences, problem-solving, cooperative or team-based projects, lessons requiring multiple forms of expression, and project work that draws on knowledge and skills from several domains."

Given the nature of changes to career and technical education curriculum, the professional teaching sequence of courses should be delivered in a mixed student environment. Like the topics contained in the general workforce education segment of the curriculum, pedagogical knowledge and skills are not unique to any one vocational specialty area. In fact, preservice teachers can benefit from the different perspectives attributed to various specialty areas.

Role of teacher educators. Successful implementation of recommended changes to career and technical teacher education programs, as well as the field as a whole, requires a recognition of the slow and difficult process of reform. Teacher educators must be especially aware of and understand how to successfully negotiate the change process. A strong effort should ensure that emerging teachers are aware of workplace inequities and be able to change them when possible.

To bridge the, sometimes, considerable gap between cutting-edge thinking and current practice teacher educators can facilitate programmatic change at both regional and national levels, serving as liaisons between *what is* and *what should be*. Otherwise, the academy may prepare emerging teachers to (a) understand a *new* career and technical education but be ill-prepared to cope with current classrooms reflecting traditional practice, or (b) be wholly prepared for traditional curriculum and school environments but lack an understanding or ability to implement emerging issues and practices.

Final Words

Using the historical record to identify issues and direction for developing a conceptual framework of career and technical education reveals how little the field has actually evolved, at least in terms of philosophical, conceptual, and theoretical underpinnings, from its inception to the present. While this situation is beginning to change with the development of tech prep and academic-vocational integration models and so forth, many of the same positions, issues, and arguments for and against school-based occupational preparation common around the time of the Smith-Hughes Act of 1917 are still common in contemporary writings. Examples of other types of perennial issues that will influence career and technical education include:

- Who should be served by career and technical education? Cliché and rhetoric must be discarded in favor of sound thoughtful positions that are implemented and successful rather than merely spoken.
- Will career and technical educators embrace democratic education principles espoused by John Dewey where students are taught to critically analyze work and participate in society, or passively accept the status quo where workers are often exploited by industry (Kincheloe, 1999).
- What should the nature of career and technical education be at the secondary level? postsecondary level? Should secondary programs reflect a broader type of workforce education or should other alternatives—e.g., specific job training for work-bound and disadvantaged youth or education through occupations (Grubb, 1997)—be implemented?

At the dawn of a new century, it seems appropriate to take stock in the future of career and technical education. Many authors have contributed to an on-going dialogue about the nature of contemporary and future career and technical education. Ideas and options have been proposed, articulated, and studied. Yet, action is slow. The development of any conceptual framework is of little value if action does not result. Collectively, the field must be willing to tackle tough questions and debate potentially contentious issues delineated in the professional literature to arrive at and then maintain a clear and concise framework. Such a

framework can guide funding priorities, program development, classroom instruction, and relationships with external constituencies. To do otherwise runs the risk of glossing over fundamental issues and concerns, repeating the same arguments and issues for another century, or perhaps worst of all, allowing others (e.g., federal and state government, funding agents, business and industry leaders) to make decisions for the field.

Endnotes

1. The terms *vocational education* and *career and technical education* are used interchangeably. However, references to historic events or thought use "vocational education" in an attempt to preserve the integrity and intent of past authors' work.

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The Futures of Career And Technical Education in a Continuous Innovation Society

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Foreword

Two years ago I visited the Marshall Minnesota public schools as consultant to a strategic development team made up of teachers, students, parents, local professionals, and administrators. As part of my introduction to the team's work, I was given a tour of the Marshall schools. What I found was astounding. Marshall was operating its schools within two service paradigms: *business as usual* with emphasis on standardized tests and State learning profiles, and *knowledge-based learning* in which students supported by state-of-the-art software, hardware, and netware conducted research in small groups.

After two years of dual-service experience, Marshall administrators found considerable acceptance for the approach in elementary grades, some in middle grades, and virtually none, save among vocational faculty, in the high school grades. The vocational faculty and students were fortunate to have a robotics/artificial life laboratory donated by a wealthy patron. The local college faculty were invited to work with high school faculty in support of knowledge-based learning but refused. The local technical school complained that recent Marshall graduates were critical of its offerings.

As a result of my consulting experience and subsequent visits to Marshall schools, I concluded that I was witnessing the evolution of a functional dual-market model for public education. The key managerial element supporting the knowledge-based model appeared to be, "Give them the tools and then stand back. No training, no extra pay. But plenty of autonomy." The key managerial element in the business-as-usual model appeared to be, "Help the teachers keep control over the students. Do little that would indicate the presence of experimentalism." After arranging for several colleagues and administrators to visit Marshall and for Marshall teachers and administrators to visit the campus, the modal campus response appeared to be, "Very interesting, but why would we want to support two service delivery paradigms when one is so dominant and butters our bread?"

I considered my experience with Marshall a lucky opportunity to spend time and energy exploring the knowledge-based model of learning. I have projected

learning into the experiential context of performances supported by software and technical resources. Into the context of performance competence I have projected continuous innovation and to consider software-supported changes in the workforce as the strongest indicators of a growing market for knowledge base school services. In this article, I attempt to shape a future for Career and Technical Education (CTE) that mirrors the last 20 years of software- and technology-driven changes in the workforce. I want to thank the Marshall superintendent, Dr. Thomas Tapper, his Board president, and his marvelous staff for stimulating these interests.

Foreground I: A New Future for Education

This is a conceptual essay from a sociologist--anthropologist. I am not a CTE professional, nor an educator. What is this article about? It is less about the past than the future. It is about human purpose and the creative development and management of software and technology for both humane and efficient purposes. It is *not* about improving conventional teacher education in Career and Technical Education. It *is* about shifting the role of CTE professionals away from teaching toward performance and innovation modeling. It is about the experiential use of software, netware, and real or simulated contexts to help make this role shift possible. It is about the contextual and experiential reformatting of education to permit "instant" human performance competence through software, with the intent of using still more software to substitute excellence for competence and innovation for excellence. It is about the technologically supported cascade of this approach across the societal meta-institutions guiding learning, living and working. It is about the potential role of CTE leadership in developing and testing a human capital paradigm that leaves repetitious performance and information storage to machines even as it provides new and saved resources for the growth of creative, inventive and innovative human beings. It is about synchronizing CTE with a knowledge-driven *Continuous Innovation Society.* It is not "fair" about all the other futures that CTE leaders might entertain.

I argue that all levels of American education must undergo a software-supported experiential mission shift to prepare, support, and evolve flexible, high-performance Knowledge Workers for a Continuous Innovation Society. Knowledge workers, supported by software and information, are the newest source of continuous innovation in the labor force. In education, this means that software will teach what is known, teachers will become role models for performance competence and excellence, and a new genre of professionals will collaborate with students in the practice of continuous innovation.

America needs 100% of its students, workers and citizens performing well and learning the skills of continuous innovation at school, at work, and in the

home and community. *Continuous Innovation* marks a shift from working well at a known task to working toward the development of new tasks that are driven by a host of change-inducing factors, including competition, shorter business and product cycles, and pressures to automate well-known tasks. The upshot of this change is that present standardized testing based on memorization could shut down over a few years, and be replaced by software supported performance base learning aimed at creating a nation of innovative students, workers and citizens. The American economy will benefit from this change through the production of lifelong performers and innovators representing nearly the entire age span. America is already moving toward rapid-cycle organizational deconstruction and continuous innovation based on distributed software. In such a society, workers must change rapidly. They must be assisted by appropriate technology, such as computers and handheld devices, together with the software and netware required to make these connectively useful.

Many school boards and administrators will face the prospect of realigning educational services to meet the needs of a knowledge-based Continuous Innovation Society. Fortunately, the U.S. workforce is already pioneering the use of distributed software and handheld devices to support the growing percentage of Knowledge Workers. As the role of software grows, the focus on just-in-time performance evolves with it. Performance competence stimulates innovation by taking advantage of cost-effective improvements supplied by software such as job automation, skill downgrading, and the freeing of worker time for innovation of next- generation jobs.

Accordingly, preK-12 and higher education should emulate the worker software movement by bringing it into the common experience of students. My arguments are premised on the assumption that software-based preparation of students for success in a Continuous Innovation Society will be driven by performance-based learning, where the skills of (a) software and device management, and (b) developing and working within fast cultures will become the new CTE basics. The separation of technical–vocational education from liberal or general education will greatly diminish, and that career education will shift to career creation and career cycling. I delineate the potential for significant social and employment sector leadership in helping schools and colleges understand the requirement for technical and software support in all forms of education, employment and daily life.

I also argue that no one should be permitted to fail in the development of software-supported performance and innovation. If Johnny cannot read, the software will do it for him. If Johnny cannot do calculus, the software will do it for him. If Johnny can operate the software, Johnny, in theory, can do *anything the software knows*. Johnny will get ‘A’s’ in everything that he alone, or his software alone, or both together can accomplish. For example:

> *It is 2005. You are S.E.L., a second grader (S.E.L.'s initials are the same as the acronym Software Enabled Learner). You are being asked to learn a new math process, multiplication. It is the first day that multiplication has been presented to you. You are having a terrible time getting the right answer all by yourself, so you move to another problem. You are marking time. The teacher seems to make no sense. Some other kids understand her but some, like you, do not.*
>
> *On the second day of multiplication class the teacher gives you a wireless device to clip into your shirt pocket. If you pull the small pen out of the device and scan it over your multiplication problem, the pocket device talks to you and tells you how to get the right answer. After a while you are making 'A's' in your multiplication class.*
>
> *Unfortunately you get stuck after a few weeks' success with multiplication. The problems have become more difficult and you are unable to do them any more. But it doesn't matter. Your teacher makes some adjustments to your pocket device. Afterward, when the teacher calls on you for results, your pocket device tells you the answer and provides explanations of how the answer was framed and arrived at. You are still making 'A's' in your math work, and you always will, because even if you cannot do the work, sooner or later the software will.*

In this scenario, multiplication tasks have been supported by a wireless pocket device that makes S.E.L. capable of performing at a novice level within a few minutes. Over time, with the assistance of a wireless pocket device, S.E.L.'s performance levels will move from novice to competent to skilled to excellent to master. The speed of S.E.L.'s progress will depend upon how s/he and the Distributed Competence software of the wireless pocket device work together.

For S.E.L., the basics of education include software and technology management. With properly managed software, S.E.L. could theoretically become a productive scientist or a garage mechanic with little knowledge of multiplication or higher math. What counts in S.E.L.'s world, in education, living, and eventual working is performance. Nothing else is as important, including what S.E.L. knows. Later, in graduate school, when S.E.L. cannot master a performance even with the assistance of software, s/he simply waits until the Distributed Competence software is upgraded to permit the performance. By this time S.E.L.'s mastery of software and machine supports will have produced a horizon much more important than competence alone: continuous innovation.

Educators ask, "Will S.E.L. be motivated enough to take advantage of these performance opportunities afforded by software, electronic nets and machines? Will S.E.L. become indifferent to performance improvements even though the software supplies answers to questions that might have taken years of

conventional schooling to acquire? Does S.E.L. give a damn about moving past performance to innovation?" I assume that we do not know what S.E.L. will do with performance- and innovation-based learning opportunities. Nor do we know what S.E.L. will do when these supports are encountered in the workplace. We may assume that S.E.L. could fare better in the workplace if school learning formats were more in line with the software-supported formats of modern work. Many S.E.L.s are chosen today, but many do not come to the trough. Our approach is to offer S.E.L. the choice to experience school as usual or knowledge-based services such as those at Marshall.

Foreground II: Heuristic Conceptions of the Argument

Knowledge management is the attempt to capture human knowledge in the form of units or objects that can be networked to other people or to software/machines. My position is that, once captured, knowledge becomes information, since the act of extracting it from context strips it of its personalized and localized qualities. (Every real world context is different. Therefore, retention of artificial context in simulations does not keep original knowledge alive, but can result in dynamically useful heuristic 'information engines'.)

The implications of the failure of current knowledge management are many, but perhaps no liabilities are greater than the depersonalization and decontextualization of meaning. It follows that implications for the future workforce of repersonalization and recontextualization are also many. Some of these implications would make Marx smile, for they promise to return to workers the control of their minds and bodies in the context of uniquely innovative work in theatres of living, learning and working. Such multi-institutionality will erode the boundaries already undergoing "slow dissolve" as networks cascade computing and software capabilities to all institutions. For CTE, the implications are enormous, including the support of personality careers and social careers as well as traditional work careers.

The five learning approaches in Table 1 share a common purpose, human capital development and application. They are often confused or in conflict. Individually, they represent different intentions, assumptions, and methods on how to accomplish their purpose. The table provides a comparison of the core properties of each approach. Each approach refers to what has become large-scale human capital development efforts: *Earlier industrial training, generalized mass education, information–knowledge transition, cybernetic supports,* and *performance–innovation base learning for the Continuous Innovation Society*. The table is intended to be heuristic rather than represent a historically faithful reconstruction of employment history.

As Table 1 connotes, it is *technology* that drives the five approaches to worker/citizen preparation. These vary greatly from the earlier industrial period through the projected Continuous Innovation Society. Examples of the technologies for each of the approaches are:

Early industry: steam- and electrically-powered factory tools, ships and trains. Simple electrical and electromechanical dials and gauges. No electronic instruments, except as the telegraph and telephone might be considered electronic precursors. Mechanical governors to control machine speed. An eighth grade education was adequate for the vast majority of jobs.

Generalized mass education: radio, television, telephone, and electric typewriters. Vacuum tube and early transistor circuitry, permitting mainframe computer development. A high school diploma was adequate for the vast majority of jobs.

Information to knowledge transition: arrival of the desktop computer and the cell phone begin to permit 'distance' relationships to living, learning and working. Growth of the service industries and the movement of many heavy industries to offshore locations. Introduction of robots in some manufacturing and assembly processes. Information management systems become necessary. Postsecondary education and training are no longer options for many types of jobs. Perhaps 5% of workers are Knowledge Workers. Some of these are futurists.

Cybernetic supports: advanced software and networking permit automated processes to enter nearly every sector of living, learning and working. Expert systems, precursors to artificial intelligence, permeate banking, the military, and dozens of other industries. Some companies embed chips in credit cards. Worries commence regarding the future roles of humans in the face of competition from cheap, job-capturing hardware and software. The effect of many technologies, especially the Internet, is to drive more Knowledge Workers into existence to cope with increasingly unpredictable customer and competitor behaviors. Advanced technology, software and netware allow Knowledge Workers to become 40% of the workforce. Virtually every knowledge worker becomes a futurist within the purview of his/her specializations, contracts, and employment. Free agency culture grows in response to massive layoffs by employers. Doubts arise as to the future of education and training; on-the-job self-preparation emerges as an expectation by employers and workers alike.

Performance/innovation base learning for an innovation society: tiny terabyte disk drives; pocketable optical and quantum computers operating at room temperatures; circuitry woven into clothing or sprayed onto skin; early implants; large percentage of flat surfaces receive painted-on interactive

TABLE 1
Five learning approaches

Learning system attributes	Earlier industrial training	Generalized mass education	Information / knowledge transition	Cybernetic supports: Person-focused electronic performance support systems	Performance/innovation-based learning for Continuous Innovation Society
Primacy (learning is performance)	Performance (learning is secondary)	Learning (performance is secondary)	Performance (performance is focus)	Performance (learning is unnecessary)	Creativity, innovation & learning are synchronous
Purpose	Prepare individuals for specific task performance	Prepare individuals for general task performance	Provide explicit information to enhance performance	Guide performance	Advise, consult, guide, facilitate, p*erform-for, innovate-with*
Approach	OJT preparation	Class preparation	Inform	Coach (perform-with-for)	Partner, *innovate-with*
Occurrence	Episodic instruction	On-going tutoring	On-demand information	On-demand performances	On-demand innovations
Focus	Group cohort	Age cohort	Group (organization) members	Employees	Integrated systems within contexts
Basis	Informal training program	Academic curriculum	Electronic information base	Software–based explicit knowledge	Individualized creativity within chaotic, emergent context
Learning sequence	Learning occurs prior to performance	Learning occurs prior to performance	Need-driven	Event-driven	Continuous (concurrent and post-performance)
Delivery platform	Human & machine-based	Human-based	Machine-based (electronic information base)	Agent-based for individuals-in-context	Agent- & human-based upgrades of distributed competence software

(*table continues*)

TABLE 1 (*continued)*

Learning initiative determinant	Trainer determines how individuals will learn	Teacher determines how individuals will learn	Need-driven	Event-driven	Learner-tool-task-context co-determine nature of innovation base learning
Context	Context dependent (partial)	Context independent	Context independent	Context dependent	Context creative
Person dependency	Muscle-command worker enticed to repetitive labor	Brain-information worker enticed to repetitive work	Mind-knowledge worker asked to adapt *continually* & to innovate occasionally	Software-backed knowledge worker choosing to adapt *continuously* & innovate frequently	Workers are strategic, innovative, & knowledge-able, generating new information, automating DC software, & contin-uouly innovating in new contexts, software, & PBL
Delivery location	OJT/classroom	Classroom	Computer node	Software network nodes	Anywhere, anytime, anyplace (user, task, context-determined)
Delivery time	Unscheduled/scheduled	Scheduled	On-demand (anytime)	On-demand (anytime)	Continuous (anytime)
Performance determinants	1.Individual cognitive aptitude/motor skills 2.Quality/quantity of training	1.Individual cognitive aptitude 2.Quality/quantity of education	1. Ability to use information base 2. Quality of information base	1. Ability to use performance support systems 2.Quality of performance support systems	1. Motivation of user 2. Quality of DC, PBL & PBI systems 3. Quality of interaction with context
Workforce implications	High relevance, but usually lags behind needs	"Just-in-case" relevance; sometimes only chance applicability	High situational relevance but very inefficient to store or access due to inform-ation mgmt. limitations	High situational relevance; essential for supporting PBL	Uploaded situational competence/innovations to points of need "just-in-time" or "just-ahead-of-time"

> displays; heads-up delivery of high-resolution images to the retina; automatic language and dialect translations; obsolescence of the keyboard; 'nano-marketing' to *individual* consumers worldwide; projections of the eclipse of *homo sapiens* by a wide range of intelligent technological and genomic varieties of humanity. Jobs whirl into and out of existence quickly, sometimes overnight. More and more, human work creates jobs that are carried out by automata. Traditional separations of living, learning and working have vanished, as the same technologies are used in all three domains. Learning is experiential, through simulations and direct, real-world involvement. Performance and innovation are paramount. Humans are expected to move forward, creating low-cost, highly efficient automated processes in their wake. Innovative Knowledge Workers make up perhaps 90% of the work force. Intelligent machines, capable of competing with innovative Knowledge Workers, are on the 20-year horizon. The individual resume replaces the transcript.

These heuristic scenarios of workforces and their supporting technologies are intended to convey a remarkably profound shift away from learning and performance as ends in themselves in favor of continuous innovation as a process of working, living and learning. A major casualty of such change is the loss of stability in the job market and parallel growth in the *opportunity* or *work* market.

Foreground III: Implications for Jobs vs. Work

For purposes of this article, *work* is what gives rise to *jobs*. In other words, work invents and innovates jobs. Compared to work, jobs are better codified. Therefore, jobs are the logical and appropriate targets for *automation,* since relatively stupid software and machines can be taught to perform them. The future of relative wealth will be tied directly to the capacity of societies to turn jobs over to non-human resources as early and successfully as possible. Rapid deconstruction of jobs will free human capital for invention and innovation. The continuous deconstruction and construction of jobs, driven by continuous innovation, offers a current opportunity for CTE leadership.

In my opinion, it is a losing choice to combat the trend of software support/ replacement in human tasks. The deconstruction of repetitious tasks frees human and other resources for continuous innovation. However, if the choice were made otherwise, it would be consistent with an institutional unwillingness to derive maximum benefit from technology (read: innovation resistance), a durable characteristic of American educational conservatism and job protection. On the other side of the coin*, innovation is the sine qua non of the Continuous Innovation Society.* Innovation is the means by which high-performing humans and their machines create new wealth. Innovation is built on *invention*, or the

potential for innovation. Like invention, innovations may be purposive or accidental and serendipitous. Innovations may be incremental–large or linear–nonlinear. Together, inventions and innovations are the symptomatic outward evidence of discontinuities, or breaks with tradition.

The role of *discontinuity* in the emergence of continuous innovation cannot be overstressed. Discontinuity is literally the engine of change, whether in markets, technology, personal lives or education. Until recently American education appeared to operate on the presumption of continuity, resisting calls for substantial change. The time and resources reserved for the management of discontinuity were meager, in part because it was assumed that discontinuity could not be managed. In effect, school managers assumed that discontinuity was synonymous with chaos, and therefore was, by definition, unmanageable. This essay's assumption is that discontinuity and chaos are inevitable accompaniments to creating and sustaining a Continuous Innovation Society. Organizations will have to learn to 'trade out' of activities that will not be valued in the future in order to justify the redirection of resources toward strategic projections and goals.

Achieving a better balance between *convergent thinking* and *divergent thinking* is a requirement for achieving reliably continuous innovation. Convergent thinking emphasizes order, linearity, and 'objective' problem identifications and solutions. Convergent thinking thrives on the qualities of the educational bureaucrat, the visionless legislature, and the conventional student: order, simplicity, routine, clear responsibilities, unambiguous measurements, and predictability are the foundation of convergent thinking. Convergent thinking works effectively in slow-changing circumstances with high levels of cross-institutional resonance and homogeneity.

Divergent thinking is the first step in creative deconstruction and reconstruction, the one-two punches of creative persons, organizations, institutions and societies. Capitalist societies derive their discontinuities, and therefore their potentials to respond to change and create new futures, from a willingness to destroy old systems and forge new ones. Creative divergent thinking produces inventions and the potential for innovations, or applied inventions. The Continuous Innovation Society is a case study in discontinuity, surprise, unpredictability, and synergy—the banes of conventional minds and all bureaucracies, but the engines of globally competitive capitalism.

Performance capital derives its efficiency and innovational qualities from the management of discontinuity and chaos at both individual and collective levels. The performance base economy requires *performance base learning*, or the use of software-supported living, learning and working within a '24/7' framework. Performance base learning is supported by continuously upgraded and ubiquitously available *distributed competence software*. The role of DC software

is to help guarantee a sustained high level of competence in accomplishing well-defined tasks.

Performance base innovation (PBI) builds upon, but is not limited by, performance base capital. PBI is intended to automate or eliminate all forms of human competency that are now, or could be, accomplished by DC software. The preferred role of humans in the innovation context is to create new work and products, not to mimic machines through repetitious thinking and motions. Education for performance base innovation will be experiential, either in real world or simulated circumstances. It will employ *body area network* technologies that are worn on the body, woven into clothing, or implanted.

Innovative knowledge workers will be the largest percentage of workers in the Continuous Innovation Society. *Innovative knowledge workers create their own work and often their own jobs.* Most of today's Knowledge Workers convert the potential of information into locally applicable knowledge that does not flow to a network. Tomorrow's Knowledge Workers will continuously create knowledge within specific living, learning and working contexts, and they will routinely network this knowledge in the form of new information to help modify distributed competence software. *They will do this because the markets, technologies, and networks are available to do so, and because they will be rewarded for doing so.* While networking newly created information to each other, they will attempt to automate their current tasks by acting as resources for upgrading distributed competence software. As a function of performance base innovation, *innovative knowledge workers will always be working themselves out of their jobs. Indeed, this will be an expectation of and for such workers.*

Foreground IV: Contextual Opportunities for Leadership

I have argued that career and technical education (CTE) is an appropriate and preferred channel for leading an educational mission shift to prepare, support, and evolve flexible, information-producing Knowledge Workers for a Continuous Innovation Society. The temporal framework for this article is 2001-2010, a frame in which artificial intelligence is not expected to play a major role in living, learning or working. For this article, knowledge is defined as information in perceived transition or transformation, animated by the interactions of individual and collective purposes, contexts, and software-driven technologies. Creativity, invention, and synthesis all require the perceived sense of knowledge in transition or transformation. Knowledge is constructed by the individual and then provided to people and machines as new or modified information. Stable information is the raw material of knowledge, while information in perceived transition or transformation is the raw material of the Continuous Innovation Society.

Because it loses both contextual and personal meaning in the process of transmission to others, knowledge acquires the properties of information. Knowledge, therefore, is a very personal resource, while shareable information is both a precursor to, and a product of, knowledge. Codified, task-focused information fuels software and machines. It can be very exact. Human knowledge, on the other hand, is born at the edges of chaos in experiential contexts. It can be very volatile. A major human requirement, therefore, is to capture knowledge as information and quickly network it, so that software-supported machines and humans can partner in performance competency and continuous innovation.

Perhaps the greatest opportunity awaiting humankind is the use of networks to distribute continuously upgraded information in the form of distributed competence (DC) software. The first use of such information is to improve performance in codified tasks; the second is to transform it for use in continuous innovation.

The Continuous Innovation Society will be platformed, not on schools, but on contextually competent and upgradeable performances supported by software-fueled machines available to everyone anytime, anyplace. While knowledge is localized and ephemeral because it is very personal, information is shareable and enduring. It is rapidly becoming the culture of domesticated, cognition-supporting machines.

Focused information pertinent to specific contexts and tasks is becoming the realm of the software-driven machine. The construction of innovation and emergent purpose are functions of the human supported by networked software-driven machines. The intent of this article is to support the leadership of CTE in considering an Innovation Society in which repetitive labor, including cognition, is accomplished by machines in support of innovative humans.

Many trends are occurring that impact work and education in new ways and at increased rates of change. One is the advent of wireless handhelds or PDAs (personal digital assistants). Wireless devices may outnumber wired ones within a few years, perhaps earliest in countries without wired infrastructures. Among the problems facing wireless developers are bandwidth, compression, viruses, cross-platform interfacing, display quality, key size, appropriate and reliable software, and affordability. The key problems and opportunities lie in software and its very timely connectivity with human performances and innovations.

There is much evidence that learning, both for students and workers, is shifting to software-supported performances. Such performances may be in the form of simulations and/or real world outcomes in the school and community, and on the job. My position is that the emergence of distributed competence (DC) software is creating a performance base learning (PBL) macro-trend in the United

States' work force. This macro-trend is consistent with, and a major contributor to, the rapid growth of Knowledge Workers in continuous innovation economies and societies elsewhere on Earth. What are the signal features of an emerging knowledge society?

- •Work and learning are beginning to merge, fusing two environments that education has treated separately since the success of the Industrial Revolution.
- •Society is relying more heavily on the mass media to provide cultural background awareness to learners and workers shifting from industry and information cultures to emerging knowledge and innovation cultures.
- •Much learning on the job is shifting away from training, moving toward more reliance on worker-initiated (and DC-supported) on-the-job learning (OJL).
- •Mass learning customization is appearing in DC-supported workplaces *because* of worker-initiated learning, which is intended to supply enhanced performances.
- •Educational institutions are laboring to reinvent themselves for relevance in the emerging innovation cultures, but this progress is too slow to accommodate the rapid change that is occurring around them.
- •At the same time, user organizations are demanding altered and enhanced performance outcomes from graduates, leading to a persistent 'performance crisis' that educators are currently not able to solve.
- •Educators are, like virtually all professionals, baffled when reality outruns their current curricula, pedagogies, and experiential or simulated contexts.
- •Educators must learn to produce graduates who can almost immediately perform the currently unlikely or unthinkable, and promptly innovate beyond those achievements. This will require that CTE and all professional leaders learn to move beyond the artifices and inefficiencies of pre-preparation to experientially valid *just-in-time* performances supported by distributed competence software. Such performances ideally will be short-lived as human activities, replaced by task-dedicated software that will free humans for continuous innovation.

What is the generic utility of wireless devices and DC software? Their major purpose is to impact PBL directly, without removing individuals from their classroom, community or work contexts. The venue of PBL lies *in the situation*, backing up, augmenting, and even replacing the performances of individual learners and workers. Real-time DC is required to accomplish this. It is important that DC be available *instantly* within the performance context.

One may ask, "Are not developing education and instructional technologies such as computer-based training (CBT) and intelligent tutoring systems already available to enhance learning?" Isn't the purpose of these systems to prepare learners to learn more quickly, and to transfer information more efficiently? In some instances, new instructional technologies have helped students learn faster and better. However,

- •Transferring existing information is not the same as making students, workers and citizens 'performance competent'
- •Instructional technologists continue to apply new technologies to old models of learning, creating persistent inefficiencies and low-quality transfers of information and skills to performance outcomes
- •Educators and trainers continue to separate learners from the contexts of their performances (e.g., the community for young learners and the job context for workers)
- •Educators are reluctant to focus on school and non-school performance outcomes as the appropriate measures of their service relevance

I believe that a major goal of learning must be to produce competence-to-master performance levels at the times and places of need. Education that continues to produce *expertness*, rather than onsite performance guarantees, faces continuing problems:

- •The learning curve is too time-consuming, while change does not wait for new curricula and for instructor upgrades.
- •Because 'expert heads' are expensive to produce and limited in application by chaotic change and unpredictable future performance needs, *everyone* will have to become an 'expert mind' as a function of altered expectations and software/netware supports.
- •The 'half-life' of expert knowledge continues to decrease even as knowledge managers have yet to find effective ways to transmit actionable knowledge human-to-human or human-to-machine; instead, they are transmitting information and skills, in the author's opinion their most important function prior to the arrival of artificial intelligence.

It does not require much imagination or insight to read the handwriting on the wall for education: Support the emerging knowledge economy by adding to or reengineering your services or face the threat of obsolescence.

Foreground V: Promises and Threats of Distributed Competence

Perhaps the ideal future is one in which age, incapacity, educational level or ignorance are no longer factors in solving problems and capitalizing on

opportunities. Distributed Competence software and its supporting technologies make possible the cascading of formerly esoteric and difficult skill sets into the contexts of human performance. For example:

> *Five year-old Yolanda brushes her teeth in the bathroom of her family's small apartment on Chicago's South Side. As she moves the smart brush up and down, its tinny voice coaches her, "Move up onto your gums. That's it! Not so hard, now…. OK, let's do the bottom teeth." After Yolanda finishes she rinses the brush and places it in its holder. Within seconds, a data stream carrying gingivitis, plaque, and bacteria types and levels, has been sent to an analytical program in a dental hygiene office.*
>
> *While Yolanda brushes her teeth and prepares to leave for school, two late-model automobiles are tested on a snowy slope in upper Michigan. The cars are positioned at the top of a winding, ice and snow-covered road descending steeply into a valley about one mile away. Both are driven by certified test drivers. The first car move down the hill, and within a thousand feet slides into a ditch. The second car follows. Employing smart steering software it negotiates the winding road perfectly, arriving in the valley without control problems.*
>
> *At about the same moment as the car arrives safely in the valley, flight control software refuses to permit a tired pilot's command to pitch up the nose of his airliner while descending into Chicago air traffic. "Your speed is too low for that maneuver, Captain," says the voice in his headphones. "Entered in the flight log," the voice concludes.*

These scenarios illustrate the real world functionality of distributed competence (DC) software embodying information base skills. DC enables Yolanda and the driver of the second car to accomplish tasks beyond their current experiential, skill and information resources. In effect, Yolanda's smart toothbrush embeds some of the dental hygienist's capabilities, while the driver has benefited from partnering with driver-enhancement software. The airline pilot may face further simulator time and even a proficiency check ride, but his passengers arrive safely in Chicago.

Information-based, skill-concentrated DC software is a direct threat to all repetitive human functions at work, in learning, or in community. At the same time, it is the most hopeful and compatible equalizer for the ignorant, the unskilled, the slow, the blind-sided, and the imaginative.

Performance point competency and learning, as illustrated in focused scope and scale within the scenarios above, demonstrate the argument for a 'post-education' paradigm. For any of the scenarios, several principles of the post-education paradigm apply. Devices with *help-me*, *show-me*, *advise-me* and *do-this-for-me* features can move information and skills through space and time,

amplify human performance and learning, and transfer responsibility for task coordination to humans. Performances, therefore, replace old 'learning-to-do.' Performances are either machine-enhanced or machine-accomplished, and machine competence gradually replaces human competence in selected tasks. These principles, when put into practice, can provide task-by-task tests of propositions asserting

•that classroom pre-learning is no longer a precondition for selected performances supported by distributed competence software and appropriate devices and networks.

•that every person supported by DC software can perform new tasks in selected situations and contexts.

•that Performance Base Learning (PBL) can replace low-efficiency and often person-destructive classroom education.

•that traditional distinctions of learning, training, education and performance can compress into body area network-supported DC software supporting performance base learning followed by performance base innovation.

When DC functions in these and thousands of other examples it acts to support increments in human performance. It permits *constructed performance,* first; *constructed innovation,* second; and *constructed understanding and intuition*, third. In the DC framework, understanding and intuition are the products of experienced performance and innovation. Constructed knowledge, the fourth product of DC software applied in context, permits the person-level codification of experience. This knowledge then may be transmitted to others as new or modified *information*.

Performance base learning (PBL) is premised on the use of DC to support increments in human learning. PBL is already in use in the workforce. What are the challenges faced by the workforce that have resulted in expanded uses of DC? Here are some of the more important challenges to (receding) information workers and burgeoning knowledge workers:

•Requirements for 'point-of-contact' performance and innovation

•Continuous changes in required competencies

•Increasing task complexity

•Demands for reduced response time

•High costs for development of competencies

•Demands for high quality

•Low tolerance for errors

These challenges to the workforce suggest guidelines for the renovation and revitalization of education services in countries such as the United States. The pioneering uses of DC in business and industry will have to be emulated by educators to help prepare students for the workforce. *I propose that the DC paradigm emerging in the world of the workforce be directly applied to the student force.* Here are several trends to support this position:

•*America and several other societies are moving toward continuous innovation founded on the performance capital generated by Knowledge Workers.*

•Knowledge work increasingly will be supported by advanced software, amplifying the advantage enjoyed by Knowledge Workers. Currently, 40% of the American workforce, it is anticipated that *innovative* Knowledge Workers *could* form over 90% of the U.S. workforce by 2010.

•Digitization of knowledge worker support is part of a long-term process that has created reductions in earlier work forces, such as farmers, blue collar laborers, and information/service workers.

•Legacies, or preexisting factors, are acting both to promote and inhibit momentum toward continuous innovation driven by Knowledge Workers and their intellectual capital. One of these inhibiting legacies is the dominant industrial paradigm of K-12 and higher education.

•What are some of the problems and inefficiencies in the preparation of students who can meet these challenges? One major impediment is the paradigm of *meritocratic pre-learning*, which limits access to software-supported simulations and experiential learning that could provide improved transfer of learning to both school and non-school performances. Several historical factors acting to limit the application of DC and PBL in K-12 and higher education settings are that:

•Schools are social technologies driven by legacy factors strongly associated with the assumptions, values, and organization of industry-based society. We believe that they should be focusing far more resources on preparation of learners for a performance base/innovation base society.

•Schools are usually conservative. Schools were set up to selectively channel some students toward success and others toward failure. This is still their functional contribution, carried out within an obsolete and damaging industrial paradigm.

•Schools consistently lag behind social and economic change. Some estimates of this problem measure school response time on the order of up to, and beyond, a generation.

•School personnel are highly aware of, and defensive about, their lagging indicator status. They are concerned that children in their classrooms often know much more about new technologies than many teachers, and they fear the professional impacts of this gap (hence, the fear of being "replaced by technology).

•Schools are generally resistant to technologies or processes that threaten teacher status and control. The blackboard, textbooks, and overhead projectors are permissible technologies because they sustain, rather than erode, teacher control over students.

•Communities, for the most part, rate their local schools highly even though they are often quite critical of national education. This dichotomy is suggestive of similar data about families: mine is OK; yours has problems.

•While changing schools is very difficult and time-lagged, adding parallel services (e.g., PBL supported by DCS) can be easier and faster. Dual-service schools (i.e., traditional and PBL co-streams) can be managed effectively within a co-service paradigm driven by consumer choice. The Marshall, Minnesota public school system already successfully operates such a dual service, in partnership with Microsoft. In the Marshall schools, technology-savvy students act as valued instructors to other students *and to faculty*.

What set of assumptions is traditional education service built upon? Here are some of the more basic ones:

•Information is a *precondition* to performance

•Teaching *facts* about things will translate into being able to *do* things ('things" are defined as methods, procedures, processes)

•Jobs are fairly static and entail predictable tasks

•Learners are largely homogeneous, and can be mass trained/educated

•Proficiency requires significant practice (demonstrated repetition) *outside* the experiential context of the task

These suppositions are at the core of an obsolete industrial paradigm that is paralyzing the transformation of educational services to meet current and emerging societal needs. I argue that digital technology will force students into co-adaptive relationships with advanced software exactly as it is already forcing the workforce. This will foster the emergence of productivity criteria placing students and Knowledge Workers within the same paradigm of assessment, support, and development. *We may, therefore, logically and accurately speak of students as developing Knowledge Workers.*

As is already the case in Marshall, Minnesota, parents and children will choose whether they wish to affirm PBL and select the corresponding educational

services, or whether they wish to refuse PBL and receive traditional or other services. CTE leaders will therefore be permitted to design services based on two paradigms driven by two markets.

Regardless of whether there is a conservative legacy market for CTE, society is arriving at a point where the integration of learning services and workforce requirements is overdue. Contrary to the arguments against technological dependency, we will not return to the days of software-free work. Performing to learn is replacing learning to perform, and as this occurs the demand for embedded DC software rises. I offer the following as premises for the necessary dovetailing of preparation and support for students and workers in the knowledge and performance base Continuous Innovation Society:

•*Pre-learning and practice are no longer absolute preconditions for acceptable performance.* The workforce increasingly includes large segments of the population who are trained continuously through DC software through On-The-Job Training (OJT) and On-The-Job Learning (OJL).

•Traditional distinctions of 'training,' 'learning,' 'education' and 'performance' are *blurring.*

•Performance base learning is replacing low-efficiency classroom/lecture-based learning.

•Traditional concepts of 'job roles' are shifting to 'performance roles.'

•Learning is moving from the classroom to the point/moment of value.

•Specific descriptions of jobs are giving way to performance-in-context expectations.

•Life itself is being recognized as a 'performance event.'

•Intensified technology support is basic to performance conduct and improvements.

•Performance-supportive 'smart' DC is increasingly transparent, ubiquitous, self-reconfiguring, and cheap.

In the traditional learning paradigm, learning is a scheduled event that occurs prior to performance (just-in-case, or JIC). In the PBL paradigm, learning is a just-in-time (JIT) event that occurs in the moment of performance or in highly detailed just-ahead-of-time (JAT) simulations that are continually revised by smart DC software. *JAT simulations, to be most effective, must be present at* pre-*operational points-of-performance within continuously running simulations.* This capability will be driven by strategically-ahead-of-time (SAT) projections and pilot projects.

CTE leaders can benefit from considering SAT, JAT, and JIT as interactive and equally worthy of their attention and development. CTE leaders can promote

bi-paradigmatic education by helping other professionals recognize that *no* field is immune from the invasion of technical support, and that such support *will* downwardly alter the roles and statuses of existing educators even as it elevates the positions and influence of nouveau knowledge base practitioners.

Foreground VI: Implications of Distributed Competence for CTE

Continuous Innovation Society as a coinage marks the experiential development and application of personal 'creativity capital' to support continuous invention and innovation. Innovation capital can be defined as an index of socially shared actionable information, based on the cumulative, transmitted knowledge constructions of individuals. America is moving toward rapid-cycle organizational deconstruction, reconstruction, and continuous innovation based on distributed software. In such a society, individuals must change rapidly. They must be assisted by appropriate technology, such as computers and handhelds, together with software and netware required to make these connectively useful.

Many school boards and administrators will face the prospect of realigning educational services to meet the needs of a Continuous Innovation Society. Fortunately, the U.S. workforce is already pioneering the use of distributed software and handheld devices to support the growing percentage of Knowledge Workers. As the role of software grows, the focus on just-in-time performance evolves with it. Accordingly, I have argued that K-12 and higher education should emulate the worker software movement by bringing it into the common experience of students. I assume that software-based preparation of students for success in a Continuous Innovation Society will be driven by both performance base learning (PBL) and innovation base learning (IBL), *in which the skills of 1) software and device management, and 2) developing and working within fast, temporary traditions will become the new CTE basics.*

I have assumed that the separation of CTE from liberal or general education will greatly diminish, and that career education will shift to career creation and career cycling. I have argued for energetic CTE leadership aimed at helping school managers understand the requirements for technical and software support in all forms of education, employment and daily life. In effect, this approach elevates technical and career education to an umbrella relationship over all other forms of education. (Will familiar education formats remain stable? K-12, for example, may become K-10 as state governments attempt to eliminate redundant and inefficient high school years, replacing these with collegiate or other human development services.)

My approach to knowledge creation has assumed that units of knowledge are generated only at the intersection of people and contexts. *Some contexts may be*

hypothetical or simulated. I adopted this experiential working definition of knowledge construction because it denotes the importance of individual-in-context as the nexus of knowledge innovation. This definition also serves to set apart information, which is seen as a raw resource for the experiential development of actionable knowledge.

Therefore, my approach to the future of CTE is individualized and closely tied to the working and community contexts of students and faculty. Students increasingly will develop knowledge individually within the contexts of living, learning and working venues. Their common goal will be to develop shareable information for use by humans and machines in *all* phases of life. Developing and implementing this integrated, experiential approach to knowledge creation and application is *de rigueur* for U.S. and other economies aspiring to move toward continuous innovation that is not limited to the workplace but manifested in all institutions. The leadership potential of CTE is multifold in this context. It may be to lead the way to the Continuous Innovation Society; to resist it; or to wait for leadership to develop elsewhere.

In light of this heuristic continuum I am able to venture several premises concerning 2001 approaches to career and technical education (CTE).

- The *first premise* is that the U.S. and other advanced societies are moving toward continuous innovation founded on individual human capital and supported by information technology.
- The *second premise* is that knowledge work increasingly will be rationalized and brought within the capabilities of advanced software, continuing and even accelerating the evolution of the natures of living, learning and working.
- The *third premise* is that digitization of knowledge worker capabilities is part of a long-term process that has created huge reductions in earlier work forces, such as farmers, blue collar laborers, and now information/service workers.
- The *fourth premise* is that digitized knowledge work will permit, or force, most workers and students into complex *proactive* relationships with advanced software. This will foster the preeminence of innovative Knowledge Workers.
- The *fifth premise* is that legacies, or preexisting factors, are currently acting both to promote and inhibit momentum toward the formulation of an Innovation Society driven by continuously enhanced human capital.
- The *final premise* is that the goal of educational systems should be the production of flexible, resilient, software-supported students, workers and citizens who can successfully compete, thrive, and live with dignity in a

technology-driven Continuous Innovation Society.

Clearly, CTE leaders will be asked to cope with futures that are increasingly driven by serendipity, synergy and counterintuitive, self-organizing forms of personal and collective organization. Individuals are becoming networked selves with planetary mind prints. Organizations are here today and gone today.

Creative, exponential approaches to self-development and career construction are challenging stovepipe models of upward mobility and advancement. Free agency culture is challenging and will defeat conventional organizational loyalty. Embedded sensors and self-analyzing/self-repairing capabilities in machines and software will mimic the healing and evolutionary processes of advanced organisms, including humans.

In the face of these changes, CTE leaders, as all educators, will be asked to help create career and technical education futures unlike any before them. Fortunately, these CTE futures are partially forecastable. Hopefully, the most preferred of these projections will be realizable. In the short term (2001-2010), we can expect to see a mission shift toward invention and innovation in higher education and 9-12—if 9-12 still exists by 2010 in states such as Minnesota. Some of the changes that will accompany this shift include:

•Learning will become performance- and innovation-based.

•Software and machine management will become new basics.

•Standardized tests and other forms of testing will disappear.

•Contextual analysis and co-evolution of persons and contexts will become a required theory area.

•Faculty will become consultants to students, who will become clients.

•Students will become innovators and entrepreneurs.

•A new social concern will be the elimination of barriers to self-development.

•New legal services will support student copyright and patent products.

•Higher education will become a for-profit industry, focused on the development and testing of new products and services, some of which will have historical foci.

•Higher education will support the Continuous Innovation Society by preparing *prosumers*, or persons who both produce and consume constantly changing goods and services.

•Parents will become investors in colleges.

•Employers/clients/benefactors will pay tuition bills, but expect to share in

stocks/profits.

Some of the CTE barriers in coping/leading in this change context are:

•Constructivism is a necessary but insufficient approach because it implicitly presumes the continuity of CTE organizations, traditions and legacies over the future of *unknown contexts*.

•Contextualism is a necessary but insufficient approach because it too narrowly defines context in an era of interactive global networks.

•Training and education are insufficient approaches because they presume the necessary preexistence of pre-defined curricula to cope with unknowable, just-in-case futures.

•The rigid application of JIC education not only prepares students, workers and citizens for the past; more importantly it creates a legacy of powerful tradition that works ceaselessly against creativity, invention and innovation.

The conventional educator is doubtless appalled at the loss of efficacy being experienced by education's industrial model of preparation and subsequent performance. But the exigencies of change demand that each must collapse one into the other to meet the demands of change. But learning and performance are not enough: Tomorrow demands continuous innovation to support successful competition and hedges against unexpected novelty, such as 11/7.

Foreground VII: New Directions for CTE?

This article has been about moving from *learning to perform* to *performing and innovating to learn*. The essay has argued that performance base learning (PBL) can effectively create learning in the context of tasks supported by distributed competence (DC) software. The essay has submitted that PBL is a process that encourages learning based on authentic *performances* supported by DC software, and that such learning should lead to performance upgrades and innovations in task conception and accomplishment. Such upgrades and innovations are not guaranteed; they are potentials in the futures of human performers and their networked DC software.

Many educators have expressed concern that all individuals require knowledge basics. They argued that while machines can break, education provides 'knowledge' that is always available to serve the individual and society. The approach taken by PBL is very different from the administrators' *should-be-learned,* or *just-in-case* information. My approach in this article is based on *could-be-learned,* or *just-in-time* information.

The Knowledge Age has produced an explosion in the generation and accumulation of *just-in-case* information. At the same time, schools are facing limitations in their ability to transfer information in ways that produce enhanced,

quicker learning and higher quality test performances. The volume of *just-in-case* information that can be developed, retained and effectively used by ordinary individuals has, arguably, remained relatively static. This is why I argue for DC software–to take the pressure off humans, permitting them time and resources to invent and innovate. The resulting opportunities for development of human creativity, invention and innovation far outweigh losses in the capacity to note-take, to recite, to earn 'honors' through mechanical memorization, and to require massive re-education after graduation. Time and resources saved through networked DC software, coupled with a new mission for earliest possible automation or elimination of human tasks and jobs, permit CTE and other professions a clear field of transition to conceptualization, simulation and support of the emerging Continuous Innovation Society.

Indeed, the power of machines and software to store and process both *just-in-case* and *just-in-time* information is increasing exponentially. PBL provides an opportunity to balance *just-in-case* information with an accelerating availability of *just-in-time, performance-driving* information. In countless work venues JIT information is now available on-demand, very often with 24/7/365 updates.

Several of the respondents stated that education employs tried and true learning approaches that have been developed over several millennia; that PBL could produce many unknown and potentially harmful impacts. "Where," they asked, "is the long-run assurance that PBL will be more effective than existing school-based?" While it is true that the full range of future impacts PBL cannot be known, the future of contemporary education is also at risk. PBL offers another choice in how we address the issue of education-related task proficiency. PBL expands the concept of learning driven by software-supported performances. PBL does more than enhance the potential ability of learners and workers to function in task environments; it regards functionality as the ~~primary~~ learning experience. The aim of PBL is to upgrade, automate and replace the tasks performed by DC-supported humans. These follow-on steps are exactly in line with the creative destruction and reconstruction processes that are now fixtures in leading industries.

Task performances can be measured through outcomes and a variety of first- through *n*-order contextual impacts. It is axiomatic that DC-supported PBL will degrade the intellectual content of existing workforce and student tasks, and that it will de- and re-skill existing jobs and professions. PBL is already changing the ways in which work is performed and is in the process of redefining work itself. Under these circumstances I argue that the purpose of learning will increasingly focus on the application of *just-in-time* information within pre-defined and emergent performance contexts.

Technology has enabled the development of new machines that are capable of expanding the scope of human performance and learning at both the individual and networked levels. Many of the administrators in the study argued that the ability to create more powerful machines does not assure more effective performance or learning. We would have to agree that, if machines are applied to learning within the present *just-in-case* model, something like neural implants will probably be required to produce large learning increments.

Realistically, there are numerous precedents to suggest that the potentials for failure amplify when humans and machines are coupled in new ways. However, contemporary manifestations of Greco-Roman, German and British educational models, with their assumptions, pedagogies, curricula, and assessment tests, are increasingly unable to keep pace with demands for enhanced performances and faster learning cycles. DC-supported PBL will increase the potential for successful performance and learning outcomes while actually *softening* traditional levels and ranges of risk. The bonus of this change is the vastly enhanced support for continuous innovation by all citizens, not only workers or students.

PBL enhances the opportunity to prototype future learning in increasingly powerful "fail-soft" experiential venues. PBL enables learner-performers to address the new while simultaneously reducing the risk factors historically associated with exploration, invention and innovation. In the labor force, PBL is designed to take advantage of growth in networked software-mediated work-learning opportunities by substituting doing-to-learn for learning-to-do. Only *one* of the effects of this change is the shift in employee recruitment from degrees earned to *personality characteristics* such as motivation, anticipation, vision, experimentalism, and capacity to learn from novel experiences and performances.

The exercise of human purposing remains at the core of PBL. Humans must now do more than apply pre-determined strategies when they work. Humans must craft strategic purpose in the form of preferred future outcomes. They must continuously redefine themselves and their performance contexts and tasks in order to achieve desired strategic outcomes and respond to surprise. In turbulent times, now the norm, increased importance is placed on the distinctively human capacity to anticipate and cope with the unanticipated. This indispensable and characteristically human trait manifests itself in the form of continuous performance changes, including ceaseless knowledge/information creation and continuous innovation.

It is important to recognize a crucial capacity difference between today's software and humans: While software *contains* embedded worldviews, humans *create* worldviews. A major goal of DC-supported PBL must be to design systems that are supportive of human heuristic thinking, goal creation and

innovation. The growing competency of software to perform a wide variety of delegated tasks enhances the opportunity for humans to experiment in fail-soft environments and engage in otherwise high-risk performance and innovation ventures. PBL relies on distributed competencies to enable authentic re-definition of learning in a manner that couples it *directly* to performance. This amplifies the human ability to deal with ambiguity and unanticipated variety through praxis (intelligent action).

The administrators correctly identified a major requirement for students and workers shifting to PBL: They will increasingly use machines to work with other machines. In that sense, the future of work is becoming tied to the ability to manage technology. It is also a trend that people will learn to use software and machines to work with people, including themselves.

Of course, none of this means that CTE *must* do anything about it, including help to lead its development. In many respects, it would be easier, and perhaps even prudent, to side with those agencies and individuals who wish to continue the inefficient and non-strategic development and utilization of human capital, innovation capital, and the other forms of value that are associated with a Continuous Innovation Society.

Will increased reliance on just-in-time knowledge through DC software limit the need for human learning? Some of the administrators in the sample foresaw the possibility that PBL might actually limit the need for learning, or control learning in disabling ways. *I submit that PBL enhances opportunities for human learning by placing humans in the context of expanding prospects for effective personal and collective action*. DC-supported PBL emphasizes both personal and networked group learning through engagement in task performances.

Will DC and PBL degrade the intellectual content of job and professional tasks? Will both be de-skilled? I think PBL will change the ways in which work is performed, and probably redefine work itself as a humanly *creative* process. The purpose of learning will increasingly focus on motivation, innovation and context creation, rather than the application of accumulated *just-in-case* knowledge and engagement in pre-defined work. Performance-based learning is merely the beginning, the take-off point for the development of performance base innovation and innovation base learning.

Several countries are creating cultures based on continuous innovation in industry, business and civic life. Their systems of K-12 and higher education are refocusing their missions to prepare performance base students, workers and citizens for continuous innovation cultures. Such cultures will offer students and faculty opportunities to examine and assess trends associated with continuous innovation and improved productivity. By far the most important characteristic of

this trend is its relative slowness in the face of growing need, in particular, *for innovation in the civic, governmental, societal, community, and personal sectors.*

What can CTE leaders begin to do on Monday morning? It is an opportune time for CTE leaders to help society cope with two schisms that, in my opinion, are more important than the digital divide. One of these is the performance divide, an ancient and traditionally devastating differential productivity problem. The second is already on the horizon and will soon rival performance and productivity imbalances. I am referring to the coming *innovation divide*.

The task for CTE leadership can be to shift from teaching to software supported construction of performance base learning (PBL) and performance base innovation (PBI). This means relinquishing adherence to curriculum downloading and testing within a *brain-as-disk-drive* approach to human capital development. It means moving to a software-supported experiential approach to constructed performances and innovations based on understanding, intuition, and emergent knowledge transferable as new information.

CTE leadership must choose to become comfortable with the heresy that virtually everyone can eventually perform, at least at the novice level, virtually all codified tasks that are supported by appropriate DC software. These tasks can range from cooking a wiener to setting a broken leg to innovating new products and services and new social and cultural systems.

CTE leadership must ask itself to become comfortable with the value of DC-supported universal success, a direct attack on the meritocratic paradigm that has crippled the educational, employment, and quality of life hopes for millions of people throughout American history. CTE leadership must ask itself to confront the importance of performance over learning, and innovation over performance. It must learn how to help free humans from machine metaphors and models (the Industrial Age syndrome), leaving these to the machines, software, and netware.

CTE leadership must ask itself to realize that the future of its profession is to become an umbrella paradigm for software-supported high performance and continuous innovation in what are increasingly borderless interactions among living, learning and working contexts.

CTE leadership must ask itself whether local- and national-level heuristic simulations of the Continuous Innovation Society and its human development potentials is worth drains on time and resources, and, in some cases, personal reputations.

CTE leadership must ask itself about the projected consequences of resistance or inaction in the face of what this author firmly believes is the first serious opportunity to create a Continuous Innovation Society, one founded upon creative, inventive and innovative thinking and practice by all Americans in their everyday learning, living and working.

The urge to control and dole out educational software in support of traditional and contemporary CTE interests is understandable, but it is not leadership. Indeed, it is easy for an outsider to recommend changes in somebody else's shop. But we are talking about everybody's shop now, in the sense that no public or private enterprise is immune from the changes explored in this essay. Education has an opportunity to move from lagging followership to decisive leadership within the change contexts we have described. As I have indicated, CTE, with its technical focus and performance outcomes mandate, is ideally positioned to lead the rest of education into new importance and prominence.

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Teacher Education in Career and Technical Education: Background and Policy Implications for the New Millennium

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The attention being given to teacher quality by the media, policymakers, and researchers is high, and the debates about teacher quality and how to produce quality teachers have been intense, creating numerous policy decisions at local, state, and national levels. However, improving teacher quality and teacher preparation is no simple task. In some schools, teachers receive increased salaries if their students score high on state proficiency examinations. Some states reward teachers with large increases in salary if they meet the requirements of the National Board for Professional Teaching Standards. Other states, in order to meet the high demand for teachers, are changing the licensing requirements for entering teaching, and are offering alternative certification for individuals who have not taken teacher education courses. Other approaches to increasing teacher quality have been to require a master's degree or a major in the subject a teacher plans to teach.

Wenglinsky (2000a) studied the link between student achievement and three aspects of teacher quality in the teaching of eighth-grade mathematics and science including (a) what teachers do in the classroom, (b) professional development in support of these activities, and (c) non-classroom aspects such as teacher education levels. He found that students whose teachers emphasized higher-order thinking skills, small-group instruction, and hands-on learning activities outperformed their peers. Wenglinsky also found "that teachers who receive rich and sustained professional development generally, and professional development geared toward higher-order thinking skills and concrete activities such as laboratories particularly, are more likely to engage in effective classroom practices" (p. 32).

Wilson, Floden, and Ferrini-Mundy (2001) examined more than 300 published research reports about teacher preparation and found 57 that reported a direct relationship to one of the following questions:

1. What kind of subject matter preparation, and how much of it, do prospective teachers need? Are there differences by grade level? Are there differences by subject area?
2. What kinds of pedagogical preparation, and how much of it, do prospective teachers need? Are there differences by grade level? Are there differences by subject area?
3. What kinds, timing, and amount of clinical training ("student teaching") best equip prospective teachers for classroom practice?
4. What policies and strategies have been used successfully by states, universities, school districts, and other organizations to improve and sustain the quality of pre-service teacher education?
5. What are the components and characteristics of high-quality alternative certification programs?

Wilson et al. reported a positive connection between teachers' preparation in their subject matter and their performance and impact in the classroom. However, little definitive research has been conducted on the kinds or amount of subject-matter preparation. In regard to pedagogical preparation, studies they reviewed reinforced the view that pedagogical aspects of teacher preparation are critical, both for their effects on teaching practice and their ultimate impact on student achievement. The authors also reported that field experiences too often are disconnected from, or not well-coordinated with, the university-based components of teacher education. Prospective teachers' conceptions of teaching and learning subject matter can be transformed through their observations and analysis of what goes on in real classrooms. In the area of policy and strategies used to improve and sustain the quality of preservice teacher education, too few studies have been conducted to make confident statements. Wilson et al. found that alternative-route programs have been successful in recruiting a diverse pool of teachers. However, they have a mixed record in attracting the *best and brightest*, and background in subject matter alone is not enough to prepare new teachers.

The effectiveness of teacher education programs in institutions of higher education has been discussed extensively, and opinions vary widely. Groups such as the Thomas B. Fordham Foundation (1999) indicate that teacher education institutions (TEIs) are largely ineffective. The National Commission on Teaching & America's Future (1996), on the other hand, are complimentary of TEIs. Undoubtedly, TEIs are neither all effective nor ineffective—but some are more effective than others.

Wenglinsky (2000a) examined the relationship of TEIs and schools, colleges, and departments of education housed in higher education institutions to students' Praxis II scores, primarily from the southeastern United States. He concluded that "institutions of higher education are appropriate as sites for teacher preparation" (p. 32). He recommended that teacher education institutions should "place greater

emphasis on content areas and less on preparation in professional knowledge" (p. 32). Wenglinsky also stated that "until all TEIs operate at a high level, policymakers need to facilitate access to high-quality TEIs for students from less advantaged backgrounds" (p. 33). Lastly, he recommended that future reform efforts in teacher education "need to be based on research that links teacher preparation practices to teacher effectiveness and other desired outcomes" (p. 33). Drew Gitomer, Vice President of the Research Division of Educational Testing Service, stated in the preface that, "Wenglinsky's results make clear once again that teaching requires a mastery of both content and pedagogy, and that one at the exclusion of the other is insufficient" (p. 3).

A similar case could be made for career and technical teacher education. First, little is known about what makes a good career and technical education teacher and how that teacher contributes to academic and technical achievement. Second, an inadequate knowledge base exists regarding what career and technical education teachers do in the classroom. Finally, there is little in the literature regarding what constitutes an effective career and technical teacher education program.

Individual, Society and the Economy

The overall purpose of education is to prepare people to perpetuate and improve the society in which they live. An educational program in any nation must be related to its political, social, and economic way of life. That is particularly true in the case of career and technical education. The National Association of State Directors of Career Technical Education Consortium (n.d.) indicated that career and technical education

> is provided in a variety of settings and levels including middle school career exploration, secondary programs, postsecondary certificates and degrees, and customized training for employees in the workplace. Career and Technical Education also provides students and adults (1) the technical skills and knowledge necessary to succeed in occupations and careers, (2) the cross-functional or workplace basics necessary for success in any occupation or career (such as problem solving, teamwork, and the ability to find and use information) as well as skills for balancing family and work responsibilities, and (3) the context in which traditional academic skills and a variety of more general educational goals can be enhanced. (p. 1)

Historically, career and technical education (CTE) teachers have been responsible for preparing individuals to enter into and succeed in the labor market. This relatively straightforward charge entailed equipping students with the essential knowledge and work-related skills to meet the demands of the contemporary workplace.

By contrast, career and technical teachers today are faced with a plethora of additional expectations and demands that tend to make CTE teachers of the 20th century obsolete. First, they were expected to assist in accommodating the growing career development needs of students to be more aware, informed, and technologically prepared for the myriad employment opportunities awaiting them. Second, CTE teachers were charged with preparing students who were more competent in academic achievement in mathematics, science, and communications, and who demonstrated higher order skills in reasoning, problem-solving, and collaborative work. Additionally, CTE teachers were held to ever-increasing demands for greater accountability. At the same time, teachers were expected to serve a more diverse student clientele who were educationally and socially challenged. Finally, CTE teachers were in the midst of a technological revolution that required ongoing curriculum revision. The expectations for CTE teachers in the late twentieth century were quite different from those in the past and they will need to be prepared to meet the challenges that confront them in the 21st century. All of the forces that have impacted career and technical education had roots in our society or economy, and have significantly impacted students, schools and communities. Each of these factors will be discussed further.

Career Development

Schools have had a long history of providing career development activities such as career days, career counseling, career and technical student organizations, and supervised work experience programs. Career and technical student organizations and some type of supervised work experience program have had a long history in career and technical education. However, in the early 1970s, interest grew toward a more comprehensive approach to career development that included all public school students.

Dykeman et al. (2001) identified 44 types of career development interventions. Each intervention was rated on five variables: time (short/long term), mode (active/passive), control (adult/youth), place (school/community), and size (group/ individual). Based on these variables, four categories of career development activities were identified: (a) introductory career interventions, (b) advising interventions, (c) curriculum-based career interventions, and (d) work-based career interventions.

Higher Academic Achievement

Changes in the workplace have impacted high school reform in terms of higher standards and expectations for academic achievement, as well as enhanced technical competence and the ability to make applications in the context of the world of work. One of the goals of the American Association for the Advancement

of Science (1990) was to increase student economic productivity through the use of the knowledge, understandings, and skills of science. The impact of the changing workplace made it clear that scientific literacy was vital for many different jobs in today's workplace. Similar cases have been made for the disciplines of mathematics and language arts.

Expectations for higher academic achievement gave rise to the integration of academic and career-technical education movement starting with the Carl D. Perkins Vocational and Applied Technology Education Act of 1990. Secondary educational institutions were encouraged to link academic and CTE curricula, and emphasize their interrelatedness in real-world contexts. The intent was to connect the curricula of various subjects so that students would be able to address in a holistic manner the problems, concerns, and issues of the environments in which they lived.

Urquiola et al. (1997) noted that curricular integration is "a natural means of…simultaneously prepar(ing) students for skilled jobs and, with the incorporation of reformed pedagogy, develop(ing) critical thinking and collaboration skills" (p. 72). According to Beane (1998), the concept of curriculum integration illustrated the potential for academic and vocational education to connect students to all aspects of the workplace.

> Integration as a curriculum design has several features: problems and issues of personal and social significance guide curriculum; learning experiences are designed to integrate knowledge in context of its use; knowledge is developed and used to address relevant issues, not in preparation for future tests; and learning activities involve the application of knowledge in real-life settings where students can experience problem solving and the intricacies of social interaction. (p. 5)

Assessment and Accountability

Accountability has been an area of concern for career and technical education for many years. Early efforts toward greater accountability included follow-up studies to determine the degree that CTE graduates found placement in jobs related to their training. The Vocational Education Act (1963) was the first piece of legislation that mandated the need for states to conduct evaluations of their CTE programs. Since that time legislation—the Vocational Education Amendments (1968), the Education Amendments of 1976, the Carl D. Perkins Vocational Education Act (1984), the Carl D. Perkins Vocational and Applied Technology Education Act (1990), and the Carl D. Perkins Vocational and Applied Technology Education Amendments, (1998)—has continued to stress the importance of accountability.

Plank (2001) studied the outcomes of alternative curricular pathways through high school and found that academic performance in core subjects was similar between academic concentrators and those with both academic and career-technical concentrations (dual concentrators). Students who were career-technical education concentrators trailed both academic and dual concentrators by a significant amount in their performance in core subjects. However, career-technical education had a positive effect in reducing the likelihood of dropping out of high school. Thus, combining career-technical education with academic coursework may have increased student attachment to school and increased the probability of completing high school. Such an observation carried significant social-demographic and economic implications.

Another facet of accountability and assessment was the role of technology in assessment. Austin and Mahlman (2000) noted that educational technology has ranged from blackboards to audiovisual media, but computers, networks, and hypermedia comprise a new frontier. While technology assessment had broad and deep implications for career and technical education, it is still in its infancy in terms of potential and application.

Diverse Clientele

According to Wentling and Palma-Rivas (2000), the changing work force has been one of the most extraordinary and significant challenges facing the U.S. today. The work force has become increasingly diverse. These population changes will continue for many years. Demographic changes have been away from European-American males and toward an increasingly diverse and segmented population including men and women of all races, ethnic backgrounds, ages, and lifestyles. This change in the work force included more people of diverse sexual/affectional orientations and religious beliefs, and different physical abilities that needed to work together effectively.

Currently, racial and ethnic minorities make up 28% of the U.S. work force (U.S. Census Bureau, 1998). By 2010, it is projected that Hispanics will supplant African Americans as the nation's largest minority group, and that Hispanics, African Americans, and Asians will outnumber non-Hispanic Whites in the 21st century. These dramatic changes in societal and workforce demographics present major challenges in language differences, cultural beliefs, and work attitudes that will have a direct bearing on how career and technical education is designed and delivered in the public schools.

Furthermore, women have made a dramatic impact in the Amreican work scene. In 1997, approximately 60% of American women were in the labor force, up from 33% in 1950. As noted by the U.S. Bureau of Labor Statistics (1998), in 1980, women made up 43% of the total work force. By 2010, they will represent

more than 48% of the work force and, along with immigrants, White women will account for 85% of the net growth in the nation's labor force.

Demographic and diversity issues have been and will continue to exert significant influences on career and technical education. Regardless of whether these issues are looked upon as societal, workplace, or educational issues, they cannot be ignored.

Technology

The impact of technology on career and technical education has not been limited to assessment. Technology has found its way into the instructional process as a teaching tool—both from the standpoint of a teaching tool and a learning process that facilitates self-paced learning and tutorial assistance.

One dimension of technology on CTE has been in the area of professional development. Brown (1998) noted that linkages with other teachers were an important professional development strategy for sharing practice and knowledge, and technology facilitated those linkages. Grubb and Hines (1999) also noted the importance of training faculty as distance learners. Schrum (2000) listed the following direct advantages of an online professional development model:

1. Instantaneous and delayed communications options,
2. access to and from isolated communities,
3. multiple and collaborative participation among widely dispersed individuals,
4. ultimate convenience, when and where one chooses to be involved,
5. interaction and collaboration among individuals from diverse cultures and academic backgrounds, and
6. ability to focus on ideas without knowledge of race, gender age or other prejudicial factors.

Electronic forms of professional development can save teachers and administrators time and money in terms of travel costs. But, just as important, CTE distance learners enhance their own technology skills that are transferable to the classroom, either as an instructional tool or an assessment strategy.

Some states have developed online learning and distance delivery methods for career and technical teacher education. For example, Virginia Polytechnic Institute and State University (2001) offers both a teacher licensure and Master of Science degree via distance learning. The teacher licensure program is a six-course program designed for provisionally licensed career-technical education teachers. The Master of Science degree program is designed to develop instructional leaders in the field of career-technical education. Indiana University of Pennsylvania (2001) has developed an online university to provide access to credit-bearing certification courses, resources for professional development, and occupational training, teacher

networking, and expertise from private business and industry. Wright State University (2001) has developed a graduate-level 43-quarter-hour teacher licensure program. This program can be completed over a two-year period, and is part of a 55-quarter hour M.Ed. program.

Historical Overview

In 1839, in response to the growing need for teachers, Horace Mann, the Secretary of Education in Massachusetts, organized and operated the first normal school in the Town Hall of Lexington, MA, designed to prepare teachers. The normal school concept flourished and soon became very popular, even though it operated on the basis of a very narrow curriculum and under minimum standards relative to the selection and preparation of teachers. However, normal school institutions did tend to provide a better teacher than had been previously realized, giving rise to the evolution of teacher education and colleges of education as a means of meeting the growing teacher needs in this country.

However, the evolution of professional teacher education was not without controversy. Teacher education, in general, suffered from anti-intellectualism. Brubacher (1966) noted that such sentiment stemmed from two major points. First, students were woefully deficient in their knowledge of the liberal arts. Second, the professional study of education had proliferated many courses that were thin and overlapping.

Assertions were made that education was not a discipline in the first place. According to some critics, the real facts regarding the necessity for an advanced general (liberal arts) education for teachers were not based on an analysis of the value of such an education to teachers, but rather on the general theory that any teacher must be an *educated person*. In more recent times, other forces have come into play on teacher education. National certification standards have arrived on the scene and have made their impact felt on the preparation of teachers. And, reports from the Holmes Group (1986) have also impacted teacher education, adding tension about the role and design of teacher education throughout the nation.

Career and Technical Education

Career and technical education had its origins in the colonists' apprenticeship programs. The apprenticeship programs included full-time work, on-the-job training, and additional instruction in the theory of the craft. However, the master craftsmen, who served as apprenticeship instructors, were required to teach more than their respective trades. They were also required to provide instruction in civic and moral responsibility. But many masters were unable to provide adequate non-vocational instruction, and during the 18th century they began to send their apprentices to evening schools for the three Rs (reading, writing, and arithmetic).

This was the first example of the separation of vocational and academic instruction.

Vocational education took on new significance with the passage of the Morrill Act (1862) that established this nation's land grant college system and provided educational pathways for the preparation of individuals schooled in the fields of agriculture and the mechanical trades. At the same time, the movement for the education of young girls and women was gaining ground and was attached to the land grant concept. Concurrently, states were concerned about how to meet their rapidly growing skilled worker needs, and various organizations began to spring up that had, as their main focus, the preparation of a skilled workforce. Examples of such organizations included National Association for the Promotion of Industrial Education based in New York and the Vocational Education Association of the Middle West (which ultimately became a part of the American Vocational Association).

In 1914, a Congressional Commission on National Aid to Vocational Education was established to study the needs and report its findings to Congress. The findings of this commission resulted in the passage of the Smith-Hughes Act (1917)—the first federally enacted legislation to promote vocational education in public high schools in America. This act provided federal funds for vocational education at the secondary level in the areas of agriculture, trades and industry, and home economics.

Career and Technical Teacher Education

The Smith-Hughes Act was also the first federal legislation to make funds available to train teachers. Sections 2, 3, and 4 in the Act authorized the use of funds to be paid to states for the purpose of paying the salaries of teachers, supervisors, and directors and in the *preparation* of teachers, supervisors, and directors. The George-Deen Act (1936) extended the coverage of vocational education to include distributive education. The George-Barden Act Amendments (1956) extended coverage to include practical nursing and the fishery trades. The Vocational Education Act (1963) included business and office education.

Throughout the history of career and technical education, extensive discussion has taken place about the distinctions between education for the mind (head) and for work (hand). Early in the history of career and technical education, the Federal Board for Vocational Education was designated by Congress to administer the Smith-Hughes Act. The Federal Board for Vocational Education and Charles Prosser, the Board's first administrator, emphasized the importance of developing the skills necessary in a craft or trade. Similarly, the Federal Board indicated that teachers should be knowledgeable of the skills needed by crafts or trades if they were to be successful as teachers, and that college and university courses contributed little or nothing to the training of secondary vocational education

teachers. Teachers of trade and industry and health occupations have often been prepared in line with Prosser's concept.

Others, such as Dewey (1933), advocated that education should prepare students for a lifetime of learning using social activities as its center. Thus, teachers must be prepared in general education and in professional education courses dealing with the context and understandings related to students' activities. Teachers of agriculture, business, family and consumer sciences, and marketing have been prepared congruent with Dewey's concepts.

There has been a great deal of separatism in the way vocational education teachers and general education teachers have been prepared. For years, vocational education teacher requirements have mandated a number of years of experience in their craft or trade outside the classroom prior to their employment as a teacher. Lynch (1996) indicated that in the areas of trade and industrial education and health occupations, alternative state certification schemes would allow those with a high school diploma, or its equivalent, and extensive occupational experience (ranging from two to nine years, with an average of four years) to teach. Bruening et al. (2001) found that occupational experience or occupational competency was used in combination with coursework and testing to certify teachers. The research team also reported that a minimum cumulative GPA of 2.5 was required for teacher certification program entry into more than 59% of the programs. This represents a substantial change over the 9.0% having a minimum GPA requirement of 2.2 earlier reported by Lynch (1991).

Bruening et al. (2001) also found that the educational reform movement has had an important impact on preservice career and technical teacher education programs. Areas of educational reform impacting preservice teacher education programs included integrating academic and vocational instruction, designing meaningful instructional tasks based on real world problems, advancing student learning, using technology, teaching teamwork and collaboration skills, constantly monitoring change, and developing leadership skills. Career and technical education teachers in the 21st century must be prepared to relate to an increasingly diverse student clientele. This diverse student clientele must perform at higher levels of academic and technical proficiency. Furthermore, the students will need to be able to reason analytically, solve complex problems, and gather and process information and data.

The National Commission on Teaching and America's Future (1996) reported that in recent years, more than 50,000 people have entered teaching annually on emergency or substandard licenses. Of the newly hired teachers, 12.5% had no license and 14.9% were on temporary, provisional, or emergency license. Additionally, 25.0% of all secondary teachers do not have a college major or minor in their main teaching field.

Darling-Hammond (1992) summarized over 100 research studies on teaching and knowledge, and concluded that fully prepared teachers were more effective in the classroom, and their students demonstrated larger achievement gains than students whose teachers were not fully prepared. Wenglinsky (2000b) found that teachers' classroom practices greatly influenced student achievement. Student achievement also increased when students had training in developing higher-order thinking skills, who were skilled at implementing hands-on experience in the classroom, and who were trained to work with special populations.

Trends and Issues Affecting Career and Technical Teacher Education

Career and technical teacher education does not operate as an island unto itself. Four major areas that impact upon career and technical teacher education include: approaches to teaching and learning, infrastructure, teacher licensure and standards, innovative programs, and teacher supply and demand. Each of these topics will be discussed in this section.

Approaches to teaching and learning. The psychological approaches in education have changed significantly in the last 50 years. From 1920 to about 1970, much of what happened in the classroom was influenced by the behaviorist approach to psychology. Behaviorists such as Skinner (1938, 1953) theorized that human behavior was highly shaped by its consequences. Skinner felt that psychology was primarily about behavior, and that behavior was largely determined by its outcomes. Other psychologists and educators thought that the behavioral approach failed to take into consideration how students develop strategies for learning. Today, cognitive psychologists portray learners as being active processors of information and assign priority to the knowledge and perspective students bring to their learning.

The University of Helsinki (2001) indicated that cognitive psychology "studies human cognitive processes such as perception, learning, memory, skill acquisition etc., which are properties of human *mind*, not of his/her brain" (www.helsinki.fi/hum/ kognitiotiede/cogsci.html). The Academic Press Dictionary of Science and Technology (2001) defined cognitive psychology as "the branch of psychology that attempts to explore and explain processes of sense, perception, memory, and thought, as contrasted with other approaches that focus on observable behavior or on the unconscious." Encyclopedia.com (2001) included cognitive processes such as problem solving and memory in its definition of cognitive psychology.

Sternberg and Williams (2002) identified three main approaches to cognitive development: Piaget's stage theory of cognitive development, Vygotsky's sociocultural theory of cognitive development, and information processing theories. Piaget's theory proposes four stages of cognitive development:

Sensorimotor (occurring between birth and age 2), *preoperational* (generally occurring between 2 and 7 years of age), *concrete* (occurring from ages 6-7 to 12 years), and *formal* (beginning at 11-12 and extending through adulthood). Piaget's theory specifies quantitative changes in cognitive development with each succeeding stage. Children, regardless of their age, actively seek to explore the world and to come to terms with it—largely from the inside, outward. Piaget's theory was prominent in the 1960s and 1970s.

Vygotsky's sociocultural theory of cognitive development takes a different view from Piaget. Vygotsky theorized that cognitive development occurs largely from the outside, inward. Cognitive development occurs due to children's interactions with the people with whom they come in contact. Vygotsky recognized that cognitive development depends as much on social and other environments as it does on maturation, and that it occurs continuously, rather than in stages. Vygotsky's theory was most prominent in the 1980s and 1990s.

Information-processing theories, the third approach to cognitive development, seek to explain cognitive development in terms of how individuals of various ages process information and represent it in their minds (Klahr & MacWhinney, 1998). These theories tend to see cognitive development occurring continuously, without stages, as a result of the child's learning and level of maturity. Information-processing theories of cognitive development have been in the literature from the mid-1980s forward.

Cognitive theorists stress the role of thinking in the learning process—the importance of knowing why—and believe that teachers provide learners with opportunities and incentives to learn. Feden (1994) stated that cognitive theorists believe, among other things, that

> 1. All learning, except for simple rote memorization, requires the learner to actively construct meaning,
> 2. students' prior understandings and thoughts about a topic or concept before instruction exert a tremendous influence on what they learn during instruction,
> 3. the teacher's primary goal is to generate a change in the learner's cognitive structure, or way of viewing and organizing the world, and
> 4. learning in cooperation with others is an important source of motivation, support, modeling, and coaching. (p. 19)

Ormrod (2000) identified several basic assumptions underlying cognitive psychology. These assumptions included:

> 1. Cognitive processes influence the nature of what is learned.
> 2. People are selective about what they process and learn.
> 3. Meaning is constructed by the learner, rather than being derived directly from the environment.
> 4. Prior knowledge and beliefs play a major role in the meanings that people

construct.

5. People are actively involved in their own learning. (pp. 225-226)

Thomas (1992) identified several reasons for supporting the relevance of cognitive theory to vocational education at all levels. Reasons for these arguments included

1. a changing environment in which cognitive capacities are critical to survival and flourishing of both people and organizations,
2. an obligation to understand and serve the needs all students have for learning,
3. the importance to the individual and collective quality of life in a democracy of cognitive capacities well distributed across the citizenry, and
4. the potential of cognitive theory to guide educational practice toward meeting these challenges. (p. 6)

Recently, cognitive development theorists have taken a constructivist view of learning. Constructivism emphasizes "the learner's contribution to meaning and learning through both individual and social activity" (Bruning, Schraw, & Ronning, 1999, p. 215). Constructivism contends that people construct meaning through their interactions with and experiences in their social environments. It presumes that prior knowledge and experiences play a significant role in learning and form the basis for subsequent actions. It focuses a learner's attention on the "why" of learning and opens the door to critical thinking and intellectual development (Manus, 1996). Constructivism builds on the research of cognitive psychologists such as Piaget, Vygotsky, Bartlett, Bruner, and Dewey. Although there is no one constructivist theory, most constructivist approaches recommend (a) compelling, challenging learning environments and authentic tasks, (b) social negotiation and shared responsibility as a part of learning, (c) multiple representations of content, (d) understanding that knowledge is constructed, and (e) student-centered instruction (Driscoll, 1994; Marshall, 1992). Student-centered instruction is sometimes referred to as constructivism "because it sees students as constructing their own understanding" (Sternberg & Williams, 2002, p. 444).

Brown (1998) indicated a number of ways that constructivism can be articulated. "Some of these include the development of learning environments that incorporate *learner-centered teaching practices, problem-based learning, contextual teaching and learning experiences, integrated academic and vocational curriculum,* and *authentic assessments*" (p. 27). All of these learning environments have been used in career and technical education since it began. Some would argue that integrated academic and vocational curriculum was not a part of early vocational education. However, fields such as construction, agriculture, and family and consumer sciences (among the first vocational areas

authorized by the Smith-Hughes Act of 1917) had to use mathematics and science in solving problems.

Contextual teaching and learning represents another approach to teaching and learning. Howey (1998) defined contextual teaching and learning as "teaching that enables learning in which students employ their academic understandings and abilities in a variety of in- and out-of-school contexts to solve simulated or real-world problems both alone and with others. Activities in which teachers use contextual teaching strategies help students make connections with their roles and responsibilities as family members, citizens, students and workers" (pp. 20-21). Contextual teaching and learning uses problem-based learning, cooperative learning, project-based learning, service learning, and work-based learning (Berns & Erickson, 2001).

The Office of Vocational and Adult Education, U.S. Department of Education, funded a project in 1997 at The Ohio State University in partnership with Bowling Green State University, designed to help prepare teachers to use contextual teaching and learning strategies to enhance student success in and beyond school. From that work, seven additional projects were funded. An interactive, web-based model of excellence for the inservice professional development of P–12 teachers in the effective use of contextual teaching and learning was also funded at Bowling Green State University. Johns Hopkins University was funded to develop, demonstrate, and evaluate an inservice professional development approach and materials for high schools supporting contextual teaching and learning within a career academy structure. A TeachNet model was funded at the University of Wisconsin at Madison to enhance inservice professional development programs by providing teachers with opportunities to participate in workplace and community learning experiences, and assisting them in applying what they learned to instructional processes. A project designed to complete a cross-program analysis of the profiles of five university preservice teacher preparation programs that exhibit characteristics of career and technical education was funded at The Ohio State University. The University of Georgia was funded to develop and implement a pre-service teacher education model that was based on a theoretical framework of contextual teaching and learning. The Washington State Contextual Education Consortium was funded to engage professors of education and arts and sciences with K–12 teachers in demonstrating innovative contextual teaching and learning classroom strategies. A project to promote a highly qualified and diverse teacher work force for the nation's urban schools by expanding on the successful school-to-career approach of teacher academies was funded at the Urban Teacher Academy Project.

Infrastructure. Infrastructure has been defined as "the resources (as personnel,

buildings, or equipment) required for an activity" (Merriam-Webster's Collegiate Dictionary, 2001). High quality career and technical teacher education programs require personnel (e.g., faculty, staff, students), productivity tools (e.g., curriculum, technology, professional development opportunities, supplies, and telecommunication technology), and physical facilities (e.g., buildings, libraries, classrooms, and laboratories). Unfortunately, higher education, for the most part, has failed to invest in career and technical education personnel, productivity tools, and physical facilities to support quality teacher education programs. In regard to funding infrastructure, the National School Boards Association (2001) stated,

> Beyond the special needs of students, our schools need greater federal funding in many other areas. These include teacher hiring, training, and professional development. Many schools also need modern computers and other technology to improve learning and ensure that children are technologically proficient and prepared to succeed in the electronic information climate. Finally, many schools need additional money for construction and renovation. (National School Boards Association, 2001, Policy Research Brief, Federal Funding for Education)

Lynch (1991) identified 428 colleges or universities that offered one or more preservice vocational teacher education programs. However, he questioned the validity of these numbers, since at least 10.0% had closed their vocational teacher education programs or had not graduated any vocational teacher education students in years. Bruening et al. (2001) updated Lynch's list to determine if the number of programs and administrative characteristics had changed over the past 10 years. They identified 385 institutions (a decrease of approximately 10.0% from 1991) that prepared career and technical teachers for certification.

The public supports the need for highly qualified teachers. Rose and Gallup (2001) asked respondents to the 33rd annual Phi Delta Kappa/Gallup Poll of the Public's Attitudes Toward the Public Schools to rate six strategies for addressing the teacher shortages expected due to retirement and increased student enrollment. The strategy with the highest support (89.0%) was to make it easier for teachers to transfer pension benefits and to receive salary credit when changing jobs between school districts and states. The second-highest supported strategy (88.0%) was to raise teacher salaries. The third highest supported strategy (73.0%) was to have the federal government provide loans that would be forgiven if a prospective teacher entered the field of teaching. And, the fourth-highest supported strategy (61.0%) was to recruit qualified teachers from other countries. The two strategies with the highest level of opposition included lowering state requirements for the training to become a licensed teacher (82.0%) and permitting persons with bachelor's degrees to become teachers without requiring preparation in the field of education (67.0%).

The National Alliance of Business (2001) reported that "we must have superbly prepared teachers . . . . We will not get there unless we expect much of

teachers and ensure that they have the knowledge and tools to do their jobs effectively. We will not get there without fundamental changes in the way we prepare, support, and compensate teachers" (p. 6). The report went on to say, "Teacher preparation programs must ready teachers to teach in a standards-based system by aligning courses within arts and sciences and schools of education and tying teacher preparation to student standards. Professional development must be designed around improving knowledge and skills necessary to help all students reach standards" (p. 8). The National Alliance of Business concluded that business leaders, policymakers, governors, school boards, and educators must work together to elevate teaching to a profession and stated that "we commit to making substantial financial, social, and political investments in teaching for however long it takes to accomplish this goal" (p. 8).

Teacher licensure and standards. Teacher certification varies greatly across states, and can be obtained in a number of different ways depending upon the requirements established by each state. Several types of certificates are available, including: initial/probationary, regular/permanent, emergency, private school, and alternative. The certificate requirements for each of the 50 states, the District of Columbia, the Department of Defense Dependents Schools, 10 Canadian provinces, and New Zealand are available from the National Association of State Directors of Teacher Education and Certification (2001). Most states have separate certification for administrators, teachers, and other school professionals such as librarians, reading specialists, and counselors.

Although numerous routes are available to obtaining a teaching certificate, relatively few studies on the effects of certificates on student achievement have been reported. Hawk, Coble, and Swanson (1985) found a strong positive effect of teacher certification on student achievement in mathematics, using a matched comparison group study that included 36 in-field and out-of-field teachers paired with students of the same general ability level. The student data included both pre- and post-tests at the beginning and end of the school year in mathematics. Courses taught by certified teachers of mathematics had students who performed significantly better in general mathematics and algebra than students who were taught by uncertified teachers of mathematics.

Monk (1994) examined data from the Longitudinal Study of American Youth (LSAY), and found that teachers who had courses in their subject matter area as well as courses in education contributed positively to student achievement. In fact, the contribution of coursework in education often contributed more to student achievement than did teacher coursework in their area of emphasis or expertise.

Druva and Anderson (1983) reviewed the research on more than 65 science education studies. They found consistently positive relationships between students' achievement in science and teachers' backgrounds in both education courses and

science courses.

Using the NELS: 88 database, Godhaber and Brewer (2000) followed 8th graders in 1988 through the 12th grade in 1992. They compared how teacher certification and other training-related variables influenced 12th grade student achievement in mathematics and science, controlling for a range of student background factors including 10th grade scores. A total of 3,469 mathematics and science teachers were included. Of all teachers, 2,800 had received certification, although it was not possible to determine if it was in-field or out-of-field, and 24 science teachers and 34 mathematics teachers held temporary or emergency certification. Goldhaber and Brewer also found that students whose teachers possessed a bachelor's or master's degree in math outperformed students in math and science when teachers were uncertified or had certification in other areas.

Walsh (2001), in a report prepared for the Abell Foundation, reported little relationship between teachers' educational preparation and student achievement. Walsh explained that the research on teacher certification and teacher quality was flawed and outdated. Based on her research, she recommended that course requirements for certification be eliminated, and school principals be allowed to hire anyone with a bachelor's degree that had passed a subject-matter examination.

Teach for America has recruited talented liberal arts graduates from competitive colleges, offered the graduates special training, and placed them in difficult U.S. public schools. In an evaluation of Teach for America, Raymond, Fletcher, and Luque (2001) found that in spite of the fact that Houston Teach For America teachers were placed in more difficult classrooms than other teachers, they performed as well as and, in many cases, better than non-Teach for America teachers. Teach for America teachers were also reported to be less likely to leave the classroom after one year. Raymond et al. dispelled the notion that Teach for America was an inferior source of teachers, and showed that different approaches to teacher preparation are feasible.

Studies of the effects of teacher certification in career and technical education on student achievement are few. Erekson and Barr (1985) reviewed the literature on the effects of teacher certification on student achievement in vocational education. They concluded that the literature had so many methodological problems very few conclusions could be drawn.

The National Board for Professional Teaching Standards (2001) identified five core propositions that describe the knowledge, skills, and dispositions that characterize accomplished teaching and has created standards for the nation's K–12 teachers including:

1. Teachers are committed to students and their learning.
2. Teachers know the subjects they teach and how to teach those subjects to students.

3. Teachers are responsible for managing and monitoring student learning.
4. Teachers think systematically about their practice, and learn from experience.
5. Teachers are members of learning communities.

Standards have been developed for Early Adolescence through Young Adulthood/ Career and Technical Education and, as of the year 2000, there were 248 National Board Certified CTE teachers.

Innovative programs. One of the major suggestions emanating from policy studies for improving education has been to ensure that students are achieving at higher levels of academic and technical competency. Career and technical education has a long history of responding to national needs and initiatives. As the U.S. transitioned from an agriculturally dependent economy to an increasingly industrial one, career and technical education played an important role in responding to challenges through its educational programming. This willingness to adapt to new needs is now being applied, as the nation moves to a knowledge-based economy.

Practitioners, researchers, and others often ask for examples of high quality career and technical education programs that can be emulated at other locations or studied to determine what makes them successful. Budke and Bragg (2000) conducted an extensive, rigorous search to identify exemplary and promising career and technical education programs. A total of 140 career and technical education programs applied for this distinction. An external review panel then visited final candidate programs, prior to assigning exemplary or promising designation. The following four criteria were used to select the exemplary programs and promising practices. First, the programs had to be of overall high quality, upholding clear and relevant learning goals that conformed to recognized standards. Second, they had to maintain educational significance on individual and societal levels. Third, the programs had to be able to produce evidence of success. Finally, the programs had to be replicable in other settings. As a result of this process, 4 secondary and 2 postsecondary programs were designated exemplary, and 20 secondary and 6 postsecondary programs were identified as promising. The four exemplary secondary career and technical education programs included programs in culinary arts and hospitality services, digital design, tech prep electronics technology, and welding technology fabrication. The two exemplary postsecondary career and technical education programs included programs in associate degree nursing and telecommunications.

Accountability and assessment. Evaluation has been an area of concern for career ant technical education for many years. Early evaluation efforts centered on conducting follow-up studies to determine whether vocational education graduates

found placement in jobs related to their training. The 1963 Vocational Education Act was one of the first pieces of federal legislation directing the states to conduct evaluations of their vocational education programs. Since that time, legislation has continued to recognize the importance of evaluation.

Teacher supply and demand. The debate over teacher supply and demand is contentious to say the least. According to a National Education Association (NEA) Fact Sheet (n.d.), the nation is in the early stages of the worst teacher shortage ever experienced. The NEA argues that a combination of the following conditions are contributing to the emerging shortage: growing student enrollments, class size reductions, a graying teacher work force, and the growing salary gap between teachers and other college graduates.

Divergent views have suggested that the alleged teacher shortage is not as acute as claimed by the NEA. Bradley (1999) observed that as daunting as the projected 2 million shortfall in teachers appears to be, it does not mean that the nation is suffering from a teacher shortage. While some Sun Belt and fast-growing states may be scrambling to find teachers, other states are consistently producing more than they can hire (Bradley, March 10, 1999).

Growing enrollments and teacher demand. The U.S. Department of Education (1998) estimates that 2.4 million teachers will be needed in the next 11 years because of increased student enrollments and teacher attrition and retirement. Public school enrollments are projected to exceed 54 million by 2008—an increase of nearly 2 million over the 1998 enrollment level. High-school enrollments will grow by 26.0% while elementary enrollments are expected to increase by 17.0%.

The teacher shortage problem may be further compounded because the anticipated need for teachers is not evenly distributed across the nation, nor across grade levels or program areas. In high-poverty urban and rural districts alone, The U.S. Department of Education (1997) estimated that more than 700,000 teachers will be needed in the next 10 years.

However, raw numbers do not present the total picture regarding the projected need for teachers. According to the U.S. Department of Education (1998) 42.0% of all public schools in the United States have no minority teachers. Minority students make up 33.0% of enrollment in U.S. public schools, while the total of minority teachers is just 13.5%. Furthermore, the ranks of minority teachers are expected to reach an all-time low of 5.0% in the early stages of the 21st century while 41.0% of the American students will be minority.

Teacher turnover and compensation. The National Center for Education Statistics (as cited by the National Education Association, undated) stated that the teacher shortage problem will be compounded by the fact that half of the teachers who will be in public school classrooms 10 years from now have not yet been

hired. Typically, an estimated 6% of the nation's teaching force leaves the profession yearly, and more than 7% change schools. Additionally, 20% of all new-hires leave teaching within 3 years, and in urban districts close to 50% of all newcomers leave the profession during their first 5 years of teaching.

Reasons for such high attrition could be due, in part, to general working conditions and unrealistic expectations regarding what the teaching profession entails. However, two significant factors that may contribute to teacher turnover relate to inadequate induction into teaching during the first year of employment and inequity in the compensation of teachers as compared to other college graduates of the same age cohort.

During the past 9 years, less than half of the teachers who were hired within that time frame participated in formal induction programs during their first year of teaching. Furthermore, teachers 22-28 years old earned an average of $7,894 less per year than other college-educated adults of the same age. The gap was three times greater for teachers 44-50 years old, and was the worst among teachers with master's degrees—who earned $32,511 less than non-teachers (Education Week on the Web Quality Counts, 2000).

A divergent view. There are differing views regarding the issue of a looming teacher shortage. In addition to Bradley (1999), Feistritzer (1984) observed:

> The teacher shortage "crisis" has been resurrected—again. It seems every few years this issue is trotted out and used to get more money, more programs, more publicity, more political points—all in the name of meeting the huge demand, now said to be two million new teachers in the next decade.…The first problem with the claim that we'll need millions of new teachers is in what exactly "new" means. When most people hear those words, they think it means teachers who have never taught before. Well, that's not what it means. (Wall Street Journal, January 28, 1998)

Feistritzer analyzed NCES data that revealed that, of the 139,000 new public school teachers hired in 1993-1994 (the latest year for which data were available), 42.0% had just finished college and had never taught before. Twenty-four percent were doing something other than going to college the year before teaching but were teaching for the first time. The remaining 34.0% of new teachers were actually former teachers coming back into the profession. In 1987-1988, 52 percent of the new teachers were re-entering the profession. Based on 1993 U.S. Census Bureau data, there were more than 6 million people holding at least a bachelor's degree in education. Feistritzer concluded that there are plenty of people in the country who are fully qualified to teach who are not teaching.

Cornett, as cited in Bradley (1999), pointed out that the nation cannot be painted with a broad brush. For example, Connecticut, Minnesota, New York,

Pennsylvania, and Wisconsin consistently produce more teachers than their schools hire—although some urban districts in those states persistently experience shortages in qualified teachers. In 1996-1997, New York licensed 21,500 teachers, but only 5,900 were hired. Still, during that same year, New York schools hired 9,000 unlicensed teachers, mostly in New York City.

In Oklahoma, the Southern Regional Education Board (1998) completed a detailed study of teacher supply and demand, and found that the problem was not a lack of mathematics teachers. It was that people who were certified to teach math were not working in schools. Only 54.0% of college graduates trained between 1994 and 1996 to teach math were actually teaching that subject by 1996. The likely reason was that starting math teachers earned $24,000, while math majors could earn $40,000 to $50,000 in the computer field when fresh out of college. Darling-Hammond (as cited in Bradley, 1999) pointed out that states need to be more strategic in pinpointing where teachers are needed and in what fields before determining a course of action.

Reliable teacher supply and demand data directly related to career and technical education have not been readily available. However, it was noted that in some regions of the country, there were reported shortages of family and consumer sciences teachers and technology education teachers. But even in the absence of hard teacher supply/demand data, based on selected circumstances confronting public education in general, there are some issues that have direct implications for career and technical education:

1. Are there geographic regions and/or career/technical fields that will be facing teacher shortages and if so, where are they?
2. How can teacher supply/demand imbalances across various regions and program areas in career and technical education best be addressed?
3. How will an increasingly diverse student clientele and declining minority teacher population impact career/technical education, and what appropriate actions will need to be taken?
4. What recruitment and retention measures should be considered to attract and retain quality career/technical education teachers?

A Futuristic Scenario

Career and technical teacher education programs occur in a variety of administrative units, and with many organizational arrangements (Bruening et al., 2001; Lynch, 1991). In preparing a futuristic scenario, it is necessary to first have a framework in which to present the scenario.

Lynch (1996) identified 10 principles that serve as the foundation upon which high quality vocational and technical teacher education may be based including:

1. Faculty are committed to their students and to students' professional development as lifelong learners.
2. Faculty use curriculum and instructional techniques to integrate theory with practice, academic and workforce education, professional education and subject matter, and learning theory and workforce preparation.
3. Faculty understand the philosophy, contemporary concepts, research, effective practice, and methods of inquiry related to workforce preparation and development.
4. Faculty use dynamic pedagogy, based on learning theory and practices appropriate for youth and adults.
5. Faculty are partners in learning communities through which they model collaboration and democratic processes for their students.
6. Programs are dynamic and change-oriented.
7. Programs are grounded in academic education, workplace subject matter, workplace processes, technology, professional education and pedagogy, and clinical experiences.
8. Programs reflect cultural diversity.
9. Colleges and universities (and administrative structures) offering programs that prepare vocational-technical teachers are committed to such preparation and provide adequate resources to sustain them at high quality levels.
10. Colleges and universities provide a clearly identified group of academic and clinical faculty for whom vocational and technical educator preparation is a top priority.

Sears and Hersh (1998) reported a framework that included the components for designing teacher education programs that was developed based on the work of Howey and Zimpher (1989) and, to a lesser extent, Katz and Rahts (1982). The framework suggested that the following components be considered when designing effective teacher education programs:

1. Goals—the mission, values, and objectives of the teacher education program;
2. Curriculum—the skills, competencies, philosophical principles, and academic disciplines transmitted to students via the activities and events constituting the teacher education program;
3. Instructional Strategies—the instructional techniques and approaches modeled by the faculty and taught to preservice teachers;
4. Contexts—the various contexts (classrooms, laboratories, community, workplaces) in which student learning occurs;
5. Learners—pre-service student characteristics such as age, sex, socioeconomic status, intellectual ability, ethnicity, and any other characteristic that can be thought to be related to the nature and outcome of teacher education programs;

6. Staff—characteristics (age; education; ethnicity of the faculty, classroom teachers, and other staff connected with the teacher education program);
7. Themes—threads that tie key concepts together throughout a variety of courses, practica, and school experiences. Themes can take on the nature of a primary concept of learning how to teach, or can be articulated in terms of a basic respect for something such as individual diversity;
8. Ethos—the intellectual and social climate or atmosphere of the program;
9. Partnerships—planned relationships with other agencies or institutions to further shared goals and values;
10. Regulations—the laws, regulations, legal restrictions, and stipulations related to teacher education and certification, as well as the requirements of school districts, local education authorities, national certifying bodies, etc;
11. Location—the location of a teacher education program on a conventional campus, urban commuter campus, a teachers' center, campus laboratory school, etc., and the type of location (urban, rural, suburban). (pp. 9-10)

The framework has recently been revised to include five components of teacher education: mission/scope; curriculum and instruction; roles, responsibilities, and relationships; governance; and evaluation.

A Scenario

This scenario was developed based on the Sears and Hersh (1998) framework for contextual teaching and learning and the factors influencing career and technical education presented earlier. The framework allows a career and technical teacher education program to incorporate the 17 questions to be asked in analyzing teacher education programs developed by the Council for Basic Education (2001) and the principles of high quality vocational and technical teacher education identified by Lynch (1996). The framework (see Figure 1) builds on the major points discussed earlier, and provides a clean slate for thinking about the future.

For this article, a hypothetical university—Utopia University—is used to present a scenario for career and technical teacher education. Utopia University is a state university, established in 1890, with an enrollment of approximately 23,000 students. The mission statement of Utopia is to offer a range of student-centered educational programs in the liberal arts, the sciences, and the professions; advance and disseminate knowledge; and provide public service. The University president promotes active outreach and engagement activities to extend the university to the entire state. The university is composed of seven colleges: Agriculture and Life Sciences, Arts and Science, Business, Design, Education, Engineering, and Human Ecology. Each college dean reports to the provost. Utopia University is the second-largest university and largest career and technical teacher education program in that state. Students wishing to be admitted to Utopia University must have completed

16 units of required academic courses—four units (years) of English, four units of mathematics, three units of social sciences, three units of natural science, and two units of a foreign language. Additionally, prospective first-year freshmen seeking admission to the University shall be ranked in the 50th percentile or higher of their graduating class in an accredited high school.

Students may enter career and technical teacher education through one of three routes. First, regular undergraduate students are admitted based on passing the Praxis I examination and earning an overall GPA of 3.0 or higher. The career and technical teacher education interdisciplinary program is housed in four separate colleges: Agriculture and Life Sciences, Business, Education, and Human Ecology. An interdepartmental council governs the career and technical teacher education program. Responsibility for the program rotates among the colleges every three years. The agriculture, business, education, and human ecology programs each graduate approximately 25 students a year who have completed an undergraduate program in teacher education. These students have completed a total of at least 135 semester credit hours in order to graduate with a bachelor of arts or a bachelor of science degree. These 135 credit hours are distributed among courses in general education (30 credit hours) across the university, courses in the college (60 credit hours) in which their teacher education program is offered, and courses in teacher education (45 credit hours) across the four areas offering teacher education. These students must pass the Praxis II: Subject Assessments and Principles of Learning and Teaching Tests during their last year of college. In order to obtain a teaching license, students must be enrolled in a mentoring program for first-year teachers and pass the *Praxis III: Classroom Performance Assessments* by the end of the first year of teaching.

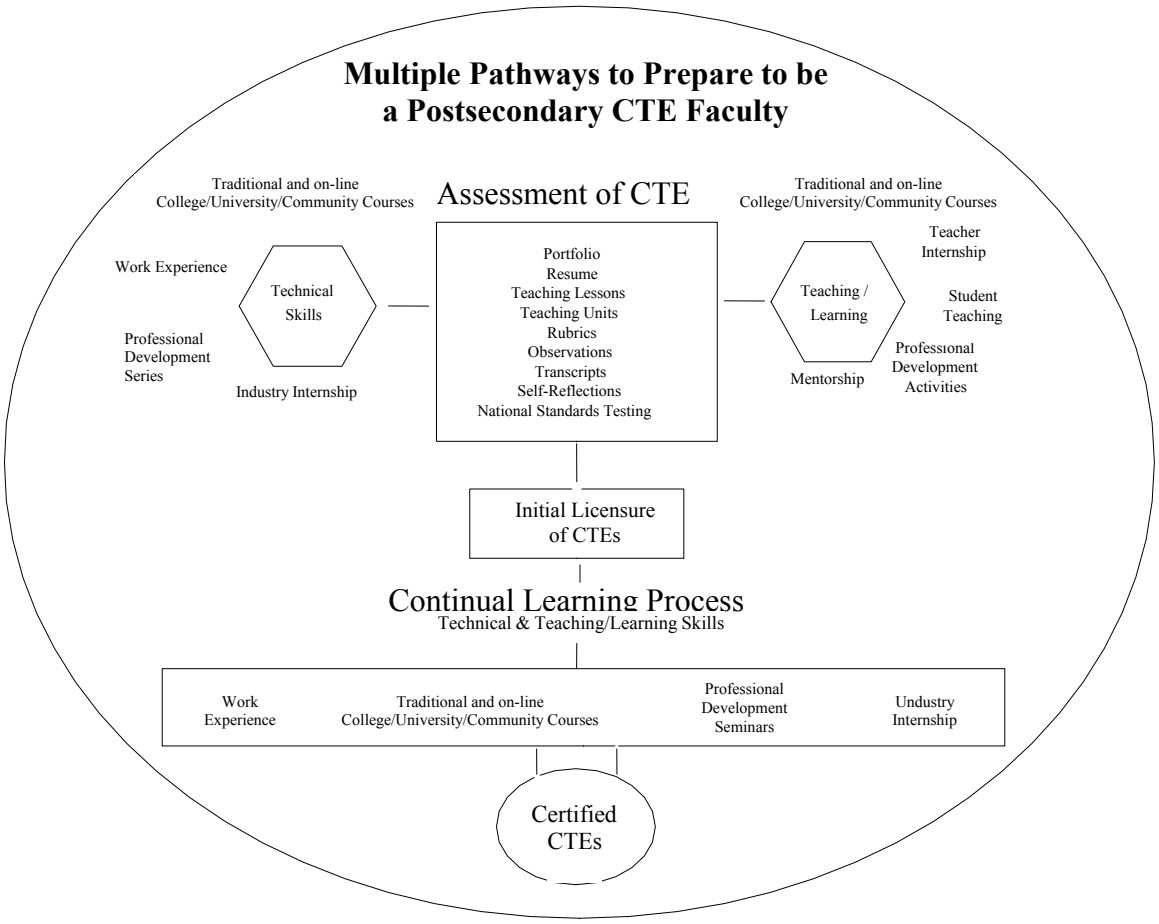

FIGURE 1. *Multiple paths for becoming a postsecondary career and technical educator.*

Second, students who have a bachelor's degree in one of the four colleges may also qualify for admission to the teacher education program of that college by passing the Praxis I academic skills and Praxis II subject matter and principles of learning and teaching examinations. These students will then be enrolled in the master of education degree program (30 semester graduate credits), which includes courses in planning and preparation, the classroom environment, instruction, and professional responsibilities. Individuals enrolled in the master of education degree program must pass the Praxis II: Subjects Assessments and Principles of Learning and Teaching Test prior to their participation in a year of supervised internship at a local education agency that is willing to employ them on a one-year probationary basis. In order to receive a teaching license, they must successfully pass the Praxis III: Classroom Performance Assessments examination by the end of their probationary one-year program.

Third, an alternative licensure program (two-years in length, and including 25 semester credits in planning and preparation, the classroom environment, instruction, and professional responsibilities) is available for individuals who are occupationally qualified, but do not have a bachelor's degree. In order to enter this program, prospective students must pass the Praxis I exam, Praxis II subject matter and principles assessment, and have been tentatively approved for employment by a local education agency. This program is taken concurrent with their first two years of employment, and includes 25 semester credit hours in planning and preparation, the classroom environment, instruction, and professional responsibility. They must pass the Praxis II examination at the end of the two-year, 25-semester-hour program to continue in the alternative certification program. The individual must also be enrolled in the school's beginning teacher assistance program—including a mentorship and supervised internship. After completing the two-year program and passing the Praxis III Classroom Performance Assessments, and no later than the end of their third year of teaching, the students will be licensed.

Faculty with full-time responsibilities for career and technical teacher education, by college, are as follows: agriculture (five), business (four), education (six), and human ecology (three). Approximately 97.0% of the students accepted in the program graduate. Utopia University has, historically, been looked upon as the major source of teachers for career and technical education in the state.

Goals. Two years ago, the four career and technical teacher education programs held a planning conference to bring the faculty, staff, and students together and develop a mission, goals, and objectives. The mission that emerged for the career and technical teacher education program was, "We are a premier source of professionals and knowledge essential for meeting the workforce needs of youth and adults as they function in their workplace, community, and family."

The principles that guide their work include:

1. We are student-centered in our approach to teaching and learning.
2. We use teaching principles that develop our students' academic and technical skills in a variety of contexts in order to solve individual and group problems related to their families, communities, and work.
3. We believe in the worth of all individuals and careers.
4. We continually strive to improve the quality of everything we do.
5. We outperform others in meeting the needs of the workplace, community, and family.
6. We are reliable and timely.
7. We are relevant to people's lives and their communities.
8. We have a sense of urgency in all we do.
9. We support the personal and professional growth of our faculty.
10. We act with integrity, honesty, and a sense of ethics.
11. We keep our commitments.
12. We are accountable for our activities.

Curriculum. The career and technical teacher education courses are developed based on the Danielson (1996) framework for teaching that includes four domains of teaching responsibility: (a) planning and preparation, (b) classroom environment, (c) instruction, and (d) professional responsibility. Using Danielson's framework should enable the students to be proficient in the knowledge and skills to enter beginning teacher assistance programs and to pass the Praxis III examination at the end of their first year of teaching. The faculty is well-grounded in the philosophy of career and technical education, and has provided excellent examples of courses that integrate theory and practice. The syllabi for the courses in career and technical education specify the problem-based learning, self-regulated learning, and higher order thinking strategies that will be included. Additionally, the syllabi identify and describe the contexts in which the course will be offered.

Career-technical teacher education students participate in a 3-week internship between their freshman and sophomore year in college. This internship is usually in a public school or institution, and is designed to give real teaching experiences prior to being admitted to the teacher education program. Students are required to have actual work experience in a business or industry related to their teaching area. The required work experience is documented through paid work experience (full- or part-time) or college internships prior to entering the teacher education program.

Instructional strategies. The faculty emulates contextual and constructivist approaches to teaching and learning. These approaches include problem-based learning that encourage higher order thinking skills; meaningful engagement through reflection and self-evaluation; addressing students' cultural and social

context; multiple authentic assessments to address students' knowledge and skills; cooperative learning in group settings; and small group interactions.

Contexts. The faculty assumes that learning occurs in multiple contexts. These contexts include families, business and industry, and classrooms and laboratories.

Learners. Learner characteristics such as age, gender, socioeconomic status, intellectual ability, and ethnicity are important items that the faculty takes into consideration in developing their courses and the career and technical teacher education program. Issues such as equity and diversity are incorporated in the career and technical teacher education program. The career and technical teacher education program also takes into consideration ethnic, cultural, and socioeconomic factors in determining the location of the field experiences. The faculty attempt to place students in field experience contexts that are different from those that the students have previously experienced.

Staff. The faculty considers all those involved in the teaching and learning process to be staff. Staff include individuals such as the faculty themselves, administrative and office associates, graduate students, mentors, and field experience instructors and administrators.

Themes. Several themes are used to ensure that the career and technical teacher education program is coherent across all of its courses. These themes include: cultural competence, gender equity, academic and technical skill integration, content relevance, accountability and assessment, educational technology and distance education, and life-long professional development.

Ethos. Faculty in the career and technical teacher education program make it clear that the strength of their program is based upon student-centered learning, mutual respect for one another, and the worthiness of all occupations. Additionally, the faculty demonstrates a respect for equity and diversity in their program.

Partnerships. The faculty and staff at Utopia University are dedicated to having a seamless program and process that ensures the teaching and learning process results in high quality teacher education graduates. In order to develop a seamless system, it is essential that Utopia University form partnerships with cooperating agencies. The career and technical teacher education program at Utopia University has critical alliances with the state department of education, local education agencies providing field-based experiences, and the professional career and technical education teacher associations.

Regulations. The career and technical teacher education program at Utopia University relies upon the The Praxis Series: Professional Assessments for Beginning Teachers, and consists of three separate tests. The Praxis I assessment of

academic skills must be passed prior to admission to the career and technical teacher education program, no later than the end of their sophomore year. Students must pass their Praxis II test of their subject matter no later than the end of their last year of college. The Praxis III performance assessment of actual teaching skills and classroom performance is administered by the end of the first year of teaching, except for those teachers who are in the alternative licensure program, where it is administered at the end of the third year of teaching.

Location. The career and technical teacher education program's main location is on the Utopia University central campus. However, the program also considers extended locations at the education agencies participating in students' field experience, educational agencies hiring the graduates of the program, and the state education agency.

Policy Implications

It is essential that states have a high quality work force, if they are to be economically competitive. When individuals increase their academic and technical skills, they can move into the workplace and be more productive as well as increase their earnings. Policymakers, recognizing these facts, have identified education as an important issue, and have been keenly interested in increasing the academic and technical skills of American students in order that these individuals can more effectively participate in an international economy as world-class workers and citizens. The major policy initiatives have included setting high standards, increasing the courses required for graduation, and establishing high stakes testing. Although the preparation of high quality teachers is critical in helping students achieve at higher levels, relatively little has been done to improve the quality of teacher education. Even less attention has been given to career and technical education teacher educators, who have an equally challenging responsibility in teaching both technical and academic skills to their students.

Producing high quality career and technical teachers that are knowledgeable of their content and pedagogy is a way that states can equip students with high levels of technical and academic skills. This, in turn, can help states and the nation have a higher quality work force and become more economically competitive.

This section identifies policy actions that should be considered at the federal, state, and local levels, and by business and industry, to improve the quality of career and technical teacher education.

Federal Level

Congress should amend the Carl D. Perkins Vocational-Technical Education Act Amendments of 1998 to include providing undergraduate scholarships for high

quality students enrolled in career and technical teacher education programs.

Congress should amend The Carl D. Perkins Vocational-Technical Education Act Amendments of 1998 to include providing funds to support career and technical teacher education infrastructure (classrooms, buildings, and equipment—including technology) and internships in business and industry for career and technical teacher educators.

Congress should amend the Carl D. Perkins Vocational-Technical Education Act Amendments of 1998 to provide leadership development awards (including subsistence for individuals and their dependents, and tuition and fees for institutions of higher education) for individuals to attend graduate education programs in order to meet the needs for qualified career and technical education personnel, including teacher educators, researchers, administrators, supervisors, and instructors.

The U.S. Department of Education, Office of Vocational and Adult Education, in cooperation with related organizations and practitioners, should provide leadership in developing rules and regulations to enhance and improve career and technical teacher education.

The U.S. Department of Education, Office of Vocational and Adult Education, should sponsor conferences and forums that address the concerns and issues of career and technical teacher education.

National Level

Career and technical teacher educators should encourage national education associations (e.g., Association for Career and Technical Education, American Association of Community Colleges, Council of Chief State School Officers, National Association of State Universities and Land-Grant Colleges) to support workforce development through activities such as conference programs, special studies, and professional writings.

The Association for Career and Technical Education and the American Association of Community Colleges should promote career and technical education and the professional development of its teachers involved in workforce development, and encourage legislative and policy efforts with national business organizations (e.g., National Alliance of Business, National Association of Manufacturers, Business Roundtable, U.S. Chamber of Commerce, and other national trade organizations).

The Association for Career and Technical Education and the American Association of Community Colleges should promote workforce development through career and technical education with national associations (e.g., National Governors Association, National Conference of State Legislatures) and encourage them to develop policy recommendations for Congress and the President.

State Level

State legislatures should enact legislation to support workforce development programs through career and technical education, and support affiliated high quality teacher education programs offered by colleges and universities.

State legislatures should provide financial incentive programs such as scholarships, student loan forgiveness, signing bonuses, and housing programs to increase the supply of high quality career and technical teachers.

State legislatures should provide financial support for those career and technical education teachers who seek and achieve National Board for Professional Teaching Standards certification.

State legislatures should establish a coordinating board for career and technical teacher education that would align teacher education programs with state and local standards; advise on the development of licensure and certification compatible with career paths for teachers; recommend exchange programs with business and industry; coordinate resources; and evaluate accomplishments of teacher education.

State education personnel should monitor federal legislative and policy practices that negatively impact career and technical teacher education, and take appropriate actions as warranted.

State legislatures should provide incentive funds for hiring career and technical education teachers who are willing to accept challenging teaching assignments (e.g., districts or schools that have a high proportion of families with low socioeconomic status, districts or schools in isolated rural areas and low-income inner-city areas, and students with special needs).

State legislatures should provide venture capital for career and technical education teachers to try innovative ways of improving students' academic and technical knowledge and skills.

State education agencies and the board for higher education should coordinate their efforts related to career and technical teacher education.

State education agencies and career and technical teacher educators should establish customized standards for quality career and technical teacher education programs that include multiple career paths in order to attract, motivate, and retain high quality teachers—resulting in an increased supply.

State education agencies should monitor institutional efforts in career and technical teacher education to ensure standards are met.

State education agencies should sponsor and convene programs, conferences, and forums on the status and best practices related to career and technical teacher education.

State education agencies should identify and nurture career and technical educators that have the potential to become effective advocates and leaders for related career and technical teacher education and state and federal legislation/policies.

State teacher licensing agencies should allow career and technical education teachers' licenses and credentials to be transferable across state lines.

State teacher licensing agencies should provide for alternative licensing and certification for programs for nontraditional teacher candidates.

Presidents, deans, and career and technical teacher education faculty should develop a policy for college and university career and technical teacher education's role in workforce development, and design programs to meet that role.

College presidents and deans should place more emphasis on developing high quality career and technical teachers in order to expand the student base for recruiting outstanding students known to be interested in occupations related to their colleges (e.g., agriculture and life sciences, business, health, human ecology, and technology).

College and university career and technical teacher education faculty should establish technical and pedagogical standards for what it takes to be a career and technical education teacher.

College and university career and technical teacher education faculty should recruit prospective career and technical education teachers from diverse population bases.

Career and technical teacher education programs should be student-centered and emphasize both theory and practice.

Career and technical teacher education programs should include knowledge and skills on current topics such as the integration of academic and technical skills, career clusters, career academies, accountability and assessment, and career development.

Career and technical teacher education faculty should conduct research on topics such as career and technical education supply and demand of teachers, the amount and kind of academic and technical skills that career and technical education students need, the degree to which teachers prepared by different means (e.g., baccalaureate, post-baccalaureate, and alternative certification) contribute to students' achievement of academic and technical skills, the effectiveness of teacher education programs delivered through distance education, and factors contributing to recruiting teachers from diverse populations.

College and university career and technical teacher education faculty should develop multiple entry points into the program (e.g., baccalaureate, post-baccalaureate, and alternative licensure) for nontraditional students.

College and university career and technical teacher education programs should include information on the use of technology in their programs.

College and university promotion and tenure guidelines should be revised to give more recognition for outreach and engagement activities such as teacher education programs.

College and university career and technical teacher education faculty should form partnerships with state education agency personnel, community colleges, local education agencies, and professional teacher associations in developing induction and mentoring programs for beginning teachers.

College and university career and technical teacher education faculty should form partnerships with state education agency personnel, local education agencies, and professional teachers associations in designing professional development programs with outcomes tied to standards and assessment that are data-driven.

College and university teacher education faculty should be encouraged to spend time in the classrooms of local education agencies.

College and university teacher education programs should place higher emphasis on helping prospective teachers understand and be able to meet the education and social needs of a diverse student base.

Local Level

Local education agencies should provide compensation for career and technical teachers that is market-driven, and provide higher pay for teachers who do more work and are judged to be among the best.

Local education agencies should develop induction and mentoring programs for their beginning teachers.

Teachers should have quality time and financial assistance available for professional development programs.

Teacher evaluation should include input by principals and peers and be performance-based, including teachers' knowledge of course content, program planning and preparation, the classroom environment, instruction, and professional responsibilities.

Local education agencies should provide venture capital for career and technical education teachers to try innovative ways of improving students' academic and technical knowledge and skills.

Business and Industry

Career and technical teacher educators should form partnerships with business and industry leaders, and ask them to serve on advisory councils to advise on the

technical and academic knowledge and skills employees need.

Career and technical teacher educators and teachers should ask business and industry to provide internship and educational opportunities for updating their knowledge of the workplace.

Career and technical teacher educators should ask business and industry to serve as speakers in their classes.

Endnotes

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Preparing, Licensing, and Certifying Postsecondary Career and Technical Educators

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Abstract

The purpose of this manuscript is to synthesize the available literature on preparing postsecondary career and technical educators and disseminate potential methods to develop postsecondary career and technical educators. One concern that emerged throughout the analysis of literature was that a preponderance of the writing focused on career and technical teacher preparation at the secondary, not postsecondary, level. Another limitation, that became apparent when attempting to discover the knowledge, skill, and ability considered necessary to become a postsecondary career and technical education (CTE) teacher, was that this information is not readily available, and can be confusing within states. With these limitations, the empirical evidence to guide CTE administrators, college faculty, and policymakers on preparing, licensing, and certifying postsecondary career and technical educators is deficient. This paper presents an overview of the information that was available and presents methods that could be used—and would definitely need to be examined through a systematic research plan—to evaluate the impact on students and teachers.

Career and technical education (CTE) administrators at the postsecondary level are challenged to fill faculty vacancies with individuals who are prepared and qualified to deliver CTE instruction. Indeed, this is not a new challenge for CTE administrators. In 1985, Erekson and Barr reported that at the secondary-level, provisional certificates were being issued to relieve the shortage of occupational skills teachers. Filling these positions will continue as an increasing concern, with the escalating shortage of teachers in CTE fields (Wright, 2001a). With a lack of licensed teachers available to fill positions in the secondary schools, many alternative options are being pursued to qualify teachers to enter the classroom. These challenges are not only face secondary career and technical educators, but also affect other levels of education, such as community and technical colleges.

The field of CTE is faced with the charge to place qualified instructors into the postsecondary classroom. At the same time, career and technical teacher preparation programs have reported a shortage of teachers and have reduced the number of programs across the nation (Lozada, 1999). In 1994, Lynch reported that colleges and universities in the United States have decreased their capacity to train teachers for the CTE field. As a consequence of the reduction of programs, Lynch

stated the enrollment of students in career and technical teacher preparation programs has also declined. These factors have caused the elimination of CTE teacher preparation programs across the nation. In turn, this will have a bearing on the number of individuals who seek to pursue a degree to teach CTE at the secondary and postsecondary levels.

An examination of the *Occupational Outlook Handbook* (2000–01) shows the fastest growing careers are in CTE areas. Many of the fields included within the high-pay areas that have growth potential are computer support specialists, registered nurses, secondary teachers, computer programmers, police patrol officers, paralegals and legal assistants, commercial artists, and medical and health service managers. In addition, other CTE areas are experiencing high growth, including database administrators, personal care and home health care aides, medical assistants, physician assistants, data processing equipment repairers, health information technicians, physical therapy assistants and aides, and dental assistants. These forecasts, combined with the associate degree being the projected education and training in highest demand from 1998 to 2008, will cause an even greater demand for teachers at the community and technical college level (U.S. Department of Labor, 2001).

Properly prepared and qualified CTE instructors are needed to educate and train students to be productive in many of the careers that are showing growth trends for the future. Faculty in CTE must have competence in the technical field, as well as the field of teaching and learning. Degree programs, many traditional in nature, are available to prepare career and technical educators to enter the classroom at the secondary level. Yet, despite these conditions, community and technical colleges are still challenged to acquire career and technical educators who are prepared. In addition, it is also a challenge for qualified community and technical college faculty in CTE to stay abreast of changes in their fields.

Definitions

It is imperative, before discussing certification and preparation, to understand key terminology. Even though sometimes used interchangeably, many definitions are very different in meaning. The following provides definitions for the terms. However, I want to specifically present the concern that the terms of licensure and certification are hard to differentiate.

Accreditation. The peer review process that schools, colleges, and universities undergo to determine whether an institution or program offering teacher preparation meets or exceeds professional standards of educational quality. Engineering, law, architecture, social work, psychology—all of the preparation programs in these professions are evaluated by their respective accrediting body.

> *Certification.* In education, certification means possessing qualifications beyond those required for a license...certification is the process by which a nongovernmental agency or association grants special professional recognition to an individual who has met certain predetermined qualifications.
>
> *Licensure*. The official recognition by a state governmental agency that an individual meets state-mandated requirements and is, therefore, approved to practice as a professional in that state.
>
> *National Board for Professional Teaching Standards.* An independent, nonprofit, nonpartisan organization has established a national, voluntary system to assess and certify teachers who meet high and rigorous standards for what accomplished teachers should know and be able to do. (National Teacher Recruitment Clearinghouse, 2001b, p. 1)

Licensure And Certification Procedures For Postsecondary CTE

Within the field of CTE, there is not just one universal set of procedures that are used for licensure or certification of all postsecondary teachers and it can be seen that the procedures differ widely from state to state. In some states, policies are nonexistent. In other states that have policies, the requirements are set by varied groups, including the regional accrediting agencies, local education agencies, state agencies, or a mixture of both state and local groups. Even in many of the states that have requirements, many are vague, hard to identify, and difficult to locate. With this said, it is apparent that individuals who are seeking to become postsecondary career and technical educators are challenged to identify how to enter the profession.

Some of the state and local education agencies have other standards in place for career and technical educators, instead of licensure and certification. These standards are the skills that career and technical educators should possess. However, in some instances, these standards are optional, and in other instances they exist but are not strictly enforced. While most secondary career and technical educators must complete a teacher licensure program and are then awarded a license to teach from the state, most postsecondary career and technical educators are not required to do so. In addition, there is an opportunity for the secondary career and technical educator to complete an optional national non-university certification administered by the National Board for Professional Teaching Standards (2001). This certification organization has identified standards for career and technical educators' knowledge of teaching and learning. This type of certification helps ensure that a teacher has teaching and learning skills considered necessary to be a master teacher.

Teaching/learning and technical knowledge areas for CTE. From reviewing the literature in CTE, it is apparent that career and technical educators must be experts in the technical competence and the area of teaching and learning. Since postsecondary career and technical educators work with students that range from high school age to adults, they need to be experienced in both pedagogy and andragogy. Knowles, Holton, and Swanson (1998) differentiated andragogy and pedagogy by stating "the concept of an integrated framework of adult learning for which the label andragogy had been coined to differentiate it from the theory of youth learning, pedagogy" (p. 58). In addition to the knowledge of learning theories, teachers should have the ability to development of curriculum and instruction, delivery instruction, assess students, and evaluate programs. When preparing postsecondary CTE community and technical college faculty, it is critical these elements are addressed.

To implement an approach that uses various methods to prepare, license, and certify career and technical educators, it is important for the CTE field to use standards to measure the desired educational outcomes for those individuals. These standards need to be developed for both the technical and teaching and learning areas. The *technical* area standards can be developed within each profession in the career clusters areas. Currently, the National Skill Standards Board (2001) is in the process of developing skill standards for many of the CTE career cluster areas. The *teaching and learning* standards can be developed across all areas of CTE and use a process similar to the National Skill Standards. The standards can be used to help assess whether CTE faculty have met certain competencies and that they are qualified and prepared to teach.

Variety of entry levels into postsecondary CTE. One problematic issue when discussing the preparation, licensure, and certification of postsecondary career and technical educators is the varying entry points and educational levels of the entrants into the profession. The National Teacher Recruitment Clearinghouse (2001b) reported teachers make career decisions to enter the profession when they were in middle school, high school, during their college years, or even later. Many individuals that enter the field of postsecondary CTE are making mid-point career changes, and some even enter the field after retiring from their careers (National Teacher Recruitment Clearinghouse, 2001a). Fugate and Amey (2000) reported career paths for the community college faculty member as primarily non-traditional. Similar to this, Furniss (1981) stated that few community college faculty entered college to pursue a career as a community college faculty member. Furthermore, it is important to understand factors that draw individuals to become a community college faculty member. Fugate and Amey stated the factors as (a) the tenure process at a 4-year institution could be avoided, (b) the community college matched their career desire to teach, (c) a terminal degree was not needed, and (d)

many of the faculty members had attended community colleges. Consequently, individuals enter positions as community college faculty for multiple reasons and with a variety of education levels—ranging from a high school diploma to a terminal degree. The rationale for developing several methods to prepare and certify career and technical educators is due to the variety of entry backgrounds.

With such a variety of entry points, a flexible plan is needed that will still enable community and technical colleges to fill vacancies with the best individuals. It would seem reasonable for these individuals to have, at minimum, a baccalaureate degree similar to that of most secondary career and technical educators. However, some individuals with exceptional work experiences could be an asset to students, and may not need to meet this requirement.

Another factor, such as accrediting agencies requirements, may also relate to the entry-level requirements of the CTE teachers. Further research is needed to examine the educational level of postsecondary CTE faculty and the impact of educational level on student achievement. These findings could o suggest changes in policies relating to the educational levels required of the CTE instructors.

Past and current practices for certifying postsecondary CTE. There is a dearth of literature on postsecondary CTE preparation, licensing, and certification due to the lack of licensing and certification at the postsecondary level, in general. Some states have reported having standards or certification for postsecondary CTE in place; however the guidelines are neither readily available nor standardized for use in other states. In some instances, these practices varied from one local agency to another within a state. In California, for example, the standards were different at the local levels.

I only found one national study that explored the certification of teachers in community colleges. The State Board of Directors conducted this national study for the Community Colleges of Arizona (1994b). They surveyed all of state community college directors and reported having a 74% (n=37) return rate. Of the responding states, a majority (78.4%, n=29) did not have certification requirements for postsecondary career and technical educators; 10.8% (n=4) reported having state certification, 8.1% (n=3) reported having a local certification, and 2.7% (n=1) reported having another type of certification procedure, which was not specified. When I contacted, the organization was unable to produce a list of states that had certification.

In the same study, community and technical colleges were asked if they had standards in place for career and technical educators. Almost half of the respondents (45.9%, n=17) had no set standards for career and technical educators. Twenty (54.1%) respondents reported having set standards. Thirteen (35.1%) of all respondents indicated that standards are set at the state level, while 8.1% (n=3) indicated that standards were set at the local level. Two respondents (5.4%)

reported having standards set at both state and local levels. In addition to this, 2.7% (*n*=1) reported that the state standards were optional and 2.7% (*n*=1) reported having standards that were set by other means, although not specified.

From these findings it can be seen that a majority of career and technical educators at the postsecondary level do not have certification. Also, it is evident that a large percentage of the postsecondary administrators do not have set standards to follow when filling vacant positions. These past practices can be seen as minimal, at best.

The current procedures for licensing career and technical educators vary greatly. In some states, the same procedures are required for all community and technical college teachers to enter the classroom. In other states, these procedures are for individuals only in the CTE areas. In Louisiana and Arkansas, postsecondary faculty members in some CTE areas are required to complete an occupational competency test or hold occupational credentials. Examples of occupational credentials are Airframe and Powerplant certification from the Federal Aviation Administration, Certified Systems Engineer from Microsoft Corporation, and the American Welding Society certification. The picture that forms when examining these procedures is unclear and inconsistent. The procedures that an individual would need to follow to make a transition from the workforce to the classroom are not easy to locate, identify, and interpret. With inconsistencies from state to state, and even within states, transition into teaching in a postsecondary career and technical education area is a concern.

Examples of state policies and procedures. The following are examples of requirements for licensure in states that have set policies and procedures for postsecondary CTE faculty. These examples are from states that have the most detailed information available. Arizona and Iowa require licensure of all community college teachers in both career-technical and arts and science areas.

Iowa requires that all community college teachers in the career and technical areas have 3 years or 6,000 hours of work experience in the technical area. In addition to work experience, new teachers must complete a new teacher workshop—within the first year of, and preferably before, teaching. The teachers are then required to take a course in curriculum development, instructional methods, measurement and evaluation of programs and students, foundations of vocational education, and an Iowa-approved course on interpersonal relations and are given 5 years to meet these requirements (Gary Borlaug, personal communications, August, 20, 2001). Arizona has different requirements for the licensure of career and technical educators, depending on the educational level of the instructor. A complete table of the requirements for occupational teaching fields is available from the State Board of Directors for Community Colleges of Arizona (State Board of Directors for Community Colleges of Arizona, 2001a).

Minnesota offers licensure for career and technical educators who are affiliated with schools in the Minnesota State College and University System. The minimum qualifications are specific to each field, but may include educational, occupational, professional, and other requirements. The requirements for full- and part-time faculty may be different. Career and technical educators must complete a Teacher Education Series (TES) core, including courses on the introduction to vocational education, student and trainee evaluation systems (vocational tests and measurements), course development (course construction), instructional methods (methods of teaching vocational subjects), and the philosophy and practice of vocational education. For the initial licensure, the individual must complete an introductory course on vocational education, whereas an applicant with an education degree is exempt from that initial requirement. Instructors have a time frame of 5 years to complete the other required courses. Two thousand hours of paid work experience during the previous 5 years, outside of teaching, is needed. Teaching experience, in the previous 5 years, in a postsecondary field may be substituted for up to 1,500 hours of work experience at the ratio of 2 hours' teaching experience for 1 hour of work. Some additional alternatives or substitutions are allowable for the work experience, including self- or family-employment, military experience, directed occupational experience, pre-approved internships, and competency-based exams. License renewal requirements involve a local renewal committee and procedure. Currently, an emergency license and new program license are also offered (Minnesota State Colleges and Universities, 2001).

Other states have certification for specific CTE areas. For example, in Louisiana and Arkansas, postsecondary CTE faculty members are required to pass a National Occupational Competency Test. This test covers only occupational, not teaching, competency (National Occupational Competency Testing Institute, 2001). The assessments from this organization are used for teachers, business/industry professionals, and students, to certify competency in a specific field.

Regional and other accrediting agencies. The Council for Higher Education Accreditation (CHEA) regional accrediting agencies has standards that institutions must meet to become and remain accredited (Council for Higher Education Accreditation, 2001). In each of the regions, various standards are identified for faculty. It should be noted that many of the documents obtained from the regional agencies were not discussed in quantitative terms and appear open to qualitative interpretation. Standards for CTE faculty are not easily quantifiable or measurable in regard to the specific qualifications that faculty must meet for many of the agencies. The Middle States Association standards indicate that faculty should be academically prepared and qualified. The North Central Association standards identify that faculty should possess educational credentials that testify to appropriate preparation for the courses they are

teaching. The Northwest Association states that faculty should be professionally qualified. The Western Association has a separate accrediting agency for community and junior colleges. This agency states that an institution must have a sufficient number of faculty members who are qualified by appropriate education, training, and experience to support its programs and, in all cases, these standards are not easy to interpret and appear to provide the institution with much flexibility (Middle States Association of Colleges and Schools, 2001; North Central Association of Colleges and Schools, 2001; Northwest Association of Schools, Colleges, and Universities, 2001; Western Association of Schools and Colleges, 2001).

The Southern Association of Colleges and Schools criteria were more quantifiable—the highest degree for the CTE instructor must be from a regionally accredited school, or the institution must provide evidence of academic preparation. The faculty member must be proficient in oral and written communication for the language in which the course is being taught. For courses that are identified as transferable, the faculty member must have 18 credit hours in the discipline and hold a master's degree, or hold a master's degree in the discipline. For courses that are not transferable, the minimum requirement is a degree at the same level being taught, plus work experience. For individuals with outstanding professional experience, this can be waived. For non-degree programs or certification programs, the faculty member must have competency in the subject, and this can be gained from work experience. While these standards for non-degree and certification programs may vary, requirements are defined by each institution. For individuals teaching basic computation or communication skills in non-degree or certification programs, a baccalaureate degree and, ideally, work experience related to the occupation are required (Southern Association of Colleges and Schools, 2001). The New England Association of Schools and Colleges has the same qualitative criteria as many of the other regional agencies and, additionally, it has quantifiable criteria. The minimum academic credential is a degree one level above the level being taught. A master's degree is the minimum qualification for general education courses being taught at an upper level or 2+2 program (grades 13–14 + 15–16). This regional accrediting agency also allows substitutions for the minimal criteria, such as scholarship, advanced study, creative activities, relevant professional experience, training, or other credentials such as licensure or professional registration (New England Association of Schools and Colleges, 2001).

Another agency that postsecondary programs need to take into account when considering accreditation concerns is the National Council for Accreditation of Teacher Education (NCATE). NCATE standards require that faculty model best professional practices in scholarship, service, and teaching, including the assessment of their own effectiveness. In addition, the unit in which certification is

taking place must systematically evaluate faculty performance and faculty professional development. These standards are of special importance when the community or technical college begins to participate in teacher preparation (National Council for Accreditation of Teacher Education, 2001). It can be seen from the current practices of the regional accrediting agencies that the standards can be vague and difficult to measure. In addition, many of the agencies provide alternative methods for institutions to allow faculty who do not meet the required teaching standards.

Best practices for the certification and licensing of postsecondary career and technical educators. Without further empirical evidence, it is difficult to identify the practices that are best for the preparing, licensing, and certifying of postsecondary CTE faculty. Further study is needed to determine if the practices of the current programs are having an impact on student outcomes such as learning and economical benefits. What can be determined from the limited availability of current practices are the following three similarities in policies and procedures where certification and licensure take place:

- The policies and procedures are flexible due to the varied levels of education and experience postsecondary educators have upon entry into the field.
- The policies and procedures include an educational component that helps develop skills in the area of teaching and learning.
- The polices and procedures include a technical-content component that ensures individuals have the technical knowledge to teach in the specific licensed area.

Multiple Paths For Preparing, Licensing, And Certifying Postsecondary CTE

When considering the pathways in Figure 1, one must consider that postsecondary career and technical educators will have varying levels of expertise when entering the field. The figure shows individuals entering the field from either a "Technical Skills" or Teaching/Learning" background. Flexibility is required when developing students from diverse backgrounds. The specific pathway for preparing, licensing, and certifying a postsecondary career and technical educator is not as important as the desired knowledge, skills, and abilities the future faculty member should obtain. As can be seen in Figure 1, these multiple preparation methods toward becoming a career and technical educator do not suggest a specific ending point, as learning should continue throughout the CTE professional's lifetime. A desired outcome can be met by the postsecondary students in both technical content and teaching and learning in a variety of forms. The illustrated pathways and methods for learning take these ideas into consideration and integrate them into the development of postsecondary CTE faculty.

A limitation of using multiple flexible methods in developing CTE faculty is that specific standards for the CTE career clusters and specific programs need to be

integrated into the assessment of the faculty. To assess faculty knowledge within the technical content areas, standards, such as those of the National Skills Standards Board (NSSB) or other national skills standards for content areas, must be used in the evaluation (National Skills Standards Board, 2001). The same development of standards is needed for the teaching and learning competencies for the postsecondary career and technical educators. Another standards resource is a book entitled "Skill Standards for Professional-Technical College Instructors and Customized Trainers" (Goldstein & Navone, n.d.) was developed by master community-college teachers and outlines skills, technical knowledge, and performance criteria for career and technical instructors.

Methods for preparing the postsecondary career and technical educator. This section provides an overview of methods that can be used to prepare, license, and certify postsecondary career and technical educators. As in many fields of education, individuals may decide to enter the postsecondary CTE field at numerous stages—pre-college, during college, after obtaining an associate's, bachelor's, master's, or doctoral degree, or after working in the CTE field. Individuals with such a wide range of backgrounds will possess a wide range of credentials—ranging from no degree to a terminal degree. These pathways provide methods for all of these individuals to develop technical content and teaching and learning content to become prepared, licensed, and certified to teach in a postsecondary career and technical program. At this time, empirical evidence has not been provided to support which of these points of entry is most desirable, or if a minimum level of education should be met before teaching in the postsecondary CTE classroom. With this said, the current pathways do not set or even suggest limitations to education prior to entry—enabling individuals with varied backgrounds the option of becoming CTE faculty.

Skill base needed for CTE postsecondary faculty. In the areas of teaching and learning and technical content, standards are needed to assess postsecondary instructors. The standards in teaching and learning can be similar for all CTE areas. For example, Lozada (1999, p. 12) reported that "all of Virginia Tech's career and technical teacher education students take their core classes together (such as those that focus on teaching pedagogy)." The technical content standards, however, will be different for each career cluster, and more specifically, for each area within clusters. The NSSB has developed national standards for many of the CTE areas (National Skills Standards Board, 2001). In addition, the NSSB and the National Centers for Career and Technical Education both serve as repositories for standards for the career cluster areas. For example, the repository provided direction to the National Business Education Association, toward locating standards for business education teachers (National Business Education Association, 2001).

No single, specific course, sequence, or method prepares an individual to be an extraordinary teacher upon entering the classroom. If this were the case, everyone would use the same prescribed methods to prepare all teachers for a high level of excellence. To meet the objectives of developing knowledge of teaching and learning, a postsecondary instructor can use many diverse methods. What appears to be consistent in many teacher preparation programs is that the basic content includes developing curriculum, planning instruction, delivering instruction (teaching and learning styles), assessing students, and evaluating programs (Iowa Department of Education, 2001; Minnesota State Colleges and Universities, 2001; State Board of Directors of Community Colleges of Arizona, 1994a). These are typically interwoven throughout the traditional courses, and then integrated within the field experiences. This means most postsecondary CTE faculty without formal teacher preparation do not have a chance to develop professionally in these areas. The pathways to develop competencies do not need to be rigid, so long as it can be shown that the standards are met.

Traditional courses. Offering traditional courses is one approach for students to gain knowledge in the teaching and learning area. However, to address the need for flexibility, it is important to think about the options outside of the traditional 4-year university setting. Community and technical colleges already have courses available under the broad scope of teaching and learning. Even though it does not appear to be traditional now, historically, the junior colleges served the needs of preservice teachers (Gerdeman, 2001). For example, in Arizona, community college instructors are required to take a course on community college teaching and learning that is offered through the community college system (State Board of Directors for Community Colleges of Arizona, 1994a). Another example is in Allen, Texas, where Collin County Community College offered one of the first technology education teacher certification programs for teachers at the community-college level (Collin County Community College, 2001; Texas Education Agency, 2000). These and other teacher preparation programs are continuously evolving in the community colleges, as they step forward in the role of preparing technical schoolteachers.

Providing traditional undergraduate and graduate courses is a method that career and technical educators may gain experience do develop technical skill. These courses can be delivered from a 4-year institution, technical college, or community college. However, it is expensive for institutions to maintain labs and equipment for CTE. In addition to this, as Lynch (1994) stated, many career and technical programs are being reduced. With this stated, it seems reasonable to suggest future partnerships that will enable postsecondary faculty and preservice secondary teachers to receive technical content from the technical and community colleges that are also preparing individuals for the technical workplace.

Distance courses. E-learning, using web-based technology, and using the capability of computer networks can provide many opportunities for students to learn. It is important that online education not be viewed as lesser alternative, but as an equally valued addition for gaining knowledge about teaching and learning. On-line courses should be more than a replacement for the correspondence course. On-line courses should engage students and require active participation. This type of course delivery benefits postsecondary faculty by providing an opportunity to take a course using a delivery method that may be required to be used in their own classroom teaching. An example of a program that does this is the Community College Teaching and Learning (CCTL) Online curriculum at the University of Illinois, Urbana-Champaign. CCTL is designed to increase the teaching effectiveness of community college faculty and build the instructional leadership of supervisory personnel (University of Illinois, 2001). Courses using Internet technologies and other distance delivery methods are viable methods for students to receive skills in the technical content area. On-line courses are available from universities in many career and technical areas. With recent developments like the use of remote labs that present simulations over the Internet (Alhalabi, Hamza, & Marcovitz, 2001), the use of broadband technologies that allow for synchronous communications, and the increasing availability of technology, barriers to distance learning are being removed.

Mentorships. A mentorship is another method that enables students to develop competencies in teaching and learning. Harnish and Wild (1994) state that mentors can impact teaching and professional growth of both new and veteran faculty. A mentor can help an individual see how the local school culture can mesh with their knowledge of teaching and learning. A mentor could also serve in the role of providing quality feedback for the teacher when discussing curriculum development, lesson planning, and assessment techniques. With developed partnerships, the mentorship could include observation and feedback on teaching for both the new teacher and master teacher. The mentorship could also provide the new teacher with a chance to reflect on their own practices. If structured correctly, the mentorship could be completed in conjunction with an educational institution for credits towards licensure and certification.

Professional development activities. Career and technical educators must continue to learn, just like all professionals, once they exit the classroom. Anglin and Mooradian (1992) reported that community colleges institutional and individual certification renewal could be met with professional development programs. One method for learning is to participate in teacher professional development activities. Career and technical organizations at the local, state, regional, national, and international level offer opportunities throughout the year to participate in activities designed to develop teaching and learning skills. Teachers

working on preparation, licensure, and certification could attend these training sessions as a method to gain knowledge in the area of teaching and learning. After attending this type of professional development session, reflections could be conducted to provide documentation of the learning that has taken place. In addition to the learning, these types of activities require the preservice or new postsecondary instructor to model an informal method of learning that can be used for lifelong learning in their profession.

In many of the CTE areas, professional development seminars are offered to provide technical skills. These sessions could be of varied length and difficulty. Many of these seminars lead to industry certifications. These activities can be documented through the individual's professional portfolio. Many of these professional development activities could allow time and resources for faculty to work on credentialing.

Student teaching, teacher internships, and induction. Student teaching is the traditional manner in which new secondary CTE teachers acquire practical teaching experience. This type of methodology could also be used for postsecondary faculty. Another applied method for postsecondary faculty may be teaching in an internship. With traditional student teaching, the preservice teacher would be able to practice the skills of teaching with the benefit of having a supervisor. The internship would not have to take a specific form for the postsecondary faculty. The internship could be taken for college credit and could be a paid position, but does not have to do either. What is important is that the process is conducted in a manner to encourage learning and is thoroughly documented. It is important to look outside the traditional form that student teaching and teacher internships have taken in the past and explore new models to help prepare, license, and certify the postsecondary career and technical educators.

A new teacher induction process is another option to provide training to the new faculty. VanAst (1992) reported this type of experience for new vocational educators lacking education backgrounds. This type of program could provide the new teachers with opportunities to earn credit towards their initial licensure. Talbert (1992) reported that induction could incorporate a mentoring perspective that requires a substantial time and resource commitment. In addition, the induction experiences are unique, and this requires a need to be general and flexible. For example, the experience and needs of traditionally and alternative certified teachers may be different.

Work experience. Work experience is the way many postsecondary career and technical educators receive technical content expertise. This experience should be valued and used to show competence in the technical area in which they will be teaching. This work experience can be documented through the creation of a portfolio, showing specific projects or tasks completed on the job. Work

experience does not always have to take the form of a traditional full-time position. Teachers could take part in industry internships to gain work experience. These internships could be paid or unpaid, and would provide the teacher with practical workplace experience. This type of experience would help teachers relate place topics into the context of the workplace for their classroom students. Teaching and learning skills may be gained through practical work experience. For example, an individual in a manufacturing setting could have practical work experience as a trainer. In many cases, individuals who have worked in a trainer role already have knowledge in the areas of teaching and learning. Numerous aspects of human resource development (HRD) parallel the teaching and learning skills a career and technical educator would use in the classroom. If these experiences are documented, an individual could be assessed to show that person meets certain standards.

Industry internships. Internships would be one method to provide practical work experience in the technical content area for postsecondary teachers. The internship could count as a substitute for work experience requirements. An industry internship would be another method to develop instructional skills. Completing an internship in an organization that requires the use of teaching and learning competencies would help the postsecondary career and technical educator develop this skill. Working in the role of a trainer, or in some other aspect of HRD, would provide an opportunity to develop skills that could be transferred to the classroom. This type of partnership could provide insights for a CTE faculty member that would be beneficial to both the business and the community college.

Continuous Learning For Postsecondary Career And Technical Educators

Once an individual is initially licensed to teach, learning should not stop. Sydow (2000) reported on the rewards in teaching and learning for community college faculty after the investment in professional development. Career and technical educators need to stay current in their field to ensure their programs are meeting the needs of students and business and industry. Changes within technology and instructional delivery methods are both occurring on a rapid basis. The postsecondary teacher should continue their own professional development, as shown in the following examples. Continual learning can occur from the same methods as initial training, but be used to further develop and update skills of the career and technical educator. The same methods could be used for advanced development of skills and to ensure teachers are up-to-date in both the technical and teaching and learning areas.

Continual learning and ties to career promotion. In higher education, the faculty member role is traditionally research, teaching, and service. However, at the community and technical college level, the roles of teaching and service are

stressed. Palmer (1998) suggested that individuals who strive to reach the highest ranks, such as full professor, seek specialized pedagogical training designed for faculty members. Another method for continuously updating community college faculty would be to have them participate in a rigorous, non-university-based certificate process that would provide more visibility and bring recognition to community college instructors. The National Board for Professional Teaching Standards has a similar program available for secondary career and technical educators (Zehr, 1999). Available research shows that professional development in community colleges benefits both the institution and individuals (Sydow, 2000). With this in mind, it would benefit the institution to support professional development and continuous learning. Rifkin (1995) stated that there is a need for constant evaluation that encourages professional development.

Benefits of comprehensive teaching and learning competencies for postsecondary career and technical educators. Another concern is the expense of providing career and technical preparation programs for all individual career cluster areas. Wright (2001b) has stated that having secondary CTE students learning together helps promote collaboration and saves money. These same collaboration practices—integrating one comprehensive set of teaching and learning competencies for all CTE areas—would help ensure the future of career and technical teacher preparation programs. At the same time, students could develop skills in technical content areas in the same courses that are preparing individuals for the workplace. For example, if a local community college has a program for teaching a high-tech skill area, the student could learn that competency there, and also take the courses on teaching and learning at the 4-year institution that may be offering the comprehensive teacher preparation program.

Benefits of national certification of postsecondary career and technical educators. The development of a national certification program could bring higher acknowledgment to the field of postsecondary teacher education as a profession. Currently, no national certification program for postsecondary career and technical educators exists. This type of program would not need to be mandatory; however, such a program would provide postsecondary teachers with recognition for obtaining a certain level of excellence in their profession. Teachers seeking such certification could demonstrate their competence through the development of a professional portfolio, and retain certification by continually updating their skills in both the areas of teaching and learning and their specialized content area. An organization such as the National Board for Professional Teaching Standards, which supports the national certification of K–12 teachers, could be responsible for this program.

These teachers could then serve as mentors in the preparation of other teachers in the community and technical colleges. This type of certification would help states show that the postsecondary career and technical teachers achieve at least a minimum level of competence—as can be demonstrated in many other professions. A national certificate would aid in the development of articulation programs, because all teachers with the certificate would be competent at this specific level. This type of certification could also aid teachers in their mobility and serve as a third-party endorsement for promotion reviews.

Call For Research To Examine Postsecondary CTE Preparation, Licensures, And Certification

The major finding of this research has been the lack of available knowledge, consistency, and organization of the requirements in this country for an individual to become a postsecondary career and technical educator. Additional research is needed to describe what all 50 states are doing in the recruitment, preparation, licensure, and certification of postsecondary career and technical educators. Once these policies and processes are described, the research should be taken a step further, to describe specific programs and practices. Research should be undertaken to examine the impact of the licensure and certification requirements on programs and practices to help build a base of research for programmatic changes. For example, a study could determine relationships between preparation and license requirements and student achievement. Another study could look at preparation and license requirements in relation to quality of instruction.

If preparation, licensures, and certification are negatively impacting student achievement, then obviously new policies need to be recommended. However, with such a diversity of policies among the states, an insufficient research base exists for measuring impact, let alone for making any recommendations.

At this time, it is also important to examine the competencies an individual needs to possess in order to be a successful postsecondary career and technical educator. This examination can develop a common set of standards for the teaching and learning area and subject-specific requirements for the career cluster areas. This type of research could determine which courses are required, and which are priorities. For instance, a course in educational technology might very useful, but not currently required in some states. In addition, research could be conducted to examine the content and impact of new teacher preparation programs.

Since many states have a variety of entry levels, it seems important to assess if minimum entrance skills are needed for successful postsecondary career and technical educators. If tied to impact on student achievement, this research could provide support for policy improvements. Of course, until research is done to evaluate the practices, it is impossible to make policy recommendations. The

suggested approaches need to be piloted and evaluated before implications to policy can occur. Another concept described in this paper was the virtual learning environment. Its impact on the licensures, and certification, and preparation of the career and technical educators also needs to be piloted and evaluated.

Examining variables such as job satisfaction and retention rates of instructors in community and technical college faculty who have not received preparation in teaching and learning vs. those who have been prepared in a formal program would be very valuable to administrators and policymakers. Similarly, it would be useful to examine the same types of variables for certified, vs. non-certified, postsecondary career and technical educators. This could help address the current and growing shortage of teachers.

Implications For Postsecondary CTE

One implication for postsecondary CTE is that if nothing is done, the current disparate practices will continue to place barriers before those individuals who would like to be postsecondary career and technical educators. At minimum, a description of the requirements and how to become a postsecondary career and technical educator in all states is needed. Another implication for postsecondary CTE faculty and those who determine teacher preparation policies and content is to look at the numerous pathways that bring potential CTE teachers to the field, and design comprehensive assessment tools to determine their preparation needs, and provide flexible programs to satisfy those needs. It is essential for qualified postsecondary CTE faculty to be in the classroom in order to transfer career and technical skills to students. The individuals who want to become postsecondary CTE faculty must understand that traditional preparation is not the only method that can be used to prepare individuals to enter the field, and that entrance into the field is happening at a variety of educational levels. Many different paths can be available to become a postsecondary teacher and the requirements differ greatly.

Call For Action

Many current practices such as the recruiting, preparation, certification, and licensure of the postsecondary career and technical educator are not supported by empirical evidence. It is critical that researchers examine these areas to develop evidence-based data. Studies must be conducted to support programmatic improvements and positively impact policy in the community and technical colleges. These examples can be piloted with postsecondary teachers on a voluntary basis, in a variety of states, and selected locations, to evaluate impact on students and teachers.

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Teacher Preparation/Licensure in Career and Technical Education: A Public Policy Analysis

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Abstract

Almost a fifth of all credits accumulated by public high school students are in courses categorized as Career and Technical Education (formerly termed vocational education). There are, therefore, well over 100,000 CTE teachers in the nation's middle and high schools. The pre-service preparation and licensure of these teachers is the topic addressed within this article. Specifically addressed are the questions: Are changes in CTE secondary-level teacher licensure requirements and teacher preparation programs necessary? If so, what should they be?

CTE teacher preparation has been a point of contention from the very beginnings of the CTE field (Lynch, 1997). Unhappy with what they perceived as the ruination of manual arts by general educators, industrialists in the early 1900s wanted nothing to do with teachers prepared in colleges, meanwhile educators wanted nothing to do with teachers who were not prepared in college (Gray, 1989). Ultimately a compromise developed whereby agriculture, business education, and home economics teachers were prepared much the same way as other public school educators, namely in full-time baccalaureate teacher preparation programs. However, teachers who taught courses related to trade and industrial (T&I) occupations were recruited from the workplace and typically had little or no formal education beyond high school.

Debate regarding CTE teacher preparation has been reinvigorated by declines in secondary-level CTE enrollments, declines in the number of CTE teacher preparation programs, and shortages of CTE teachers. Equally important is the emergence of public education reform in general, and efforts to improve the quality of teachers in particular, as a "major" political issue at the state and national levels. These developments have led to a significant amount of scholarly writing and debate among CTE teacher professionals (University Council for Vocational Education [UCVE], 1996).

Limitations

The intent here is not to duplicate previous scholarly work regarding CTE teacher preparation, nor to present an extensive review of this literature, nor an exhaustive account of teacher preparation/licensure. The intent is to use a policy analysis perspective to stimulate debate, and ultimately consensus, that will in turn lead to reform.

Policy analysis requires certain assumptions about the present state of affairs, yet little or nothing can be stated about the specifics of CTE preparation and licensure that is true in every state. Thus, some degree of "generalization" was required for this analysis.

Who are CTE Teachers?

Among the many variables confounding the issue of CTE preservice education, is the thorny issue of who exactly are the teachers under consideration? This is a difficult question and perhaps the main reason why reforming CTE teacher preparation has never progressed far beyond the talking stage.

Roughly 25% of secondary-level teachers are classified as CTE teachers. Of this group, 79% teach in comprehensive high schools, the rest in separate vocational high schools. Within this 25%, however, there is more diversity than commonality (NCES 1994). The Public Secondary School Teacher Survey on Vocational Education identified 11 different types of CTE teachers. Listed in order by the total percentage of all teachers they are (1) business education, 29%; (2) trade and industrial education, 18%; (3) vocational and academic subjects, 12%; (4) technology education/industrial arts, 10%; (5) agriculture education, 8%; (6) family and consumer sciences, 8%; (7) marketing/distributive education, 4%; (8) occupational home economics, 4%; (9) technical/communications education, 3%; (10) health occupations, 3%; and (11) other vocational, 2%.

The fact is that many teachers within these program areas do not view themselves as vocational teachers. Historically, it was not a common mission that united these six programs; rather it was 1917 political realities surrounding the need to gather enough votes to pass Smith Hughes, and later the lure of federal dollars that brought these groups together. It was and is a marriage of convenience. The point being that CTE is not a homogenous profession, rather it is a diverse set of programs with differing missions, making the development of a consensus regarding teacher preparation and licensure extremely difficult.

Differences in CTE Teacher Preparation/Licensure

The majority of CTE programs—business education, technology education, agriculture education, family and consumer sciences, and marketing/distributive education—all use the traditional four-year baccalaureate model similar to those

used for elementary, middle school and secondary education teachers. Trade and industrial (T&I) and health occupations education (HOED), on the other hand, typically use an alternative preparation/certification model that stresses work experience and occupational competence over academic credits and degrees earned. On average, T&I and HOED teachers will have nearly twice as much work experience related to their teaching assignment (15 years) as other vocational teachers, (8 years) and three times as much as academic teachers, (6 years) (NCES, 1994).

The diversity of CTE programs thus leads to the question, "What exactly are we attempting to reform?" (1) the traditional baccalaureate model, (2) alternative/ sub-baccalaureate mode, or (3) both? The focus of previous CTE teacher education reform debates has been—implied or otherwise—on replacing the alternative/sub-baccalaureate T&I/HOED model that has required extensive work experience but only a high school diploma. Rejecting this model out of hand, however, no longer seems to be a prudent decision.

The External Policy Context

General Teacher Education Reform Trends and Issues

A beginning step in this policy analysis is a consideration of the contemporary context that will influence the selection of CTE policy alternatives. Indicators of the current importance of the overall issue of teacher preparation, are the 32nd annual Kappan Gallup Poll finding the public believes the best strategy for improving school achievement to be "qualified and competent teachers in every classroom" (Rose & Gallup, 2000, p. 44), and that nearly every state has enacted new licensure requirements for public school teachers.

Proficiency testing. By the spring of 2000, 42 states had instituted a set of standardized examination requirements as conditions for teacher licensure. These requirements typically include testing in three areas: pedagogy, subject matter knowledge, and general knowledge. The content of these tests is closely aligned with baccalaureate degree curricula, and the related assumption that candidates will have completed approximately 60 credits of general education.

Subject matter knowledge. Some contend that subject matter knowledge is the only thing necessary to be a good teacher (Wise & Liebbrand, 2000). Of particular importance to this analysis of CTE preparation/licensure is that subject matter expertise is now considered to be very important for all teachers and, therefore, a strong argument for alternative certification routes that do not require formal teacher training (Hawley, 1992).

Minimum grade point average. The third variable that has emerged regarding the alleged poor quality of teachers is the view that those who are accepted into teacher preparation programs are the less capable college students, therefore,

resulting in less capable teachers. In an effort to improve the quality of new teachers, policies establishing minimum GPA prerequisites for admission to teacher preparation degree programs were instituted These requirements may well contain some unanticipated consequences for CTE as it is unclear how these regulations will impact those who consider entering the profession via either the baccalaureate or the sub-baccalaureate routes.

Assessment: Performance-based teacher education. Responding to an alleged disconnect between what is taught in college and what teachers need to know to be successful in the classroom, the National Council for Accreditation of Teacher Education (NCATE) announced outcome-based standards called NCATE 2000 (http://ww.ncate.org.). Likewise, the National Council on Teaching and America's Future recommended state licensure requirements conform to the outcome-based standards such as those set by the Interstate New Teacher Assessment and Support Consortium (INTASC).

Professional Standards Board. The National Board for Professional Teaching Standards was created in 1987 to lead the effort to develop professional standards in various subject matter areas including CTE.

> The mission of the National Board for Professional Teaching Standards (NBPTS) is to establish high and rigorous standards for what accomplished teachers should know and be able to do; to develop and operate a national, voluntary system to assess and certify teachers who meet these standards; and to advance related education reforms for the purpose of improving student learning in American schools. (http://www.nbpts.org)

By 2000, 29 states had enacted legislation to provide financial incentives for teachers to become nationally certified (Keller, 2000). However, T&I/HOED teachers are largely ineligible since a baccalaureate degree is required for participation.

Teacher shortages. Ironically, while states were busy making teacher licensure more rigorous, increasing school enrollments, teacher retirements, and large numbers exiting the field have produced shortages. It is estimated that the nation will need one million new teachers by 2010 (Dohm, 2000). While technically an ample labor supply of teachers exists, the number of those willing to work in urban/rural areas, and/or for the salaries offered is inadequate. Thus, problems associated with filling teaching positions are overshadowing issues of making new teachers more proficient.

Non-traditional/alternatives/Sub-baccalaureate licensure. Aside from dramatically increasing the potential pool of beginning teachers, some research studies suggest alternative routes are more effective in attracting both men and minorities to teaching (Olson, 2000). "What we are seeing are market forces in

action" (Feistritzer, 2000, p.1). While some states may have specific alternative teacher licensure legislation, virtually all (48 in 1990) have emergency licensure provisions that allow for circumvention of the traditional requirements (AASCU, 1995). Many have begun to view alternate routes to be of equal, if not more importance than traditional teacher preparation programs (Kantrowitz & Wingert, 2000).

Summary of External Policy Context

General K-12 teacher preparation in 2000 was responding to two primary issues: (1) the perceived need to improve the quality and rigor of teacher preparation as a means of improving schooling, and (2) the need to fill one million teacher vacancies in the next ten years. Classic labor-supply theory suggests that these two goals are incompatible. Nonetheless, policy makers at the turn of this century were diligently in pursuit of both (Darling-Hammond, 1999).

The Internal Policy Context: The Case for Change

CTE educators tend to agree that teacher preparation programs are in need of a reformation. There is, however, considerably less agreement about why CTE preparation should be changed, or how.

State Testing Requirements

Most states have instituted standardized testing requirements for entrance into teacher preparation programs and/or for licensure. CTE teacher candidates often do not score well on these tests, particularly those who enter from business and industry with limited, or no, formal education beyond high school (Gray & Wang, 1989). Some states exempt CTE teachers, while others provide a longer period of time within which to pass the tests. Is it in the best interest of CTE to employ teachers who have not passed state licensure tests, and thus are frequently regarded as "less than" their general education counterparts?

Increased Training Credentials of Technicians

Historically, CTE was designed to prepare youth for the apprenticed trades, particularly in manufacturing and construction, to be family farmers, competent homemakers and businesspersons (Gray, 1989). However, work and our communities have changed dramatically, as have the aspirations of youth. Until relatively recently most of the traditional skilled craft occupations did not require postsecondary study for entry-level positions. Now, however, many of these occupations do require either certifications or associate degrees. Traditional CTE teacher licensure—and therefore teacher preparation programs—are focused on the goal of preparing students for immediate entry-level employment, when in fact,

many CTE students now choose to enroll in higher education directly after high school.

Dual Mission: Transition to Work and Postsecondary Education

With the inclusion of Tech Prep in the Carl Perkins Act of 1990, the mission of Career and Technical Education, at least as defined by federal legislation, was expanded to include both preparation for employment and preparation for postsecondary pre-baccalaureate technical education. According to that National Center for Educational Statistics, during the 12-year period of 1982 to 1994, the percentage of vocational majors enrolled in postsecondary study within two years of their graduation date increased from 42% to 55%. During the same period, the number of students who completed both a college preparatory curriculum and a vocational concentration increased from 0.6% to 4.5% (NCES, 2000).

Clustered/Generic Occupational Focus

Many CTE programs, especially those within T&I/HOED, are occupation specific with a student performance goal of mastery of employment related skills. State licensure regulations for the teachers of those programs are correspondingly specific restricting individuals to teaching a single area–automotive mechanics, automotive body repair, carpentry, welding, etc.

An alternative idea is to organize instruction around broadly-based clusters of occupations to provide students with a "breadth" of knowledge in several related fields as opposed to "in-depth" training within a single field. Although this concept was proposed by Maley (1975) as a result of his research during the period of 1965 through 1969, it was never widely adopted. Now, however, the profession seems to be more receptive to clustering for several reasons (Hoachlander, 1999). First, the strict distinctions that existed among the traditional crafts have given way to a blurring of the lines, reflecting the need for more versatile technicians. Second, in response to the importance of helping teens develop career direction as a basis for postsecondary planning, (Gray, 2000) many school districts have instituted career majors, or pathways, organized around broad clusters of occupations as part of the high school curricula. Finally, occupational clustering has become a federal priority for CTE.

Work-based Learning

In the 1990s, school sponsored and supervised work-based learning gained in popularity (Bailey & Hughes, 1999); the best indicator being the School-to-Work legislation with its emphasis on learning in the workplace. "In 1997, of those employers who reported hiring front-line workers with prior work-based learning experience (cooperative education, internships, or apprenticeships), most were

more satisfied with these new hires than with other newly hired front-line workers aged 18-25" (NCES, 2000, p. 44).

Arguably, the best predictor of success in college is having a verified career interest, thus, a goal. Therefore, CTE students who go on to pre-baccalaureate technical education benefit from having verified their tentative career choice by actually working in the field, and these experiences generally provide the very context for their postsecondary studies (Gray, 2000).

Previously, only those who were candidates for cooperative education, marketing/DE, and agriculture education teacher licensure were trained in initiating and administrating work-based learning. In the future, all CTE teachers need such training.

Integration of Academic with Career and Technical Education

Another federal priority is strengthening the academic skills of CTE students by integrating academic instruction. Attempting to provide clarity missing in the Perkins legislation, researchers at RAND investigated the definition of integration and identified four themes that together define the integration of academic and CTE education: (1) richer, better sequenced curricula that enhance academic and generic skills needed by all workers; (2) facilitative instruction (rather than didactic) that motivates students to learn and provides them with a practical and applied understanding of the world; (3) increased collaboration and coordination among academic and vocational teachers to create a more unified schooling experience; and (4) more attention to the skills and knowledge students need to transition effectively from school to work and college (Rand Organization, 1994).

Surveys of CTE teachers indicate, however, that very little of their time is spent teaching academic skills even though opportunities to do so are frequently presented. Equally important, while 91% of CTE teachers indicated they felt prepared to teach vocational subject matter, only about half felt adequately prepared to teach algebra, and only 29% felt they could teach problem solving using math more advanced than algebra (NCES, 1994).

Students with Special Needs

During the 1960s through the 1980s, increasing access to CTE by special needs students was a federal priority. By the 1990s, the access problem had reversed itself; in many cases, special needs students were now the majority (leading ironically to charges of tracking). "As a result, while 34 percent of the graduating class of 1992 were special education students (disabled, disadvantaged, or LEP), 43 percent of the vocational credits earned by this class were earned by special population students" (OERI, 1994, p.17).

Many CTE teachers do not feel competent to design and implement accommodations for special needs students. Typically, when asked to identify their biggest deficiency, number one is how to deal with special needs students. So consistently does this factor surface, Harvey (1999) recommends that all CTE teachers complete at least 6 semester hours focused upon (1) building an understanding of the classifications, (2) legislation, (3) general modifications/ accommodations, (4) instructional strategies, (5) classroom management, and (6) IEP/IVEP development.

CTE Teacher Shortages

There is a general shortage of CTE teachers. In some programs, such as technology education, the shortage is so severe that it threatens the program of study's very existence—school systems that cannot find CTE teachers often just drop the program (Weston, 1997). While the problem is complex, one conclusion is unavoidable, the predominant system of CTE teacher preparation, based upon full-time baccalaureate study, simply does not have the capacity to meet the demand.

Declining Numbers / Consolidation of CTE Teacher Preparation Programs

Concurrent with the decline in CTE secondary enrollments in the late 1980s, enrollment in CTE teacher preparation programs declined, as did the number of CTE teacher preparation programs. It is estimated that of the 432 institutions that offered CTE teacher licensure programs in the 1980s, there were at least one-third fewer by the 1990s (Dykman, 1993). While many higher education programs were simply eliminated, those that survived were typically downsized (UCVE, 1996). Perhaps the most important effect of this reduction and consolidation is that CTE teacher educators find that they can no longer offer two to five unique preparation programs, and seek to combine them into a single common program of study and a rationale/consensus for doing so.

Summary

There are significant reasons for the conclusion that CTE teacher preparation/licensure must change. First, teacher candidates generally struggle to pass state required examinations, especially in pedagogy and general knowledge, without some postsecondary preparation. Second, the traditional labor markets that CTE has focused upon have evolved; many now require some postsecondary education. Third, the expanded instructional content of CTE programs requires teaching advanced academics as well as initiating and supervising work-based learning. Fourth, special needs students often are the majority in CTE classrooms and providing effective instruction for these students requires special training. Finally, the present system of teacher preparation is not meeting the demand for

teachers and it is unlikely that models predicated upon full-time undergraduate students alone have the capacity to meet the demand.

Policy Constraints

Public policy options are always limited by constraints; money to implement the policies being the best example. Frequently, the best policy solution is the most expensive and a cheaper solution selected for implementation. Policy planners who ignore relevant constraints often suffer disappointments, if not outright failures.

Multiple Programs

There are at least six different CTE program constituency groups: (1) agriculture, (2) business education, (3) family and consumer sciences, (4) marketing/ distributive education, (5) technology education, and (6) trade and industrial/health occupations. Each has unique state teacher licensure, preparation programs/degrees, as well as professional organizations at the state and national levels. Among the many problems this causes, is the reality that there is no existing mechanism to establish an effective dialog among the six groups.

Lack of Consensus Regarding CTE Mission

The "ideal" teacher preparation/licensure model depends primarily upon the mission to be fulfilled. Is the mission: 1) the transition of students to entry-level employment; 2) the transition of students to postsecondary education; 3) both; or 4) to teach academic concepts to all students? There is no consensus on this issue among the various CTE constituents, as each has a different mission and the same program may have different missions in different high schools.

State Teacher Licensure Regulations

In all states, teaching CTE programs in public secondary-level schools requires licensure, and in a few states at the postsecondary-level as well. These regulations provide the template from which teacher preparation programs are constructed. While higher education faculties have latitude in how to fulfill the requirements, they are powerless to change them; only state legislatures, state boards of education, and/or licensure boards can accomplish that task. One criticism that may be made of much of what has come before regarding reforming CTE teacher preparation, is that the proponents seem to assume that the preparation programs drive licensure. In reality, it is exactly the reverse.

CTE Teacher Shortages

A final, and most formidable constraint facing the reform of CTE teacher preparation/licensure, is the almost universally short supply of CTE teachers. As a result, virtually every state has an emergency teacher licensure provision that allows administrators to hire individuals who have not met the formal teacher preparation requirements. Thus, while teacher licensure continues to become more rigorous nationwide, the number of individuals who enter the profession with emergency licensure is also climbing, and alternatives to formal teacher preparation programs are becoming more numerous. In short, when classrooms do not have teachers, all rules are off.

Policy Variables

Typically, CTE teacher licensure regulations address four issues that become the basic framework of preparation programs: (1) certifying subject matter knowledge; (2) minimum academic credentials; (3) general knowledge; and (4) instructional design and delivery (pedagogy). It can be predicted that a fifth will be added; clinical assessment of actual classroom performance.

Acquiring and Verifying Subject Matter Knowledge

One outcome of the national debates regarding teacher preparation and the quality of teachers is a consensus that the teachers should be subject matter experts in the field(s) they teach. The related variables in CTE preparation/licensure are (1) what subject matter knowledge is necessary, (2) how will candidates acquire it, and (3) how it will be verified?

The baccalaureate model of providing subject matter expertise through course work is the primary CTE teacher preparation methodology, except within the T&I/HOED grouping. There are, however, questions regarding the effectiveness and efficiency of this model based upon three specific factors: (1) teaching CTE occupational knowledge requires unique and expensive facilities; (2) the rate of change in most occupations makes it virtually impossible for CTE faculty to keep their skills current and still fulfill the expectations for promotion and tenure; and (3) attracting individuals with both technical knowledge and academic credentials commensurate with tenure-line faculty status is extremely difficult.

T&I/HOED have historically relied upon related work experience as verification of subject matter knowledge. However, the assumption that years of related work experience are sufficient to insure technical competence is increasingly questionable. According to the National Occupational Competency Testing Institute, 18 states currently require completion of the related Experienced Worker written and performance tests as part of the CTE teacher licensure process as a means of verifying technical competence (NOCTI, 1999).

A more recent option is requiring prospective T&I/HOED teachers to have a related associate degree or technical certificate in the field within which he/she is seeking teacher licensure, in lieu of an examination, and in some cases, of work experience. The advantages are that CTE teacher candidates possess formal technical education in the field, have higher education experiences, are better prepared to develop instruction designed to facilitate transition from secondary to postsecondary technical education, and CTE teacher preparation programs are not required to have occupational instructional labs.

Is Work Experience Necessary?

Lynch (1996), in his review of the literature for the 1994 *National Assessment of Vocational Education,* reported that there was little evidence of a relationship between years of occupational experience and teaching effectiveness for experienced teachers, but that a relationship did exist for beginning teachers. Walter (1984) found a correlation between a minimum of two years of related work experience and the attainment of tenure by secondary-level vocational teachers. While occupational experience was not related to student performance, it was correlated with credibility of the teachers in the eyes of their students. A university degree on the other hand, was associated with professionalism, student learning, and longevity in the teaching profession. It is useful to remember, however, that the historical purpose of the occupational experience requirement was *not* to improve the quality of teaching, rather to insure that those who taught industrial education were subject matter experts.

Thus, the real issue is not "work experience yes or no", rather it is how subject matter expertise is acquired and assessed. Is attempting to teach subject matter expertise through baccalaureate requirements still a viable option for CTE teacher preparation programs? Is a relevant technical certificate, associate degree, or advanced degree sufficient evidence, or is a formal assessment such as the NOCTI Experienced Worker tests still needed? Is some amount of occupational experience still desirable if a candidate has earned the relevant certificates, associate degrees, or advanced degrees?

Academic Credentials

Most states require agriculture, business, family and consumer sciences, marketing/DE, and technology education teachers to have earned at least a bachelor's degree for entrance into the profession. In the majority of states, T&I/HOED teachers need only be high school graduates with relevant work experience and licensure.

Reasons to conclude that high school diplomas and work experience may no longer be sufficient include (1) most states require CTE teachers to pass

standardized examinations and success on these exams is highly correlated with postsecondary education experiences, (2) many secondary CTE students enroll in postsecondary education immediately after graduation, which argues for all CTE teachers to have some postsecondary education independent of how they gain subject matter knowledge, (3) the need to teach advanced math and science skills in CTE classrooms suggests that teachers will have completed courses typically associated with admission to, or graduation from, postsecondary degree programs, and (4) the long-standing gulf between academic teachers and CTE teachers who do not have degrees, hinders efforts by secondary-level faculty members to integrate academic and CTE curricula.

Instructional Design and Delivery (Pedagogy)

While subject matter expertise is essential, teachers are not paid to be subject matter experts. Rather, they are paid to promote learning, and if the students do not learn, then the teacher has failed. The policy issue is not whether all CTE teacher candidates need pedagogical training, rather it is how they are to secure it. The prevalent model is classroom-based methods courses followed by practice teaching. However, successes within the movement toward learning center environments, in which students spend more time learning on-the-job by actually working in schools and less time in traditional methods courses, suggests that CTE teacher preparation programs need to consider moving away from exclusive reliance upon traditional classroom-based methods courses. In the extreme, a majority of new teachers in CTE teacher preparation programs may not graduate from their programs at all, making how to provide teacher training to this group the major challenge.

General Knowledge

Many states require a general knowledge test as part of the preparation/licensure process. If CTE teachers must pass these examinations, then teacher preparation programs must include general knowledge courses. Furthermore, whereas teaching related math and science is now an instructional objective in CTE, it becomes important that teachers have advanced math and science skills. The real challenge will be made manifest if states continue to allow CTE teachers to enter the profession via an alternative/sub-baccalaureate route with work experience requirements in lieu of degree requirements, and then mandate that they pass a general knowledge test based upon baccalaureate degree general education requirements.

Assessment

Citing little relationship between students' grade point averages in colleges of

education and their performances in classrooms, many are promoting the assessment of what CTE students and graduates can actually do. Early developments suggest that authentic assessment methodology may well be dictated by state regulations, while a broad outline will be supplied by NCATE to those institutions that are so accredited. It can be predicted that most, if not all, CTE teacher preparation programs will have to develop authentic assessment methods in the future.

What is the Mission of CTE Programs in the Public Schools?

Literature and practice suggest there are at least five variations of the mission of CTE being proposed and/or practiced: (1) traditional, (2) tech prep, (3) traditional combined with tech prep (TTP), (4) education through occupation (ETO), and (5) work/family/community (WFC).

Traditional

The traditional mission of CTE, excepting perhaps family and consumer sciences and technology education, is preparation for the transition from school to work. The performance objective is to provide students with occupational skills that result in labor-market advantage when competing for non-professional career opportunities. Outcome assessment is based on related job placement, annual earnings, and retention on the job.

Tech Prep (2+2)

Tech Prep is a combined, or articulated, secondary and postsecondary program that leads to an associate degree, or certificate, in at least one field of engineering technology, applied science, mechanical, industrial, or practical arts of trade, agriculture, health or business. Outcomes assessment is based on the transition to postsecondary technical education without remediation, postsecondary graduation, and employment in a technical field as identified in the federal legislation.

Traditional/Tech Prep (TTP)

Whereas both traditional and tech prep are designated by the federal funding legislation as missions of CTE, and whereas many traditional programs have added tech prep components, a prevalent third mission is preparing students entry-level employment and postsecondary technical education. As a result, some students pursue both full-time employment and postsecondary education on a part time basis, often with tuition assistance from their employer.

Education through Occupation (ETO)

Education through employment's (Grubb, 1997) mission is based upon the

concept that when woven together, academic and vocational integration acts as the foundation for education through occupation when (1) broadened occupational content is integrated with, (2) traditional academic subjects using, (3) new institutional structures, and (4) other types of school to work (Bragg, 1997). Performance goals are traditional academic measures though and the outcome goals are only loosely related to employment, seeking instead to generalize the curriculum into a more academic and career exploration mode.

Work/Family/Community/Technology (WFCT)

As outlined by Copa and Plihal (1996), the purpose of CTE in this model is to "enhance the overall vocational development characteristic of individuals." Overall vocational development is defined as the ability of an individual to integrate work, family, community, and to these three we (not Copa and Plihal) have added technology. The stated mission of the program suggests academic performance goals, higher education without remediation, and retention as the outcome goals.

Which Mission: What Content?

Which of the five CTE missions will prevail in the future? The authors contend that present developments suggest two overarching missions will dominate secondary-level CTE programs in the public schools: (1) a more specific Integrated Model (TTP), and (2) a more general Related Model (ETO/WFCT/TP).

Integrated model of CTE. Some argue that the traditional mission is obsolete since all students go to college. National longitudinal follow-up data suggest otherwise. At least a third of all students do not enter college within two years of high school graduation. Of those who do enter college, 30% drop out during their freshman year. Only about half of those who persist graduate in six years and of those who do not graduate within six years only 10% ever finish a degree (see Gray & Herr, 2000). Unless college becomes absolutely free and mandatory, it is unlikely that the percentage of students matriculating directly after high school will increase much more and only time will tell if the graduation rate improves for those who do matriculate.

Career and technical education is an elective in the curriculum of the American high school; courses that students do not select are eliminated. The CTE programs that have experienced the least decline over the last 15 years are within the T&I/HOED grouping, the programs with the strongest traditional ties to employers, occupational skill education, and job placement (NCES, 2000). This suggests that some students and parents value a program that leads to full-time employment after graduation from high school.

The Integrated Model will be prevalent in the future because (1) it is the model

funded by federal CTE legislation, (2) many states have invested heavily in traditional T&I/HOED/AG ED facilities, programs, and staffs, (3) this type of education has tremendous face-validity and the support of the general public (*Techniques*, Sept. 1997), (4) traditional CTE has been effective in keeping teens in high school, (5) while traditional CTE has fallen out of favor among national policy makers, it is still strongly supported at the local level by employers, many of whom are former CTE students, and (6) Integrated Model CTE programs are the prime feeder of secondary students to postsecondary technical education.

Related model of CTE. Clearly, the mission of the Related Model of CTE has already been adopted by some programs, and many if not all of these programs have endorsed the tech prep philosophy as well. Agriculture education, in many states, has already initiated its move into the Related Model by emphasizing its biological and environmental sciences content, and the large numbers of its students who enroll in postsecondary education. For example, as a result of the Reinventing Agricultural Education in Pennsylvania for the Year 2020 initiative funded by the W.K. Kellogg Foundation, the new vision is: "Educating people for life through agriculture: food, fiber, and natural resource systems" (PPDC, 1999, p. 3). Many technology education students pursue postsecondary education, and the program was never intended to be occupational training (although at the local level it often has become that). Family and consumer sciences' mission is clearly consistent with that of the Related Model. Indicative, of this general education trend in some CTE programs, New Jersey education department officials ruled in December 2000, that they would accept family and consumer sciences and technology education as components of the visual and performing arts graduation requirements.

Policy Recommendations for CTE Preparation/Licensure Regulations

The philosophy of this analysis is the specifics of CTE teacher preparation/licensure should be dictated by the missions of the programs within which candidates will teach. At the same time, making policy recommendations for all of the possible combinations of the five different missions identified is unrealistic. Therefore, for the purposes of this analysis, the two overarching missions for CTE were identified as: the Integrated Model and the Related Model.

Mission I: Integrated Model of CTE

Occupational/technical knowledge. Whereas, teaching occupational skills is an instructional objective in the Integrated Model, occupational/technical knowledge is required. Therefore, the primary questions are: (1) Where will individuals preparing to teach within the Integrated Model CTE programs learn that body of knowledge? and (2) How will their mastery of that knowledge be assessed?

The three options for acquiring occupational/technical knowledge are (1) on-the-job experience and training, (2) formal degree programs, and (3) a combination of work experience and higher education. Option 3 is recommended for the well being of CTE. Specifically, teacher licensure minimums for the Integrated Model should be established as an associate degree or equivalent in a relevant field, and related work experience of one year or 2000 hours.

Minimum academic credentials. It is recommended that all Integrated Model teachers be required to hold a postsecondary degree at the associate/certificate level for initial certification, and that a bachelors degree be required for permanent certification (most states provide for at least two levels of certification, initial and permanent). With evidence suggesting that a majority of new T&I/HOED teachers have at least an associate degree, requiring a bachelor's degree for permanent licensure is no longer a dramatic change. However, it is only fair that states also insure that associate degree holders can transfer to baccalaureate granting institutions without losing all of the earned credits.

Instructional design and delivery (pedagogy). State licensure requirements should mandate that candidates for Integrated Model certification master specific competencies in instructional design and delivery prior to their entering the classroom. However, it is not realistic to require completion of an entire formal teacher preparation program. Thus, this training could be course work, or it could be intensive train-the-trainer type seminar(s).

General education. The relevance of general knowledge for Integrated Model teachers hinges on whether or not states have a general education test as part of the CTE teacher licensure/certification requirements. It is recommended that in states that have such tests, Integrated Model teachers not be exempted from the requirement, rather that they either be given a different test that is more workforce specific, or additional time to pass the test if they do not have a four-year degree.

Outcome assessment. Two types of outcome assessments are desirable for the licensure of beginning teachers in Integrated Model programs. The first is an assessment of their subject matter expertise, typically accomplished by either standardized tests or authentic assessment by a review committee of subject matter experts. The second issue is an assessment of candidates' skills as teachers. Whereas some Integrated Model teachers will not have completed a formal teacher preparation program, and thus not done practice teaching, this assessment will have to take place during their first or second year in the classroom.

Mission II: Related Model of CTE

Occupational/technical knowledge. Teaching occupationally specific skills is not an instructional objective within the Related Model, thus extensive occupational/technical knowledge is not necessary. It can be argued, however, that

non-teaching work experience is still necessary. Hartley, Bromley, and Cobb (1996) propose, that new CTE teachers have the skills to develop a sequential series of work-based clinical experiences. However, one of the main reasons academic teachers do not use many occupational contexts, let alone clinical experiences, is that they know little about occupations outside of education. Thus, while extensive work experience may not be required, some related occupational experience would seem preferable for Related Model teacher candidates.

Academic credentials, pedagogy, general knowledge, and assessment. The mission of the Related Model is not transition from school to work, rather it is teaching academics, general knowledge of work roles, and preparing students for transition to postsecondary education. Since these goals are similar to those of other secondary subject areas, it would seem that other than requiring some related work experience, state licensure requirements should be similar. This is essentially a status quo recommendation as virtually all CTE teacher state-level licensure requirements, except T&I/HOED, follow the framework required of other secondary-level teachers.

Implications. The primary implication of these recommendations is that there would be only two types of CTE state licensure: Integrated and Related. However, LEA-level program distinctions such as agriculture, business, technology education, etc. will remain. Thus, for this proposal to be viable, the mission of each program must be defined. This could be done at the national-level, state-level, or even the local-level with each district defining the missions of its CTE programs and requiring the relevant certification. There is of course one clear advantage to this process: School officials at all levels will be forced to contemplate and answer the question: What is the mission of CTE in their schools?

Recommendations for CTE Teacher Preparation Reform

Program Content

Training for teaching effectiveness is necessary regardless of mission. As the National Board for Professional Teaching Standards (NBPTS) states,

> Knowledge of subject matter is not synonymous with knowledge of how to reveal content to students so they might build it into their systems of thinking. Accomplished teachers possess what is sometimes called "pedagogical knowledge." Such understanding is the joint product of wisdom about teaching, learning, students and content. (NBTS, 2000, Proposition #2, p. 3)

Pedagogy

The starting points for the design of CTE teacher preparation programs are the fundamental requirements for proficient teaching as outlined by NBPTS:

> (1) a broad grounding in the liberal arts and sciences; (2) knowledge of the subjects to be taught; (3) knowledge of the skills to be developed; (4) knowledge of the curricular arrangements and materials that organize and embody that content; (5) knowledge of general and subject-specific methods for teaching and for evaluating student learning; (6) knowledge of students and human development; (7) skills in effectively teaching students from racially, ethnically, and socio-economically diverse backgrounds; and (8) skills, capacities and dispositions to employ such knowledge wisely in the interest of students. (NBPTS, 2000, Introduction, p. 3)

Regardless of mission, CTE teacher preparation programs should enable graduates to (1) provide student information and experiences that will assist in career development planning and decision-making, (2) model their understanding of appropriate professional and ethical practices, (3) develop programs based on models of effective instructional designs and techniques, (4) integrate academic and technical skills in applied contexts, (5) participate in developing Individualized Education Plans for learners with special needs, revise curricula to align with these plans, and adapt their instructional methods to fulfill the plans, (6) evaluate, select, and use instructional resources and technology, and (7) provide students with multiple clinical experiences including supervised work-based learning.

In addition, CTE teacher preparation for programs within the Integrated Model, should enable graduates to (1) analyze the classroom/laboratory environment and develop a plan to maximize the effectiveness of the instructional program while safeguarding the health and well-being of all, (2) design/deliver instruction within the competency-based methodology, (3) identify and involve relevant stakeholder groups, (4) develop and cultivate business, industry, and community partnerships, (5) implement Tech Prep fundamentals, (6) plan, initiate, and supervise work-based learning, and (7) assist in the post-graduation placement of students.

General Knowledge

Basic literacy is also necessary for all CTE teachers whether the program mission is Integrated or Related. Defining what literacy means is another matter, as is the question of whether the same level or type is needed for both CTE missions.

In *Workforce Education: The Basics*, Gray and Herr (1998) identify the knowledge base of the field (a requirement for national accreditation) as human capital development theory, labor economics, sociology of work, and career development theory. Also emphasized are professionalism, mission, ethics, human resource development in industry, and workforce development public policy.

Assessment

Considering the direction of accreditation groups such as NCATE and state licensure requirements, it is clear that outcomes-based assessment is on the horizon. The main implication of this development is likelihood that CTE teacher preparation programs will be required to be involved in the authentic assessment of their graduates' actual performances on-the-job. It is recommended that programs start planning now for involvement.

Organize CTE Teacher Preparation Programs Around Mission Not Program Titles

Those seeking to reform the existing university-based CTE teacher preparation programs should consider a redesign based upon mission rather than occupational content or existing program titles. Two overarching missions have been offered, (1) Integrated Model (TTP), and (2) Related Model (ETO/WFCT/TP).

Develop Alternative Route Licensure Models

Policy makers continue to propose more stringent teacher licensure requirements while school systems cannot find teachers, students do not have permanent teachers, and parents are angry. Thus, pressures mount for policy makers and teacher educators to develop/approve, or just look the other way to, a host of alternative routes. This may well result in the U.S. having both the most rigorous teacher education requirements and the highest percentage of uncertified teachers in the classroom.

Developing alternative teacher preparation routes is critical for CTE because shortages threaten its very existence. When school LEA's are unable to find a teacher for a CTE program there are only two options: (1) hire someone using the emergency/alternative licensure route, or (2) *close the program*. Just such a scenario led Volk (1997) to predict the total demise of technology education teacher preparation.

The reality is that *all* CTE teacher preparation programs would be wise to strategize how they can be a component of an alternative teacher licensure model. Our view of the labor-market for CTE teachers suggests that, shortly, those who come through the alternative licensure route could well outnumber those who complete the formal full-time teacher preparation model.

Further Recommendations

Modify State CTE Teacher Licensure Requirements

This analysis suggests that all CTE state-level teacher licensure could be reduced to just two: Integrated and Related. LEA's would be required to have a

specific mission statement on file for each CTE program and hire teachers with the appropriate certification.

Of all CTE teacher licensure, the T&I/HOED grouping will require the most change. In general, they tend to be to occupationally specific and inflexible. In some states these regulations actually are a major obstacle to the development of programs based upon occupational clusters. The recommended policy is to eliminate those occupational licensure titles that are based upon obsolete labor-market assumptions and hinder program flexibility to address broad-based occupational clusters. Then, using analysis as a guide, change the licensure specifics as necessary. The desired outcome of this process is the plethora of T&I, HOED, and Occupational Home Economics certificates would be reduced to one–Integrated–with endorsements related, as much as possible, to labor-market data, national skill standards, and the broad cluster definitions currently being developed at the federal level.

Link CTE Licensure/Preparation Reform to Federal Funding

While teacher preparation/licensure requirements have changed dramatically in virtually every state, CTE, especially T&I/HOED, have changed little. In many states, the tactic has been to get exemptions from the various pieces of reform legislation. *Thus, ultimately CTE teacher preparation/licensure reform comes down to the question of how to get the states to act.* It is recommended that a policy implementation strategy be employed to insure national adoption of CTE teacher preparation/licensure reforms by making it a condition for federal funds.

Develop an Implementation/Phase in Strategy

It is recommended that a program to phase in these recommended changes be developed to provide districts, administrators, and teacher preparation programs with the time needed to make the adjustments. Having such a plan will do much to win support from these important constituents. This is particularly true for CTE administrators who may philosophically support change but cannot find teachers who are able to meet the existing regulations. A phase-in plan will go a long way toward lessening these legitimate concerns.

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The Virtual Teacher Training Center: A One-Year Program to Transform Subject-Matter Experts into Licensed Career and Technical Education Teachers

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Abstract

The 1998 report, The Quality of Vocational Education: Background Papers from the 1994 National Assessment of Vocational Education (NAVE) sounded an alarm over the growing shortage of career and technical education (CTE) teachers without identifying ways to increase the number of vocational educators. The Virtual Teacher Training Center offers a model for a one-year teacher education and licensure program offered via the World Wide Web. This program is designed to transform experienced workforce professionals into classroom CTE teachers. Participants gain knowledge of educational pedagogy while at the same participating in practical classroom experiences. The model includes descriptions of the courses as well as several hypothetical schedules for delivery of instruction within one academic year.

The Challenge: A Crisis in CTE Teacher Availability

In 1998, *The Quality of Vocational Education: Background Papers from the 1994 National Assessment of Vocational Education (NAVE)* was published by the Office of Educational Research and Improvement, U.S. Department of Education. The Carl D. Perkins Vocational and Applied Technology Education Act of 1990 mandated this study. It encompassed a broad-based assessment of vocational education from a wide range of sources, both published and unpublished. Five of the background papers within the NAVE report focused on the quality of vocational education, and played a vital role in the formation of Volume II of the final report. These papers focused on teachers in vocational education, and outcomes of vocational and academic schooling. Two papers, both by Richard L. Lynch (1998a, 1998b), particularly focused on the training of teachers in vocational education; *Vocational Teacher Education in U.S. Colleges and Universities, and its Responsiveness to the Carl D. Perkins Vocational and Applied Technology Education Act of 1990,* and *Occupational Experience as the Basis for Alternative Teacher Certification in Vocational Education*. These two papers formed the primary impetus for development of this teacher training program.

Lynch's studies (1998a, 1998b) sounded an alarm regarding an

approaching crisis in the availability of vocational education teachers.

> We are facing a burgeoning need for career and technical teachers to train potential workers, yet have fewer and fewer educators to train the teachers. Nearly 10% of colleges and universities have closed their vocational teacher education programs, and others haven't graduated a vocational education teacher in years. (p. 191)

However, the final recommendations by NAVE focused on implementing higher standards for vocational education, not on exploring ways to increase the number of vocational education teachers that were being prepared to teach.

In 1998 another study from the U.S. Department of Education, as a part of Title II of the Higher Education Act also sounded an alarm related to projected teacher shortages. This study warned that 2.2 million teachers would need to be hired by 2008. Looking back, the seriousness of the impending crisis in vocational education appears to have been underplayed. Whether this oversight was due to the breadth of the overall NAVE study blurring what was being said specifically about the crisis in vocational education, or whether this oversight was due to the depth of the U.S. Department of Education study such that vocational education, as one of many, got lost in the crowd, is difficult to say.

A number of external factors could have accounted for the inattention to the impending crisis in vocational education including rapid changes in technology and its application to vocational fields, and the diffusion of information technologies within the general workforce. Rapid loss of educational funding nationwide, and the continuing attitude that teaching is a vocational effort has meant that vocational teachers are doubly pressed to prove their professionalism and status at 4-year institutions where they are competing with academic disciplines for prestige, legitimacy, funding, and other resources. The more recent movement of integrating vocational subjects within academic disciplines in the name of broadening the capabilities of potential employees for the workforce is having the effect that academic considerations are subsuming vocational considerations (CFDA, 2000; Lucas, 1999) and that teachers in traditional academic subjects are taking over teaching computer-related subjects as part of their subject-area discipline.

Endemic to the training of career and technical educators are several other issues. One of these is that career and technical education teachers must have practical experience in their subject-area field before their teacher education training, rather than afterward. Several years of workplace experience (500-4,000 hours) plus a bachelor’s degree in a subject-area, and then teacher training, can translate into an overall cost of training for a career and technical

education teacher of $100,000 or more. It can also consume 8 to 12 years before a CTE teacher can step into the classroom (Gamoran, 1998). Additionally, there are no bachelor's degrees for those who are in fields such as welding, auto shop, or the construction trades. This makes is impossible for people in these fields to enter a graduate-level teacher education program unless they have a degree in a related subject.

Even though there are an increasing number of workforce professionals coming out of industry into the teaching field, they are discouraged by the protracted period of teacher training, and the elimination of potential job sources at the high school level as vocational programs and courses, which are electives, are curtailed or eliminated (Lewis, 2001). New CTE teachers who get laid off because of budget cuts are hesitant to wait out a summer to see if a job turns up in the fall when they can go back into industry immediately and make more money. This situation also contributes to the low retention rates of new teachers in vocational subjects.

At the same time, schools in outlying geographic areas with low enrollments often turn to academic-subject teachers to teach the few vocational classes they offer. These teachers may have little more than anecdotal experience with career and technical education subjects (Lucas, 1999). In states where large urban areas have more jobs than teachers and more remote agricultural areas have more teachers than jobs there exists the perception that there is a shortage of jobs while at the same time there is the perception of a shortage of teachers.

The 2000-2001 edition of the U.S. Department of Labor *Occupational Outlook Handbook* states that career and technical education teaching positions will grow 10-20% by 2008. A comprehensive study to see what changes had occurred in the decade since Lynch's (1998a, 1998b) reports, which were completed in 1990, is cited. The study confirms the predicted decline in our capacity to produce CTE teachers representing at least a 10% decrease in ten years. However, there had been no concomitant process developed to train replacement teachers. In the intervening decade, actual teacher preparation programs declined. This is shown by the NCCTE study that observed, "The profession is looking toward more distance education as a means to deliver education" (p. 49). Since 1990, "The number of career and technical education teacher preparation programs has declined about 11%" (p. 49). Plans to double their distance education course offerings via the World Wide Web in the next 3 years was reported by 44% of respondents to the CTE questionnaire, yet current programs remain very traditional in the structure and delivery of their courses. The ten years since the 1990 and 2000 studies appears barren in producing programs for preparation of new CTE teachers. As the 2000 study shows, there were only plans for offering programs on the

World Wide Web. This effort will consume most, if not all, of those three years and, in the meantime, the shortage of CTE teachers grows.

Many reports agree with the conclusions in the 1998 NAVE report that vocational education should be more integrated with academic education. As the NCCTE (2001) report expressed,

> Workplace skills need to be evaluated to determine which skills and experiences CTE educators need to have to maintain educational standards for technical competencies...these respondents seem to be in concert with the latest literature indicating strong support for themes like academic integration. (p. 51)

Depending on the way one interprets these findings, they could be viewed as another effort to make vocational education more academic and less vocational to the detriment of vocational education.

A study completed by the Vocational Technical Council (VTC) published in 2000 focused on establishing a process "that was consistent with the statewide skill standards projects....(Believing) that the only way to achieve creditable vocational certification would be to enlist the industry (community and technical colleges) in setting the standards/competencies for instructors" (CFDA, 2000, p. 1). The VTC report recognizes that career and technical educators of the twenty-first century require more than the skills of their profession and identifies those skills sets while at the same time reinforcing the fact that these educators must be thoroughly trained and adept in the vocational areas in which they are teaching:

> The traditional ways of training people seem to be falling short. Although there are many reasons for this, a large part could be the disconnect between the workplace and the training institutions; be they elementary, secondary, or college, some schools do not have their fingers on the pulse of the changing economy and world of work. (CFDA, 2000, p. 5)

More courses, extended degree programs, higher degrees, and requirements for larger numbers of academic subjects within teacher education programs for career and technical education teachers will not produce knowledgeable subject-matter specialists anytime soon. On the other hand, no educator wants to respond with a short-term solution that may become a long-term problem.

However, there is a solution that can effectively and efficiently provide both a short-term solution and could become an integral part of a long-term one. In addition, this solution looks to new sources of potential teachers (subject-matter specialists from the work force), new ways of preparing them for the classroom (practical, experiential, reflective, and inquiry-based), and new technologies to deliver educational training for these newcomers (web-

based delivery). This solution is the Virtual Teacher Training Center.

A Solution: The Virtual Teacher Training Center

The Virtual Teacher Training Center proposed in this article relies on two major foundations. First is an abundant source of experienced workforce professionals, trained and experienced in various vocational subjects areas who want to become licensed CTE teachers. Second is a flexible dynamic reconfigurable teacher education program of 27-33 credits that can be completed within one academic year using state-of-the-art Internet technology. These programs can be delivered to would-be teachers in their homes and communities at the same time they are gaining practical experience and student teaching near their homes with a cooperating or master teacher.

The solution provided by the Virtual Teacher Training Center integrates a program of educational pedagogy and practical experience that is not dependent upon a bachelor's degree as a prerequisite. Of the three configurations suggested, one can provide a bridge from vocational training in the field, another from vocational training coupled with a community college degree in the field, and the third can bridge from a four-year degree earned at a university. The vital piece to all configurations is the workforce experience in the field. Using web-delivered instruction, programs like the Virtual Teacher Training Center provide potential career and technical education teachers with academic opportunities to synthesize their work-based experience with knowledge and practical experience in education and its pedagogy (see Figure 1).

The Virtual Teacher Training Center, by virtue of its delivery via the World Wide Web can reach populations who, for reasons of economy, time, or distance have been unable to enroll in traditional teacher preparation programs which are based at a fixed university site. Using the proposed program does not preclude more extensive academic training, it just does not make that training a necessary prerequisite to teacher education and licensure for experienced professionals.The proposed center can create a training arena where career and technical teacher education and licensure are not reliant on either an undergraduate or graduate degree program. Courses and experience from traditional and nontraditional sources can be applied as verification of subject-matter knowledge acquisition. Sources can be:

- 2-year community college subject matter content,
- training and experience in trades with union affiliation and instruction,
- trade schools that focus on career and technical subject training,
- workshops that function as specialized enhancement training,

- on-the-job training from industries that provide detailed training to employees,
- courses offered by industry training programs in specialist areas.

A web-based delivery system has greater capability than a bricks-and-mortar classroom to reach students who would be teachers, who have career and technical content knowledge gained in the workplace, who have content knowledge from vocational sources, or who have a combination of academic and vocational knowledge and experience. These students are generally older, often site-bound by jobs and family responsibilities, and may or may not have academic training in their subject areas but who have extensive practical experience. These are people who have worked in their specialty areas long enough to have gone beyond entry-level skills to supervisory and managerial levels. These are also students who may be living in remote or isolated areas where (a) schools have a scarcity of career and technical teachers and (b) where there are no colleges or universities located nearby.

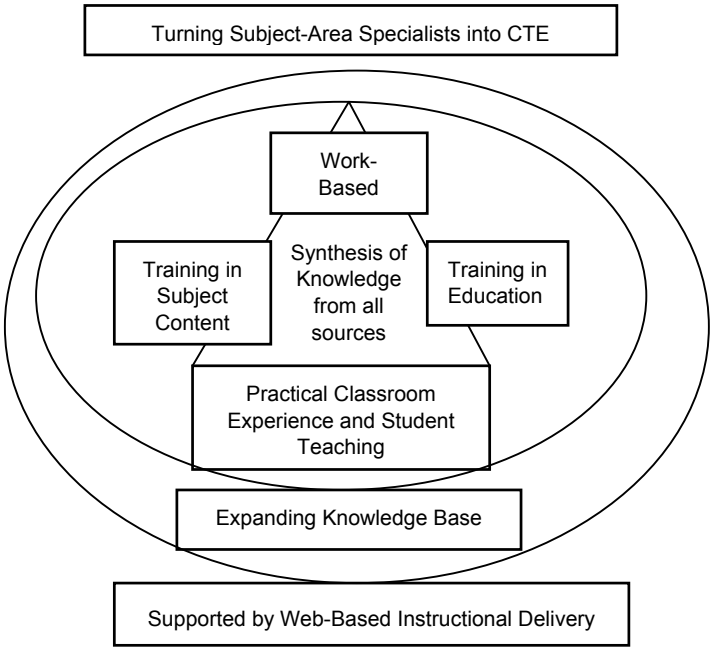


FIGURE 1. *Turning Subject Area Specialists into CTE Teachers.*

The Virtual Teacher Training Center makes several presumptions:

1. Experienced workforce professionals have subject-area knowledge

from their experience which is sufficient for teaching once they are trained in the pedagogy.

2. A broad-based liberal education to the graduate-degree level is not required before a new teacher begins teaching (Goodlad, 1990).

3. A 1-year web-delivered course of teacher education coupled with site-based practical classroom experience and student teaching can provide a beginning teacher with experience and knowledge to be effective.

4. Effective supervision of new teachers' performance can be accomplished through the combined efforts of on-site cooperating teachers and supervision (electronic or not) from the university site, or periodic university supervision on-site.

5. Students who would be teachers can learn the fundamentals of education and its pedagogy via a series of courses that are inquiry-based and reflective, and delivered via a web-based program.

6. Performance of new career and technical teachers trained in such a manner matches in quality the performance of teachers trained in traditional types of programs.

7. Such a program may or may not need to remain in an academic setting but can be expanded to include community colleges or state-approved commercial or vocational teacher preparation sites.

8. A series of bridges can be built in both directions to allow opportunities for workforce professionals without degrees to become teachers, and that teachers who have become licensed without bachelor's degrees in their subject area can be mainstreamed into bachelor's or graduate degree programs at some later time.

Discussion: Some Thoughts About Training CTE Teachers

Lucas suggests that there is nothing remotely resembling a national consensus on the best way to train teachers for the classroom, even among teachers themselves (Lucas, 1999). As a result, any proposed solution to the teacher crisis will be plagued by the residual effects of our long history of separating academic training from vocational training, and the further separation of teacher training from training in specific academic subjects.

Historically, career and technical education teachers have come from the workforce. Beginning in the late 19th century, throughout the United States artisans and craftsmen were recruited to teach in vocational schools. This practice culminated in the Smith-Hughes Act of 1917. In the 1950s as demand for consumer goods increased and wages for *blue collar* jobs increased, training of workers had difficulty keeping pace. At the same time, college

degrees became more accessible and educated status translated to trained. Workers who had formerly been known as blue collar could prepare for their professions with a college degree, which gave legitimacy to certain vocational professions. Concurrently, the number of vocational schools diminished and industrial arts programs blossomed at colleges. Throughout the 1960s and 1970s into the 1980s, students came into these programs in large numbers. College-based programs in career and technical education modified their curricula to meet the level of perceived substance and rigor of the more traditional science, math, and liberal arts programs (Lucas, 1999).

During the 1990s, business and computer Science curricula remained at the university level but industrial arts programs began to disappear as courses considered vocational moved down to the community college level. At the same time, many courses identified as vocational moved up from the high school level to the community college level. During this time the usage of computers, robotics, performance support systems, and computer-aided design and manufacturing meant that entry-level jobs became increasingly more technical. Simultaneously, workers with special skills knowledge were retiring (CFDA, 2000; Gery, 1997; Raybould, 1995). As the twentieth century wound down, it became apparent that industry could not handle all the training of their own workers, and with fewer teachers to train workers, it followed logically there were fewer trained workers.

Skills Teachers Need to Teach Vocational Education Students

A number of surveys discussing the skills sets necessary for all teachers show considerable agreement on those skills required to be successful in any classroom:

- extensive practical teaching experience as well as student teaching,
- knowledge of classroom management, multicultural issues, theories of learning, methods of student assessment, application of theory to practice, human growth and development, curriculum and instructional design, and integration of technologies into the classroom,
- ability to collaborate with colleagues, parents and community (Holste & Matthews, 1991; NBEA, 1997; NWREL, 1999; Simpson & Sandidge, 1994).

The skill most commonly required and discussed was practical experience in the classroom and student teaching, surpassing academic skills for importance (Lucas, 1999). However, vocational teachers need an additional skill; they need to know how to correctly operate the machines they are teaching students to use, and to stay current. CTE teachers need to

return constantly to a learning modality, not just back in industry but for

> reviewing and changing theoretical foundations for the subjects they teach in order to keep updated. This means that they will have to be able to access information in a variety of ways, including global information, process it quickly, and use it in teaching and learning situations. (CFDA, 2000)

The acquisition of a physical skill requires a different brain activity than cognitive-skills acquisition (Bandura, 1986; Carlson, 1997; Fischer, 1999; Posner, 1988; Skinner, 1953). The School to Work Opportunities Act (CFDA, 2000). Suggests that the dual requirement of staying current and maintaining excellence means that the future career and technical education teacher will have to be a generalist in order to meet the rapid changes in workplace (CFDA, 2000. However, at the same time workers of the future will need to be able to make specific application of the changes. This requires them to be the ultimate transformative learner (Cranton, 1996; Mezirow, 1994).

Model for Virtual Teacher Training Center

A viable and functioning model for the Virtual Teacher Training Center already exists at Oregon State University in the School of Education. It is the Professional Technical Teacher Education Program (PTE) and is totally web-based. This program was designed and developed by Dr. Mark Merickel, approved by Oregon's Teacher Standards and Practices Commission (TSPC) in Spring of 1998, and began accepting industry professionals who wanted to be CTE teachers in the Fall of 1998. It began with 12 students, almost equally divided between professionals who wanted to be Business Education teachers and those who wanted to be Technology Education teachers, between males and females, having a combined average of industry experience of 8 years and mid-thirties in age. Presently, the PTE Program is in its fourth year with 32 students who are placed in high schools all over the state. The success of the online PTE program makes it an exemplary model upon which to base a hypothetical model for web-based teacher education and/or licensure.

Discussion of the Model

The courses proposed for the Virtual Teacher Training Center are not templates, but are models of the courses presently used in the online teacher education program. An underlying issue in the design of courses for web-based delivery is that the instructor is at a distance from the student, and as one teacher states, "I could not take the face-to-face class as I taught it and put it up [on the web]. It wouldn't work" (Morihara, 2000). Also of concern is the issue of the impact of the technology on the content and student learning. Conclusions have ranged from no impact because the technology is just a

delivery method and nothing more (Clark, 1983) to discussions of the effect that media has on cognitive efficiency (Cobb, 1997). Research on all of these areas is in process and will, no doubt, continue to be so. However, with Web-based instruction there are several attributes, which are an advantage because of those methods of instructional delivery; coursework can be scaled according to the level of skill acquisition—from novice to expert—within the confines of course content. This level of scaling is difficult to accomplish in a face-to-face class, but can be done relatively easily in the electronic environment where learners are working more independently.

Courses in the model program are grouped according to the basic skills that the prospective teacher needs before becoming a full-time teacher. These courses were designed to be inquiry-based and reflective allowing students the opportunity to synthesize knowledge from reading and research and to apply the results in their specific practicum environment. This factor personalizes the learning making it more authentic and memorable. As a result, each student's responses to activities are different because of their unique combination of experience, thinking, and learning. Students also share their knowledge and experiences with their peers in an online threaded discussion where they post their activities and responses to other's activities.

The courses in the model are designed around the following schema:

*Students and learning***.** Courses in this category address the general topic of students, their diversity, and how they learn.

- Diversity among students
- Interpersonal communication
- Thinking and problem-solving
- Learning theory

Curriculum, instruction, and assessment. Courses in this category address curriculum, instruction, and assessment

- Organization and management of the learning environment
- Models of teaching, learning, and technology
- Assessment
- Curriculum and Instructional design

School, community, and professional cultures. Courses in this category address cultural contexts for teachers.

- Students, families, and communities
- School and workplace cultures
- School law
- Exploring new roles

Improving practice. Courses in this category address improving teacher practice through reflection, systematic inquiry, and professional activism.

- Reflective practice
- Action research
- Leadership and the teacher

Each course includes 3-4 open-ended activities plus a capstone activity, all of which are posted to an asynchronous discussion forum. All students participate in discussion about their work with instructors and peers. Additional courses may be added, appended, or interfaced with those in the model allowing student learning to be scaled upward or broadened. For this reason, overall design of the course offerings is meant to be flexible and inclusive, with the intent of increasing students' competence, regardless of each student's locus.

Within the Virtual Teacher Training Center, an extensive list of resources accompanies the instructional content including web links, books, and journals. Additional facilities exist for evaluation tools for student self-evaluation, teacher evaluation of students, an online grade book, an open chat room, and a place for announcements. Delivery of such a program can be accomplished either through a virtual site constructed completely from HTML code or from one of several instructional delivery software packages currently available. Course content may also be provided or reinforced by software available from publishers on CD. If an instructional delivery package is used, a separate virtual home base site can be developed which provides students with other benefits for a virtual program:

- A message center for notices relating to the program, information about the institution providing the program, transcripting, and other services.
- Information about the licensing agency; licenses, forms, and renewals.
- Links to forms required during the educational process; applications, and evaluations.
- Links to resources like national library databases, web-sites, portfolios, and work samples.
- Student-teacher evaluation forms for cooperating teachers to access and complete.
- A general discussion forum where students can sit around the virtual lounge and chat.
- Any other information which is desirable and necessary can also be included. Students come to see this site as a virtual home base for themselves in the program.

Concurrent with classes that students will be taking through the Virtual Teacher Training Center, students would be gaining practical experience in a high school near their home where they are observing and working with a cooperating or master teacher. Upon completion of their academic work and

their practical experience, students complete their student teaching, take whatever tests the state requires, and become licensed. The purpose of the concurrent experiences of academic work and practical experience is to allow preservice teachers with classroom experience at the same time they are taking their academic preparation. This dual learning and practical experience aids in synthesizing the academic with the practical in a live learning environment under the supervision of a cooperating teacher. As a result, students completing this experience are prepared upon completion, both academically and experientially to begin teaching.

Translation of Courses into Programs

The Virtual Teacher Training Center proposes a one-year program of study (see Figure 2) using web-delivered instruction to train and license experienced workforce professionals to become career and technical education teachers in one academic year. This program can be utilized in conjunction with work experience alone, 2 years of community college career or vocational training, or a 4-year bachelor's degree in a career and technical content area. As proposed, the program includes 27-33 credits including academic work, practical experience in the classroom, student teaching, subject-area methods courses, and a course in work samples/portfolio.

Flexibility in Course Offerings and Delivery

An example of the Virtual Training Center program is presented in Table 1. Courses in the sample are based on quarter credits, each requiring 30-33 hours of work. For institutions on the semester systems, credits and hours required could be adjusted. Also, one-credit courses could be combined in various ways to accommodate graduation requirements.

The one-credit design allows greater flexibility in course offerings for both - teachers who are working toward a beginning license and inservice teachers who are working toward continuing licensure or are taking classes for professional development credit. The sample includes 15 one-credit courses for preservice teacher training, 10-12 credits of student teaching, 1-3 credits of subject-area methods of teaching, and 1-3 credits of work sample/portfolio.

Two possible configurations are presented in Figures 3 and 4, each designed to be completed in 1 academic year of full-time work. Courses in Figure 3 are completed in 32 weeks providing the student the full basic background training of teaching pedagogy, development of work samples, and extensive practical and student teaching experience. At this point the new teacher is ready to be licensed according to the requirements of the state-

licensing agency.

Courses outlined in Figure 4 are completed in three 11-week blocks full-time blocks. In both Figures 3 and 4 all of the time during the last block is spent on completing subject-area methods and work samples/portfolios concurrently with student teaching.

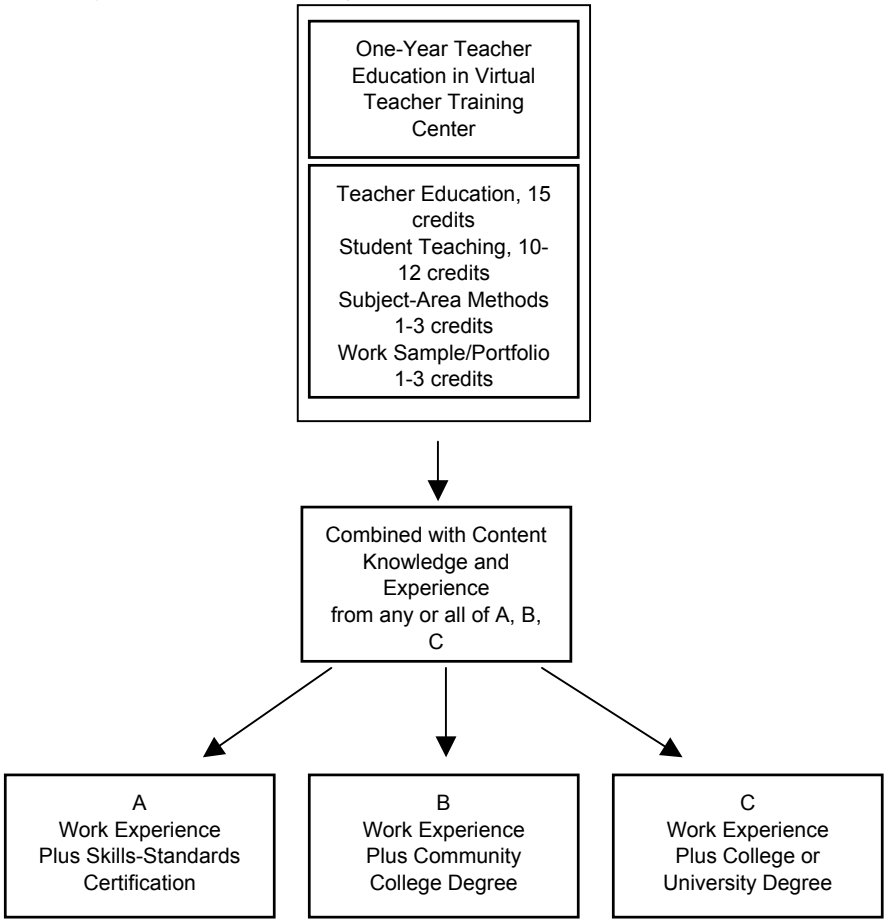


FIGURE 2. *Virtual Teacher Training Center 1-Year CTE Teacher Education Program*.

Concurrently with coursework, students spend part-time in remote classrooms gaining practical experience. Practical experience in many cases is not for credit. In this example it is not nor is it included in the 30 credits of work identified in the program. Requiring noncredit practical experience is

common practice in education and is an equivalent to lab experiences for potential teachers. Institutions adopting such a program should collaborate with local school districts asking the district to provide this practical experience for students as part of providing the master or cooperating teacher's time. However, the student teaching, which is full-time, is taken for credit. These credits are included in the program and would be transcripted.

TABLE 1. *A One-Year Teacher Education Program in a Virtual Teacher Training Center: Hypothetical Configurations for Offering 1-Year Programs*

#1	1 cr.	Diversity among students
#2	1 cr.	Interpersonal communication
#3	1 cr.	Thinking and problem-solving
#4	1 cr.	Learning theory and human development
#5	1 cr.	Organization/management of learning environments
#6	1 cr.	Models of teaching, learning, and technology
#7	1 cr.	Assessment
#8	1 cr.	Curriculum and instructional design
#9	1 cr.	Students, families, and communities
#10	1 cr.	School and workplace cultures
#11	1 cr.	School law
#12	1 cr.	Exploring new roles
#13	1 cr.	Reflective practice
#14	1 cr.	Action research
#15	1 cr.	Leadership and the teacher
Practical experience	0 cr.	Practical experience observing in classroom with master teacher in preparation for student teaching
Teaching methods	1–3cr.	Methods of teaching specific subject-areas such as web-access, keyboarding, woodworking, & autoshop.
Work samples & portfolio	1–3cr.	Work samples & portfolio reflecting academic work and student teaching-classroom experiences
Student teaching	10–12 cr.	Teaching under mentorship of master teacher in classroom using lessons that student teacher has developed consistent with curriculum & subject
Total credit	27–33 cr.	Variable depending upon implementation of program

The hypothetical programs depicted in Figures 3 and 4 reflect the flexibility that the Virtual Teacher Training Center offers. Major program strengths include:

- one-credit courses encompassing the basic knowledge that entry-level teachers require,
- independence from a traditional college/university semester or quarter system for time blocks,

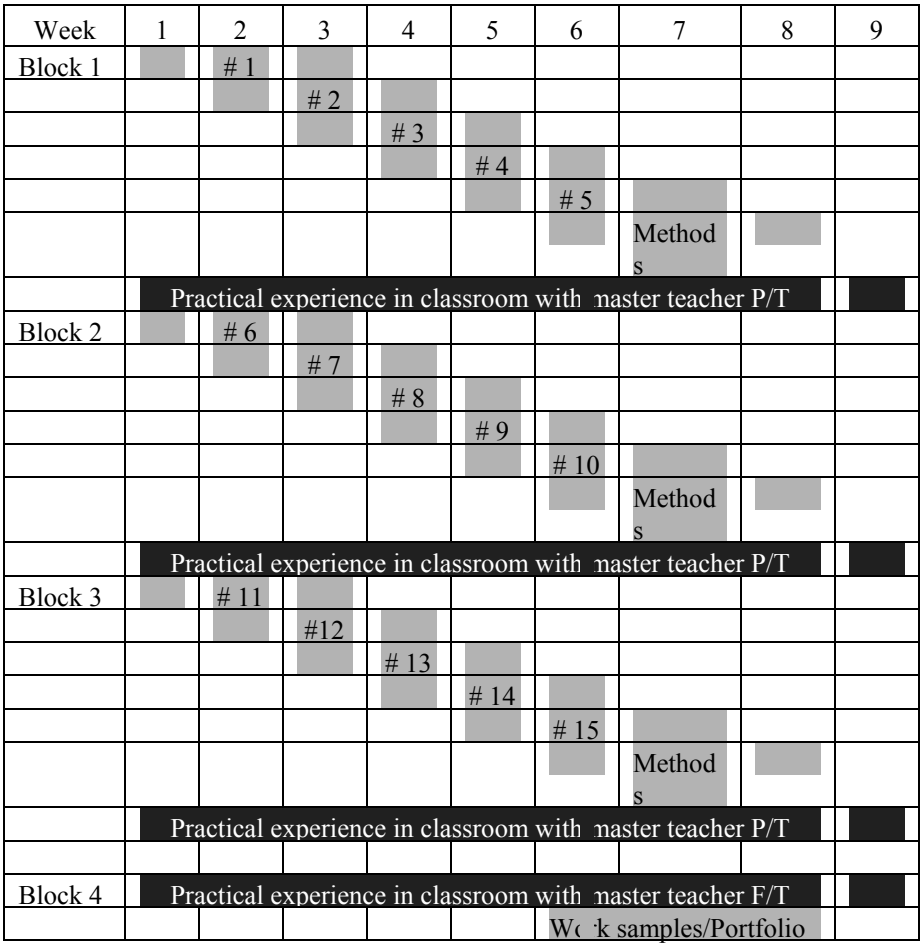
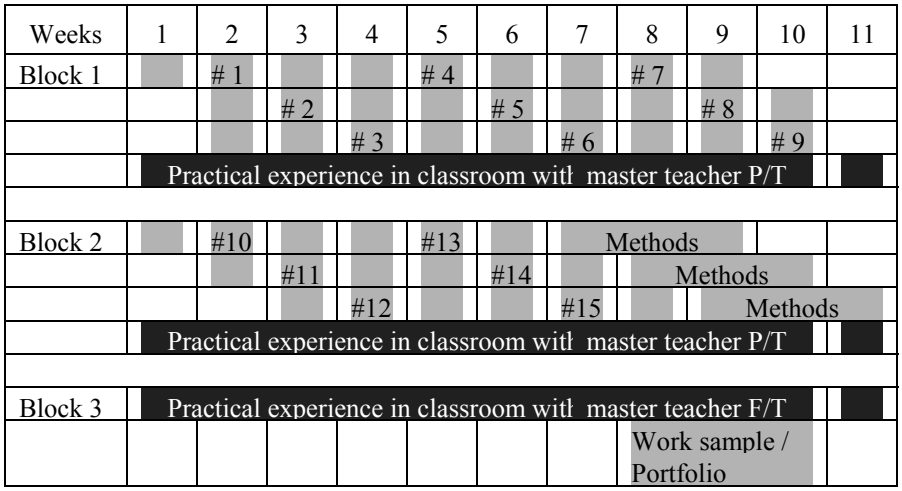


FIGURE 3. *Possible Configuration for Varied Scheduling Possibilities: Full-time Program Based on Four 8-Week Blocks Adjustable Longer or Shorter.*

- independence from the traditional college/university system of prerequisite courses (if desired) of a bachelor's-level liberal arts degree,
- longer practical experience in the classroom, and
- dependence upon previously acquired subject-area knowledge from work and/or trade experience.

It must be noted that the above suggestions and Figures 3 and 4 do not preclude a liberal arts education. What they do is remove it as a necessary prerequisite to the teacher education program offered in a Virtual Teacher

Training Center. New teachers may continue study toward a degree or degrees after entering the classroom. The courses offered in the Virtual Teacher Training Center should carry course-credit with them, which new teachers can transfer into other degree programs if they choose. It is also recommended that student teachers completing this 1-year program receive a certificate of completion and that courses shown on this certificate are also on a transcript.



Note: 1 credit of coursework or student teaching = 30-33 hours of work.

FIGURE 4. *Hypothetical Configuration for Example of Varied Scheduling Possibilities: Full-Time Program Based on Three 11-Week Blocks (adjustable for longer or shorter time)*

Evaluation and Assessment

Not only is the design of a course for a web-based environment different from those for a face-to-face environment, but the evaluation tools must also be different. Michael Moore suggests that the realities of the separation of learner from instructor and instructor from administering agency means that success of any distance delivered system will be dependent upon and must rely upon an effective monitoring and evaluation system (Moore, 1999).

In a web-based environment, most evidence of learning is presented by students in written form. Therefore, the preparation of students to produce quality written work is crucial; this has led many universities to reinstitute courses in basic writing and literacy skills for their graduate-level teacher candidates. In web-based environments portfolios have taken on a new role as

a primary evaluative tool for both new teachers and for teachers working toward their continuing licensure.

Virtual Supervision

In many states, supervision of pre-service teachers is the responsibility of the program coordinators. In others, supervision is part of a separate unit involved only with supervision and advising, not with teaching classes to pre-service teachers. The issue in a web-based program is that students and teachers who would be doing the supervision are often separated by some considerable distance. This means that the program coordinator or other designated supervision person from the entity delivering the education program may be required to travel some distance to the student school site in order to do supervision. One possible solution to the distance issue and frequency of supervision is the use of a supervising contractor who may be a retired teacher. Or, this responsibility could be shared with or performed by someone who works for the school district where the is student is teaching.

All of these options have limitations to their effectiveness in supervising student teachers at a distance. Relying upon others to do the supervision leaves a gap in knowledge for the institution delivering the program that is required to verify that the new teacher has gained the skills that the program requires of them. Nor does it necessarily provide the licensing agency with an assurance that the program, which they approved, is assuring that the skills required have been acquired by the student whom they are being asked to license.

The Virtual Teacher Training Center could develop a process and protocol for online supervision using the tools of multi-media. This type of supervision must deal with a number of factors:

- a designed and approved process for performing virtual supervision,
- an elaborated protocol for the technology required to accomplish this feat,
- capability from the institution to provide a variety of technologies for virtual supervision to and from a variety of schools which also have a variety of technologies,
- capability from the classroom to provide at least one technology to participate in virtual supervision,
- maintenance of a source of traditional supervision should a school not have the technology for virtual supervision or should parents object,
- establishment of guidelines regarding the legal issues surrounding the capture and transmission of the student teacher's student's images, and
- storage and archival of tape and video of student and student teacher

images.

When one dwells on the issues involved in virtual supervision, the first instinct is to abandon the idea as too complex. However, with virtual delivery of instruction will need to come virtual support of students at a distance with services from the delivering institutions such as registrar, admissions, or transcripts. And, virtual instruction may also require virtual supervision.

Discussion as a Learning Tool in a Virtual Environment

Any discussion about offering virtual programs must address whether such a delivery method provides learning for students. Since students and teachers are at a distance from each other, the primary method used for learning in a web-based environment is the discussion that occurs between and among the teachers and the students in the virtual class.

Discussion in a virtual environment, whether it is synchronous (in real time similar to a face-to-face conversation) or asynchronous (delayed interaction similar to a letter) can be a powerful tool for learning. Resistance to this form of instruction comes from its basic challenge to our basic beliefs about communication and learning. These beliefs coming from our lengthy experience in traditional classrooms have become embedded in our concepts of what we feel is necessary for students to learn and teachers to teach. However, if web-based instruction is to gain its place among the honored and accepted methods of instructional delivery for teachers and learning environments, and for students of all types, these prejudices have to be examined because they set up a serious learning impediment for both teachers and learners.

Conclusion: Looking Forward by Looking Backward

In order to look forward with action, we need to look backward and re-think our traditional beliefs about what it takes to train teachers; beliefs which may be impeding our ability to apply new ideas and new technologies for solving problems in teacher education and licensure. We may need to take a different perspective in thinking about status, professionalism, methods of training and licensure, career or degree paths evolving from a teacher's entry point into teaching, and continuing professional development for career educators. We need to examine our beliefs and perspectives regarding:

- new sources of potential teachers for career and technical education,
- new methods of delivering teacher education using newer technologies,
- shorter and/or alternative teacher education programs,
- separation of preliminary teacher training from lengthy degree programs,

- horizontal career paths for new teachers that would move non-degreed but professionally licensed teachers from initial licenses into and through degree-granting programs,
- vertical career paths moving from novice teachers to expert teachers much as workers in the trades progress from apprentice to journeyman to master.

Obviously, serious consideration of these issues and accommodation to the needs that result must also be accompanied by several major perspective changes:

- at the professional and community college level to provide additional basic skills work;
- at the college and university level to allow for one-year alternative teacher education and/or licensure programs;
- to implement policy changes at the state and national level regarding teacher education and licensure; and
- to incorporate alternate sources of course and program work which satisfy these goals.

Use of Technology to Broaden Access

Technology has the capability to broaden access to education. The Virtual Teacher Training Center lends itself naturally to this inclusion and can provide access to a number of features and services for distant students that are readily available to on-campus students:

- multi-media as an integral part of content delivery within any program;
- web-based technology to extend learning in non-traditional ways to diverse audiences,
- alternate licensure designs—horizontally, including transitional, preservice, and continuing licensure; vertically, including licensure-only, licensure and masters combined, and masters-only, as well as inclusion of undergraduate and non-academic work to satisfy licensure;
- collaboration with on-campus services (registrar's office, admissions, and graduate school) for acceptance of academic work from non-traditional sources (i.e. University of Phoenix, private sources), work in life and cultural experience (such as teaching native languages on a reservation);
- acceptance of non-traditional knowledge production;
- electronic-learning collaboration agreements so that students from any state may take courses from any other state and have them transcripted by their home university for students to build credits toward licensure or a degree within the state where they reside;

- collaboration among universities, community colleges, and professional organizations in development of content methodology available to all collaborators which may be used as required or as electives within the home universities' programs;
- combined programs, electronically controlled, as a combination in-class and electronically delivered series of courses which combine university, professional, and community college courses to satisfy the training of the next generation of technology education teachers;
- combined programs for continuing licensure that accepts 'credits' from a variety of traditional and non-traditional sources which lead to continuing licensure and/or advanced degree (if desired);
- high intensity focus on non-duplication of effort and greater utilization of various on-campus and on-line courses across programs and disciplines where content area of courses is so similar that various programs and disciplines could use the same courses in their programs;
- acceptance into degree programs of coursework done outside of bachelor's in content areas at community college level where no bachelor's programs exist in the individual subject area (technology);
- web-based training, discussion, chat room, and instruction between faculty and remote local teachers in mentoring and supervision;
- a cadre of web-pages which are accessible by more than one program, instructor, or course, broadening the availability for internal pages for linking, reduction in duplication of effort, broadening of knowledge base in all courses, and reduction in time required to maintain separate web pages which cover the same or related information.

A Change in Perspective

A number of the above suggestions require a change in perspective. We have made teacher education more academic than it needs to be for training entry-level teachers. Whether we have done this in the belief that the more education a teacher has the better teacher they will be or whether it is because educators themselves still long for professional status in universities devoted to academic subjects, it would be impossible to determine. At some point we need to examine the motivations behind this push to higher and higher academic degrees for entry-level teachers.

The Virtual Teacher Training Center allows us to focus upon something more pragmatic in order to resolve our current teacher shortage. It also allows to ask some thought provoking questions:

- Are traditional ways of training students and teachers so much better than new ways that we are willing to reject the potentials of new

technologies for delivery of instruction?

• Does more heavily weighted academic study provide specific tasks such that career and technical education teachers are as effective in their classrooms as they would be from an alternative method of training which focused more heavily on workplace skill-related tasks and practical classroom application for their initial entry into the classroom?

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