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The Journal of Vocational Education Research

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Editor's Note

Joe W. Kotrlik
Louisiana State University

This is an exciting time for career and technical education research. Those of you who participated in the AVERA and higher education discussions and meetings in Las Vegas during the Association for Career and Technical Education (ACTE) Convention know that several major changes occurred at this year's AVERA business meeting.

First, the name of the *Journal of Vocational Education Research (JVER)* has been changed to *Career and Technical Education Research (CTER)*, and the American Vocational Education Research Association (AVERA) has changed its name to the Association for Career and Technical Education Research (ACTER), both changes effective in 2005. The name changes will not impact the philosophy of the journal or the organization, nor will the changes impact the rigor of the journal or the types of manuscripts accepted for publication. Discussion about potential name changes has occurred over the past several years and the decisions taken at the AVERA business meeting were unanimous. I encourage you to read former AVERA President Jay Rojewski's Presidential speech that was published in the *Journal of Vocational Education Research*, Volume 28, Number 1, pages 3-13, and former AVERA President Bill Camp's Presidential speech that was published in the *Beacon*, Volume 34, Number 2 (http://www.tadda.wsu.edu/avera/BeaconV34.pdf). Both articles address the reasons why the name changes should occur.

Another major change is that ACTER will host a day-long research conference starting with the 2005 ACTE Convention in New Orleans, Louisiana. The conference will be a pre-session held on the day before ACTE (Wednesday, December 7, 2005) and will be a double-blind, peer reviewed conference. ACTER President Diane Jackson will appoint the Chair of the new research conference.

Another important event occurred during the ACTE Convention. A new organization, the Academy for Career and Technical Teacher Educators (ACTTE), has been formed. The purposes of this organization, as stated in the draft of the ACTTE constitution, are as follows:

- To act as a vehicle for strengthening and supporting excellence in higher education programs that prepare and support career and technical teacher education nationally and internationally.

- To identify and disseminate resources that support the preparation and professional development of career and technical educators as a field of study, research, and practice.

- To provide opportunities for the professional development of university faculty and persons in related organizations and agencies that deal with the preparation and professional development of career and technical educators.

- To study, adopt, and disseminate positions on social, economic, and political issues of concern to career and technical education.

- To serve as a proactive advocacy group for legislative, policy, and funding matters pertaining to career and technical education.

- To provide a forum for critical reflection and dialogue on scholarship and practice in career and technical education.

- To provide a caring, supportive, and collegial community for university faculty and persons in related organizations and agencies that deal with the preparation and professional development of career and technical educators.

Note. These purposes will be edited slightly before the draft of the constitution is adopted.

This organization is not a part of ACTER. ACCTE will have task forces, affiliates, and special interest groups (SIGs). ACTER will be an affiliate of ACTTE and the membership dues have been set at $20. If you are interested in being a charter member of ACTTE, contact ACCTE President Bill Camp at wgc4@cornell.edu.

This is also my final issue as Editor. I want to thank Morgan Lewis, JVER's Managing Editor for his excellent work in support of this journal. I also want to thank the members of the Editorial Review Board. Their top quality performance has made my job much easier and it has truly been a pleasure to serve as Editor of the Journal of Vocational Education Research for the past two years.

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Journal of Vocational Education Research, 29(3), pp. 157-179.

Distance Education Programming Barriers in Career and Technical Teacher Education in Ohio

Chris Zirkle
The Ohio State University

Abstract

The use of distance education at postsecondary levels continues to grow, including utilization in career and technical teacher education. Despite distance education's "learn anytime, anywhere" approach, there can be significant institutional, faculty/instruction and student/learner barriers to implementation. This study examined the perceptions of one state's career and technical teacher educators with respect to these barriers. The study also sought to determine demographic characteristics of the educational institutions involved in distance education, including the number of distance education courses and programs offered.

The use of distance education at the postsecondary level in the United States continues to grow. Studies over the past several years (Lewis, Alexander & Farris, 1997; Lewis, Snow, Alexander & Farris, 1999; Waits & Lewis, 2003) have documented the increased use of distance education as a way in which to deliver courses and programs to learners. In addition, recent studies have shown increases in the use of distance education for delivering career and technical education (CTE) courses, particularly at the two-year college level (Johnson & Benson, 2003).

The use of distance education for teacher preparation has also grown. Teacher preparation courses and programs at a distance are increasing, and some institutions involved with teacher preparation are beginning to provide pedagogical coursework in distance education as part of their programs (Thompson, 2003). Despite growth, the use of distance education in teacher preparation in CTE is still in its beginning stages. However, many colleges and universities across the country are utilizing distance education, in whole or in part, to prepare CTE teachers.

Distance Education Defined

The separation of teacher and learner is fundamental to distance education (Keegan, 1983). According to Holmberg (1978), it is this separation that differentiates distance education from all other forms of traditional instruction. This separation can occur through a number of methods, which has, in turn, led to a number of terms to describe the process of education in which the teacher and learner are separated, among them distance education, distance teaching, distance learning, open learning, distributed learning, asynchronous learning, telelearning, and flexible learning (Picciano, 2001). A relatively new term, E-learning, has been developed largely as a result of new technological innovations, and describes distance education as "applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, and CD-ROM" (Kaplan-Leiserson 2000). Other definitions of distance education mention bridging the physical separation though the use of some technical medium (Holmberg 1981; Moore & Kearsley 1996; Simonson, Smaldino, Albright, & Zvacek 2003).

Distance education can be delivered synchronously, in "real time" or asynchronously, in time-delayed mode. The technology utilized in distance education takes many forms. See Table 1 (University of Idaho College of Engineering, 2004; Zirkle, 2003).

Table 1
Technology Utilized in Distance Education by Technological Category and Time Mode

Technological Category	Time Mode	
	Synchronous	Asynchronous
Voice	telephone, audioconferencing	audiotapes and radio
Video	real-time moving images combined with audioconferencing (one-way or two-way video with two-way audio)	still images (slides), pre-produced moving images (e.g., film, videotape)
Data (Computer Applications)	electronic mail, fax, real-time computer conferencing, World-Wide Web applications, Internet relay chats (IRC)	computer-managed instruction (CMI)
Print	not applicable to print media	textbooks, study guides, workbooks, course syllabi, and case studies

Data and video options such as Internet-based courses and two-way video are the leading technologies for distance delivery (Waits & Lewis, 2003). With the virtually universal access of the Internet, it is likely that this technology will continue to be the preferred choice for offering courses at a distance.

Theoretical Framework

The ability to learn at virtually “any time and any place” is a major attraction of distance education. Time-bound or place-bound students are able to access distance education courses and programs largely on their own schedules, rather than the institutions’. Although seemingly eliminating the access barriers experienced by traditional students, distance education has its own set of constraints, or barriers for students (Zirkle, 2003).

The framework for this study is grounded in the work of Patricia Cross (1981), who discussed the reasons why adults participate, and perhaps more importantly, why adults do not participate in learning activities. Cross defined three barriers to learning: Situational, institutional and dispositional. Situational barriers arise from an individual’s situation in life at any given time. Institutional barriers are obstacles constructed by educational institutions (often unintentionally) that discourage learners from accessing educational opportunities. Dispositional barriers are related to attitudes and self-perceptions about oneself as a learner (Cross, 1981, p. 98).

Despite its long history, distance education has not been the subject of extensive educational research. Early forms of distance education primarily used written correspondence and instructional radio and television, playing a relatively small part in the educational process Zirkle, 2003). Adaptation of Cross’ work on barriers to participation and access to learning activities to distance education has been the subject of selected recent studies (Berge, 1998; Berge & Muilenburg, 2003; 2003; Berge, Muilenburg & Haneghan 2002; Cho & Berge, 2002; Muilenburg & Berge, 2001; Zirkle, 2001, 2002). These studies have continued Cross’ focus on institutional barriers and student barriers and have also explored faculty barriers to offering courses at a distance, primarily because of the time constraints on faculty associated with distance education. However, most of the above-cited studies did not examine institutional and student barriers with respect to their impact on CTE courses and programs. Specific research on the utilization on distance education in CTE is still relatively limited (Zirkle, 2003).

Literature Review

Institutional Barriers

With regard to educational institutions, program implementation barriers have been well documented. Garland (1993) and Yap (1996) listed several of these barriers to distance education:

- Program costs
- Lack of equipment and support
- Scheduling
- Resource availability
- Technical assistance

Start-up, as well as ongoing, costs for distance education can be significant (Hall, 1996; Van Dusen, 2000; Zenger & Uehlein, 2001). Studies in agricultural education (Miller & Miller, 2000; Murphy & Terry, 1998) have identified these costs. McClelland and Saeed (1986) analyzed these costs in a statewide effort to implement distance education programs in adult and vocational education. Ndahi (1999), in a study of trade and industrial education faculty, described the impact of the types of equipment and support available for a distance education program and identified it as a significant factor in the unwillingness of faculty to teach at a distance.

Scheduling courses can be a significant barrier to distance education. Satellite technology may have limited channels on which to broadcast. Universities that seek to offer complete degree programs at a distance may have difficulties getting university-wide "buy-in" to offer courses, as illustrated in a study by Zirkle (2002), in which trade and industrial education majors were able to access courses in their major, but were unable to schedule needed university general education courses, such as physical education, in order to graduate.

Other institutional barriers can include student advising, library services, and scheduling and/or registration in formats conducive to the distance learner. Students at a distance must be provided with alternative means of accessing these services; otherwise, they can be made to feel as "second-class" students (Zirkle, 2002). Distance students may not be aware of some specific course offerings and registration deadlines (Flowers, 2001).

The lack of an effective institutional network of technical assistance can be a significant barrier to offering distance education (Berge, Muilenburg, & Haneghan, 2002). Students who have difficulty accessing online course materials must have access to capable technical assistance, which can be both difficult to staff and costly to provide.

Faculty/Instructional Barriers

Faculty and instructional concerns pervade distance education courses and programs. Many faculty are resistant to offering courses and programs at a distance (Dillon & Walsh, 1992), simply because the process of converting a traditional, on-campus class to distance delivery can take considerable work (Birnbaum, 2002; Paloff & Pratt, 1999; Picciano, 2001). Several studies regarding the use of distance education in CTE have highlighted the time constraints associated with distance education programming (Miller & Miller, 2000; Murphy & Terry, 1998; Ndahi 1999; Ragothaman & Hoadley, 1997; Zirkle 2002). Many faculty are in need of professional development activities related to technology, and this training may also be difficult to provide at times that meet with faculty schedules. Financially compensating faculty and providing other incentives to encourage the course conversion process has also been investigated (Franklin & Kaufman, 1999; Lynch &

Corry, 1998; Picciano, 2001; Saba, 1998; Wolcott, 1999). Providing faculty with incentives of some type has been identified as a key to moving any distance education programming forward (Murphrey & Dooley, 2000).

A set of instructional questions regarding the appropriateness of teaching and learning CTE content has begun to emerge. Can psychomotor skills, such as those found in traditional trade and industrial programs such as welding or automotive technology, be taught through distance technology? Can some business courses, particularly those with a focus on interpersonal skills, be effectively taught online? These questions have been investigated by several studies in CTE (Fann & Lewis, 1997; Miller & Webster, 1997; Zirkle, 2002), with mixed results. While some of the computer-based skills found in business education-related courses can be effectively taught online, many of the skills found in labs can only be obtained through actual interaction with the equipment.

Finally, with respect to CTE teacher education, there has been little research conducted from a faculty perspective related to barriers to the use of distance education for teacher preparation. Recent studies focused on career and technical education have described the characteristics of teacher educators (Bruening et al., 2001a) and the use of distance learning in course and program delivery (Bruening et al., 2001b) but have not specifically examined barriers to use.

Student Barriers

A significant barrier to the delivery of distance education can be the students themselves (Hillesheim, 1998). Galusha (1998) listed access barriers experienced by students in distance education as follows:

- Costs and motivators
- Feedback and teacher contact
- Alienation and isolation
- Student support and services
- Lack of experience/training

The financial cost of taking courses would appear to be an obvious barrier. As college costs continue to rise, students at a distance face many of the same financial constraints of their on-campus counterparts. In addition, many students at a distance are "non-traditional", i.e., they are older, working adults with the challenge of balancing their studies with the demands of family and work (Grace, 2001). For these students, the personal costs may outweigh any financial issues, and educational institutions will continue to see students accessing distance education with significant family/work responsibilities and limited time (Sikora & Carroll, 2002).

Instructor feedback and contact has been identified as a barrier in distance education. The positive relationship between learning and the level of teacher-student contact has been documented in CTE distance education studies (Miller & Webster, 1997; Zirkle, 2002), as has the need for feedback and interaction as an integral part of CTE distance education courses or programs (Dooley, Patil, & Lineberger, 2000; Flowers, 2001; Murphrey & Dooley, 2000; Swan & Jackman, 1996).

Students at a distance can feel isolated from one another and may want to be a part of the larger school community (Galusha, 1998). While not greatly explored to date in CTE studies on distance education, Flowers (2001) and Zirkle (2002) noted students' sense of isolation and the lack of interaction with fellow students in their distance education programs.

Effective student advising at a distance can be difficult for both the student and institution, but is an absolute necessity for any successful program (Birnbaum, 2002). This issue has not been examined in CTE distance education studies. However, Irani, Scherler, Harrington, and Telg (2000) stated the need for close examination of the advisement process for distance learners. This need was also documented by Zirkle (2002) who found that students involved in a trade and industrial teacher education program were concerned about getting appropriately advised into courses needed for graduation and teacher credentialing.

Career and Technical Teacher Education in Ohio

The state of Ohio has had a long association with teacher education in career and technical (vocational) education. Ohio's first state plan for vocational education was completed in 1917 and provided for the appointment of state supervisors for the three instructional programs that were to receive Smith-Hughes dollars, along with funding for teacher trainers at The Ohio State University (Ohio Association for Career and Technical Education, 2002). Through the 1920's and into the 1940's, programs to prepare vocational teachers were also based at the University of Cincinnati, the University of Toledo and the University of Akron. During the 1960's, teacher education in vocational education blossomed as a result of funding through the Vocational Education Act of 1963 and the Vocational Amendments of 1968 (Pinchak, 2003). Other institutions were added, including Kent State University and Bowling Green State University. In 1986, data indicated Ohio had 66 teacher educators in vocational education (Pinchak, 2003). In 2004, fourteen Ohio educational institutions, both public and private, had programs to prepare teachers for career and technical education. See Table 2.

As defined by the Teacher Education and Licensure Standards developed by the Ohio Department of Education (2003), Ohio currently offers career and technical education teacher licensure programs in seven broad teaching areas within CTE. In addition, Ohio offers two pathways to licensure in career and technical education.

Baccalaureate programs can be found in all seven areas at various colleges and universities in Ohio. These degree-based programs, known as "Route A", require general education, content coursework and a teaching pedagogy, including field

Table 2
Ohio Colleges and Universities Offering Career and Technical Teacher Education Programs in 2004

College/University	Institution Type (Public/Private)	Licensure Programs Offered
University of Akron	Public	Family and Consumer Sciences (Route A)
		Integrated Business (Route A)[a]
Ashland University	Private	Integrated Business (Route A)
		Family and Consumer Sciences (Route A)
Bluffton College	Private	Family and Consumer Sciences (Route A)
Bowling Green State University	Public	Family and Consumer Sciences (Route A)[a]
		Integrated Business (Route A)
		Marketing (Route A)
		Route B (all areas)
		Technology Education (Route A)
Kent State University	Public	Family and Consumer Sciences (Route A)
		Route B (all areas)
		Technology Education (Route A)
		Trade and Industrial Education (Route A)
Mount Vernon Nazarene University	Private	Integrated Business (Route A)
		Family and Consumer Sciences (Route A)
Ohio Northern University	Private	Technology Education (Route A)
Ohio State University	Public	Agriculture (Route A)
		Family and Consumer Sciences (Route A)
		Integrated Business (Route A)
		Route B (all areas)
		Technology Education (Route A)
Ohio University	Public	Family and Consumer Sciences (Route A)
University of Rio Grande	Public and Private[b]	Integrated Business (Route A)
		Route B (all areas)
University of Toledo	Public	Health Occupations (Route A)
		Integrated Business (Route A)
		Route B (all areas)
		Trade and Industrial Education (Route A)
Wilmington College	Private	Agriculture (Route A)
Wright State University	Public	Integrated Business (Route A)
		Marketing (Route A)
		Route B (all areas)
Youngstown State University	Public	Family and Consumer Sciences (Route A)
		Integrated Business (Route A)

[a]The University of Akron and Bowling Green State University have approved programs in these areas, but are not currently accepting students. [b]The University of Rio Grande consists of a two-year public community college and a four-year private university.

experiences and clinical practice (student teaching) and are available in the following areas:

1. Agriculture
2. Health occupations
3. Integrated business
4. Family and consumer sciences
5. Technology education
6. Marketing
7. Trade and industry (p.16)

A type of alternative licensure, known as "Route B" is also available to individuals who meet specific work experience and educational requirements. Route B teaching licenses historically have consisted of teachers from the technical trades, such as carpentry, automotive technology, and cosmetology, but recently, in response to changes in the workplace and the economy, more Route B licenses have been developed in health occupations and marketing education. Route B licensure is available in the following fields:

1. Agriculture
2. Business
3. Family and consumer sciences occupations
4. Health occupations
5. Marketing
6. Trade and industry (p.17)

Bruening et al. (2001b) found that almost two-thirds of the institutions involved in CTE teacher education regularly offered courses via distance education methodologies, while the remaining one-third offered distance education courses occasionally. In addition, Zirkle (2003) found institutions across the country offering CTE courses and programs via distance education. However, neither study attempted to examine the utilization of distance education in specific courses and programs, or by type and size of institution (public or private).

Purpose of the Study

The purpose of this study was to determine the perceptions of teacher educators in Ohio with respect to barriers to offering courses and programs via distance education methodologies and to obtain specific demographic information regarding teacher education programs. Specifically, three research questions were addressed:

1. What is the present status of CTE teacher education in educational institutions in Ohio with respect to courses and programs offered and numbers of students enrolled?
2. Which courses and programs in CTE teacher education are offered through distance education technology?

3. What are the perceptions of CTE teacher educators in Ohio regarding specific barriers associated with offering CTE courses and programs at a distance?

Method

Subject Selection

Participants for the study were selected from a list maintained by the Ohio Department of Education, Division of Career, Technical and Adult Education. The list contained the contact information for all the teacher educators and/or administrators responsible for program delivery in each area of CTE. Twenty-three teacher educators from 14 educational institutions were identified as the population for this descriptive survey research.

Instrumentation

The first section of the survey questionnaire consisted of demographic information regarding institution type and size, CTE programs offered, and courses and programs offered at a distance. The second section addressed distance education barriers, and was constructed based on the work of other studies on distance education barriers by Garland (1993), Galusha (1998), Hillesheim (1998), Waits and Lewis (2003), Yap (1996), and Zirkle (2002). Barriers to distance education delivery were divided into three distinct categories: Institutional barriers, faculty/instruction barriers and student/learner barriers. Twelve statements (barriers) were developed for each of the three categories, for a total of 36. A four-point Likert scale was constructed. Respondents were asked to rank their perceptions of the impact of selected barriers as to the amount of impact each had on their CTE teacher education program's efforts to offer courses/degrees via distance learning with the following scale:

1 – no impact for this barrier
2 - minor impact – on isolated occasions, is/was a barrier
3 - moderate impact – is/was a barrier on several occasions
4 - major impact – is/was a consistent barrier

The final section of the survey questionnaire asked respondents to elaborate on any of the previous barriers or provide additional barriers to distance education if appropriate. An open-ended question was utilized.

The research instrument was examined for face validity by a panel of experts. Three faculty at The Ohio State University with teaching expertise and research interests in distance education comprised the panel and reviewed the survey questionnaire. Minor changes were suggested regarding the wording of the barriers and incorporated into the survey.

Procedures

The survey distribution procedure began in an email delivery format. The teacher educators were emailed the survey instrument, constructed as a Microsoft Word© form. The survey could be saved, and emailed back to the researcher. However, in an attempt to improve coverage and reduce nonresponse (Dillman, 2000), respondents were also given the option of printing the survey from the email and writing their responses and returning it via regular mail or via facsimile. After the surveys were distributed, five individuals did not respond during the initial two-week window requested for return. It was discovered during a follow-up phone call that several of the teacher educators were reluctant to open email attachments from unfamiliar sources due to computer viruses and other security concerns. These individuals were mailed a paper survey with a return envelope, which was returned promptly. With respect to this particular survey, it is unlikely that the use of this “mixed-mode” (Dillman, 2000, p. 219) for response purposes lead to any response errors.

Data Analysis

Data were analyzed in three ways:

1. Demographic data were summarized according to institutional characteristics, numbers of licensure programs, and the number and type of distance education courses and programs offered
2. Responses to the Likert style questions were input into the statistical package SPSS and analyzed through basic descriptive measures
3. Responses to the open-ended questions were summarized qualitatively and examined for themes, specific data and other information.

Limitations

Technology is constantly changing, and distance education is still evolving. Educational institutions are continually entering the distance education marketplace, while some are opting out (Zirkle, 2002). The difficulty of accurately determining, at any given time, the status of courses and programs in career and technical education that utilize innovative technology for distance delivery, as well as barriers to implementation, is recognized as a potential limitation of this study. However, as the use of distance education expands, this study may serve as a baseline for future studies.

Results

All 23 teacher educators responded to the survey questionnaire. Seventeen were returned via email, 4 through postal mail and 2 were faxed. Despite initial concerns with computer security and the need for additional response strategies, all surveys were returned within three weeks.

Since the survey questionnaire contained multiple choices within a Likert scale, Cronbach's Alpha was the method of choice to determine inter-item reliability (Gloeckner, Gliner, Tocterman & Morgan, as cited in Farmer & Rojewski, 2001). Using the Likert-style questionnaire and the data from this study, Cronbach's Alpha was calculated at .90.

Demographics of Teacher Education Institutions

Ohio's teacher education institutions for CTE are both public and private, and institutional enrollments range from just over 1,000 at one private institution to over 50,000 at the state's land-grant university. Individual programs range in size from just six students in one Family and Consumer Sciences program to almost 200 students in one Route B program. Two institutions are no longer accepting enrollments in specific programs. However, overall, teacher education in career and technical education in Ohio appears to have significant enrollments in several areas, except for health occupations, marketing education and trade and industrial education. See Table 3 for the distribution among areas.

Table 3
Numbers of Students Enrolled in Ohio Career and Technical Teacher Education Programs by Area in 2003-2004

Area within Career and Technical Education	Students Enrolled
Agricultural Education	195
Business Education	186
Family and Consumer Sciences Education	230
Health Occupations Education	8
Marketing Education	28
Technology Education	103
Trade and Industrial Education	20
Route B (all areas except Technology Education)	443
Totals	1213

Distance Education Courses and Programs

At present, none of the CTE teacher education programs in Ohio offer complete teacher education programs through distance education methodologies. Some individual courses can be found at various universities. Table 4 lists the institutions and their respective courses.

Table 4
Distance Education Courses Offered in Career and Technical Education by Ohio Colleges and Universities in 2003-04

Educational Institution	Course(s)
University of Akron	Fatherhood
	Parent-Child Interactions
	American Families in Poverty.
Bowling Green State University	Contextual Teaching and Learning
Kent State University	Curriculum and Design\Administering Cooperative Education Programs
	Disadvantaged Youth in CTE
	Student Assessment and Evaluation
The Ohio State University	Administration of CTE
	Class and Lab Management in CTE
The University of Toledo	Occupational Safety and Liability
	Construction and Utilization of Learning Activity Packets
	Strategies for Teaching Technical Theory
	Principles of School-to-Work Transition
Wright State University	Survey of Vocational Education
	Vocational Classroom/Laboratory Management
	Selection/Organization of Workforce Education Curriculum Coordination Techniques in Workforce Education
	Student Behavior Management in Workforce Education
	Curriculum Development for Workforce Education
Youngstown State University	Web Development

Most of the courses listed are Internet-based, utilizing course software such as WebCT or BlackBoard. In addition, The Ohio State University has used synchronous Internet-based videoconferencing with bridging technology to deliver courses to multiple sites.

From a content standpoint, the majority of the courses are focused on teaching pedagogy, not the technical content associated with the areas within CTE. Only the University of Akron and Youngstown State University offer courses in the CTE field of study.

Distance Education Programming Barriers

Institutional Barriers

Respondents were asked to rank their perceptions of the impact of each of the 12 institutional barriers with regard to the ability of their institution to offer courses and programs at a distance. Table 5 lists the means and standard deviations for these barriers.

Table 5
Institutional Barriers to Distance Education as Perceived by Teacher Educators

Institutional Barriers	*M*	*SD*
Support staff to help course development	3.03	.74
Start-up costs for distance education programming	2.75	.92
Strategic planning for distance education	2.70	1.14
Funds to implement distance education programs	2.65	.98
Shared vision for distance education in the institution	2.57	1.19
Technical support	2.39	.89
Climate for organizational change	2.26	1.05
Technology-enhanced classrooms, labs or infrastructure	2.08	.90
Library access to get resources for class	1.56	.99
Local versus out-of-state tuition	1.52	.89
Security issues (computer crime, hackers, piracy, viruses)	1.47	.84
Registration – students' ability to register for classes	1.39	.65

This section elicited only a few elaborations to the listed barriers. One respondent noted the need for a support system to be in place for distance education, stating, "I never seem to get satisfactory answers when I ask about offering a course at a distance. No one seems to know how to get started." Another respondent mentioned the lack of funds for distance education initiatives, "We have enough difficulties staffing our on-campus courses in a satisfactory fashion, let alone have funds to do distance education." Perhaps ironically, despite the reservations about responding to an email survey, the security issue was not mentioned in any further discussion and received one of the lowest overall rankings.

Faculty/Instruction Barriers

Respondents were asked to rank their perceptions of the impact of each of the 12 faculty/instruction barriers with regard to the ability of their institution to offer courses and programs at a distance. Table 6 lists the means and standard deviations for these barriers.

Table 6
Faculty/Instruction Barriers to Distance Education as Perceived by Teacher Educators

Faculty/Instruction Barriers	*M*	*SD*
Time commitment	3.74	.54
Faculty training to implement distance education	3.32	.71
Faculty compensation, incentives, etc. to implement distance education	3.19	.72
Ability to teach career/technical content at a distance	3.14	.76
Faculty level of technical expertise	2.97	.85
Resistance to online teaching methods	2.61	.84
Keeping up with technological changes	2.48	.99
Colleague knowledge/support of distance education	2.30	.97
Concerns with evaluation, testing, assessment, outcomes	2.17	.65
Ability to monitor identity of distance education students	2.13	.87
Intellectual property issues	1.72	.83
Job security issues (faculty will be replaced by technology)	1.21	.67

This section prompted several respondents to add comments. The time constraint was mentioned specifically by two respondents, one who emphatically stated, “I put in an enormous amount of time setting up course materials on the course web site of the course I taught.” Another said, “Faculty time availability is a constraint to distance education.” Another respondent lamented the lack of available faculty to teach at a distance, stating, “There are not enough faculty to devote to any distance education initiative.” One other respondent mentioned other responsibilities that hindered faculty involvement in distance education, citing “It is in our plan to develop distance education courses. The need for new program development keeps bogging us down. We will get there, but not soon enough.”

Student/Learner Barriers

Respondents were asked to rank their perceptions of the impact of each of the 12 student barriers with regard to the ability of their institution to offer courses and programs at a distance. Table 7 lists the means and standard deviations for these barriers.

A few respondents added additional comments in this section, mostly addressing the ability to prepare teachers at a distance. One said, “I guess I am old-fashioned, but I want to see the student and the entire educational setting going on all at the same time. I do not feel this can be done to my satisfaction through distance learning.” Another respondent mentioned the difficulties of teaching CTE at a distance, by asking, “How do we expect to train technicians at a distance? Better yet, how to interact with people in a teaching setting? I just don't think we can do these things at present."

Table 7
Student/Learner Barriers to Distance Education as Perceived by Teacher Educators

Student/Learner Barriers	*M*	*SD*
Ability to learn career/technical content at a distance	3.37	.64
Absence of an instructor (creates motivation, quality of student work issues)	2.97	.73
Isolation from other students and faculty	2.78	.86
Time constraints associated with job responsibilities	2.61	1.15
Student's level of technical expertise	2.39	1.15
Student's availability of technology (Internet service, computer access, etc.)	2.30	.97
Technology fees (increased costs associated with distance education courses	2.13	1.01
Student support services (help with advising, admissions, financial aid, etc.)	2.08	.99
Monetary issues – paying for courses	1.87	.91
Transferability of credits	1.86	.96
Instructor availability (students' ability to contact instructor to discuss concerns	1.82	.98
Obtaining grades, transcripts and other course-related records	1.34	.71

Conclusions

Demographics of Teacher Education Institutions

Career and technical teacher education programs have been established in all the surveyed Ohio institutions for years, and in many cases, decades. Public institutions have the largest CTE teacher education programs. Two institutions have recently dropped programs from active enrollment of new students, and there may be an overabundance of programs in some areas of CTE, specifically Family and Consumer Sciences, where there are eight active programs. There appears to be a slight need for more preparation programs in marketing education and health occupations, especially since these are areas with potential growth for programming at the high school level. If these teacher preparation programs are not developed, a significant number of CTE teachers in these areas may continue to be trained through the alternative "Route B" licensure, which focuses primarily on work experience as the initial hiring factor, not pedagogical preparation, and still is the largest single program area for Ohio's CTE teachers. Overall, however, with over 1,000 potential teachers in preparation programs, there appears to be a healthy supply of preservice teachers in the state.

Distance Education Courses and Programs

Career and technical education courses at a distance are offered exclusively by state-supported educational institutions. None of the private colleges and universities involved in CTE teacher education offer courses at a distance. This finding would seem to run counter to that found by Bruening et al. (2001b), who found almost two-thirds of the institutions involved in CTE teacher education regularly offered courses via distance education methodologies, while the remaining one-third offered distance education courses occasionally. This finding, however, is consistent with a recent National Center for Education Statistics study (Waits & Lewis, 2003) that found public institutions are more likely to offer distance education courses than private institutions. This may be due to a lack of financial resources at smaller educational institutions (Zirkle, 2004) or simply because, as one teacher educator at a small college put it, "We are a small liberal arts college, and believe in personal contact with our students. Distance education is not part of our mission."

There are no complete CTE licensure programs offered via distance education in Ohio. This may be due to several factors. Colleges and universities often lack the resources and faculty "buy-in" to offer entire degree programs at a distance (Zirkle, 2003). While one department or degree program may wish to offer a complete program at a distance, securing the needed courses from other areas may be more difficult.

In addition, CTE faculty have had reservations about the use of distance education in teacher preparation (Bruening et al., 2001b). The acquisition of the interpersonal skills associated with teaching may be difficult to obtain, as well as the technical content expertise needed by CTE teachers. Until technology develops improvements in some of the present methods used to teach skill development (videostreaming, simulation software, etc.), these reservations may persist.

Barriers to Distance Education

The move to a delivery system other than the traditional on-campus model would require major institutional modification. Most of these changes are reflected in the barriers rated most highly by the respondents. With respect to institutional barriers, respondents seemed most concerned with having resources to implement and sustain distance education programs. While many Ohio CTE teacher preparation programs appear to be functioning well, there seemed to be a preference from the respondents to keep their present program structure viable rather than make a marked foray into distance education. The highest ranked institutional barriers can ultimately be linked to financial resources (or the lack thereof). This finding is consistent with a recent national study on distance education in postsecondary institutions (Waits & Lewis, 2003).

Faculty/instruction barriers had the highest set of rankings overall. The time commitment associated with distance education, faculty training to implement distance education, and faculty compensation and incentives for distance education all ranked highly. This finding is also consistent with other CTE distance education studies (Miller & Miller, 2000; Murphrey, & Dooley, 2000; Murphy, & Terry, 1998; Ndahi, 1999; Zirkle, 2002). Perhaps surprisingly, three barriers that have been mentioned prominently in other studies ranked fairly low overall. Intellectual property issues, a debated topic with faculty involved in distance education (Saba, 1998; Simonson, et al., 2003), the ability to monitor identity of distance education students and concerns with evaluation, testing, assessment, and outcomes all received little emphasis from the respondents. This may be due to the experience level of the group of respondents as a whole. With few courses and no complete programs offered at a distance, Ohio CTE teacher education faculty may have little personal experience with these barriers, hence the low ranking.

The results from the section of student/learner barriers highlighted the reservations Ohio CTE teacher educators have with the ability of students to learn CTE-related content at a distance, a finding shared by other related studies (Bruening et al., 2001b; Fann & Lewis, 2001; Miller, 1997; Zirkle, 2002). Coincidently, the ability to teach CTE content at a distance was also ranked fairly high in the list of faculty/instruction barriers, indicating this group’s reservations with the use of distance education in preparing technically-competent instructors. The absence of a “live” instructor in distance education and the perceived issues that scenario creates (a lack of motivation, students not working as hard as they might with an in-class instructor, etc.) also ranked highly. Clearly, many of the respondents shared the perceptions of the one individual who wanted “…to see the student and the entire educational setting going on all at the same time.”

Recommendations

Demographics of Teacher Education Institutions

As mentioned, overall the number of individuals in CTE teacher education programs is substantial. However, there may be some areas of concern. First, based on a recent supply and demand study (The Ohio Collaborative, 2003) the number of Family and Consumer Sciences programs in Ohio may exceed the need and has resulted in some extremely small programs. This is perhaps most evident in three of the private institutions offering the program, where total enrollments are six, 12 and 15, respectively. A re-examination of the number of Family and Consumer Sciences programs may be needed. Secondly, only two institutions offer Marketing Education as a Route A program, and there have been shortages of some fully qualified marketing teachers. In partial response to this, in 2003, Ohio developed a Route B license for “Marketing Technology” which allows someone with industry experience to teach some marketing courses that were previously only taught by individuals with full marketing licensure. This may point toward the need for increasing the enrollments in the two existing programs, or developing a Route A Marketing Education program at a third institution. Finally, the need may also exist to develop more Route A programs in the Health Occupations and Trade and Industry areas, as more programs are being developed in these areas at the secondary level in Ohio.

Distance Education Courses and Programs

Based on other data regarding distance education utilization in CTE (Zirkle, 2003), Ohio appears to be behind other states in the number of CTE teacher education courses and programs available at a distance. From this survey, there also appears to be a lack of resources and a sense of “maintaining the status quo” from the respondents. Shrinking budgets, limited institutional support for CTE programs, and the lack of a unified vision for distance education may be a few of the significant reasons for Ohio’s current situation. Ohio’s educational institutions may wish to look to collaborative models, such as those found with Texas A&M and Texas Tech’s “Doc at a distance” doctoral program, Indiana State University’s collaborative Ph.D. in Technology Management or the Family and Consumer Sciences Distance Education Alliance, located in Texas, in order to pool resources within the state’s educational institutions to offer CTE teacher education. Another possibility would be leadership for distance education program development from the state department of education, which has funded some CTE course development for distance delivery in recent years.

Barriers to Distance Education

With respect to institutional barriers, Ohio’s CTE teacher education institutions must look for innovative ways to implement and sustain distance education programming. Overcoming funding and resource allocation issues is a significant challenge. In addition, institutions interested in offering entire degree programs at a distance need to search for ways to have campus-wide support for distance education programs. While a career and technical education program might wish to utilize distance education in its degree program, unless other academic departments are willing to follow suit, the student will be unable to complete degree requirements.

Faculty/instruction barriers must be addressed if distance education efforts are to be successful. Course development time, training to migrate courses to distance delivery, and incentives for development must all be provided if institutions are to move forward with any distance education initiative.

Addressing student/learner barriers is also a key to any distance education effort. Teacher education programs in career and technical education must design solutions to the issues of technical and pedagogical knowledge and skill development. These programs also need to ensure quality of instruction and high levels of interactivity between instructor and students and between students themselves, so student motivation and performance stay at high levels. As new technologies become available to increase quality of instruction and interaction, they should be tested and implemented.

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Technical Education Curriculum Assessment

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Abstract

The purpose of this paper is to describe and determine the efficacy of a Technical Education Curriculum Assessment (TECA). The TECA was designed to guide the judgment of the quality of technical education curricular materials. Three research strands were combined into a theoretical framework which underlies the education of effective technicians. The TECA consists of sets of rubrics which focus on workplace competencies, technical accuracy, and pedagogical soundness. The rubrics were constructed using a deductive-inductive approach. This was an iterative process that ensured validity by moving back and forth from the theoretical framework uncovered in the literature review (deductive) to the application of the rubrics to actual curricular materials (inductive). We describe the process of rubrics development and provide data which support their validity and reliability. This psychometrically sound instrument should assist industry and education professionals to make more informed decisions when designing, implementing, and evaluating technical education curriculum.

Introduction

Many publications in the last decade have outlined how advanced technology, the global economy, and changing demographics have intensified the need for new educational programs to supply industry with qualified technicians. The U.S. national need for more technicians was anticipated in the early 1990s in reports such as *Gaining the competitive edge: Critical issues in science and engineering technician education* (National Science Foundation, 1993) and *Technology for all Americans: A rationale and structure for the study of technology* (International Technology Education Association, 1996). Occupational and technical programs are especially important today in our rapidly changing job market. When asked about the economy, community college administrators mentioned several of their programs as particularly relevant to national economic recovery: digital systems, facilities technology, manufacturing process technology, and telecommunications (Coley, 2000). As discussed by Grubb (1999), the occupations with the highest growth rates require less than a bachelor's degree, typically one to two years of postsecondary technical education. In no other area than in vocational and technical education has greater emphasis been placed upon the development of curricula that are relevant in terms of substantive outcomes for students and the industrial community (Finch & Crunkliton, 1999).

Standards are needed to help ensure the quality of education and the development of employees for technical level jobs. The study by Benn and Stewart (1998) with committee members for technical programs showed that the use of standards increases communication between industry and education, because the standards provide a basis for curriculum and assessment. Finch and Crunkliton (1999) distinguished between *in-school* and *out-of-school* technical education success standards. *In-school* success standards must be closely aligned with the performance expected within the given occupation. For instance, the criteria used by instructors should be the industry standards. *Out-of-school* success standards are determined by the employment-related success of a program's graduates. For example, *out-of-school* success standards can be occupational placement ratings, graduates' incomes, workplace competencies, technical skills, and entrepreneurial skills. In the last few years, the National Skill Standards Board has been encouraging business and industry to communicate their requirements to educators (West, 2001). Technical education curricula should reflect these requirements so that graduates possess the competencies and skills that are critical to employer needs.

The purpose of this paper was to describe and determine the efficacy of a Technical Education Curriculum Assessment (TECA). The TECA was designed to guide the judgment of the quality of technical education curricular materials. It consists of sets of rubrics which assess workplace competencies, technical accuracy, and the pedagogical soundness of technical education curricula. The process of rubrics development and data supporting their validity and reliability is described. The TECA was developed and implemented to assess the quality of 30 sets of curricular materials which were part of the National Science Foundation's Advanced Technology Education (ATE) Program.

Theoretical Framework

In order to develop an effective curriculum evaluation tool, the theory underlying the development of effective technicians needs to be explicated. Technical and vocational education research literature and curriculum and assessment research literature provide multiple perspectives on the production of effective technicians. We have merged these differing strands of research into a coherent theoretical framework. The major theoretical foci discussed here include the Secretary's Commission on Achieving Necessary Skills (SCANS, 1991), Finch and Crunkilton's (1999) curriculum development theory for technical and vocational education, and Wiggins' (1993, 1998) model of assessment and curriculum development.

The SCANS (1991) commission identified the competencies and skills needed to succeed in the world of work. The report identifies the following competencies that effective workers can productively use: resources, information, interpersonal skills, systems, and technology. Resources refer to allocating time, money, materials, space, and staff. Information means that a worker can acquire, organize, maintain, and evaluate data and use computers to process information. Interpersonal skills are human relation skills such as the ability to work on teams and lead, negotiate, and work well with people from culturally diverse backgrounds. Systems refer to an understanding of social, organizational, and technological systems. Workers should be able to monitor performance and design and improve systems. Technology implies that workers can effectively apply technology to specific tasks and maintain and troubleshoot equipment. The SCANS (1991) report also identifies three foundational skill sets that competent workers in a high-performance workplace need. These are basics skills (e.g., reading, writing, speaking, arithmetic), thinking skills (e.g., problem solving, decision making, reasoning, creativity), and personal qualities (e.g., self-esteem and self-management, sociability, integrity). Although the commission completed its work in 1992, its findings and recommendations continue to be a valuable source of information and continue to be cited in career and technical education literature (http://www.scans.jhu.edu/NS/HTML/Articles.htm). Similarly, Benn and Stewart (1998) suggest standards linking industry and vocational education programs, and Dyrenforth (2000) suggests that employability and basic skills should be considered more heavily than company specific needs.

Finch and Crunkilton (1999) propose that the success of technical education curricula is not only measured by students' achievement in school, but also through the results of that achievement in the world of work. Therefore, curricula must be oriented and justified by both the process (learning experiences within the school setting) and the product (employment opportunities derived from in-school experiences). They suggest that curricula must simultaneously be justified by industry, yet remain pedagogically focused. Under this model, technical education curricula must directly help students develop a broad range of knowledge, skills, attitudes, and values that clearly contribute to the graduate's employability. In order to accomplish these tasks successfully, technical education curricula must be responsive to the technological changes in society. Finch and Crunkilton list the following factors that must be considered to keep curricula highly relevant to assist students in entering and succeeding in the world of work.

a. Data-Based: decisions regarding content need to be grounded in school and community data.

b. Dynamic: curriculum is responsive to changes in the workplace and modifications should be tangible improvements.

c. Explicit Outcomes: curricular goals should be measurable; the more explicit the outcomes, the easier it is to determine if students achieve them.

d. Fully Articulated: the scope and sequence of curricular concepts should be logical and efficient. Linkages between grades and across courses should be thoughtful.

e. Realistic: student experiences should be practical and fully contextualized.

f. Student-Oriented: instructional approach should assist students to prepare for the world of work.

g. Evaluation Conscious: continuous effort should be made to evaluate the effectiveness of the curriculum.

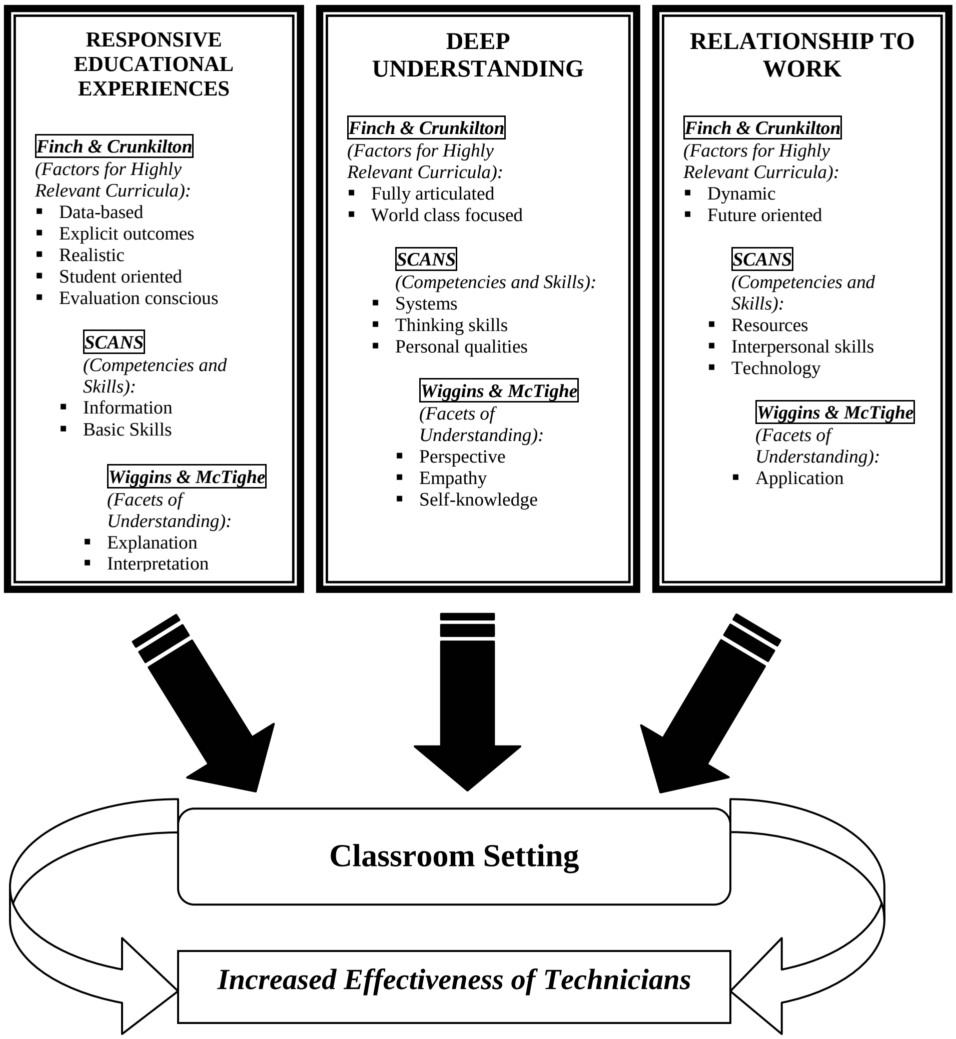
h. Future-Oriented: extent to which curriculum will be effective in the future should be determined.

i. World Class Focused: formal effort to benchmark world-class standards and focus on total quality.

Wiggins (1993, 1998) and Wiggins and McTighe (1998) offer an underlying theory which emphasizes the careful selection of what should be studied, closely ties to real world use of the knowledge, and authentically assesses understanding. To show real competency, students should be able to demonstrate each of the following six facets of understanding: explanation, interpretation, application, have perspective, empathy, and have self-knowledge. Explanation is understanding revealed through performances and products that clearly, thoroughly, and instructively explain how things work, what they imply, where they connect, and why they happen. Interpretation is meaning-making (e.g., rendering a concept personalized, accessible, and/or translated) rather than explanation. Application is the ability to use knowledge effectively in new situations and diverse contexts. Perspective implies that the student can consider concepts from different vantage points. Empathy is similar to perspective but implies the ability to understand another person's feelings and worldview without necessarily agreeing with them. Finally, self-knowledge implies that students recognize their own patterns of thought and how these might affect understanding. More recently, Vars and Beane (2000) suggest that technicians should solve authentic problems with multidisciplinary knowledge.

We have combined these different research strands into a theoretical framework which underlies the education of effective technicians. As can be seen in Figure 1, the research strands are integrated to support three themes: responsive educational experiences, deep understanding, and relationship to work. Responsive educational experiences describe curricula that place the student in the center of the pedagogical universe. These are dynamic curricula in which the content and instructional strategies are responsive to the needs of the learners. Deep understanding refers to curricula which promote thorough and in-depth comprehension of content and meaning. These are curricula that would score high on Bloom's taxonomy (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). Relationship to work refers to curricula which are oriented and justified by workplace demands. Each of these themes is informed by SCANS (1991), Finch and Crunkilton (1999), and Wiggins (1993, 1998). These three themes, supported by the core instruction, materials and assessments, are shown as combining to produce distinctive classroom environments which in turn lead to the production of effective technicians. This theoretical model guided the development of our technical education curriculum assessment (TECA).

Figure 1 - Theoretical Strands



TECA Construction

The TECA was constructed with a deductive-inductive approach by moving back-and-forth from the theoretical framework uncovered in the literature review to actual curricular materials. This iterative process of theoretical critique and application of the rubrics to the curricular materials allowed us to constantly check their validity from the standpoint of the accepted knowledge in the literature review (deductive) while remaining compatible with the actual material (inductive). This process of using specific exemplars of work is discussed by Wiggins and McTighe (1998). They contend that effective rubrics should be based on specific exemplars using the widest range of quality possible so that all potential performances fit within the rubric. The authors of this paper used this back-and-forth process three times to construct a draft of the TECA. The draft was given to a technical and science education assessment expert for review and feedback. Improvements were made in wording, in rating scales, and the number of items. It was decided that a series of "yes"/"no" questions should precede the rubric questions to assure that raters would attend to specific elements of the curricular materials and better understand the intent of the rubric questions. Another round of this iterative process of critique and application resulted in a refined draft of the rubrics which could be used to assess curricula designed for technician education in a wide range of vocational fields.

This refined draft was sent for review to the ATE Evaluation Project's Advisory Committee. This committee is a nine-member team, composed of technical education and evaluation experts. The committee was given the opportunity to actually use the TECA instrument to rate a piece of curriculum similar to the ATE materials included in the sample. Although the Advisory Committee viewed TECA as comprehensive and as asking the right questions about quality, they also made suggestions for improvements. Suggestions included better alignment with Science, Technology, Engineering, and Mathematics (STEM) standards; improved structure and more careful wording of items; more consideration of workplace diversity; and more emphasis on how well curricular materials included or considered student assessments. Each suggestion and comment was considered in light of the theoretical framework from which the rubrics emerged and the practical issue of actually using the rubrics to assess a large number of materials. These considerations resulted in yet another revision. The revised draft was then used by three science and technology education experts to independently rate three different materials. These curriculum materials were specifically chosen, because they reflected a wide range of quality with respect to pedagogical soundness and technical accuracy. The science and technology education experts then met to discuss their ratings, interpretations, ease of use, and the clarity of the rubrics. This resulted in further minor modifications in wording, definitions, instructions, and clarity. The process of development and refinement stretched over nine months and resulted in a significant evolution of the original rubrics. The TECA is available at http://www.wmich.edu/evalctr/ate/evalproducts.htm.

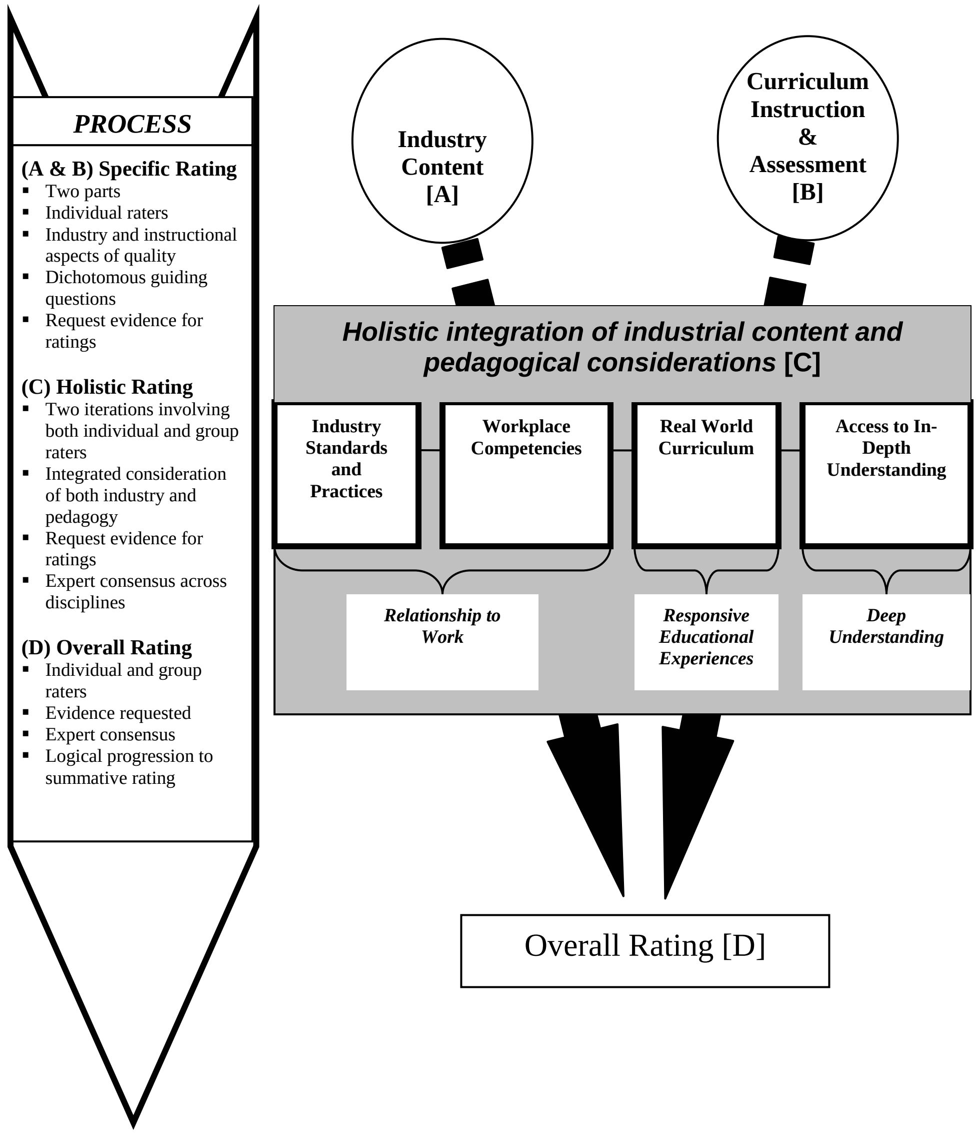
TECA is composed of three sets of rubric questions. As depicted in Figure 2, the first set of rubrics has two parts, A and B, the second set is part C, and the third set is part D. The first set of rubrics (A and B) is designed to separately assess the technical value and pedagogical soundness of the materials being rated. Three types of experts are identified to use the TECA: industry experts who respond to part A, curriculum design experts who respond to part B, and expert teachers who respond to part A or B depending on their personal expertise. In addition to rating the rubric items within parts A and B, the experts are asked to respond to simple "yes-no" questions about what is included in the materials as well as to describe the evidence that supports the ratings of each item. Part A is composed of five items that are answered by industry experts specific to the curricular material that is being reviewed. These items consider issues of alignment of materials with the workplace, application of knowledge, use of technology, rigorous content and quality performance. Part B is composed of six items that are answered by experts in curriculum, instruction and assessment. These items considered issues of instructional strategies, problem solving, general education, assessment, personal qualities, and diversity.

The second set of rubrics, C, is called holistic ratings. This set of four items is designed to assess the materials in a more holistic manner by simultaneously considering the technical and pedagogical aspects of the materials. These questions are broad and are meant to capture the general quality of the materials. These items are answered by all reviewers, regardless of the area of their expertise. The items in this section are explicitly linked to the more specific ratings in parts A and B in order to help the reviewer understand the underpinnings of the question. In order to explicitly connect the theoretical framework to the TECA, the three themes (i.e., relationship to work, responsive educational experiences, deep understanding) from figure 1 are mapped to the four items which compose the holistic ratings depicted in figure 2.

The third set of rubrics, D, is one question which serves as an overall rating (figure 2). This is designed to be a summary assessment of the effectiveness of the materials in helping students learn the knowledge and practices needed to be successful in a technical workplace. This rating is not intended to be an average of all the previous ratings, but an overall judgment of quality and likely impact of the materials. This item is answered by all reviewers, and they are asked to describe the evidence that supports their ratings.

After each individual reviewer completes all the sets of rubrics (Part A or B, Part C, and Part D), the team of reviewers meet to discuss their individual ratings and develop a group consensus. The group of three reviewers then provides a group consensus rating for the four items in Part C and the one item in part D. Therefore, there are 4 ratings for each of the items in Parts C and D; one from each of the three expert raters and one from the group of raters as a whole.

Figure 2 - Conceptual Diagram of TECA



The process of selecting expert reviewers stretched over several months. A database of 60 potential expert reviewers was constructed from recommendations of ATE Principal Investigators (PIs), a request to provide nominations for expert reviewers at the 2002 annual ATE PI meeting, a textbook author and literature search, and an industry search for technical experts. These 60 potential reviewers were contacted and asked about their willingness to serve and to provide a short curriculum vita. Based on the reviewers' expertise, they were classified as industry experts, curriculum experts or instructional experts. Expert reviewers were then matched to our sample of curricular materials. Based on this analysis, 18 reviewers were invited to attend a meeting to be trained on using the rubrics and to rate the materials.

Expert reviewers traveled to a large upper Midwest university to be trained on the sets of rubrics and evaluate the materials. As discussed above, teams were constructed so that each material was rated by a technical expert, a curriculum expert, and an expert teacher. Reviewers received four hours of training on the rubrics. During the training, they had the opportunity to use the rubrics to evaluate three different pieces of curricular materials. On each training material, reviewers rated the material independently and then worked in small groups. Finally, a large group discussion was held to share and discuss ratings. This provided an opportunity for reviewers to ask questions, make suggestions, and eventually reach consensus regarding interpretation and use of the rubrics. The training appeared to be effective because by the end of the training the small groups were generally in agreement about the quality of the materials with all ratings within 1 point of agreement.

Reliability and Validity

Each material in our sample was rated four times, once by each type of expert (i.e., industry, curriculum, and instructional) and once by the team of experts assigned to each set of materials. The team ratings were done after each team member completed his or her individual rating and after the team had the opportunity to meet and discuss the material. The ratings were successfully completed and revealed a wide range of quality among the ATE developed materials. The specific ratings for the materials ranged from 0 to 4 and the overall ratings ranged from 1 to 4. This spread in scores allowed the materials to be categorized and compared on different aspects such as format, type of technology, and setting.

Inter-rater and intra-rater reliabilities were calculated for each rubric item. The inter-rater reliabilities for the holistic and overall rubrics suggest that all reviewers, despite their varying expertise, interpreted the rubrics in the same way. On average, over 50% of the time reviewers were in perfect agreement and 90% of the time they were within 1 point of agreement. Similarly, the intra-rater reliabilities suggest a high degree of internal consistency between the three sets of rubric questions. Qualitative evidence, such as feedback from the expert reviewers, also suggests these rubrics are trustworthy and valuable to use when evaluating technical education curricula. In other words, the rubrics appear to be internally consistent from both industrial and pedagogical perspectives.

Within group reliabilities were calculated for the four holistic rubric items and the overall rubric item. These scores were calculated by tallying each instance individual reviewers were in perfect agreement, within one point of agreement, within two points of agreement, etc. with the team rating for a particular material. These intra-group reliabilities suggest a high degree of internal consistency between the three individual ratings and the group rating with over 90% being within one point of agreement. Correlations between the within group ratings of the holistic and overall ratings averaged 0.77.

TECA provides a valid and reliable way to determine the quality of technical education curricula. The review process demonstrates how validity among raters can be achieved, which ultimately increases the validity of the curriculum evaluation. The careful training of raters adheres to the substantial amount of literature demonstrating that familiarizing judges with measures, ensuring their understanding of the order of operations, and providing guidance on the interpretation of normative data can reduce rater effects (Rudner, 1992). By applying the rubrics to actual curricular materials and examining the scoring criteria, technical education and curriculum and instruction experts were able to improve the structural validity of TECA (Cohen, Manion, & Morrison, 2000; Messick, 1995). Developing rubrics that evaluate the extent to which curricular materials meet industry and occupational needs provides evidence of criterion-related validity, while attention to both inter-rater and intra-rater consistency attend to the two forms of reliability typically considered in rubric development (Moskal & Leydens, 2000). Using technical education experts to rate the content of curricular materials addressed content-relevance and criterion-related validity (Cohen et al., 2000; Sax, 1997). These experts are able to determine how accurately and to what extent the TECA items measure the domain in question. Finally, the method of training utilized, short duration between ratings, limited contact between raters during individual rating sessions, and reasonable expectations for number of ratings completed mount significant evidence in favor of strong internal validity (Harwell, 1999).

Discussion

There is a critical need for professional technicians who possess state of the art technical skills and workplace competencies (Secretary's Commission on Achieving Necessary Skills, 1991; National Science Foundation, 1993; International Technology Education Association, 1996; Clagett, C. A., 1997). To meet this growing need, educational programs must shift to prepare knowledgeable workers who are both flexible and high performing (Harkins, 2002). Employer needs have changed and while foundational technological skills are still thought of as important, employability and basic skills have surpassed those that are machine or company specific (Dyrenfurth, 2000). Integration of curriculum is viewed as one method of organizing the life skills necessary for all citizens of a democracy and centers around solving real world problems requiring content and skill application from numerous disciplines (Vars & Beane, 2000). Curricula will have to remain aligned with the changing skill sets required of workers to produce the outcomes vital to employers. Careful assessment of curricula is crucial to ensuring this alignment.

TECA is an effective evaluative instrument to judge the efficacy of technical education curricula. It provides insight by teasing apart the technical value and pedagogical soundness inherent to a curriculum. These sets of rubrics are able to successfully evaluate curricular materials based on the characteristics that Finch and Crunkliton (1999) suggest distinguish technical education curriculum. TECA evaluates the extent a curriculum is oriented towards, and justified by, industry and occupational needs, while at the same time, evaluating how well the curriculum focuses on the pedagogical needs of the student. The varying sets of rubrics help ensure validity and attention to the different aspects of technical education. They are tied to the research literature (Finch & Crunkliton, 1999; Pucel, 1995, 2000; Wiggins 1993, 1998 and Wiggins & McTighe, 1998) and national standards for technological education (NBPTS Standards Committee, 2001; SCANS, 1991). TECA helps illuminate the features that Clark and Wenig (1999) identified as quality characteristics of a technical education program. As such, TECA not only provides a basis for the evaluation of existing materials but also a guideline for the development of new curricula. These rubrics could be used by a wide range of industry and technical education professionals.

This psychometrically sound instrument should allow industry and education professionals to make more informed decisions when designing, implementing, and evaluating technical education curricula. By providing an integrated examination of both technical value and pedagogical soundness, TECA attends to curricular components necessary for ensuring that an increasing number of technicians will enter industry positions possessing both technical skills and workplace competencies. TECA could be instrumental in the vital endeavor to continue to foster high quality and pertinent education in economy-driving, high-technology fields.

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Career and Technical Education in the Late 1990s: A Descriptive Study

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Abstract

We examined the prevalence of specific career and technical education (CTE) programs and activities in American high schools in the late 1990s, following a decade of education reform. We also examined the extent to which CTE-oriented professional development is available to school staff and explored the other kinds of supports offered in schools to facilitate career and technical education. School Survey data from 1996 and 2000 from the National Longitudinal Survey of Youth 1997 showed CTE programs were created or strengthened in the early 1990s, most notably in the areas of business and technology. School administrators perceived that CTE enrollment (a) increased during the 1990s due to the availability of these programs, and (b) were not affected by changes in graduation requirements. We also found that most schools offered more career development programs than work-based learning or specific CTE activities. We concluded that CTE has made significant strides in the 1990.

Introduction

Our purpose in this paper was to address the prevalence of specific career and technical education (CTE) programs and activities in American high schools in the late 1990s. We also examined the prevalence of support offered in schools to facilitate CTE activities, including CTE-oriented professional development. Our analyses follow a decade of school reform, and we particularly focused on the effects of the federal legislation aimed at revamping CTE nationwide— the Carl D. Perkins Vocational and Applied Technology Education Act of 1990 or Perkins II; the School-to-Work Opportunities Act or STWOA; and the Carl D. Perkins Vocational and Technical Education Act Amendments of 1998 or Perkins III—and the reforms introduced by states in their school systems. Most prior studies preceded the 1990s reforms and thus the current analysis is needed about offerings of CTE programs and activities in schools. Using data collected through surveys with school administrators within the general framework of the National Longitudinal Survey of Youth 1997 (NLSY97) we examined how those reforms played out in schools.

Federal school reform legislation introduced significant changes to the policies and systems in place in 1990, which were a shift from the historical approach of targeting the support of specific areas of labor market preparation, general occupational preparation, and family and consumer sciences. The most recent policy wave of the 1990s put less emphasis on specific programs and more on reform and accountability (Perkins II), strengthened the requirements for accountability (Perkins III), and influenced the creation of more transparent and viable systems of workforce development (STWOA).

Within this framework, many changes were introduced in CTE, including curriculum integration, career pathways, secondary-postsecondary articulation, dual enrollment, career academies, tech prep, and a greater emphasis on work-based learning activities.

Concurrent with these career and technical education reform efforts, a general movement emerged to increase the amount of traditional academic coursework taken by all high school students. Spurred by reports such as *A Nation at Risk* (Gardner, 1983), schools, government and other stakeholders sought to cure the perception of a poorly performing education system with a prescription for increasing the number of rigorous academic courses required for all students. In response, states began to increase the amount of traditional academic coursework required for graduation. The average number of credits required to graduate from high school increased from approximately 22 in 1982 to 26 in 2000. Despite this concerted effort to increase academic performance, standardized academic test scores in math, science and reading for 17 year olds, according to the National Assessment of Educational Progress, have remained flat since the 1970s (Castellano, Stringfield, & Stone, 2001).

The objective of this research is to develop a benchmark profile of CTE and related activities in American high schools in the year 2000. This is an important time for such an analysis as it follows an intensive period of education reform and precedes the advent of perhaps the most encompassing federal intervention in public schools known as *No Child Left Behind* (Public Law No. 107-110, 2001). We provide descriptive data detailing school offerings, program participation and CTE-oriented professional development using school data available from the National Longitudinal Survey of Youth 1997 (NLSY97).

School to Work Reforms

In the early 1990s, the U.S. school-to-work system was mainly made of ad hoc arrangements between schools and businesses, and school-to-work programs had a tendency to differentiate college-bound and career and technically oriented students (Bailey & Merritt, 1993). In 1993, the U. S. General Accounting Office (GAO) reported that many states had begun to build school-to-work systems, but only two states had established joint state-business-labor bodies: Oregon and Wisconsin. According to Bailey and Merritt (1993), the level of employer involvement across the nation was not enough to support a comprehensive career transitions. Certification programs were maintained on a school-by-school basis, resulting not only in a lack of solidarity amongst school-to-work programs but also in a lack of recognition from industry.

The CTE and STW reform legislation introduced in the 1990s consisted in sum of two main components. It introduced program changes as well as system changes to link school and work. The following are descriptors of specific programs or pedagogies that relate to, and resulted from, these reforms of the past decade.

Curriculum Integration

Changes in this area aimed at integrating and contextualizing curricula. As part of this effort, private organizations helped meet the need for new curricula. For example, the Center for Occupational Research and Development—CORD (1990) released curricula designed to teach academics while simultaneously meeting the needs of CTE students (Lusterman & Lund, 1991). However, recent reports suggest that curriculum integration has not taken hold in U.S. high schools despite the tremendous investment in such activities (for a more detailed discussion of this topic, see White, Charner & Johnson, 2001)

In the 1991-1992 school year, 82.4% of comprehensive schools that offered vocational courses and 91.1% of vocational schools reported that they were making curriculum integration efforts (Levesque, Lauen, Teitelbaum, Alt, & Librera, 2000). However, efforts were mainly made by career and technical instructors to incorporate academic material, rather than academic subjects taking on career and technical subject matter (Bailey & Merritt, 1993). In 1993, career and technical teachers reported that they spent 10% of their class time on academic subjects.

The 1994 National Assessment of Vocational Education [NAVE] reported that schools that experienced a significant Perkins II influence had taken one step (out of a possible 10) towards curriculum integration (Levesque et al., 1995). Each additional step taken to integrate was associated with a minimum increase of 1.4% in CTE enrollments. More heavily funded districts took specific steps to integrate class work, with higher percentages reported for every integration step delineated by the 1994 NAVE. Using the schools that reported being influenced by the Secretary's Commission on Achieving Necessary Skills (SCANS) and "Goals 2000" in the early 1990s, school administrators reported that 1.3 more steps had been taken to integrate their curricula than schools not so influenced. The "developing all aspects of industry" element of Perkins reforms was met by 13% of regular high schools and 19% of career and technical schools. These early reform efforts seemed to have no effect in students' enrollment decisions (Levesque et al., 1995).

Tech Prep

Tech prep refers to programs that offer at least 4 years of sequential course work beginning at the secondary level and continuing into postsecondary institutions for the purpose of preparing for technical careers. By the late 1980s and early 1990s, most tech prep programs were in their infancy. By then, more than 33 states had reported establishing tech prep programs (Bailey & Merritt, 1993). About the same time, the American Technical Education Association established a set of minimum standards for tech prep programs (Choy, 1994). Using these criteria, Stern, Raby and Dayton (1992) found that only 7% of schools offered full-fledged tech prep programs in the 1990-1991 school year. On the other hand, Levesque et al. (1995) reported that 41% of districts reported that they had some kind of tech prep initiative. However implementation varied depending on the location (urban-suburban) and CTE focus. Suburban districts reported higher implementation levels than did urban districts. Business and trade and industrial programs were reported as the tech prep foci more than agriculture, marketing, health or occupational home economics.

Co-op Programs

Cooperative vocational education (Co-op) is a structured method of instruction whereby students alternate or coordinate their high school or postsecondary studies with a job in a field related to their academic or occupational objectives. Cooperative programs have been recognized as one of the most effective CTE strategies (Hamilton, 1990). In the late 1980s, approximately 10% of CTE students participated in a co-op program (Hamilton, 1990), increasing to 12% by 1994 (Levesque et al., 1995). The 1994 NAVE research found that 4% of students (403,000) in grades 9-12 participated in co-op programs, a figure that is slightly lower than the U.S. General Accounting Office's 1991 report of 430,000 co-op students. By the late 1990s, the percentage had increased to approximately 15% (Silverberg, Warner, Fong, & Goodwin, 2004). Stern (1992) estimated that 49% of secondary schools offered cooperative education in 1990-1991. In the early 1990s, 37% of coop students were enrolled in marketing education, 20% were in trade and industry, and 17% were in business occupations (U.S. General Accounting Office, 1991).

Career Academies

Originally created to address the needs of at-risk students (Stern et al., 1992), career academies integrate core academic and vocational coursework within a cohesive, curriculum framework focused on a career theme (e.g., health, business). Ninth and 10th grade students either voluntarily enroll or are referred to the program by teachers or counselors, remain in the academy throughout their secondary school experience, and complete coursework designed to be both academic and highly applicable to vocational settings (Elliott, Hanser, & Gilroy, 2002). Various school districts from around the country did institute such programs but these usually served a relatively small percentage of students—e.g., 5% in Philadelphia, 7.3% in California's first established program (see Stern, 1992, for a more complete review of career academies and their outcomes in the early 1990s; and Maxwell, 2001, and Kemple, 2001 for more recent reviews). Privately sponsored career academies also appeared in the early 1990s. For example, the National Academy Foundation sponsored career academies recruited a higher academically performing group for the purpose of developing "future employees" for the finance industry. These career academies enrolled over 4,000 students in 74 different schools in the 1991-1992 school year (Bailey & Merritt, 1993).

Youth Apprenticeships

Youth apprenticeships are typically multiyear combinations of school- and work-based learning in a specific occupational cluster designed to lead directly into either a related postsecondary program or a registered apprenticeship. Although 250,000 to 300, 000 adult apprentice positions were occupied each year between 1980-1990 (Hamilton, 1990), schools were slow to offer this CTE transition opportunity to their students. School-sponsored youth apprenticeships as characterized by active employer participation, integration of learning, structured linkages between work and school, and an award of completion were offered in only 5-11% of schools in the early 1990s. Only 3,300 students were involved in such programs (Levesque et al., 1995). Other sources report that 3,500 students participated in apprenticeship programs in 1990 (U.S. General Accounting Office, 1991). Hoachlander (1994) cites still a smaller number of students: approximately 2,000 of the 13 million secondary students. Stern et al. (1992) estimated that in the 1990-1991 period, 6% of secondary schools offered school-to-apprenticeship programs, while only 2% provided youth apprenticeship opportunities.

School-Based Enterprises

School-based enterprises (SBEs) are educational experiences in which goods or services are produced by students as part of their school program. They qualify as school to work activities by providing participating students with real-world work experiences, such as marketing, shipping and receiving, coworker relationships, and production within the enterprise (e.g., retail operations). The NAVE reported that in 1994, 23% of schools had adopted a school-based enterprise, but numbers vary—Stern et al. (1992) estimated that 19% of secondary schools offered work experience opportunities in school-based enterprises in 1990-1991.

CTE Youth Organizations

Some authors have asserted that student organizations such as FFA, DECA or SkillsUSA are an integral part of the educational process, and are credited with being a primary driver for support of agricultural career and technical programs (Bobbitt, 1988, as cited in Bailey and Merritt, 1993). These student organizations emphasize an active role for the student in their development activities, in that they use their own initiative and creativity to choose and complete various projects. The student's use of hands-on learning to solve real-world problems mirrors school-sponsored CTE program efforts. This element of learning speaks to the broader academic applicability of student organization membership.

The State of Career and Technical Education in the Early 1990s

By 1999 vocational education was available in most of America's 11,000 comprehensive high schools, 1,000 vocational high schools, and 800 area or regional vocational schools, (Silverberg et al., 2004). However only 66% offered at least one vocational "program" (Hudson & Shafer, 2002). This contrasts to the early part of the 1990s when 74% of secondary schools offered CTE programs (Levesque et al., 1995).

The pervasiveness of career academies in the early 1990s is unknown and tech prep was just beginning. The current NAVE report estimates that by the late 1990s, 23.5% of the high schools in the country offered career academies, 47.1% offered tech prep programs, and 80% offered articulated or dual college credit programs (Silverberg et al., 2004).

CTE Enrollment

Given that so many schools offer career and technical education options that involve so many students, it is important to consider the effect that educational reforms have had on secondary students' educational experience. Some authors cite a decline in participation in CTE courses over the past two decades. In the early 1980s, the average student enrolled in 4.6 CTE courses. By 1992, the figure had declined to 3.8 (Hoachlander, 1994).

The 1994 NAVE found that although Perkins II mandated the offering of a coherent sequence of courses, students tended to only take introductory courses (Levesque et al., 1995). Using transcript analyses, Levesque and Hudson (2003) estimated that the percentage of occupational concentrators taking advanced career and technical education courses dropped from 70% in 1982 to 56% in the early 1990s.

Other studies using transcript data also documented the steady decline of the percentage of youth who are identified as CTE majors or concentrators. Roey et al. (2001) had found that in 1990, 10.4% were CTE concentrators, whereas in 1998 the percentage dropped to 4.4%. Tuma (1996) reported that in 1992, 24.4% students were CTE concentrators. Very different estimates are derived when student reports of high school curriculum are used. Stone and Aliaga (2003) reported that only 6.6% of students say they are CTE concentrators and a slightly smaller number indicate they are dual concentrators. This latter group are “double majors” combining an academic concentration with a CTE concentration. Surprisingly, the largest group of students in school (53%) does not identify with any concentration—they are neither academic, CTE or dual concentrators.

Schools reported that any increases they experienced in career and technical enrollments were due to four factors: a) integration of academic and vocational curricula, b) career exploration programs, c) increased state support, and d) student leadership programs (U.S. Department of Education, 1994).

Why the overall decrease in career and technical enrollments? The 1994 NAVE reported that school administrators strongly felt that the emphasis on academic subjects caused decreases in career and technical enrollment. Later research has demonstrated that students are indeed choosing to take academic credits over career and technical education coursework: the average number of career and technical credits decreased in the early 1990s and has remained flat since 1994, while both general (0.9%) and academic (0.8%) credits have risen (Levesque et al., 2000). In other words, with student enrollment in CTE credits remaining constant, the percentage of CTE coursework taken during secondary education has decreased overall, because the total credit requirements have risen.

Enrollment numbers have changed in other ways as well. Research in the early 1990s found that while fewer students are CTE concentrators, increasing numbers of students are taking a fragment of introductory career and technical classes as electives (Stern, Finkelstein, Stone, Latting, & Dornsife, 1994). In addition, the largest student enrollment decreases in career and technical courses were among students who scored highly on tests and had a good academic record, rather than traditional CTE students (Levesque et al., 1995), demonstrating a widening dichotomy between academic and CTE students and coursework.

Regardless, it is clear that many students are also not in the “college-track,” and therefore do not benefit from academically-oriented educational reforms. (Hoachlander, 1994). In recognition of “the forgotten half” (W. T. Grant Foundation Commission on Work, Family, and Citizenship, 1988), and in response to perceptions of increased threat from international competition, the school-to-work legislation passed in 1994 encouraged schools to develop alternate programs to serve non-academically focused students.

The prevalence of non-academically focused students is the driving force behind the CTE reforms and initiatives. This group of students do not benefit from the public investment in academic-track coursework. At the same time, there is a substantial body of evidence that shows significant, positive economic benefits resulting from pursuing a CTE concentration in high school (Bishop & Mane, 2004; Silverberg et al., 2004).

Current population data show that 21.4% of people 15 years old or over are not high school graduates, an increase from 15% in the early 1990s (U.S. Census Bureau, 2002). Greene (2001) reports a national graduation rate of 71%—or 29% who do not graduate of high school—without counting alternative high school diplomas and credentials. The college graduation rate is even lower. Today, only 41.3% of adults age 30-34 have an Associates degree or higher (Krei & Rosenbaum, 2001). This means that the majority of students are not helped by the main thrust of most education reform that directs young people to think of college as the only useful post high school trajectory (see Rosenbaum, 2002).

The Current Study

In this study, we address the following critical areas with regards to the current status of CTE programs and activities in our nation's high schools at the beginning of the 21st century:

- type and availability of vocational programs
- prevalence of supportive professional development
- prevalence of administrative and structural supports, and
- changes in participation.

Type and Availability of Vocational Programs

The availability of vocational education programs and activities in the nation's secondary schools will necessarily affect student participation patterns and rates. Such patterns are both affected by and in turn affect state and federal funding. The present study provides a picture of the nation's high school CTE offerings by the year 2000. Regarding availability of vocational education, we ask four questions:

Question 1: What kinds of vocational programs—sequences of courses—do high schools offer? To what extent do schools offer programs in multiple areas?

Question 2: How does the availability of special career preparation programs and activities vary by the characteristics of the school?

Question 3: What are the characteristics of career preparation programs?

Question 4: To what extent do schools sponsor chapters of CTE Student Organizations?

Prevalence of Supportive Professional Development

Effective vocational education programs require administrative support in a number of ways. Perhaps the most important is the provision of professional development to keep faculty current. We posed the following question:

> Question 5: To what extent are schools providing in-service opportunities for teachers to expand their awareness of careers and career preparation strategies? How do in-service opportunities vary between academic and CTE teachers.

Prevalence of Administrative and Structural Support

Career development support activities act in tandem with reforms supported by Perkins II, the STOWA and Perkins III. The existence of supportive career development activities is an indicator of the depth of a reform effort. This study investigates the degree to which these supports exist.

> Question 6: To what extent do high schools have the supports commonly used to implement special career preparation programs and activities? To what extent have these supports become more available over time?

Changes in Participation

As discussed previously, career and technical education has been through significant changes in the decade of the 1990s. Specifically, the introduction of the Perkins II legislation in 1992, the School-to-Work Act in 1994, and the Perkins III legislation in 1998 acted as catalysts for many of these changes. As well, we might expect changes in school offerings and CTE participation due to other school reforms and increases in academic requirements. The present study compares data from 1996 to the same data collected in 2000 with the following research questions:

> Question 7: To what extent do schools offer, and do students participate in, other special career prep programs and activities? How has the availability of and participation in these programs and activities changed over time?

> Question 8: To what extent do principals perceive that vocational enrollments have changed between the 1995-96 and the 1999-2000 school years? Do such changes differ by school type? Is there a relationship between changes in vocational enrollments and changes in course credits required for graduation?

Data and Method

The National Longitudinal Study of Youth of 1997 (NLSY97) is a study that measures variables that contribute to the youth's transition from school to the labor market. Data were collected through the youth questionnaire, and parent interviews. In addition, the NLSY97 conducted a survey of school administrators—the School Survey—to provide data on schools attended by the youth in the sample (Bureau of Labor Statistics, 2003). Access to these restricted data was granted for purpose of this research.

In the present study we analyzed data collected from the School Survey, in which administrators were asked to report school demographic characteristics; program offerings such as job placement, dropout prevention, and summer school; staff characteristics; student body demographics; college entrance test-taking rates and scores; and graduation test and credit requirements.

The NLSY97 conducted two School Surveys—in 1996 and in 2000. The 1996 data collection process consisted of a school census that was mailed out to an administrator in all high schools that included a 12th grade within the 147 Primary Sampling Units (PSUs)—a metropolitan area, rural areas, a county or group of counties—from which the NLSY97 student sample was selected. For the first School Survey of 1996, 7,342 surveys were mailed and 5,253 were returned, yielding a response rate of 71.5%. Although vaguely documented, it seems as though the sampling procedure varied for the second School Survey data collection of 2000. Surveys were sent to all high schools with a 12th grade in the original 147 PSUs. A second group of schools was added if they met two criteria: a student originally part of the NSLY97 had moved to and now attended the school, and it had a 12th grade. Additionally, vocational schools were added to the original sample of schools. The response rate for the 2000 data collection process was 70.9%—6,393 schools responded out of a possible 9,013 schools. Overall, the retention rate of schools from 1996 to 2000 was 74.2% (Bureau of Labor Statistics, 2003) taking into account the process of attrition and addition of schools between the two samples. Statistical weights provided by the Bureau of Labor Statistics (BLS) were used in the data analyses.

Different analyses were conducted separately for each year. However, the same school characteristics were drawn for analyses, to allow a comparison. Following the Bureau of Labor Statistics guidelines, we weighted the observations to estimate population parameters (Bureau of Labor Statistics, 2002).

For this study, we conceptualized CTE in two different meanings. First, we refer to CTE as the *curricular program* students can be enrolled in while in high school—and the areas within CTE were students enrolled. Second, CTE is also referred to as a set of structural strategies related to preparation for work supported by the STWOA—i.e., career pathway, tech prep, and the following School-to-Work or work-based learning activities: cooperative education, job shadowing, mentoring, school-based enterprise, and internship/apprenticeship.

Since vocational schools only were added to the second School Survey, type and availability of vocational programs and prevalence of supportive professional development were analyzed for year 2000 only. Five types of schools are identified in the data: comprehensive, technical, special education and alternative, special emphasis, and a catch all group identified as "other." Because of the relatively small number of schools other than comprehensive we will confine our discussion to the data for all schools but present data for each type.

Results

We present our findings as descriptive percentages. The following text and tables address each of the specific research questions outlined above.

Type and Availability of Vocational Programs in 2000

We begin our analysis by identifying the kinds of CTE programs offered by high schools and the extent to which multiple CTE programs are available. A substantial number of secondary schools offer some choice of CTE programs to their students. Furthermore, a plurality of schools offered three to five CTE programs, and over a quarter of high schools offered six to eight of those programs, which in itself represents a significant proportion considering that 66.5% of high schools offered at least one occupational program. The number of programs offered are somewhat similar to the data reported by Phelps, Parsad, Farris, Hudson, and Green (2001), who found that in 1999, 18% of public high schools offered between six and ten occupational programs, and 13% of those schools offered more than ten programs.

Table 1 shows that business programs were the most frequently offered CTE program in high schools with technology and communications ranking second. More than 70% of high schools offered three or more programs for students to choose from (see Table 2), whereas 25% of high schools offered a full array of CTE programs. These data are consistent with NCES transcript analyses showing more than 98% of high school youth take some CTE (National Center on Educational Statistics, 1999).

We next explored the prevalence of special career preparation programs and activities. Tech prep, introduced as part of Perkins II was the most frequently occurring special career program with more than one-third of U.S. high schools providing this for their students. Career pathways, introduced as part of the STWOA is now found nearly one-fourth of U.S. high schools (see Table 3). Career academies, which have a history predating Perkins II and the STWOA were reported less frequently.

Work-based learning, especially job site visits and job shadowing are prevalent in U.S. high schools. More than half of schools report offering both (see Table 4).

More than one-third of schools offer cooperative vocational education opportunities while fewer than 20% provide apprenticeships or school-based enterprises.

Table 1

Percentage of U.S. High Schools Offering of Specific CTE Programs, 2000

CTE Program Areas	Percentage of High Schools
Business	57.51
Technology and communications	43.03
Child care and education	33.18
Trade and industry	31.96
Agriculture and renewable resources	29.54
Health care	27.78
Marketing and distribution	27.54
Food service and hospitality	27.00
Personal and other services	12.24
Public and protective services	7.49

Table 2

Percentage of U.S. High Schools Offering of CTE Programs by Number of Programs, 2000

Number of CTE Programs Offered	Percentage of High Schools
2 or fewer programs	28.56
3 to 5 programs	41.74
6 to 8 programs	25.20
8 to 10 programs	4.50
Total	100.00

Table 3

Percentage of U.S. High Schools Implementing CTE Reform by School Type, 2000

		School Type				
CTE Reform	All	Comp.	Technical	Special Ed. and Alt.	Special Emphasis	Other
Career major/pathways	23.20	20.44	1.38	0.78	1.64	2.33
Career academies	7.26	6.07	0.79	0.35	1.09	0.90
Tech prep	37.13	32.75	2.82	1.47	2.04	4.22

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

Table 4

Percentage of U.S. High Schools Offering of Work-Based Learning Strategies by School Type, 2000

		School Type				
Work based learning strategy	All	Comp	Technical	Special Ed. and Alt.	Special Emphasis	Other
Job site visits	69.71	59.14	2.83	3.75	4.20	9.41
Job shadowing	50.25	44.36	2.43	2.74	2.62	5.28
School sponsored enterprise	17.83	15.75	0.89	0.93	1.13	2.11
Cooperative education	36.24	31.59	1.85	1.52	2.17	3.80
Apprenticeships	19.65	16.16	1.88	1.22	1.35	3.58

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

The frequency of career development activities, including college counseling, is shown in Table 5. A high percentage of schools reported offering these activities. College counseling, school visits by employers and career interest inventories were most frequently offered career development activities. Involving parents in career planning and individualized career plans were the least reported career development activity.

Table 5

Percentage of U.S. High Schools Offering of Career Development Activities by School Type, 2000

		School Type				
Career Development Activities	All	Comp.	Technical	Special Ed. and Alt.	Special Emphasis	Other
School visits by employers	80.68	67.41	3.16	4.40	5.81	11.95
College guidance counseling	93.82	79.05	3.27	5.00	6.74	14.42
Occupational guidance counseling	71.96	61.59	3.29	4.73	4.76	8.91
Career interest inventories	86.03	73.34	2.60	4.61	5.59	11.40
Career assessments	64.37	54.77	2.24	3.44	4.09	8.42
Individualized career plans	53.84	45.98	1.99	2.95	2.90	6.81
Career information centers	66.31	57.99	2.11	2.65	4.42	8.16
Parental involvement in student's career plan development	46.80	40.07	1.66	2.34	2.48	5.90

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

Junior and senior students were more frequently the focus of career preparation programs like tech prep, career pathways, career academies, and apprenticeships than were younger students (see Table 6). This is not surprising given the focus of the legislation. Some of these programs have minimum GPA requirements. This was most often associated with career academies and apprenticeships and least likely to be required for entry into a career pathway. Program tenure within schools varied among the several career programs. Apprenticeship programs have had the longest tenure of the four types of programs (9.23 years), with the other three programs averaging between 6 and 7.5 years. One interesting aspect of these data is that in no case, did a majority of schools target any of these career preparation programs at non-college bound students or at risk students. This may be evidence that such programs are becoming more mainstream.

We then explored the data to determine the extent to which schools sponsor chapters of CTE Student Organizations (CTSO). We found that about 30% of high schools sponsored one or more CTSOs (see Table 7). The most frequently offered CTSO was the Future Homemakers of America followed by the Future Farmers of America and Future Business Leaders of America. These findings are consistent with reports of student enrollments provided by Levesque et al. (2000).

Prevalence of Supportive Professional Development in 2000

The most common form of professional development reported by principals was conference attendance (see Table 8). The most frequently reported focus of professional development was curriculum integration for both academic and CTE teachers. Conferences and workshops focusing on students' transition from high school to postsecondary schools or work was the second most prevalent focus of professional development for academic and CTE teachers. Our analyses showed the academic teachers were afforded professional development more frequently than CTE teachers with the exception of professional development focused on developing employer linkages. Surprisingly, academic teachers had more opportunities than CTE teachers to attend conferences and workshops on the implementation of STW programs (see Table 9).

Prevalence of Administrative and Structural Supports in 2000

For career programs to be effective, they require structural support from the school. We examined the type of support provided by high schools to implement those programs. The NLSY97 identified nine forms of structural support such as block scheduling and dual enrollment. We also explored the extent to which these supports have become more available over time. As shown in Table 10, the largest proportion of schools reported offering dual enrollment for academic courses and requiring staff development for CTE teachers. Interestingly, more than 20% fewer

Table 6

Average Life of Career Prep Programs and Percentage of U.S. High Schools Targeting Specific Grade Levels and Specific Populations in 2000

Career Prep Program Characteristics	Percentage of High Schools Reporting Program	Average Tenure of Program (years)
Apprenticeship Programs		
Average years implemented/operating		9.23
Grade levels targeted		
9th	5.14	
10th	11.28	
11th	37.71	
12th	45.86	
Students targeted		
At-risk	23.18	
Non-college bound	39.84	
Minimum GPA required for entry	38.93	
Career Majors/Pathsays		
Average years implemented/operating		6.4
Grade levels targeted		
9th	17.82	
10th	22.77	
11th	29.51	
12th	29.90	
Students targeted		
At-risk	23.02	
Non-college bound	28.53	
Minimum GPA required for entry	18.65	
Career Academies		
Average years implemented/operating		6.13
Grade levels targeted		
9th	16.84	
10th	24.59	
11th	29.60	
12th	28.97	
Students targeted		
At-risk	30.53	
Non-college bound	29.11	
Minimum GPA required for entry	33.25	
Tech-Prep		
Average years implemented/operating		7.25
Grade levels targeted		
9th	13.20	
10th	18.81	
11th	33.62	
12th	34.38	
Students targeted		
At-risk	19.31	
Non-college bound	28.56	
Minimum GPA required for entry	20.38	

Table 7
Availability of CTE Student Organizations (CTESOs) by School Type, 2000 (Percentages)

		School Type				
Type of CTESO	All	Comp	Technical	Special Ed. and Alt.	Special Emphasis	Other
Business Professionals of America	11.04	9.69	0.91	0.21	0.45	1.34
Distributive Education Clubs of America	17.79	16.31	0.70	0.62	0.99	1.52
Future Business Leaders of America	29.77	27.41	1.71	1.46	1.79	2.76
Future Homemakers of America	31.72	29.72	1.26	0.80	1.62	2.03
Health Occupations Students of America	13.20	10.54	1.72	0.78	0.56	2.94
Future Farmers of America	30.70	28.64	0.90	0.68	1.39	2.36
National Postsecondary Agricultural Student Organization	1.53	1.52	0.05	0.01	0.00	0.04
National Young Farmers Educational Association	2.88	2.84	0.06	0.01	0.01	0.06
Technology Student Association	7.30	6.72	0.27	0.27	0.43	0.50
CTE Industrial Clubs of America	20.66	16.39	2.41	1.13	1.10	4.50

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

schools offered dual enrollment for CTE courses than for academic courses. Quite telling is that fewer than 20% of schools reported offering joint planning time for academic and CTE teachers. This may explain the limited growth of integrated curriculum reported elsewhere (see the Interim NAVE report, Silverberg, Warner, Doowin, & Fong, 2002). Requiring community service or vocational credits for graduation were not a major part of the educational landscape by the year 2000.

Changes in Participation 1996-2000

Virtually all measures identified in the NLSY97of CTE reform, work-based learning, and career development options, and student participation increased

Table 8
Percentage of U.S. High Schools Providing Teacher In-Service Opportunities, 2000

	Percentage of High Schools	
Professional Development Activities	For Academic Teachers	For CTE Teachers
Unpaid summer internships	12.64	10.95
Paid summer internships	22.39	20.91
Internship during the school year	9.27	9.55
Attendance at conferences and workshops on integrating academic and CTE	65.73	56.95
Attendance at conferences and workshops on the development of employer linkages	35.32	38.10
Attendance at conferences and workshops on the development of linkages with postsecondary education	54.46	41.34
Attendance at conferences and workshops on the development and implementation of STW programs	51.80	48.80

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

between the 1996 and 2000 school surveys (see Tables 11-14). However, vocational schools were added to the year 2000 sample potentially skewing the results. Thus, we cannot draw any definitive conclusions about changes in school offerings over time.

Another way of looking at the issue of changes in student participation in CTE is by relying on data collected from administrators. Administrators' perceptions are used and limited to the context of this study. Within that framework and limitation, two questions were asked of administrators. First, did CTE enrollments change between 1995-96 and 1999-2000 school year? Second, were changes in graduation requirements related to changes in CTE enrollment?

A majority of schools reported an overall increase in student enrollment (see Table 15) in the five year span ending in 2000. More school administrators reported CTE enrollment increases (34.14%) than reported decreased CTE enrollment during this same period (23.34%). However, when asked about specific CTE programs, more administrators reported decreases in CTE enrollment in all program areas except for increases in business and office education programs than reported increases. One possible explanation for this is what administrators perceive to be included under the CTE rubric. It is possible, that special work related programs not connected to an identified occupational area may be part of the administrators thinking regarding this question. A second possible explanation is that fewer students are following a concentration and instead, taking more, non-sequential CTE courses.

Table 9

Percentage of U.S. High Schools Providing Teacher In-Service Opportunities, 2000

		School Type				
Professional Development Activities	All	Comp.	Technical	Special Ed. and Alt.	Special Emphasis	Other
Unpaid summer internships						
Academic teachers	12.64	11.38	0.52	0.53	0.84	0.91
CTE teachers	10.95	9.41	0.64	0.36	0.55	1.26
Paid summer internships						
Academic teachers	22.39	20.05	0.78	1.00	1.34	2.15
CTE teachers	20.91	18.05	1.63	1.09	0.97	3.03
Internship during the school year						
Academic teachers	9.27	7.99	0.46	0.55	0.79	0.92
CTE teachers	9.55	7.83	0.55	0.44	0.66	1.50
"Curriculum integration" conference and workshop attendance						
Academic teachers	65.73	58.34	2.84	3.97	4.10	6.71
CTE teachers	56.95	49.82	3.06	3.03	3.13	6.62
"Development of employer linkages" conference and workshop attendance						
Academic teachers	35.32	31.22	1.37	1.94	1.86	3.27
CTE teachers	38.10	32.69	1.97	1.72	2.07	4.55
"Development of linkages with postsecondary education" conference and workshop attendance						
Academic teachers	54.46	48.00	1.75	2.37	3.58	6.60
CTE teachers	41.34	36.53	1.98	1.74	2.21	4.23
"Development and implementation of STW programs" conference and workshop attendance						
Academic teachers	51.80	47.08	2.49	3.16	2.77	4.50
CTE teachers	48.80	42.90	2.85	2.87	2.58	5.59

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

Table 10

Percentage of U.S. High Schools Implementing Career Development Support Activities and Programs by School Type, 2000

		School Type				
Support Activity	All	Comp.	Technical	Special Ed. and Alt.	Special Emphasis	Other
Block scheduling	34.44	28.83	1.75	2.32	3.01	4.70
Staff development days required for voc teachers	64.92	56.78	3.20	3.27	3.29	7.34
Joint planning time for academic and CTE teachers	18.60	15.88	1.12	1.15	1.78	2.21
Dual enrollment for academic courses	67.35	60.45	2.32	3.02	4.33	6.91
Dual enrollment for CTE courses	43.62	39.27	2.39	2.20	2.45	3.84
Voc credits required for graduation	18.03	14.54	1.50	1.24	1.63	2.63
Community service requirements for graduation	18.81	14.65	0.48	0.59	2.17	3.89
Written agreements with employers	45.07	38.80	2.71	2.66	2.76	5.83
Paid coordinator to arrange student work placements	45.00	39.59	2.18	1.57	3.04	4.53

Note. The "All" column reflects the composition of all schools for each category. Percentages for each type of school are a distribution within each type of school.

Table 11

Percentage of U.S. High Schools Implementing CTE Reforms: 1996 and 2000

	Percentage of High Schools	
CTE Reform	1996	2000
Career Major/pathways	14.39	23.20
Career Academies	2.13	7.26
Tech Prep	30.02	37.13

Table 12

Percentage of U.S. High Schools Offering of Work-Based Learning Options

Work-Based Learning Options	Percentage of High Schools 1996	Percentage of High Schools 2000
Job site visits	58.57	69.71
Job shadowing	25.84	50.25
Cooperative education	32.12	36.24
Internship	19.91	30.09
School-sponsored enterprises	12.53	17.83
Apprenticeships	12.77	19.65

Table 13

Percentage of U.S. High Schools Offering Career Development Activities

Career Development Activities	Percentage of High Schools 1996	Percentage of High Schools 2000
School visits by employers	78.85	80.68
College guidance counseling	90.65	93.82
Occupational guidance counseling	68.47	71.96
Career interest inventories	80.48	86.03
Career assessments	56.12	64.37
Individualized career plans	39.87	53.84
Career information centers	69.82	66.31
Parental involvement in student's career plans development	31.65	41.38

Table 14

Number of Students Participating in Specific STW/CTE Activities

STW/CTE Activity	1996 Number of Students	1996 Percent	2000 Number of Students	2000 Percent
Total secondary students (NCES)	14,007,000		14, 731,000	
Apprenticeships	49,365	.35	223,477	1.51
Job shadowing	134,221	.96	663,249	4.50
Internships	67,665	.48	251,299	1.70
Career major/pathways	365,725	2.61	1,647,728	11.19
Career academies	NA		474,661	3.22
School-sponsored enterprises	50,276	.36	219,624	1.49
Cooperative education	206,317	1.47	485,272	3.29
Tech prep	309,815	2.21	1,259,027	8.55

Note. The student numbers are estimates obtained with sample weights provided by the NLSY97.

Table 15

Administrator Perceptions of CTE Enrollment Change Between the 1995-96 and the 1999-2000 School Years (Percentages)

Type of Enrollments	Change in CTE Enrollments (% of schools)			
	Increase	Decrease	No sig. change	NA
Total student enrollment	58.22	20.34	21.16	0.28
Total CTE enrollment	34.14	23.34	14.60	27.92
CTE enrollment among educationally or economically disadvantaged students	27.55	35.67	5.08	31.70
CTE enrollment among disabled students	23.02	35.17	3.57	38.24
Enrollment in agriculture education	14.37	17.67	7.24	60.72
Enrollment in business and office education	31.18	28.71	11.83	28.28
Enrollment in marketing/distributive education	16.30	21.90	7.18	54.62
Enrollment in trade and industrial education	21.46	25.51	9.83	43.20
Enrollment in home economics	22.85	28.49	14.50	34.16

Note. Data for the School Survey 1996 were collected during the 1995-1996 school year, and for School Survey 2000 were collected in the 1999-2000 school year.

When we analyzed the same question by school type (comprehensive, technical, or alternative) we find some differences (see Table 16). A higher proportion of technical and alternative schools reported increases in student enrollments than did comprehensive high schools. Not surprisingly, nearly 60% of technical school administrators reported growth in CTE concentrators during this time period a rate nearly double that reported by comprehensive and alternative school administrators. More schools saw a decrease in special needs and disabled students during this five year period. This was true regardless of school type.

A majority of school administrators reported no change in credit requirements for graduation (see Table 17). For those schools reporting increased requirements, administrators were nearly evenly split on whether there was a concurrent increase or decrease in CTE enrollments. Most reported no change. This is consistent with NCES reports of student enrollments in CTE discussed earlier. More schools reporting a decrease in credits required for graduation also reported a decrease in CTE enrollments.

Schools that increased graduation requirements by 3 or more credits, were twice as likely to see an increase in disadvantaged enrollments in CTE as they were to see a decrease. This suggests that CTE may be serving as an escape valve for students with special needs. The data do not show the same pattern with disabled students.

Table 16

Percentage of U.S. High Schools Reporting of CTE Enrollment Change between the 1995-96 and the 1999-2000 School Years by School Type

Type of Enrollments and Type of School	School Reporting CTE Enrollment Change			
	Increase	Decrease	No sig. change	NA
Total student enrollment (Total)	58.22	20.34	21.16	0.28
Comprehensive High School	58.42	19.53	21.92	0.13
Technical or Vocational	67.95	13.62	16.55	1.88
Special Ed or Alternative	68.21	16.27	14.76	0.77
Total CTE enrollment (Total)	34.14	23.34	14.60	27.92
Comprehensive High School	36.40	25.29	15.05	23.26
Technical or Vocational	59.65	22.36	16.24	1.76
Special Ed or Alternative	33.67	17.70	7.50	41.13
CTE enrollment among educationally or economically disadvantaged students (Total)	27.55	35.67	5.08	31.70
Comprehensive High School	28.93	38.06	5.68	27.33
Technical or Vocational	29.48	39.87	9.26	21.39
Special Ed or Alternative	20.66	19.94	4.38	55.03
CTE enrollment among disabled students (Total)	23.02	35.17	3.57	38.24
Comprehensive High School	23.90	38.29	3.29	34.52
Technical or Vocational	26.73	44.95	2.60	25.72
Special Ed or Alternative	17.29	21.76	1.49	59.46

Discussion

The purpose of this study was to examine the prevalence of specific CTE programs and activities in American high schools in the late 1990s, following nearly two decades of general education and specific vocational education reform. We attempted to determine the extent to which reform efforts have influenced the availability of high school vocational education and student participation in the United States. We also examined the extent to which professional development was available to staff and explored the other kinds of supports offered to facilitate CTE.

Overall, the picture that emerges is one that highlights both positive trends and weaknesses in the system. In general, many of the reforms discussed in this paper were created between 1991 and 1994, as indicated by the average tenure of the programs. This suggests that the CTE reforms embodied in Perkins II and the STWOA were at least in part responsible for the creation or strengthening of these programs. Furthermore, the prevalence of business and technology CTE offerings reflects changes in the nation's economy and labor market over the past decade.

Table 17

Percentage of U.S. High Schools Reporting Changes between 1996 and 2000 in General and CTE Enrollment as a Function of Changes in Credits Required For Graduation

	School Reporting Enrollment Change Due to Credit Requirement Change				
Change in CTE Enrollments	1 credit increase	2 credit increase	3+ credit increase	No change	Credit decrease
Total student enrollment					
Increase	7.11	5.61	18.87	57.55	10.86
Decrease	8.16	4.66	14.86	65.65	6.67
No sig. change	6.34	7.16	22.17	46.70	17.64
N/A	0.00	11.60	17.23	58.47	12.69
Total CTE enrollment					
Increase	7.14	3.88	19.15	62.64	7.18
Decrease	6.22	3.56	14.73	61.86	13.63
No sig. change	6.44	10.51	24.44	41.88	16.72
N/A	9.30	7.77	19.87	50.94	12.11
CTE enrollment among educationally or economically disadvantaged students					
Increase	5.73	4.16	23.95	59.28	6.88
Decrease	7.08	5.97	12.25	64.22	10.48
No sig. change	10.70	6.99	24.33	28.03	29.96
N/A	8.48	7.08	19.92	50.94	13.58
CTE enrollment among disabled students					
Increase	8.32	3.69	16.22	61.11	10.66
Decrease	7.88	4.18	17.28	63.21	7.45
No sig. change	0.95	4.28	39.05	30.69	25.03
N/A	6.65	9.19	18.27	50.82	15.07

Schools in the survey offered more career development activities than either work-based learning options or the specific CTE reform programs. Given that career development activities take far less manpower and resources to offer, it makes sense that high investment work learning opportunities were provided less often. However, this may not be the most beneficial route in the long run if helping youth make intelligent decisions regarding high school and post high school curriculum decisions is important. Tech prep programs were offered in about a third of schools, but fewer schools offered career majors/pathways programs; fewer still provided career academies for their students.

Schools are offering teachers many opportunities for professional development opportunities, usually in the form of conferences and workshops, but it is interesting that academic teachers had more opportunities than CTE teachers for such development. What is especially curious is that more schools offered academic teachers workshops in curriculum integration and school-to-work implementation than they did to CTE teachers. This was true for all schools and for the subset of comprehensive high schools. With the expectation of increased academic content in CTE courses, this could mean that CTE teachers, and therefore CTE students, are placed at an unfair disadvantage in the current era of reform.

In terms of the association between increased academic requirements and CTE enrollment, some reports have concluded that the number of CTE concentrators has decreased but that overall CTE course-taking has remained the same (Levesque et al, 2000). The 1994 NAVE found that correlations between requirements and enrollment rates were weak (Levesque et al., 1995). In this study, we found that the majority of administrators feel that CTE enrollments have not been affected by changes in graduation requirements. However, it is important to note that these are not actual numbers but rather school administrator's perceptions. As noted in the results section, we were not able to analyze actual patterns of enrollment over time because of the different samples (particularly, the addition of vocational schools) at the two NLSY97 data collection points (1996 and 2000). Future research should create panel weights for each year to use analyses of how schools changed over time.

However, while secondary school administrators believed that CTE enrollments have been steady or increasing over time, they perceived that enrollments for specific programs were decreasing. This supports the contention that students are now taking a collection of CTE classes rather than a more structured program, or as suggested earlier, it may suggest increased enrollments in non-occupationally specific CTE. If there are fewer students "concentrating" in CTE, this may pose a long term shortcoming for high school youth given the value of concentrating in CTE to economic outcomes discussed earlier. Thus, continued efforts to recruit students into CTE fields should emphasize the importance of a sequential program, such as becoming a CTE "concentrator" (three courses) or "specialist" (four courses) in a particular field. As academic credit requirements continue to rise, school administrators may be limiting the CTE coursework and the opportunity to concentrate. To foster the development of the "forgotten half", schools should ensure that academic standards are met while student are allowed to pursue a particular vocational interest.

While we are not able to offer a longitudinal perspective with the NLSY97 data, our findings showed that in 2000 a slightly larger number of students participating in co-op programs than those reported by the U.S. General Accounting Office (GAO, 1991). However, the largest increase with respect to the GAO 1991 report is seen in participation in apprenticeship programs—from 3,500 as reported in the GAO report to 39,365 in 1996 and 223,477 in 2000 as reported in our study. This is likely an artifact of the now sunsetted STWOA.

We find a slight decline in the availability of school based enterprises over the period represented in the data. While slight, this may be evidence of a viable work based learning option being squeezed out by increases in other school requirements. It may also reflect the decline in Marketing Education programs reported by administrators.

Finally, in terms of students participating in CTE, we are not surprised by the continued focus on 11th and 12th graders for CTE programs and activities. Many schools also continue to target at-risk and disabled students despite changes in the Perkins III language. Our analysis is consistent with the current, NAVE that reports CTE continues to serve a diverse student body, including special needs and academically oriented students CTE has made great strides in the 1990s, with significant help from federal legislation.

Career pathways and tech prep are now an important part of the educational landscape. The vast majority of schools continue to offer CTE, work based learning and career development to American youth. While the pressures created by various non-CTE reform efforts may be affecting the number of youth who concentrate in CTE, the impact may have stabilized in the latter part of the twentieth century. It will be valuable to revisit these questions a few years hence when the full impact of the federal *No Child Left Behind* act (2001) will be realized.

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Cognitive Learning, Student Achievement, and Instructional Approach in Secondary Agricultural Education: A Review of Literature with Implications for Future Research

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Abstract

The "coin of the realm" in education today is student achievement, its measure, and its relationship to school accountability. An almost singular emphasis is placed on student achievement in "core" academic areas. The constructs of cognitive learning, student achievement, and instructional approach in agricultural education have been studied by researchers; however, little has been reported about it in the context of today's educational priorities. This study reviews research describing the kind of cognitive learning that ought to be occurring in secondary agricultural education and suggests implications for future research about cognition, achievement, and instruction. Future inquiries should involve interdisciplinary partnerships to identify practices that hold promise for supporting student learning across the curriculum if delivered effectively in the context of secondary agricultural education. Moreover, it is recommended that the integration of effective curricula and instructional approaches from other disciplines into secondary agricultural education and opportunities for reciprocity be studied further.

Introduction and Conceptual Framework

"Over the past decade the United States has been engaged in the most sustained period of educational reform since the Progressive Era" (Elmore, 1995, p. 356), a trend that continues in the 21st century. Evidence of impetus for this reform movement has been well documented by national reports such as *A Nation at Risk* (National Commission on Excellence in Education, 1983), *Secretary's Commission on Achieving Necessary Skills (SCANS)* (1991), *Breaking Ranks: Changing an American Institution* (National Association of Secondary School Principals, 1996), and the *No Child Left Behind Act of 2001* (United States Department of Education, 2004). These reports called for a restructuring of fundamental components of the American educational system and identified opportunities for systemic improvements in education.

Further, the National Research Council (1996) concluded that the level of "scientific literacy" needed to understand and make informed decisions about the use of technology continues to increase. Yet assessments of student achievement for the sciences and mathematics, frequently, do not indicate levels of performance congruent with a society and workplace that is increasingly demanding that its citizens and employees be literate in these disciplines. In the case of student performance in mathematics, close scrutiny of National Assessment of Educational Progress (NAEP) data reveals that, although some moderate improvement of scores for selected age groups has occurred, the math performance of 17 year-olds remained more or less “flat” for three decades (United States Department of Education, 2001). The science achievement of this age group actually declined.

Researchers (Britton, Huntley, Jacobs, & Weinberg, 1999; Hoachlander, 1999; Parnell, 1995) have suggested that often the science and mathematics being taught is too “abstract,” and, it appears that for many students, it lacks the sufficient real world “connection” and relevant “context” necessary to be learned adequately and applied effectively. Concomitantly, investigators (Balschweid & Thompson, 2002; Balschweid, Thompson, & Cole, 2000; Conroy & Walker, 2000; National Research Council, 1988; Shelley-Tolbert, Conroy, & Dailey, 2000) in agricultural education have suggested that agriculture, food, and the environment are robust and authentic contexts for improving student learning in science and mathematics. However, does sufficient empirical evidence exist to support that claim? To this end, the National Agricultural Education Research Work Group called on the agricultural education profession to

(1) identify current research in agricultural education that corroborates effective school-based educational practice,

(2) analyze and probe the “gaps” in the research, and

(3) focus action and engage others in seeking ways to communicate and coordinate a research agenda that will aggressively examine research problems related to high school student achievement, particularly mathematics, science, and reading, over the next five years (G. Shinn, personal communication, August 19, 2002).

Moreover, informing school leaders about factors that impact student learning, and, ultimately, student achievement, and assisting them in making related decisions should be one of the primary goals of educational researchers, including those who investigate the performance of students enrolled in secondary agricultural education. So, what has been *said* about what *ought to be* occurring in agricultural education in regards to student learning is an important body of literature to coalesce and interpret; thus, it was the focal point of this study.

Cognitive Learning

This paper examines the mental processes or thinking behaviors underpinning cognitive learning or cognition from a “situated” or “contextual” perspective, i.e., knowledge acquisition and understanding gained by students enrolled in secondary agricultural education who experience learning in the situation or context of agriculture, food, and the environment. Imel (2000) argued that "contextual learning" or learning "directly related to the life experiences or functional contexts" (p. 1) of the learner is grounded in constructivist learning theory. Doolittle and Camp (2004) defined constructivism as "the belief that learners construct their own knowledge from their experiences" (Constructivism section, para. 1), and operationalized it as "the active creation and modification of thoughts, ideas, and understandings as the result of experiences that occur within a socio-cultural context" (Constructivism section, para. 2).

Moreover, Brown, Collins, and Duguid (1996) opined that the context in which learning and its requisite cognizing occurs "is an integral part of what is learned. Situations might be said to co-produce knowledge through activity. [And that,] Learning and cognition, it is now possible to argue, are fundamentally situated" (p. 20). Brown et al. also framed context-rich learning experiences as authentic learning or "authentic activities," i.e., "ordinary practices of the culture" (p. 25) through which the act of learning unfolds. Other researchers (Capaldi & Proctor, 1999) posit the role of context vis-à-vis how one learns is not restricted to theories about learning but that, "Context is also presumed to play a crucial role in perception, cognition, and memory" (p. 112), prerequisites to sustained learning and measurable cognitive achievement. Researchers in agricultural education, e.g., Buriak, McNurlen, and Harper (1996), supported that position when they concluded, "The best way for learners to learn how to use knowledge in multiple contexts is to have the experience of *applying* [italics added] knowledge in multiple contexts" (p. 32). It was from the aforementioned perspectives that literature describing student achievement in secondary agricultural education was explored.

Student Achievement

Glaser (1963) defined "achievement measurement . . . as the assessment of terminal or criterion behavior" (p. 519), and stated that it involved "the determination of the characteristics of student performance with respect to specified standards" (p. 519). In addition, he posited that "Underlying the concept of achievement measurement is the notion of a continuum of knowledge acquisition ranging from no proficiency at all to perfect performance. [And, that] An individual's achievement level falls at some point on this continuum as indicated by the behaviors he [or she] displays during testing" (p. 519). Regarding the measure of student achievement in an era of "High Stakes Testing," such as assessments used to determine a student's readiness for advancement in grade or one's eligibility for high school graduation, Connors and Elliot (1995) found that high school seniors in Michigan "who had agriscience and natural resource classes performed as well as seniors who did not . . . on the [standardized] science achievement test" (p. 62). Moreover, Chiasson and Burnett (2001) found that 11th grade agriscience students from all schools in Louisiana "achieved significantly higher overall scores than non-agriscience students on the science portion of" their state's Graduate Exit Examination.

Elliot and Zimmerman (2002) compared the performance of career and technical education (CTE) students, including students enrolled in agricultural education, with that of other students on the Stanford9 high stakes test in Arizona. They concluded that, "When the appropriate extraneous variables[, i.e., handicapped, limited English proficiency, economically disadvantaged, academically disadvantaged, or being a single parent,] are built into the equation and controlled for, there usually is no difference between CTE and other students on standardized test scores" (pp. 11-12). And, that "differences in scores can be attributed to the effects of the extraneous variables and not because of curriculum choice" (p. 12).

Seminal work by Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) described six levels of cognition, that is, the levels of thinking often referred to as Bloom's *Taxonomy*. This approach to describing thinking behaviors delineated cognition into lower- and higher-order thinking skills and conceptualized them in a hierarchical fashion (Bloom et al.). Numerous researchers (Cano & Martinez, 1989; Flowers & Osborne, 1988; Newcomb & Trefz, 1987; Torres & Cano, 1995a; Whittington & Newcomb, 1993) in agricultural education have supported, tested, and/or adapted Bloom et al. posits. For example, using Bloom's model as a framework, Newcomb and Trefz (1987) developed a similar model for classifying cognitive behaviors consisting of "four levels of learning" that may be demonstrated by agricultural education students: remembering, processing, creating, and evaluating. What is more, "The need to have students graduate with the demonstrated capacity to think at the higher levels of Bloom's taxonomy is more urgent than ever. The nature of the world we live in demands it" (Newcomb, 1995, p. 4). So, teaching methodologies and instructional practices that support the creation of such intellectual "capacity" by students must be a priority of all educators, including secondary agricultural education teachers.

Instructional Approach

Carroll (1963) posited a "model" for understanding differences in educational achievement that involved the interaction of five variables. Two of Carroll's variables were expressed "in terms of achievement": "'quality of instruction' and [the student's] 'ability to understand instruction'" (Carroll, 1989, p. 26). In support, Bloom (1974) stated that, "When the quality of instruction is high, the level of achievement of the students and the time on task increase" (p. 687). Other researchers (Rettig & Canady, 1996) reported that in schools where active learning methods were pervasive the students demonstrated "significantly higher achievement as measured by the National Assessment of Educational Progress" (p. 2). To this end, Darling-Hammond and Falk (1997) concluded,

> Research on schools that have met high standards and maintained low retention rates with diverse student populations provides insights into successful teaching strategies. Teachers in these schools offer students challenging, interesting activities and rich materials for learning that foster

> thinking, creativity, and production. They make available a variety of pathways to learning that accommodate different intelligences and learning styles, they allow students to make choices and contribute to some of their learning experiences, and they use methods that engage students in hands-on learning. Their instruction focuses on reasoning and problem solving rather than only recall of facts, ... (p. 193)

Many agricultural educators posit that instruction in agricultural education, i.e., classroom and laboratory teaching and learning, inculcates much of what investigators (Bloom, 1974; Carroll, 1963; Carroll, 1989; Darling-Hammond & Falk, 1997; Glaser, 1963; Rettig & Canady, 1996) have identified as the variables required for cognitive learning to occur effectively.

Further, Lynch (2000) asserted that, "Much of the recent theories and research on cognition and learning clearly support some of the pedagogical approaches historically used by career and technical educators—'learning by doing,' 'heads and hands,' 'theory and practice,' and cooperative education" (Student Learning Motivation, and Achievement section, para. 4). In particular the hands-on/minds-on approach to learning (Haury, 1993; Haury & Rillero, 1994; Lumpe & Oliver, 1991; National Research Council, 1996; Von Secker & Lissitz, 1999) espoused by a plethora of educational theorists, researchers, and practitioners—whether called applied learning, authentic learning, contextual teaching and learning (CTL), inquiry-based instruction, problem-based learning (PBL), self-regulated learning, or situated cognition—shares pedagogical "kinship" with the philosophical basis on which secondary agricultural education rests. Accordingly, "learning in agricultural education has been [and continues to be] both 'hands-on' and 'minds-on' in intent, design, and delivery" (Edwards, Leising, & Parr, 2002, p. 2).

But, arguably, more has been *said* about cognitive learning, its ultimate outcome student achievement, and the role of instruction in regards to what *ought to be* occurring in secondary agricultural education than has been measured rigorously and replicated experimentally. Cano (1990) argued that, "An analysis of the literature related to cognitive development of students, indicated a *paucity* [emphasis added] of findings regarding vocational education students' level of cognitive performance. [And, that,] Specifically, research in determining the level of cognitive performance of vocational agriculture students was lacking" (p. 74). Moreover, the National Agricultural Education Research Work Group concluded that, "more rigorous research in school-based agricultural education is needed to identify effective practices that contribute to state and national educational priorities and to identify strategies for assessment and documentation of student achievement based on accepted educational standards" (G. Shinn, personal communication, August 19, 2002).

Purposes of the Study

A primary purpose of this study was to review selected research describing what has been *said* by earlier investigators about cognitive learning, student achievement, and instructional approach in secondary agricultural education. The central research question supporting attainment of this objective was the following: What have researchers in agricultural education *said* about what *ought to be* occurring in secondary agricultural education in regards to cognitive learning, student achievement, and instructional approach? A second purpose was to suggest implications for future systematic research about cognitive learning, student achievement, and instructional approach in secondary agricultural education.

Procedures

Sources of data included findings, conclusions, implications, and recommendations made by agricultural educators who had described cognitive learning, student achievement, and instructional approach in agricultural education (n = 42). Manuscripts focusing on career and technical education (n = 13) from a broader perspective and, in some cases, general education (n = 26) were cited as well to provide additional sustenance to the conceptual frame of the paper and to support selected recommendations and implications.

The literature reviewed included doctoral dissertations, national commission reports, articles from professional journals and magazines, position papers, books, papers from research conference presentations, and on-line Internet publications. Studies appearing in these references were found through library system searches at three land-grant universities and through selected on-line search engines. Cited manuscripts were published from 1956 through 2004. All references were subjected to internal and external criticism.

Marsh (1991) concluded that, “Integrative inquiry involving empirical/historical/ interdisciplinary approaches demonstrates moderate levels of success in bringing together important concepts from diverse sources” (pp. 279-280). However, Marsh maintained that one of the most important outcomes resulting from an integrative inquiry or “research synthesis” was to “point up the gaps in available knowledge which researchers still need to fill” (p. 276). To that end, selected guidelines for conducting a form of integrative inquiry were followed (Marsh, pp. 271-283). Special attention was paid to six guiding principles, i.e., “primary activities,” identified by Roberts (as cited in Marsh) regarding selection, analysis, and interpretation of literature supporting this inquiry. They were,

> identify need/request, conduct preliminary search, clarify request; conduct the search for and retrieval of studies; selecting, screening, and organizing studies;
>
> determining the conceptual framework and fitting it to the information from the analysis; developing the synthesis and interpretation into a material product; and delivering the results of synthesis. (p. 277-279)

Findings

Cognitive Learning and Student Achievement in Secondary Agricultural Education

The Committee on Agricultural Education in Secondary Schools (National Research Council, 1988) concluded that a re-directing of agricultural education programs was in order if program graduates interested in studying agriculture at the college and university levels were to do so and then be prepared to enter the workforce successfully. Implicit to the committee's conclusion was the need for agriculture teachers to provide students with ample opportunities to practice critical thinking skills with increasing variety and frequency.

Ware and Kahler (1988) supported the committee's conclusion when they stated, "It is important that critical thinking be stressed to encourage students to think critically, objectively, and analytically in order to handle real-life situations and problems" (p. 283). They also found members of the discipline concurred that the teaching of critical thinking "must be pushed to the forefront of instructional emphasis in the vocational agriculture curriculum" (p. 280). Additionally, Ware and Kahler opined, "Since the agricultural industry is becoming increasingly technical, teaching critical thinking will grow in significance in agricultural education" (p. 280). The researchers concluded that there was a "need to refocus their [i.e., agriculture instructors'] teaching more toward critical thinking, problem solving, and decision making" (p. 283). In agreement, Rollins (1990) stated that "agricultural educators should incorporate principles of critical thinking and problem solving into their curricula" (pp. 52-53).

Cano (1990) reported that significant associations existed between agriculture teachers' "intended" levels of cognitive instruction, i.e., their instructional objectives for a given lesson, and students' levels of cognitive performance when tested. Accordingly, Cano recommended that instructors should "develop [and deliver] a curriculum which appropriately challenges the students at all levels of cognition" (p. 79), including higher-order thinking behaviors. Cano and Metzger (1995) observed Ohio horticulture teachers to determine their cognitive levels of instruction as identified by the Florida Taxonomy of Cognitive Behaviors (FTCB), a derivative of Bloom's *Taxonomy* modified to include the levels of "translation" and "interpretation" (instead of comprehension). They found that "84% of teaching occurred at the lower levels of cognition (knowledge, translation, interpretation and application), and that teaching at the higher levels of cognition (analysis, synthesis, and evaluation) occurred 16% of the time" (p. 39). The investigators concluded that teachers should modify their curriculum (Cano, 1990) and course materials as well as instructional practices if the ultimate aim was to assist students in achieving learning objectives that supported higher-order thinking.

Moreover, Cano and Newcomb (1990) argued that agriculture teachers "should purposefully create learning situations which assist in the development of higher cognitive abilities in students" (p. 51). Similarly, Cano and Martinez (1989) recommended that, "Students of vocational agriculture should be challenged to develop stronger cognitive abilities and critical thinking abilities at higher levels through the instruction they receive" (p. 364). And, Rollins, Miller, and Kahler (1988) asserted, "As a result of low levels of critical thinking observed . . ., agricultural educators must incorporate principles of critical thinking and problem-solving into their curriculum if [students'] scores are to be improved" (p. 40). Rollins et al. (1988) contended further, "It is vital that knowledge and thinking skills become tools that can be used by students for the preservation and advancement of agricultural knowledge by present and future generations of this society" (p. 34). The investigators also maintained that, "By teaching students how to think and learn independently, we increase their power to think and learn outside of the classroom" (p. 34).

Regarding the transfer of learning, Miller (1998) opined that, "Nurturing higher-order thinking and the ability to transfer are particularly important in a rapidly changing environment" (n. p. #). Yet Cano and Newcomb (1990) posited that, "if insufficient learning occurs at the higher levels of cognition, then students are not graduated adept at operating at the higher orders of cognition" (p. 46).

Cognitive Learning, Student Achievement, and Instructional Approach in Secondary Agricultural Education

Boone (1990) stated, "The problem solving approach to teaching has been widely accepted as the way to teach vocational agriculture [i.e., agricultural education]" (p. 18), and "When students solve real problems, use the scientific method to reason through a problem solution, test potential problem solutions, and evaluate the results of the solution, retention of knowledge learned through this activity has to be increased" (p. 25). Further, Boone (1990) concluded that, "The problem solving approach to teaching increases the level of student retention of agricultural knowledge learned during an instructional unit" (p. 25). In support, Flowers and Osborne (1988) found "that for high level cognitive items [e.g., analysis, synthesis, and evaluation] students taught by the problem solving approach had less achievement loss than students taught by the subject matter approach" (p. 25).

Torres and Cano (1995a) posited that, "The use of thinking skills in problem situations is universally recognized as a prominent objective for all educational academies" (p. 46), including agriculture. Torres and Cano (1995b) also argued, "Cooperative learning, integrating higher-order thinking skills into the current curriculum, and a more constant use of the problem-solving approach to teaching are but a few means by which we can excel in teaching higher-order thinking skills" (p. 9). And, Cano and Martinez (1989) recommended that, "Further research needs to be conducted to determine the extent to which problem solving instruction, which has been the cornerstone of vocational agriculture, contributes to the cognitive ability and critical thinking ability development of the students" (p. 364).

Dyer and Osborne (1996) concluded that, "the problem solving approach is more effective than the subject matter approach in increasing the problem solving ability of students," and, moreover, the "increase transcends [students'] learning styles" (p. 41). The results of their study indicated that the problem-solving ability of agricultural education students who are field-dependent learners can be enhanced "to a level of effectiveness nearly equal to that possessed by field-independent learners" (p. 41) if the instructional approach is used effectively.

In a study where students received instruction either via simulation or through the use of appropriate realia (power train or tractor), Agnew and Shinn (1990) found no significant differences in student achievement, immediate or delayed, for selected agricultural mechanics subjects (i.e., dc electricity and hydraulics). Therefore, the researchers concluded that simulation could be an effective method when teaching these subjects in the absence of actual materials.

Although Johnson, Wardlow, and Franklin (1997) found no significant differences in the achievement of agriculture students—either immediate or delayed—regarding the mastery of physical science principles, they reported that students who received instruction involving hand-on activities, as opposed to traditional worksheets, expressed "significantly more positive attitudes toward the subject matter" (p. 14). Johnson et al. recommended that agriculture teachers "expand the use of hands-on instructional activities to enhance student affective outcomes" (p. 14). Further, the researchers encouraged agriculture instructors to consider using selected methodologies commonly practiced in science education as a means of improving their teaching**.** In addition, Johnson (1991) used the FFA Agricultural Mechanics Contest as a "lens" to assess students' "mathematical problem solving ability" (p. 27). He found that their abilities to solve related mathematical word problems were poor. Johnson suggested that if the event participants' mathematical ability was representative of all secondary agricultural education students, then "instructional programs should be designed" (p. 27) to mitigate their deficiencies.

Roegge and Russell (1990) assessed "the effect of incorporating [i.e., integrating] biological principles into a unit of instruction in vocational agriculture on student achievement and attitudes" (p. 27). Students who were taught through the "integrated" instructional approach performed better overall and on specific measures of applied biology than those students who did not receive integrated instruction. Other investigators (Enderlin & Osborne, 1992; Osborne, 2000) also explored the applicability of science education methodology in the teaching of agriculture. For example, Enderlin and Osborne (1992) compared student achievement and thinking skill attainment of learners enrolled in integrated agriculture and science courses, i.e., Biological Science Applications in Agriculture

(BSAA), to those who received instruction in traditional horticulture courses. After comparing pre- and post-achievement test scores, they found that the BSAA group achieved significant gains in agricultural and biological science knowledge while the students enrolled in horticulture did not. Although student gains for composite thinking skills were not significant for either group, the researchers concluded that students who received "higher quality laboratory instruction" (p. 43) performed better.

Osborne (2000) compared student performance in laboratory-based agriscience courses depending on "level of openness" for selected laboratories. He compared the efficacy of using prescriptive lab experiments (i.e., a "cookbook" or "recipe" approach) to lab exercises that were substantially more investigative or "open" in format. The researcher found that students who participated in labs that followed a prescriptive format performed better than those who carried out the same experiment but in a more open, investigative nature. However, Osborne suggested that students' preferred learning styles ("a large majority of students . . . were field dependent learners") may have mitigated his results. Thus, the researcher only cautiously recommended that those "agriculture teachers with primarily field dependent learners should use a prescriptive, cookbook approach to [teach] their experiment-based agriscience labs" (p. 75).

Conclusions, Recommendations, Discussion, and Implications

Researchers have concluded that cognitive learning, including student behaviors involving critical thinking, higher-order thinking skills, and problem-solving, ought to be occurring in secondary agricultural education. In addition, various instructional methodologies, including problem-solving as a teaching approach, simulation, applied learning activities, integrated curriculums, and laboratory teaching practices, have been tested and then proffered by researchers to describe and, in some cases, explain relationships between cognitive learning, student achievement, and instructional approach in secondary agricultural education.

Investigators believed that the agriculture, food, and environmental system could be an appropriate learning context for assisting students in thinking critically, in exercising higher-order thinking skills, and in coalescing these and related thinking behaviors to solve problems, assuming agriculture teachers demonstrate effective instructional behaviors in a sustained fashion and support progressive cognitive learning by their students. Further, substantial congruence exists between what some eminent educational researchers (Bloom et al., 1956; Bloom, 1974; Carroll, 1963; Carroll, 1989; Darling-Hammond & Falk, 1997; Glaser, 1963; Resnick, 1987; Rettig & Canady, 1996) have said is "best practice" in the pursuit of improved student learning and what occurs in many agricultural education classrooms and laboratories.

The National Agricultural Education Research Work Group, in cooperation with the profession “at large,” is attempting to identify “research-based practices used in secondary school-based agricultural education that contribute to student achievement in the academic areas” (G. Shinn, personal communication, December 12, 2002). After conducting a synthesis of literature describing preservice agriculture teacher education programs nationwide, Myers and Dyer (2004) found support for the work group’s initiative. They concluded, “Major emphasis is being placed on how agricultural education can contribute to the academic achievement of students in the areas of science, mathematics, and reading. [And,] Research is needed to identify how agricultural education can fill this gap” (Myers & Dyer, 2004, p. 50). However, inherent to the success of this effort may be the profession’s acumen in reaching out to scholars, practitioners, and other potential collaborators, who represent the academic subjects that agricultural education seeks to establish its relevance to, and support of, in regards to student achievement. Sustained effort should be devoted toward that purpose at all levels of teacher education (Conroy & Sipple, 2001; Eisenman, Hill, Bailey, & Dickison, 2003; Parr & Edwards, 2002; Parr, 2004; Pearson, 2004; Zirkle, 2004).

Much of the research described by this study relied on descriptive and causal-comparative methodologies. Undeniably, investigations of this nature, when done with sufficient rigor, hold substantial value (Gall, Borg, & Gall, 1996). Yet if testing treatments to establish “cause and effect” and to make “inferences” about the efficacy of those interventions with significant confidence is the ultimate aim, then more studies that employ experimental designs are needed (Slavin, 2003). Preferably, inquiries employing randomized controlled trials that are well-designed and implemented and thus capable of yielding “‘strong evidence’” (United States Department of Education, 2003, “How to evaluate whether an educational intervention . . .” section) are required.

More so, high-level decision-makers in many state education agencies and at the federal level are making decisions that are founded solely on empirically-based evidence that was rigorously obtained (Slavin, 2003). In the future, more research on student achievement in secondary agricultural education must reach or exceed these standards.

Is the aforementioned “picture” adequate in the context of contemporary educational initiatives? Is the “frame” containing the portrait even large enough for today’s agenda? Moreover, is the study of cognitive learning, student achievement, and instructional approach solely in the context of secondary agricultural education “sufficient”? Perhaps it is not. In particular, problem-solving, as an instructional approach and as a learning outcome of agricultural education, was highlighted by the findings of this study. However, is “problem-solving,” in the context of agricultural education, i.e., how teachers use it and how students are expected to demonstrate it, congruent with how the method and learner expectation is “operationalized” in science education (Myers & Dyer, 2004; Parr & Edwards, in-press) or in mathematics education (Shinn et al., 2003)? For example, is it correct to assume that "problem-solving" and the "scientific method" are one in the same? Further, what about curriculum integration and contextualized learning? And, what about the constructs of critical thinking and higher-order thinking skills? Is our "collective" meaning and practice similar or different? Are the ways that agricultural educators conceptualize and practice these teaching strategies similar to those of colleagues whose disciplines we may aspire to support while furthering the career preparation objectives of secondary agricultural education?

But if agricultural educators are serious about effectively demonstrating their discipline's relevance to *supporting learning across the curriculum*, now is the time to ally with science, mathematics, and reading educators such that we act in concert in discovering how agricultural education may best serve student learning in an interdisciplinary scheme (Castellano, Stringfield, & Stone, 2003; Zirkle, 2004). For example, exploratory work by Myers, Washburn, and Dyer (2004) concluded that a purposive sample of secondary agricultural education teachers in Florida (n = 40) did possess a high level of "requisite knowledge to perform and apply [science] integrated process skills" (Conclusion section, para. 2). In turn, teachers who possess these skills should be more ably equipped to help students learn and understand the plethora of scientific principles and concepts undergriding agricultural knowledge and practice. The measure of student performance in a randomized control trial would be the "litmus test" for this posit (United States Department of Education, 2003).

According to Myers et al., "Science integrated process skills have been identified in the science education literature as an effective inquiry method of teaching science" (Conclusion section, para. 1). This kind of work is encouraging and needed but, as the investigators indicated, teachers sampled had an "expressed interest" (Conclusion section, para. 2) in integrating science into their teaching, and additional research was required before broader generalizability of findings could be established. Moreover, these inquiries should reach the standards of rigor described by Slavin (2003), the United States Department of Education (2003), and others.

Interdisciplinary partnerships would also assist agricultural educators in understanding better how selected pedagogical aspects of science (Edwards et al., 2002; Johnson et al., 1997; Melodia & Small, 2002; Myers, Washburn, & Dyer, 2004; Parr & Edwards, 2002; Parr & Edwards, in-press; Roegge & Russell, 1990; Stewart, Moore, & Flowers, 2004; Zirkle, 2004), mathematics (Melodia & Small; Shinn et al., 2003; Stewart et al., 2004; Zirkle, 2004), and reading education (Parks & Osborne, 2004; Stewart et al., 2004; Zirkle, 2004) could improve teaching and learning in agricultural education and include opportunities for reciprocity toward other curriculums. Hernández and Brendefur (2003) examined teacher participants in MathNet a project where mathematics and vocational-technical teachers were teamed for the purpose of developing authentic, integrated, standards-based mathematics curriculum. They concluded that under optimal conditions teachers who represented different disciplines and views about schooling and school culture could work together effectively to produce “highly authentic, integrated, and standards-based curriculum units” (p. 277). But the researchers (Hernández & Brendefur) concluded that, “the research base for conducting interdisciplinary curriculum integration initiatives in secondary schools and post-secondary institutions is largely undeveloped” (p. 278-279).

Regarding another effort to impact student mathematics achievement, Pearson (2004) described the pilot-phase of an experimental study testing the hypothesis that high school students could learn selected mathematical concepts better if the teaching and learning relied on a “math-enhanced CTE curriculum” (p. 22) delivered using an aligned instructional approach than would their peers who received a more traditional curriculum and teaching method.

This study was pilot-tested during the spring semester of 2004 and involved five CTE program areas, including secondary agricultural education, i.e., agricultural power and technology and horticulture. Participating career and technical education teachers developed the math-enhanced lesson plans in cooperation with math teacher partners who, in most cases, were colleagues at their local schools. The project was planned and facilitated by the National Research Center for Career and Technical Education (NRCCTE) (Stone, Alfeld, Jensen, Lewis, & Pearson, 2004). This study reaches the standard of experimental rigor (Posttest-Only Control Group Design; see Campbell & Stanley, 1963), i.e., a randomized controlled trial, called for by the United States Department of Education (2003, “How to evaluate whether an educational intervention . . .” section), by Slavin (2003), and by other educational researchers.

Further, Parr (2004) found that Oklahoma secondary students who received instruction in agricultural power and technology through the math-enhanced curriculum and instructional approach performed significantly better than their peers who did not. Student post-treatment math performance was measured by a nationally-normed, standardized examination used frequently to determine an individual’s need for math remediation at the post-secondary level. The effect size or “practical significance” of the finding was “large” (Parr, p. 83). Other measures of student math achievement for the one-semester pilot study were not significant. However, the study is being conducted for a full academic year during 2004-2005 (Pearson, 2004; Stone et al., 2004) and researchers anticipate that the model’s effect on student math achievement will be demonstrated more broadly.

Notably, the most recent *National Assessment of Vocational Education (NAVE)* report (United States Department of Education, 2004) identified “curriculum development strengthening academic content of vocational courses” (p. 21) as a strategy to improve student academic achievement. The NRCCTE-sponsored study described (Stone et al., 2004; Parr, 2004; Pearson, 2004) and those similar in design seek to empirically test the effects of that NAVE-recommended strategy in the context of career and technical education programs, including secondary agricultural education.

In 1990, Cano recommended that additional research be carried out that focused on “the level of cognition of instruction and student performance in agricultural education on a broader, more comprehensive scale” (p. 79). Cano’s use of the phrase “comprehensive scale” may have been farsighted. It is no secret that today the “coin of the realm” in education is student achievement, its measure, and its relationship to accountability—student, teacher, program, school, and organization. What is more, an overarching, almost singular emphasis is being placed on student achievement in “core” academic areas. So, if this is the “table of education” now and, perhaps, for the foreseeable future, will secondary agricultural education have a place at that table? The evidence needed to answer that question affirmatively must be gathered and then shared with appropriate decision-makers at all levels, especially those who are charged with allocating resources and establishing educational priorities (Stewart et al., 2004).

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Journal of Vocational Education Research Field Reviewers for Volume 29

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