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Bits and Pieces

Welcome, Readers, to Volume 45, Number 2, Fall 2008 of the Journal of Industrial Teacher Education (JITE). As mentioned previously in this column, Volume 45 marks the inauguration of the three issues per volume publication cycle with Winter 45.3 to follow as the conclusion to this Volume.

The lead off article for this issue is a conceptual piece from Hae-Young Lee and Gene L. Roth. Their focus is knowledge management and using this strategy to gain competitive advantage.

> *The essence of knowledge management is to leverage knowledge within work units and organizations, positively affect individual and organizational performance, and improve work outcomes. These are worthy goals for career and technical education (CTE) teacher educators. When the name of the game for many CTE teacher education programs is survival, becoming more efficient and effective can hopefully lead to gains in performance and competitive advantage. (p. 6)*

M. Scott Williams has chosen to explore whether or not Career and Technical Educators' decisions to adopt, or not adopt, virtual reality as an instructional tool can be influenced by a positive or negative disposition.

> *This pilot study was based on the premise that reluctance or willingness to adopt an innovation may be influenced by the creation of a negative or positive disposition. The purpose of the study was to compare the disposition toward a desktop VR presentation of CTE educators who received neutral, negative, or positive primes. If disposition can be altered then it may be possible to influence the adoption rate of a given innovation. (p. 39)*

Next, Marie Kraska examines learning communities as a possibility for retaining graduate students in our programs.

> *The purpose of this article is to present information about ways in which LCs are defined, background information regarding the*

> *development of LCs, benefits of LCs, reasons for graduate student attrition, and common models of LCs for graduate students. (p. 55)*

After all, if we cannot retain students, from where will the next generation of Career and Technical Teacher Educators arise?

Speaking of teachers, or the lack thereof, Luke Joseph Steinke and Alvin Robert Putnam decided to investigate why individuals prepared as Technology Education teachers choose to accept teaching positions. *"This study sought to identify effective recruitment techniques by determining the factors that influence technology education teachers to accept teaching positions"* (p. 72). Given the difficulty some areas of the country have in attracting Career and Technical faculty, their findings are an interesting read.

We are fortunate to be able to include two book reviews in this issue as well to assist you in making choices for your personal or professional collections. The first, contributed by Henry L. Harison III, provides insights into, Garmire, E., & Pearson, G. (Eds.). (2006). *Tech tally: Approaches to assessing technological literacy.* Washington: National Academy Press. $43.16 (hardcover), 358 pp. (ISBN 0-309-10183-2). *"Career and technology educators at all levels should embrace the text and promote its recommendations to the fullest extent"* (p. 95).

The second, contributed by Michael P. Glass, examines, Middleton, H. (Ed.). (2008). *Researching technology education: Methods and techniques.* Rotterdam, The Netherlands: Sense Publishers. $49.00 (paperback), 228 pp. (ISBN-10: 9087902603).

> *No recipes for research proposals are presented, nor will the reader find that all methods are appropriate for technology education but technology educators who are searching for different views or methodologies which might be applicable to their research will find this collection worth purchasing. (p. 100-101)*

Enjoy!

Knowledge Management: A Tripartite Conceptual Framework for Career and Technical Teacher Educators

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Abstract

Researchers and practitioners consider knowledge management to be a strategic intervention that integrates organizational resources such as technologies and human resources. This conceptual paper focuses on the foundational contributions of economics, sociology, and psychology to knowledge management. Select theories from each foundational area are illustrated. Links are made to the research and practice of career and technical teacher educators. Suggestions for further research include examining the inter-connective links of these foundational areas as a means to help career and technical teacher educators identify the value they add to their broader organizational work contexts.

The Journal of Industrial Teacher Education (*JITE)* targets a readership inclusive of professionals in technology education, technical education, trade and industrial education, teacher education, industrial training, and military training. These professionals share common challenges – they work in settings in

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which they are asked to do more with less. They work in settings in which they are expected to continually improve. They search for ways to become more efficient and effective, and they understand that each year they will be held accountable for their performance. This preceding backdrop is intended to build an awareness of why this article on knowledge management is relevant to career and technical teacher educators. The essence of knowledge management is to leverage knowledge within work units and organizations, positively affect individual and organizational performance, and improve work outcomes. These are worthy goals for career and technical education (CTE) teacher educators. When the name of the game for many CTE teacher education programs is survival, becoming more efficient and effective can hopefully lead to gains in performance and competitive advantage.

Knowledge management has emerged as a corporate strategy for integrating technology applications and human resources in the pursuit of improved organizational performance. Knowledge management has addressed some key concerns of human resource development (HRD) and has also triggered new debates on HRD practices (Thomas, Kellog, & Erickson, 2001). The influence of knowledge management, like other business management strategies, has possibilities for affecting the work settings of representatives of the *JITE* readership. The positive possibilities of knowledge management include an emphasis on the value of knowledge within organizations – including school systems and universities (Serban & Luan, 2002). This article offers a useful conceptual framework that can help CTE teacher educators understand the foundational roots of knowledge management, and hopefully allow them to make useful connections between the theory and practice of it in their own work contexts.

Background and Rationale for the Study

A widely-accepted premise of knowledge management in the business world is that competitive advantage stems from the unique knowledge possessed by members of an organization. The advantage is attained and maintained if and when other competitors in the same industry are unable to duplicate this unique knowledge. School settings and universities can also benefit from maximizing in-house knowledge that leads to enhanced effectiveness and efficiency and a competitive advantage over other educational providers. An example of a competitive advantage in CTE would be high levels of effectiveness and efficiency by a CTE program in aligning curricula with current industry standards. Another example would be capitalizing on expertise from across departments that would allow highly desirable integration of academic and technical content in teaching and learning transactions. The outcomes of both of these examples are presumed to be desirous and can positively affect the success of program graduates.

The emphasis on the expertise and experience of workers in the business management community has benefited primarily from three academic disciplines: economics, sociology, and psychology (Lee & Roth, 2007). Central to the debates among economists has been the organization – an economic organization, in particular. Sociologists have examined the complexities of the organization as a social entity and its relationship with the environment. Researchers in psychology have examined the actions of individuals and groups within organizations.

The literature on knowledge management may be described as a piecemeal approach, devoid of thorough explanations of the theoretical underpinnings of knowledge management. One of the reasons for this shortcoming is that knowledge management is in an early developmental stage. Second, knowledge management researchers have emerged from a variety of academic disciplines. Third, most of the existing knowledge management studies are project-based. That is, rather than focusing on theory building and systemic understanding of the application of knowledge management, many knowledge management studies attempt to seek a tactical, immediate solution to a specified problem. (For a more in-depth critique of knowledge management models, see Yang, Zheng, & Viere, 2004). Very few studies have examined knowledge management in the context of schools and/or universities.

Problem Statement

Common perceptions of knowledge management are somewhat simplistic, yet they tend to be rapidly spreading. The absence of a sound theoretical foundation may hamper the maturation of knowledge management as a research construct. Missing from the literature are attempts to link knowledge management to the work contexts of CTE teacher educators. CTE teacher educators work in a variety of colleges and/or schools within universities. The conceptual framework offered in this manuscript can provide CTE teacher educators with insights about knowledge management and how it might be used to help them strategically manage knowledge in their colleges and departments. Universities, similar to businesses and industries in the global economy, must seek out competitive advantages and calculate ways to do more with less.

A basis for examining knowledge management

Several researchers purport that knowledge management has emerged because organizations have struggled to cope with rapidly changing markets (Chatzkel, 2003; Drucker, 2002; Nelson & Winter, 1982; Nonaka & Takeuchi, 1995; Saint-Onge, 2003; Wiig, 2000). Drucker (2002) investigates the historical background of knowledge management and the so-called knowledge work or knowledge economy. Although Drucker does not offer a definition of knowledge management, he argues that in knowledge-based organizations the organization needs knowledge workers more than they need the organization. In order for an economic organization to increase productivity, therefore, it has to provide proper and continuous learning and training programs for workers and to allow them to make decisions on their own area.

Wiig (2000) asserts that knowledge management serves to foster and promote intelligent behaviors. He views organizational learning as a means to successfully accomplish goals by learning from experiences, research, and observations. Although his descriptive framework lays out strategies of knowledge management, it fails to illustrate how these strategies and dimensions of knowledge and knowledge management can be cohesively integrated at the levels of the individual and the organization. Stated another way, his conceptual framework does not fully elaborate the critical issue between individual learning and organizational learning: whether organizational learning is the accumulation of individual learning outcomes or whether both are qualitatively different in nature. This fragmentation of Wiig's framework is not an isolated case; rather, it is a common problem in knowledge management literature.

Chatzkel (2003) asserts that knowledge management deals with the flow of knowledge, not the stock of knowledge. He explains that intellectual capital is likely to be costly and wasteful if the organization is unable to access, share, or capture value from knowledge. In this regard, nurturing, leveraging, and sharing knowledge in an organization is an action-based organizational strategy. Similarly, Saint-Onge (2003) claims that knowledge management should build the capabilities and the relationships that constitute the intangible assets so that those assets enhance the performance of the organization. These perspectives indicate that social relationships between organizational members are critical preconditions for successfully implementing knowledge management. On a related note, Shim and Roth (2008) explain the barriers that exist in universities for the sharing of knowledge between faculty members. They highlight how CTE teacher educators probably face additional challenges for knowledge sharing because of the lab-based contexts and other unique characteristics of CTE teacher education programs.

Some researchers focus on how knowledge is created and transferred between people in an organization. Nonaka and Takeuchi (1995), for instance, focus on how knowledge is created at the individual level by stressing the notion of tacit knowledge. They attempt to account for how tacit and explicit knowledge is transformed in a team setting. This perspective on knowledge management posits that albeit knowledge management benefits from the development and use of information technology, people are the key factors that actually converge, create, and share knowledge and information. These views stress the significance of cognitive processes in an organization.

Nelson and Winter (1982) view knowledge, based on a tacit knowledge perspective, as an organizational competency. They focus on the process of knowledge that may enhance organizational ability to learn and adapt. This perspective emphasizes inter-organizational relationships and collaborative networks in creating and transferring knowledge.

This section of this conceptual paper highlights select themes of the knowledge management literature. Prominent themes of knowledge management literature suggest that its purposes are to attain and sustain organizational competence and to develop competitive knowledge workers for organizational survival in a competitive market. In other words, knowledge management can be viewed as: (a) an emerging strategy to generate competitive resources so that an organization can survive in market competition, (b) an organizational process to create and share knowledge and information – a strategic, intangible asset of an organization, and (c) an organizational and an individual activity with which cognitive and behavioral changes are engaged. In this respect, comprehending the whole picture of knowledge management requires understanding three principle dimensions: economic environment, organizational dynamics or relationships, and individual or collective cognitive process. The following section examines the intellectual property of knowledge management, based on three academic disciplines: economics, sociology, and psychology.

Three Pillars of Knowledge Management

Shaping an inter-disciplinary approach may serve to mold an enduring theoretical framework of knowledge management as well as to provide insights for practice for CTE teacher educators. Researchers and practitioners from the diverse academic orientations of economics, sociology, and psychology have examined the essence of knowledge management and its benefits for the individual and the organization.

Since this study is a conceptual piece based on a literature review of knowledge management, in this section previous studies are reviewed that have dealt with the intellectual property of knowledge management. First, since knowledge management focuses on internal resources for economic growth, it can be closely associated with economic theories. Although most universities that house CTE teacher education programs are non-profit organizations, they certainly are competing for students and scarce resources in the turmoil of difficult economic conditions.

Economists have long attempted to understand and explain what factors influence economic growth at various levels: individual, organization, and nation. Neo-classical economists such as Schultz (1971) and Becker (1975) postulate that economic growth is dependent on the quality of the workforce and technological innovation. They emphasize the contributions of human factors to economic growth. They consider factors such as a well-trained, quality workforce and the accumulation of workers' skills and experiences by applying the value of human capital in their economic equations. The premise of their theory, human capital theory, is that human capital has economic value and can be quantified and measured. The economic value of the workforce is acknowledged through these measures, and through these measures an organization recognizes the need to invest in training its workforce. Since their inception, CTE programs have contributed to this investment of training the nation's workforce, and Threeton (2007) outlines how federal legislation has guided the direction of vocational education, and more lately CTE, as a response to the economic climate of the country.

A second strand of literature for investigating the construct of knowledge management is sociology. Several researchers have used sociological methods to examine economic organizations, work relationships, and other economy-related social events in capitalist society, or the market economy. In this regard, social network analysis may be used to reveal the complexity of social relations in an organization. Social network theory offers rigid ground for depicting and understanding personal relationships, commitment, communication, and value-adding mechanisms in association with knowledge management. Based upon the analysis of knowledge-intense organizations, Adler (2001) claims that as knowledge becomes increasingly important, high-trust institutional formation is an effective way to deal with knowledge-based capital. However, Adler appears to overlook the dynamics of interpersonal relations between organizational members. Knowledge, in his view, is seen as an asset that has already been formulated, not created by people through transferring and sharing.

Psychology provides a third foundational approach to understanding knowledge management. Psychology, especially industrial and organizational psychology, has long contributed to the analysis of management processes, managing people and organizations, and explaining socio-cognitive processes (mental models at individual and collective levels) (Gertler & Wolfe, 2002). Studies in industrial-organizational psychology bring to the forefront the importance of the cognition process (e.g., learning) and the emergence of individual competence as an organizational asset. Historically, CTE programs have collaborated with business and industry to make sure that their graduates added value as organizational assets. Studies that pertain to knowledge creation and transfer emphasize this enhancement of individual competence (Burke & Hutchins, 2008; Delamare Le Deist & Winterton, 2005) and these studies have contributed to understanding the multifaceted nature of knowledge management as a management strategy. Based on a psychological perspective, links have been established among the analytical units of individual, team, and organizational learning. Organizational competencies are created by cognitive processes at individual and organization levels, fostering the emergence of the notion of organizational learning.

In summarizing the preceding foundational elements of knowledge management, minimal common ground exists for analyzing and interpreting the nature of knowledge management among these academic orientations. Depending on the interests and backgrounds of academic principles, the research orientation of knowledge management varies considerably. Finding an intersection among them in terms of research agenda, theoretical emphasis, method, and unit of analysis is challenging. However, an inter-disciplinary approach might be most beneficial for helping CTE professionals understand the basics of knowledge management. Hence, in the following section, discussions are offered that explore the complex nature and foundational elements of knowledge management.

Knowledge Management and Foundational Links to Economics

In the so-called knowledge-based economy, organizations in both private and public sectors have shifted their survival tactics from traditional physical resources to the intangible assets possessed by their employees. The premise of this strategic shift is that knowledge has become a determinant of economic growth. Many economists, neo-classical economists in particular, posit that investment in human capital ensures economic growth and productivity improvement. This notion penetrates the realms of CTE and HRD. (For a thorough description of neoclassical economics and its relationship to HRD see Wang & Holton, 2005). Knowledge has been illustrated in various ways or described as types of capital such as human capital, intellectual capital, social capital, and structural capital. The implication is that knowledge is an intangible economic asset that an organization and its members may possess.

This section discusses how resource-based theory has contributed to the development of knowledge management. Resource-based theory originated from the concept of economic rent theory. Resource-based theory regards an organization as a collective entity that contains capabilities. In classical economics, analysis focuses on three main factors of production – land, labor, and capital – which have a unique type of income – rent, wages, and interest, respectively. Classical economists use these factors to examine the difference between income earned by the factors and cost of producing those factors. Neo-classical economists utilize this concept of (economic) rent to distinguish the difference in investment between the production cost and the opportunity cost. In other words, the judgment on investment is made when return on investment is secured within an industry. By identifying and analyzing market competition and other external forces that might affect income or return on investment, an organization determines how much and where the allocation of organizational resources should be allocated.

Resource-based theory examines the resources and competencies of an organization that enable it to induce a higher return of investment and a sustainable market advantage. From a resource-based theory perspective, the various ways that an organization acquires and allocates organizational resources account for the origin of economic rent. According to the theory, identifying and utilizing resources that are valuable, rare, and difficult to duplicate is an important strategy for sustaining organizational growth and securing profits. An organization can gain a higher return of investment if it has better, if not the best, resources available and they are in unique forms that protect them from being duplicated by competitors. In this regard, knowledge created and possessed by internal members of an organization is seen as a key resource for gaining competitive advantage over competitors in an industry (Barney, 1991). Resource-based theory provides interesting food for thought when applied to the contexts of CTE teacher educators. It can lead one to ask, in what ways do our faculty members, students, and other stakeholders provide a competitive advantage compared to other programs and institutions to which we benchmark?

Traditional strategy models, such as Porter's (1987) five forces model, focus on the external competitive environment of an organization. Most of the strategy models do not attempt to look inside the organization. In contrast, resource-based theory highlights the need for a fit between the external context (the market) that an organization faces and its internal capabilities. One of the fundamental assumptions of resource-based theory is that the internal resources and capabilities of an organization are more critical to shaping strategies than the external environment. Although resource-based theory recognizes that organizational strategies might be dictated by external factors, it claims that the unique internal resources and capabilities of an organization provide the basis for strategy. Organizational strategies are expected to identify and harness core competencies of an organization. Most universities, and the colleges and departments within them, engage in strategic planning processes to identify core competencies.

Resource-based theory can help CTE teacher educators understand the relevance of knowledge management along these lines: (1) core knowledge that cannot be duplicated by other programs deemed as competitors can be critical to the success and survival of a CTE teacher education program; (2) knowledge and skills embedded within program members can be vital resources for increasing innovation and productivity; and (3) strategies should be implemented and institutionalized to sustain program growth.

A caveat of the resource-based theory is that it overlooks the social context of resource decisions. All organizations have unique histories, norms, and social networks that can influence knowledge sharing. Most CTE teacher education programs are steeped in histories that featured more faculty members, higher student enrollments, and greater access to state and Federal funding.

Knowledge Management and Foundational Links to Sociology

The internal movement of knowledge is a challenging problem for most organizations (Brown & Duguid, 1998). Organizational innovation is the social process within an organization that occurs within and between groups of people. Management strategy for performance improvement and structural change requires integrated actions at multiple layers in an organization. This issue is a central theme of social network analysis.

Social network analysis provides a systemic means of assessing informal networks by mapping and analyzing relationships among people, teams, and organizations. It offers a means of determining the way in which work is or is not occurring in the informal networks. Social network analysis can reveal information flow and provide a basis for understanding how the actors in an organization share and create knowledge. This conceptual article attempts to briefly delineate the nature of social network analysis to help develop a conceptual framework of knowledge management. (For a comprehensive examination of social network analysis, see Storberg-Walker & Gubbins, 2007).

A central premise of social network analysis is that empirical data or indications derived from mathematical methods can be used to build up theory in order to explain social relations and interactions (Dubin, 1976). Scott (2000) suggests that social network analysis was first introduced by J. L. Moreno, a psychiatrist using "sociometry" in the 1930s. Social network analysis mainly employs mathematical methods to analyze the characteristics of a system and the patterns of relationships. Methods commonly used in social network analysis are observation, questionnaires, and examination of records. Through this process, social network theory surfaces the informal structures of the organization (Wasserman & Faust, 1994).

Understanding social interactions within an organization can help to reveal the process and structure of knowledge transfer and sharing between and among individual members of the organization (Lee, 2000). Contractor and Monge (2002) explain that psychological, sociological, and communication approaches to investigating the networks provide a venue to conceptualize knowledge management. These approaches examine where knowledge is created and how knowledge networks are linked and maintained. According to Contractor and Monge, the study of knowledge networks focuses on communication linkages between individual members and various types of aggregates of individuals. These aggregates include knowledge retrieval from human and non-human agents, allocation of information and knowledge, trust and authority relations, formal alliances, and so on. Social network analysis may be posited as an in-process measure as well as a multi-level approach that has potential for contributing to an evolving conceptual framework of knowledge management.

Knowledge Management and Foundational Links to Psychology

This literature review confirms that learning is an important component of improving the competencies of individual employees and the organization. Wiig (2000) claims that knowledge management as an organizational innovation can be built up and successfully implemented through explicit and formalized knowledge. Psychology, industrial and organizational psychology in particular, has long contributed to the development of theories vis-à-vis organizational behavior and cognitive processes of the individual in the workforce. In knowledge management literature, a common tenet is that learning is a keystone for achieving organizational goals. Several topics could be explored in this section that relate to learning in the workplace, such as learning how to learn, informal and incidental learning, self-directed learning, and learning transfer, among others. However for the sake of example, this section will flesh out relationships between knowledge management and psychology by elaborating on organizational learning. (For a comprehensive examination of learning and organizations see Watkins & Marsick, 2003).

Several researchers have developed conceptual models depicting how workers learn in organizations, and their work can be associated with behavioral psychology. Argyris and Schön (1978), for instance, argue that many organizations have difficulty learning and seldom question the foundation of their own problems. According to them, organizations lack abilities to connect understanding and action, and tend to be resistant to change. Argyris and Schön postulate that learning is an iterative process guided by organizational vision and strategy. In this iterative process organizations continually attempt to become competent in taking action while simultaneously reflecting on the action for the sake of learning.

Another psychological influence on knowledge management stems from models of information processing (Huber, 1991). Huber cites four learning-related processes in organizational learning: knowledge acquisition, information distribution, information interpretation, and organizational memory. According to Huber, learning-related activities at an individual level trigger events that move people and organizations to higher levels of a cognitive system. Similarly, other researchers claim that over time an organization accumulates knowledge generated by individual members (through their learning) who share the mental model of the organization (Levitt & March, 1988; March, 1991). They assert that organizational learning creates competitive advantage in terms of management innovation so that organizations can manage sustainable growth. However, organizational learning differs from individual learning in several respects. First, organizational learning occurs through shared insights, knowledge, and mental models. Second, individual learning builds on past knowledge and experience, and memory and sense-making processes. Scholars who contend that organizations learn assert that organizations are seen as learning by encoding inferences from history into routines that guide behavior.

It can be argued that organizational learning is an integrative path that links two different dimensions: individual and organization. Furthermore, this kind of effort may also help to translate knowledge management theories into practice. Organizational learning is multi-faceted and it requires considering two main dimensions, individual and organization, and the converging process of the two (Seemann, DeLong, Stucky, & Guthrie, 2000). Linking knowledge management with organizational learning is useful as it connects the various actors in the organization: the individual, groups of people, and the organization as a whole. Several researchers have focused on these linkages of individual, organization, and knowledge management. For example, Grobmeier (2007) positioned the individual as the linking point for knowledge management and the learning organization. Zheng (2005) examined factors associated with organizational culture and their influence on knowledge management.

Discussion, Summary and Implications for Future Research

This conceptual paper examined the foundational bases of knowledge management, how it has emerged as a research construct and area of practice, and how the individual and collective actions of workers in organizations are related to knowledge management. The authors have emphasized the multifaceted nature of knowledge management so that CTE professionals may be better able to grasp its foundational roots. Knowledge management involves behaviors, relationships, and other phenomena that are grounded in economics (e.g., resource-based theory), sociology (e.g., social network analysis), and psychology (e.g., organizational learning theory). This tri-part analysis is aligned with Storberg-Walker's (2005) description of how people and processes function in organizations as forms of capital: "individual knowledge, skills and attitudes (e.g., human capital); social relationships (e.g., social capital); and organizational systems (e.g., structural capital)" (p. 329). She notes that the manner in which the relationships among these three components are understood and mediated can affect how value is created in organizations.

Career and technical teacher educators (and other CTE professionals) can benefit by using a multifaceted approach to examining knowledge management in their work contexts. Economics, and in particular resource-based theory, can help CTE teacher educators understand how their collective knowledge needs to be valued by the larger university and external stakeholders. These resources should include knowledge and skills of faculty and students that are difficult to duplicate by other programs within and outside of the university. The work outcomes of CTE teacher educators should be aligned with the strategic planning goals of the university and with the goals of external constituents (such as CTE professional organizations). The value added of CTE teacher education programs to the broader strategic planning processes of the university can help these programs survive during periods of retrenchment. Many CTE teacher education programs have struggled with survival for several decades. The problems that Daugherty (2005) outlines for technology teacher education programs are common to other CTE teacher education programs: "shortages of entering pre-service teachers, program closures, and shortages of funding to support substantial programmatic adaptations" (p. 41). Of course, CTE teacher education programs are not the only programs that are facing challenges. Grossman (2008) notes the jurisdictional challenges to university-based teacher education programs in general. She describes how university based teacher educators "are facing a sharp attack on their ability and their right to control the preparation of teachers" (p. 11).

Another foundational area of knowledge management, sociology, can help CTE teacher educators better understand how collaboration can enhance their learning and the learning of their students. More effective social contexts are needed that can enhance knowledge sharing among CTE teacher educators and their constituents. With regard to public school contexts, Lieberman and Pointer Mace (2008) explain how teacher learning takes place through experience and with practice. “They learn through practice (learning as doing), through meaning (learning as intentional), through community (learning as participating and being with others), and through identity (learning as changing who we are)” (p. 227). These authors encourage the creation of networks of teacher communities to enhance knowledge sharing. Similar recommendations can be made for creating teacher educator communities as a means to break down the structural barriers to knowledge sharing within universities (Shim & Roth, 2008).

Successful collaboration often requires innovation and risk taking. Hill (2006), for example, considers the implications of technology teacher educators establishing systemic collaborative relationships with engineering faculty and engineering professional associations as part of a curricular shift to engineering design. He notes how this type of curricular shift would certainly affect the preparation of prospective technology teachers and the work contexts of technology education teacher educators. Hill’s examination of this curricular shift highlights the possible reverberations to resurrect a field of practice (technology education) that is grounded in rich (and oftentimes constraining) traditions.

Kearney, Self, Bailey, Harris, Halcomb, Hill, and Shimp (2007) describe an innovative collaborative effort between a college of education and a government agency. The authors stress the importance of changing the way that universities traditionally operate in order to succeed in this type of multi-year partnership. The authors cite the challenges of crafting innovative partnerships with entities that are used to the turbulence of a global economy and have little patience for slow moving bureaucracies (e.g., practically any university). “Contemporary educational initiatives must be fluid and visionary to meet the needs of a rapidly changing workforce, global demands and increased time compression and the need to maximize scarce resources” (p. 88). Knowledge management can help CTE teacher educators identify the value that they can add to the goals and vision of partnerships.

Finally, this study emphasized psychology as the third component of a conceptual framework for knowledge management. This study found that most knowledge management scholars, regardless of their academic discipline, view the competencies of individual workers as the quintessential assets for ensuring sustainable growth of an organization. This belief endorses the notion that organizational learning is a key organizational strategy that can lead to competitive advantage. This paper concludes that organizational learning, one of the strategic means of knowledge management, can also play a key role in linking CTE teacher educators to the diverse organizational actors of individuals, teams, and technologies in university settings. These seem to be natural links for CTE teacher educators, who have historically been involved in augmenting human performance through technologies and teamwork.

Future research on knowledge management, as Foss and Volker (2005) note, should take into account individual actors in an organization who possess and can leverage knowledge. In this regard, researchers who focus on CTE might consider exploring how technical education students and graduates, career and technical educators, and CTE teacher educators create and share new knowledge in their respective work contexts. Finally, it is hoped that this conceptual paper has helped CTE teacher educators and other readers of *JITE* understand foundational elements of knowledge management. Theoretical contributions associated with knowledge management should consider the underpinnings of the inquiry, what is known about it, and inadequacies of the existing literature associated with it. Positioning the research of knowledge management within the realms of economics, sociology and psychology provides a framework with a well established lineage, and hopefully a useful conceptual framework upon which CTE teacher educators can link their research and practice.

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Pilot Study of the Effects of Supraliminal Bipolar Primes on Occupational Educators' Viewing Time and Perceived Confidence with Desktop Virtual Reality

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Abstract

Virtual reality (VR) has been demonstrated to offer learning benefits over traditional instructional methods in many technical and occupational areas. However, in the framework of Rogers' innovation diffusion theory, adoption of VR in Career and Technical Education and occupational programs appears to be lagging. This study used experimental methodology to test the possibility of positively influencing the dispositions of occupational educators toward desktop VR through application of prime theory in a context of supplantation and technology self-efficacy theory. Supraliminal bipolar primes were used to test whether a positive disposition more conducive to VR adoption could be created in a sample of 30 occupational educators prior to introduction of a desktop VR presentation**,** with "disposition" defined as a pair of specific performance measures. Intended as a pilot study, this inquiry used ANOVA and correlation statistical analyses to produce sufficient indications of relationships between positive primes, VR viewing time, and perceived confidence in VR to merit recommendation of further investigation.

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Introduction and Background

Conceptual forms of virtual reality have existed since the 1920s. The technology was first introduced by the Link Corporation, which created a simulated training device for pilots called the Link Trainer. It basically consisted of an airplane cockpit set atop a pneumatic platform which was controlled by the pilot via a directional stick. The entire platform would shift in response to the pilot's control as the horizon line changed. Movie projectors would later be introduced to the device in order to provide a more realistic experience (Gladdis, 1997).

Virtual reality (VR) began to increase in popularity during the 1970s and 80s. This was in a large part due to advances in computer technology. In the early 1970s Myron Krueger coined the term "artificial reality", which was later modified in the 1980s when Jaron Lanier conceived the term "virtual reality" (Siddens, 1999). However, there is no generally agreed upon definition of virtual reality. To further complicate matters, there are numerous types of VR being developed and experimented with. These include but are not limited to artificial reality, augmented reality, immersive reality, and telepresence. The different types of virtual reality provide varying experiences in relation to immersion, interactivity, and unencumbered navigation (Krueger, 1993; Pantelidis, 1993).

The various forms of VR can be viewed as a collection of innovative ideas and instructional extensions based on the general premise or purpose of allowing the user to have realistic experience from which learning can derive. Therefore, a much broader definition for the technology was needed. Ausburn and Ausburn (2004) identified and fulfilled this need with their representative explanation:

> VR can range from simple environments presented on a desktop computer to fully immersive multisensory environments experienced through complex headgear and bodysuits. In all its manifestations, VR is basically a way of simulating or replicating an environment and giving the user a sense of 'being there', taking control, and personally interacting with that environment with his/her own body. (p. 34)

Because of substantially lower cost, training viability, and ease of use, VR formats that are not fully immersive have gained popularity. These VR formats have been identified as desktop VR (Ausburn & Ausburn, 2004; Hunt & Waller, 1999). They are generally accessed from a desktop or laptop computer and consist of a virtual reality movie that the user can control, explore, and navigate by using devices such as a mouse, scrolling ball, or glove. The VR movie can be generated with specific software packages and played in a viewer like Apple's QuickTime player. Web based environments are made available through the use of virtual reality modeling language (VRML) or as VR movies played with Flash or Java. Similar to exploring an ordinary website, individuals can access an online virtual world or movie with three dimensional images surrounding their on-screen movement.

As a learning tool, desktop virtual reality provides distinct opportunities across the educational spectrum (Dickey, 2005; Neel, 2006; Revenaugh, 2006; Shim, Kim, Park, Park & Ryu, 2003; Smedley & Higgins, 2005; Vogel, Bowers, Meehan, Hoeft, & Bradley, 2004). Secondary, post-secondary, and higher education can use virtual reality to aid in the learning process. With strong growth in distance education being provided via the Internet and DVD, a viable pathway towards integrated acceptance is present for desktop virtual reality. Even greater opportunity for effective use of VR exists when considering those students in secondary and post-secondary school systems who are being home schooled by their parents or a privately hired instructor. VR can fill a gap in the educational opportunities available to these students:

> Virtual learning plays an important role in a home-schooled student's education. The traditional homeschooler does not have many of the educational opportunities as those in public or private schools. Students in public and private schools don't always have all the educational opportunities of their neighboring districts. Virtual learning levels the playing field and provides endless opportunities for homeschoolers. (Jancek, 2001, p. 11)

An abundance of possibilities exist for virtual reality as a training tool within the career and technical education field (Ausburn & Ausburn, 2006; Park, Jang, & Chai, 2006; Seth & Smith, 2004; Tiala, 2007). Introduction to and familiarization with complex and often dangerous locational environments is often necessary in occupational preparation. Programs, courses, and training are provided in order to prepare future and current engineers, technicians, and end users on new processes, techniques, and skills. When such opportunities encounter issues in offering access to the "real thing", a highly contextualized VR option could prove beneficial. Technical skill development within professional occupations can also benefit from the technology. The medical profession is one area that is seeing measurable gains with VR over traditional methods when training surgeons (Ahlberg, Enchsson, Gallagher, Hedman, Hogman & McClusky, 2007; Ganai, Donroe, St. Louis, Lewis, & Seymour, 2005; McClusky, Gallagher, Ritter, Lederman, Van Sickle & Baghai, 2004; Seymour, Gallagher, roman, O'Brien, Bansal & Andersen, 2002).

Virtual reality is a multi-faceted tool capable of providing an increased sense of connectedness between learner and content. As education becomes more student centered and exploratory activities frequent course curricula, assistance through advanced technological applications can be expected to evolve into a standard practice. Virtual reality, with its ability to immerse learners in an environment, experience it with multiple senses, and control the pacing and flow of exploration, has the capability to transform the future of advanced instructional methodologies. Key to the movement and adoption of this instructional innovation will be continued research focused on practical development and adoption of the technology through demonstration of its specific positive effects on learning. This is especially important as some may view the technology as an alternative to traditional methods. The impetus for this pilot study came from the proposition that VR is an innovation and that the adoption of this innovation in CTE and occupational education, particularly in its cost-effective desktop form, might be facilitated if a positive disposition toward the technology could be increased in occupational educators. The study was intended as a first step in testing this proposition.

Theoretical and Conceptual Framework

The theoretical framework for this study came from three primary areas: (a) innovation diffusion theory, (b) prime theory of behavior influence, and (c) self-efficacy theory.

Innovation Diffusion Theory

Beginning with the first edition of Roger's *Diffusion of Innovations* in 1960, the theoretical foundation for research in this area was well established. Rogers' diffusion of innovation theory characterized phenomena associated with the adoption of innovative products and practices. More recently, Rogers (2003) explained that

> Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system…a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system. (p. 5)

Five types of adopters are identified within Rogers' theory, including innovators, early adopters, early majority, late majority, and laggards. Each adopter classification has a specified rate of innovation adoption based on an existing predisposition or threshold. Rogers (2003) illustrated the theoretical percentages in a bell curve shown in Figure 1. The adoption curve is characterized by symmetry where innovators and early adopters constitute the same percentage of innovativeness as the laggards, but on different ends of the curve. This represents those individuals who readily accept change and those who do not. Surry (1997) related innovation adoption theory to the range of adoption of instructional technologies in education, claiming that "Some instructional technologists blame teachers and an intrinsic resistance to change as the primary causes of instructional technology's diffusion problem" (Diffusion theory and instructional technology section, ¶ 3).

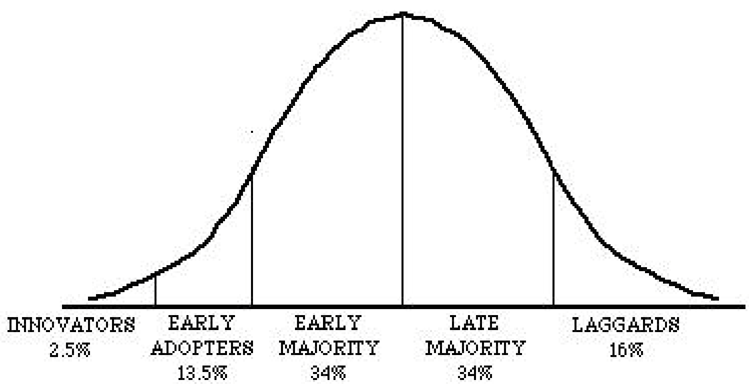

Figure 1. *Rogers' Innovation Diffusion Bell Curve*
Note. From Rogers, E.M. (2003). *Diffusion of innovations*.
New York: The Free Press.

The decision to adopt a given innovation can sometimes incur significant barriers within an educational system. Rogers (2003) addressed adoption within a system and detailed the decision types by categorizing them in three groups. First, *optional innovation decisions* "are choices to adopt or reject an innovation that are made by an individual independent of the decisions of other members of the system" (p. 28). This is sometimes seen within educational cultures that provide significant levels of autonomy concerning individual decision making. Second, *collective innovation decisions* "are choices to adopt or reject an innovation that are made by consensus among the members of a system" (p. 28). These types of decisions are often seen in organizations that use committees to guide incremental processes. Third, *authority innovation decisions* "are choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise" (p. 28). Organizations using a centralized approach to management tend to make these types of innovation decisions. On a practical level, the types of innovation decisions made by a given organization are not categorical and should be viewed as a continuum. Educators could be susceptible to any of

Rogers' three decision types with specific circumstantial contingency. Other factors such as social system constraints and financial caveats also play a role in an innovation decision. Thus, innovation diffusion can be systemic on many levels.

According to Rogers' theory, the vast majority of adopters (68%) reside within the early majority and late majority region of the innovation diffusion curve. Adoption by this segment could be seen to have a relationship with the observational experiences from the innovators and early adopters. "The perceived attributes of an innovation can be important considerations for those attempting to facilitate the adoption and diffusion of instructional innovations" (Gustafson & Surry, 1994, p. 23). This suggests that it is possible to modify innovation adoption by influencing perceptions of the innovation and to thus have the power of providing or effacing eventual sustainability. Further, Rogers proposed that while laggards undoubtedly affect the holistic adoption curve, it is the critical mass that determines the effectiveness of adoption. Thus significant attention is paid to individuals residing in this group by educational technologists.

Priming Theory and Supraliminal Bipolar Primes

Where innovation diffusion theory focused on adoption and how an innovation became adopted, priming is positioned more towards behavioral influence. As a concept, priming has been studied and practically implemented since the 1970s. "Researchers investigating the effect of primes on impression formation have demonstrated that mentioning traits in one context can reliably change the way that people think about a social target in an entirely different context, often without the awareness of the perceiver" (Claypool & DeCoster, 2004, p. 2). Conceptually this effect is often seen in common activities used as a social ice breaker. For example, asking an individual to stand before a group and say silk, silk, silk, silk, silk three times and then immediately asking the individual "What do cows drink?" Invariably the individual will respond with the answer "milk". It is common knowledge to the group as well as the individual that cows drink water, not milk. However, through the process of repeating the word silk several times, the individual was primed for the "milk" response. In essence, future behavior was affected for a fixed duration following the prime treatment. Bargh, Burrows, and Chen (1996) summarized the priming concept: "Priming refers to the incidental activation of knowledge structures, such as trait concepts and stereotypes, by the current situational context" (p. 230). Thus, according to priming theory, the affects of administered treatments remain for durational periods, thereby affecting future behavior. "Many studies have shown that the recent use of a trait construct or stereotype, even in an earlier or unrelated situation, carries over for a time to exert an unintended, passive influence on the interpretation of behavior" (Bargh, Burrows, & Chen, 1996, p. 230).

Several types of priming exist and have been researched or implemented within their respective constructs. Supraliminal and subliminal are the descriptors associated with the priming technique, the former being implemented for this particular study. The main distinction between the two types of priming relates to the level of consciousness between the prime treatments. *Subliminal priming* would occur below the level of individual consciousness while *supraliminal* would allow the individual to be aware of the priming stimulus but not of its intended association. Claypool and Decoster (2004) provided an explanation of the supraliminal priming technique and distinguished it from subliminal priming:

> Used originally by Higgins et al. (1977), research participants are exposed to trait primes in an initial task. Then, in an ostensibly unrelated part of the experiment, the participants are asked to provide their impression of a person or behavior. This method is known as 'supraliminal priming' because participants are made consciously aware of the primes, although not of the link between the primed construct and the object of impression. The dissociation of the primes and the target relies on the fact that participants believe that the priming and impression tasks are unrelated. (p. 4)

Claypool and DeCoster (2004) also distinguished between two other comparative priming treatments: unipolar and bipolar. *Unipolar* refers to studies where primes are related to a single trait, one primed group and a control group for example. *Bipolar*, the treatment type used in this study, "are typically related to two descriptively similar but evaluatively opposite traits" (Claypool & DeCoster, 2004, p. 5). Most often this appears with a positive prime group and a negative prime group. The analysis therefore would be deterministic of the differences between groups primed in these opposite directions.

Bandura's Theory of Self-efficacy

When influencing a possible adoption decision confidence in the technology could be a factor. However before confidence in a technology can be gained a certain level of self-efficacy is needed. As a line of inquiry, conceptual forms of self efficacy have been prevalent since the mid to late 1960s. Albert Bandura laid the foundation for such work with his 1969 book *Principles of Behavior Modification*. He continued to inquire along these same lines with "Self-efficacy: Toward a Unifying Theory of Behavioral Change" which appeared in a 1977 volume of the *Psychological Review*. The theory base has been continually expanding and includes a 1997 book by Bandura titled *Self-Efficacy: The Exercise of Control*. Self-efficacy has thus been a primary focus for Bandura over several years. The theory has been studied by many respected scholars and applied across numerous research areas (Bandura, Delia, Taylor, & Brouillard, 1988; Bandura & Locke, 2003; Dawes, Horan, & Hackett, 1997; Hipp, 1996; Luzzo, 1994; Peterson & Arnn, 2005; Ritter, Boone, & Rubba, 2001; Thiessen, 1995; Williams, 1998; Wise, 2007). However, it is Bandura and his original social cognitive theory that is generally recognized as the foundational knowledge base from which further adaptations have derived. According to Cervone and Scott (1995), "Perceived self-efficacy must be understood as part of a much broader theoretical perspective, namely, Bandura's social cognitive theory" (p. 356).

At its core, self-efficacy basically "refers to perceptions of capabilities for performance within a given situation, activity, or domain" (Cervone & Scott, 1995, p. 360). The theory is broad enough to be applied to multiple diverse areas. Many situations, socially driven or otherwise, that involve self-perception of an individual in association with a given outcome can be studied using Bandura's theory of self efficacy (Cervone & Scott, 1995).

Several factors, both internal and external, are said to affect self-efficacy. These include experience, social modeling, social persuasion, and physical and emotional states. These factors are also identified by various scholars as enactive experience, vicarious experience, verbal persuasion, and affective and psychological states (Cervone & Scott, 1995). While concept descriptors vary, the theoretical construct remains, thereby providing a sustainable foundational meaning.

Bandura's theory of self-efficacy has been directly applied to technology and its use or adoption (Brown, 1996; Dusick, 1998; Lumpe & Chambers, 2001; Tam, 1996; Wang, Ertmer, & Newby 2004; Webster & Hackley 1997). The principal components of the theory and its varying constructs are directly applicable to individual attempted use, and adoption of, new technology. The self-efficacy concept can be further applied toward gaining an understanding of why an individual technology is or is not adopted for instructional use. According to Wang, Ertmer, and Newby (2004), "There is substantial evidence to suggest that Teachers' beliefs in their capacity to work effectively with technology – that is, their *self-efficacy* for technology integration – may be a significant factor in determining patterns of classroom computer use" (p. 231).

Theoretical Framework for the Study

The theoretical framework for this study is shown in Figure 2 as a conjunction of innovation diffusion, priming, and self-efficacy theories. The framework conceptualizes virtual reality (VR) as an innovation and combines innovation diffusion theory, prime theory, and self-efficacy theory to form a substantive theory that priming may be able to influence users' dispositions toward VR. Figure 2 shows that priming can act as either a negative influence or positive influence on an individual's perception of VR prior to being introduced to the technology innovation. According to the framework, following a primed introduction to the VR innovation,

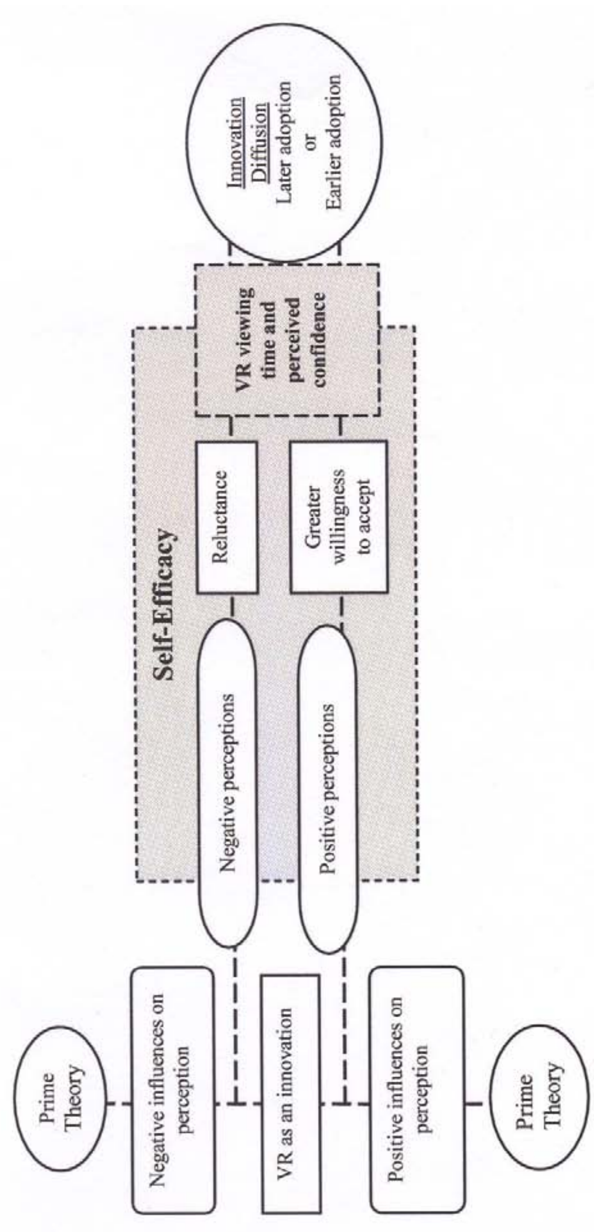

Figure 2. *Theoretical and Conceptual Framework for the Study*

perceptions are formed which lead to an effect on an individual's technology self- efficacy. From the individuals' various levels of technology self-efficacy may emerge either as reluctance or a willingness to accept the technology innovation. This would be observable through elective viewing time of a VR presentation and self-reported confidence in the medium. Ultimately the effects of perceptions of VR on self-efficacy would represent themselves in either later adoption or earlier adoption of the technology innovation. In essence, Figure 2 proposes that if an individual can be primed for a positive disposition toward a technology innovation (i.e., VR) which affects their self-efficacy, then they might possibly adopt the innovation earlier than would have transpired without the priming treatment. The impact of positive priming would initially be manifested in increased VR viewing time and higher levels of self-reported confidence in VR.

Many variables are present when a technology adoption decision is made on either the individual or organizational level. Rogers' diffusion of innovation theory and Bandura's self-efficacy theory illustrate the complexity underlining such variables and how they relate to individual adoption outcomes. Conservatism should therefore be maintained in gross applicability of the model shown in Figure 2 when interconnecting various theory bases to form a theoretical framework for a specific technology study.

This study is conceptualized as an experiment in influencing technology self-efficacy through the use of a specific strategy in the form of supraliminal bi-polar priming. However, it is theorized for the present study that by combining the theories discussed here, the likelihood of positively affecting the personal perception of VR and ultimately the adoption of this new innovation is high. To examine this substantive theory operationally, priming technique would be used as a tool to affect an individual's disposition which, in turn, would impact self-efficacy, thereby skewing Rogers' identified individual threshold for innovation. Thus, the theory presents a possibility of turning a potential technology laggard into a late majority adopter or a late majority adopter into an early majority adopter. Holistically, this would skew the technology adoption curve, essentially expediting the adoption process.

Research Purpose and Hypotheses

While research has shown virtual reality (VR) to be an effective instructional medium in CTE and occupational education (Ahlberg, et al. 2007; Dickey, 2005; Ganai, Donroe, St. Louis, Lewis, & Seymour, 2005; McClusky, et al. 2004; Neel, 2006; Park, Jang, & Chai, 2006; Revenaugh, 2006; Seymour, et al. 2002; Shim, et al., 2003; Smedley & Higgins, 2005; Tiala, 2007; Vogel, Bowers, Meehan, Hoeft, & Bradley, 2004), many individuals among CTE/occupational education may be resistant or reluctant to adopt this innovation. Participation in numerous educational reform movements and pressures for continual integration of emerging instructional technologies may have contributed to developing in some CTE educators a disposition toward falling into the late majority or laggard sectors of the adoption curve. This would be problematic in light of the documented high levels of success and potential of VR in technical training.

This pilot study was based on the premise that reluctance or willingness to adopt an innovation may be influenced by the creation of a negative or positive disposition. The purpose of the study was to compare the disposition toward a desktop VR presentation of CTE educators who received neutral, negative, or positive primes. If disposition can be altered then it may be possible to influence the adoption rate of a given innovation. In the context of this study, "disposition" was defined operationally as voluntary viewing time of a VR presentation and self-reported confidence level in ability to describe to others the scene presented in the VR presentation.

The study used experimental methods to test the following null hypotheses:

1. There is no difference in the voluntary VR viewing time of occupational educators who receive neutral, positive, and negative primes prior to a VR presentation.
2. There is no difference in the perceived confidence levels of occupational educators who receive neutral, positive, and negative primes prior to a VR presentation.
3. There is no relationship between VR exploration time and reported VR confidence level.

Methodology

General Research Design

This study used a quasi-experimental, posttest only design with a control group and two experimental groups. Data analysis was quantitative, using one-way analysis of variance and correlational statistical techniques.

Subjects

The sample for the study was a convenience sample of 30 occupational educators from career and technology centers as well as community colleges in Oklahoma. The sample consisted of 23 females and 7 males ranging in age from 42 to 58, with a mean of 48. The 30 subjects were randomly assigned in equal numbers (n = 10 in each group) to three non-repetitive, mutually exclusive treatment groups: (a) no prime/control group, (b) negative prime/experimental group 1, and (c) positive prime/experimental group 2.

Virtual Reality Presentation

The VR presentation used in this study was developed for a recent study of the effects of desktop VR compared to still imagery on learner performance and confidence in mastery of a scenic environment (Ausburn & Ausburn, 2006; Ausburn, et al., 2006). It was used in this study with permission of the principal investigators of the original study. The VR presentation consisted of interconnected rooms in a house that contained a complex array of visual details, cues, and interrelationships. This scenic environment allowed for exploratory autonomy by the subjects and gave each participant an equal starting point, as no subject could have previously seen the location or its content and details. Ausburn and Ausburn (2006) pointed out that the house scene was also appropriate for a generic test of VR in a CTE environment because it represented an entire class of learning tasks frequently found in technical training, i.e. mastery of positional orientation and details in a complex environment such as laboratories, shops, equipment interiors, on-site locations, etc.

The VR presentation was made via computer as a QuickTime 360-degree panorama desktop VR movie under learner control. Each learner could use the computer's mouse to move at will around the scene, click on "hot spots" to jump to various locations, and use a zoom feature to examine various details within the house rooms. This simulated walking around within the environment and moving toward and away from items within it. Each user was free to "move" as he/she chose and to visit and re-visit views and objects at will.

Instrumentation

Prior to viewing the VR presentation, each experimental group received their respective primer in the common form of a scrambled sentence test while the control group did not receive a priming test. The priming tests and procedures were taken from a priming study of social behavior by Bargh, Burrows, and Chen (1996). The priming stimuli used appeared within sets of scrambled sentences, each set being 15 sentences in length. The subjects were required to reorganize the words appearing in each scrambled sentence so that it made sense. Within each sentence test, a primer stimulus was included. Prime Experimental Group 1 received a negative prime; Prime Experimental Group 2 received a positive prime; and the Control Group received no priming.

Every third sentence in both primed groups consisted of a neutral prime which Bargh, Burrows, and Chen (1996) defined as not having any strong stereotypical values associated with it. This was done to maintain a level of neutrality. "The dissociation of the primes and the target relies on the fact that participants believe that the priming and impression tasks are unrelated" (Claypool & DeCoster, 2004, p. 4). The negative priming stimuli included the following words within its scrambled sentence test: bother, disturbing, intrude, infringed, interrupted, bold, obnoxious, bluntly, rude, and aggravating. Conversely, the positive priming stimuli consisted of the following words: respected, considerate, appreciation, discretely, courteous, polite, cautiously, patient, yielded, and graciously. The neutral primes included in both tests were exercising, successfully, normally, prepares, and occasionally. Table 1 provides an example of three scrambled sentences for each experimental group. The priming stimuli are italicized for identification purposes only, the actual instrument used in the study made no such distinction.

Table 1.
Experimental treatment examples of primes

Negative Primes	1. they her *bother* see usually 2. should now *intrude* purposely we 3. *infringe* sometimes get rights upon
Positive Primes	1. them was *respect* give always 2. from are here *considerate* people 3. can the show *appreciate* they

The dependent variables for the study were time spent voluntarily viewing the VR presentation after the priming treatment and perceived level of confidence in the VR presentation. Viewing time was defined operationally as the total time (in seconds) the subjects spent without prompting viewing the VR presentation. Perceived confidence level was defined operationally as the subjects' self-reported level of confidence on a Likert-like scale that they were capable of effectively describing the scene shown in the VR to another person. The ratings were based on a five-point scale where 1 = absolutely no confidence; 2 = a little confidence; 3 = moderate confidence; 4 = good confidence; and 5 = absolute confidence. This scale was identical to the one used by Ausburn and Ausburn (2006) and Ausburn, et al (2006) in the earlier study of VR using the house scene presentation.

Procedures

Each experimental group received their respective primer via the appropriate scrambled sentence test prior to being asked to explore the VR house scene presentation. The control group received no priming test prior to the VR presentation.

Once each experimental subject completed the appropriate primer exercise, he/she was given an opportunity to explore the desktop VR presentation on the computer. Minimal explanation was given with regard to the technology. Subjects were simply instructed to explore the VR presentation until they felt comfortable with the technology, the layout of the rooms, and their contents. While the VR exploration was in progress, a continuous timer was maintained in order to determine each subject's voluntary exploration time with the VR medium. To eliminate timing stress and avoid influence of timing knowledge on time taken, the timing was unknown to the subjects.

When the subjects acknowledged their exploratory acceptance regarding the VR presentation, they were asked to rate their confidence in being able to effectively describe the scene and its details to another person using the 5-point scale described above.

When all subjects had completed the priming activity, the timed exploration of the VR presentation, and the self-rating of confidence, all data were coded and entered into the SPSS computer program for statistical analysis with analyses of variance on the time and confidence variables, and Pearson correlation between the two measures.

Findings

Means were initially calculated for the control and experimental groups on the two dependent measures for descriptive examination. They are shown in Table 2.

The mean scores in Table 2 show differences among the three groups on both performance variables. As predicted by priming theory and literature, the negative prime group had the lowest mean, the control group exhibited the middle mean, and the positive prime group had the highest mean. Additionally, the positive prime group was the only group in which a subject reported a confidence score of 5 on the rating scale, or absolute confidence in the VR presentation. Conversely, the group receiving the negative prime was the only group to report a confidence level rating of 2, or little confidence.

Table 2.
Means for Control and Experimental Groups on Dependent Measures (*N* = 10 per group)

Variable and Group	*N*	Mean Score
VR Voluntary Viewing/Exploration Time (in seconds)		
No Prime/Control	10	256.1
Negative Prime/Experimental 1	10	245.6
Positive Prime/Experimental 2	10	301.6
Perceived Confidence in Ability to Describe after VR		
No Prime/Control	10	3.3
Negative Prime/Experimental 1	10	3.0
Positive Prime/Experimental 2	10	3.7

Further analysis was conducted for the two dependent measures using one-way analysis of variance (ANOVA). Two separate ANOVAs were conducted, one for each dependent measure. As shown in table 3, the ANOVA for VR viewing/exploration time approached the .05 significance level and showed a large effect size for the priming treatments (F = 2.695; df = 2,27; p = .09; η^2 = .17). However, no significant difference was found between the three groups. Although, this may be indicative of a possible trend that if variance was maintained across groups could have attained statistical significance with a larger sample, particularly in light of the obtained effect size.

The ANOVA for perceived confidence level in being able to accurately describe the house scene after viewing the VR presentation yielded a significant difference between the groups with a large effect size (F = 4.061; df = 2,27; p = .03; η^2 = .23). To locate which groups the significant difference occurred between, a Tukey

Table 3.
ANOVA for VR Viewing Time (in seconds)

Source	Type III Sum of Squares	df	Mean Square	F	P	η^2
Treatment	17721.667	2	8860.833	2.695	.086	0.166
Error	88783.700	27	3288.285			
Total	2257475.000	29				

R Squared = .166

Table 4.
ANOVA for Confidence (5-point scale)

Source	Type III Sum of Squares	df	Mean Square	F	P	η^2
Treatment	2.467	2	1.233	4.061	0.029	0.231
Error	8.200	27	0.304			
Total	344.000	29				

R Squared = .231

Honestly Significant Difference (HSD) test was conducted. As shown in table 5, this test revealed that the significant difference occurred between the two primed groups (HSD = .700; p = .02). The post-hoc result and large eta-squared value for the ANOVA indicated that a considerable amount of the variance between groups on their reported post-VR confidence levels was related to the priming treatments conducted prior to introduction of the desktop VR presentation medium.

Table 5
Tukey HSD Post-Hoc Test on Confidence Level Variable

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.
Control	Exp. 1	.3000	.24646	.454
	Exp. 2	-.4000	.24646	.253
Exp. 1	Control	-.3000	.24646	.454
	Exp. 2	-.7000(*)	.24646	.022
Exp. 2	Control	.4000	.24646	.253
	Exp. 1	.7000(*)	.24646	.022

(*) $P \leq .05$

As a direct measure of the strength of association between the dependent variables of VR viewing/exploration time and the subsequently reported confidence level, a Pearson correlation was calculated. The correlation value was large and statistically significant ($r = .850$; $df = 28$; $p = .00$). This correlation showed that as VR exploration times increased, so did VR confidence levels. The coefficient of determination (r^2) for this correlation was .723, indicating that approximately 72% of the variance in reported confidence levels was related to variance in VR viewing time, which indicated a strong level of association between the performance measures.

Discussion, Recommendations, and Conclusion

This pilot study conceptualized the use of desktop VR technology as an innovation. It was designed to test the researcher's substantive theory – based in priming, innovation diffusion, and self-efficacy theories – that the presentation of positive and negative primes to occupational educators prior to presenting them with a desktop VR presentation of a complex scene could affect their disposition toward this innovative technology. The study operationally defined "disposition" as time spent voluntarily exploring a VR presentation and the subsequent self-reported level of confidence in the ability to effectively describe the scene presented in the VR to another person. The major findings of the study were (a) a trend toward differences in the VR exploration time between the negatively and positively primed groups, (b) significant difference in the reported confidence levels of the negatively and positively primed groups, and (c) strong positive correlation between VR viewing time and reported confidence level.

While the small size of this pilot study makes its findings inconclusive, it did yield sufficient support for the researcher's substantive theory to merit a full-scale study using a more complex pre-test/post-test research design. Based on the findings of this pilot, it appears there could be a causal relationship between positive supraliminal priming and the amount of time occupational educators spend viewing VR presentations, as well as the level of confidence they feel regarding their ability to explain scenes they have experienced via VR. The data from this study also showed a strong relationship between length of VR viewing time and subsequently reported level of confidence in understanding of the scene presented in the VR. Given the study's findings and sequential presentation order of the primes, the VR presentation, and the reporting of confidence level, it seems possible the relationship between viewing time and confidence level may be causal, and that increased viewing time may be an outcome of the priming technique which leads to increased technology self-efficacy. It is recommended that further studies be conducted to explore these possibilities. Experimental procedures with a pre-test/post-test design are suggested to establish a chain of causality from positive priming, to increased VR viewing/exploration time, to increased perceptions of confidence in the effectiveness of VR. Other types of priming techniques and various performance variables associated with positive disposition toward VR should also be investigated.

Establishment of priming as a successful technique for favorably disposing occupational educators toward desktop VR could have important implications for CTE and occupational education. VR technology has a record in the research literature of success as both an instructional medium in technical education and as an effective workplace tool in a variety of industries (Ahlberg, et al., 2007; Dickey, 2005; Ganai, et al., 2005; McClusky, et al., 2004; Neel, 2006; Park, Jang, & Chai, 2006; Revenaugh, 2006; Seymour, et al. 2002; Shim, et al., 2003; Smedley & Higgins, 2005; Tiala, 2007; Vogel, Bowers, Meehan, Hoeft, & Bradley, 2004). For both these reasons, VR should be considered an important technology for CTE and adult occupational education. Ausburn and Ausburn (2006) also pointed to VR's efficacy at presenting the type of three-dimensional, complex scenic environment that is frequently required in CTE and occupational education. They claimed that this is a class of learning environments that is very important in CTE and that VR is an excellent vehicle for teaching mastery of that class of environments. These appear to be sound reasons for CTE and occupational education to take a leadership role in the adoption of desktop VR technology; that is, to assume innovator and early adopter roles in terms of Rogers' innovation diffusion curve, rather than settling at the late adopter/laggard end of the curve.

This pilot study was a first step in the examination of priming techniques as an agent for increasing positive dispositions toward and confidence in desktop VR technology in CTE and occupational education. If ongoing research can establish this connection, it may also be possible to advance the adoption rate of VR as an instructional tool among occupational educators – another area ripe for experimental research efforts. Additional research focused on practical applications and derived instructional advantages as demonstrated in its effects on learning is needed to further support sustained adoption. Areas of instruction that consume considerable amounts of scare resources or require access to difficult locations may benefit from the development of such initiatives. These possibilities appear to this researcher to merit further investigation. VR may be an important tool for CTE and adult occupational programs, and research into speeding its adoption may be a productive line of inquiry for the field.

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Retention of Graduate Students Through Learning Communities

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Abstract

This manuscript addresses learning communities (LCs) as a strategy to retain graduate students until program completion. Definitions of LCs and their early development are presented. The benefits of LCs to groups of students with common interests are discussed. In addition, reasons for early graduate student attrition are included. Common models of LCs and characteristics of effective LCs are elaborated. Finally, suggestions for further research are given.

Introduction

An emerging trend in higher education is the formation of learning communities (LCs). Historically, a major goal of LCs was to increase undergraduate student success and retention. However, in the past several years, LCs are being studied as a strategy to improve graduate student retention. For example, the attrition rate for doctoral students has been reported to be as high as 40 to 50 percent nation-wide (Bowen & Rudenstein, 1992; Golde, 2000; Smallwood, 2004). Person (2002) found that students who entered career and technical education and other selected graduate programs through TOEFL scores rather than through English as a second language course had a non-completion rate of 28 percent.

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Graduate students will help to shape the future, not only of undergraduate education, but of business and industry as well. Consequently, success of graduate students is important to meet future societal needs. The purpose of this article is to present information about ways in which LCs are defined, background information regarding the development of LCs, benefits of LCs, reasons for graduate student attrition, and common models of LCs for graduate students.

The term “learning community” is defined in different ways, all of which may be appropriate for a given situation. The term “cohort” appears in many of the definitions, and in some cases the two terms are used synonymously. Chairs, McDonald, Shroyer, Urbanski, and Vertin (2002) define a cohort as a group of participants who enter a program together and enroll in most courses together; however, Yerkes (1995) cautioned that learning communities go beyond a cohort of students enrolled in the same courses with the same assignments. She stated that effective learning groups share a common purpose, social interaction, and pursuit of individual and group learning opportunities. Thompson (1998) defined a learning community as follows:

The learning community is intertwined with the academic program and serves as a process of shared decision-making between faculty and students. The purpose of the community is to provide a safe environment for trust building so that students and faculty serve as instructors of one another. Additionally, the community provides opportunities for peer coaching and a resource network. (p. 3)

Norris and Barnett (1994) noted the similarities between the two concepts by defining cohorts as purposely formed and structured groups to create an environment for effective learning. Meiklejohn (1932) suggested that LCs were deliberately restructured curricula designed to meet the educational objectives of a specific cohort of students and their respective faculty. John Dewey (1933) alluded to LCs in his educational philosophy by promoting collaborative learning that would “foster community and poise the teacher as more of a facilitator within a group of learners than merely as an outside authority” (p. 59). He supported relationships between teachers, learners, the curriculum, and learning. Dewey promoted learner-centered instruction with the teacher as facilitator and guide. These earlier ideas laid the groundwork for more recent inquiry into LCs. For example, Smith and Hunter (1988) suggested that LCs structure curriculum to support and enhance academic relationships between and among teachers and learners over a sustained period of time. They stated that restructuring the curriculum "supports effective learning and creates an enhanced sense of academic community between students and faculty" (p. 39). Rasmussen and Skinner (1999) defined LCs as specially designed curricula in which two or more courses in a single program are coordinated. Hess and Mason (2005) described LCs as classrooms in which students and their teachers work in cooperative groups. Cross (1998) defined a learning community as a cohort of students who take one or more courses together where the courses are linked together through a common theme. Lawrence (2002) suggested that cohort groups and learning communities are inseparable when he stated:

> Collaborative learning—defined as students and teachers engaged in a process of mutual inquiry and reflection through the sharing of ideas, experiences, and perspectives—is at the core of the cohort model…. In a learning community, all participants are responsible for the growth and well-being of every member. (p. 85)

Development of Learning Communities

Indications of LCs can be seen in the Socratic Method of teaching which emphasizes engaging both teacher and students in open-ended discussions of individual beliefs. The work of Meiklejohn (1932), an innovative educational theorist, promoted a method of teaching in the 1920s whereby students would acquire knowledge based on the conduct of their own lives. Specifically, Meiklejohn advocated abolishing mandatory attendance, lectures, and examinations, and creating collaborative learning between and among students and faculty. He implemented his philosophy in 1927 in an experimental college in a small, intensive, residence-based program for the first two years of college within the University of Wisconsin. The program was controversial and lasted only five years, perhaps for reasons due more to differences in personalities, philosophies, funding, and bureaucrats than to pedagogy. However, Meiklejohn's work laid the foundation for another learning community at the University of Wisconsin in 1948 when the University implemented a wide variety of general education programs in response to post-war needs for a more sophisticated approach to education, especially in the sciences. The Integrated Liberal Studies program, as the name implies, integrated the physical sciences and the fundamentals of several other sciences. Siegfried (1997) reported that the program is still operational today.

John Dewey (1916) advocated that a major role of education is to prepare students to participate effectively as citizens in a democracy. Dewey (1938) recognized the importance of experience and the application of knowledge and skills to real-world situations. He provided a theoretical framework for LCs by emphasizing collaborative learning between and among teachers and students as critical to a learner's education.

Tussman (1969), following in the footsteps of his mentor, Meiklejohn, introduced the idea of LCs in the University of California at Berkeley. His work helped to provide an impetus for the development of LCs in community colleges and universities. The growth of LCs continued throughout the 1970s, 1980s, and 1990s in community colleges and universities at the undergraduate level. Today virtually all types of institutions have some form of LCs. Recently, the benefits of LCs are being acknowledged as valuable for graduate students as well. Results of a study on doctoral student retention by Dorn and Papalewis (1997) showed that doctoral students who belonged to a group felt encouraged to remain in their programs and to progress in a timely manner toward their degree.

Benefits of Learning Communities

There is a paucity of literature and research on learning communities in adult education and career and technical education. However, the relationship between LCs and increased retention of undergraduate college students in programs other than career and technical education is well documented in the literature. The early work of Tinto (1973) set the stage for later studies on student attrition. Lenning and Ebbers (1999) and Rao (2005) indicate that LCs yield significant benefits to faculty members, as well as to students. Chickering and Gamson (1987) contended that student-faculty interactions, both in and out of classrooms, contribute to student retention and yield greater student satisfaction with their educational programs. For example, results of a study by Tinto, Goodsell-Love, and Russo (1994) indicated that students at Seattle Central Community College who were involved in a coordinated studies program had higher academic achievement and lower attrition rates compared to their counterparts who were enrolled in traditional courses (52 percent compared to 66.7 percent respectively). Schulte (2002) investigated ethical climate of cohort and non-cohort students and found that both groups perceived ethical climate as an important student retention factor; however, cohort students rated ethical climate more positively than their non-cohort peers.

Freeman, Field, and Dyrenfurth (2001) developed a nonresidential, non-collateral course-based technology learning community (TLC) in which student feedback indicated that the value of continual interaction with industrial mentors gave them the opportunity to discuss the importance and relevance of their coursework, as well as receive feedback and positive reinforcement. Baker and Pomerantz (2001) reported that students who participated in LCs at a commuter metropolitan university had higher grade point averages and were more satisfied with their college experiences than those students who did not participate in a learning community. Tinto (1998) reported that students at LaGuardia Community College in New York City who participated in a learning community were more satisfied with their educational experiences as indicated by their persistence rates. Those in a learning community persisted at a rate of 69.8 percent compared to students who were not in a learning community who had a persistence rate of 62.6 percent. The Washington Center for Improving the Quality of Undergraduate Education at the University of Washington reported an increase in students' academic achievement and intellectual development, involvement, and motivation when students were involved in a learning community. In addition, students in LCs persisted in school and completed their degrees in a timely manner.

Results of a study by the Office of Institutional Research at Bowling Green State University (2001) revealed that students' academic and social integration into college life have a greater impact on their retention than their pre-college academic skills. Dorn and Papalewis (1997) suggested that cooperation and collaboration within a group are equally important as the tasks to be performed. Wilkie (n.d.) compared student outcomes on retention, student performance, student development, and faculty-student ratios of students in LCs to students in traditional stand-alone courses. Results of Wilkie's study revealed that retention rates were greater for students in coordinated classes than for those in non-coordinated classes - 87 percent and 81 percent respectively for students enrolled from Fall of 1986 to Winter of 1989. For students enrolled four or more quarters from Fall of 1988 to Winter of 1990, the difference in the retention rate was even greater, 78 percent for those in the coordinated classes compared to 50 percent for those in the non-coordinated classes. Cross (1998) stated:

> …students who are involved with the people and activities of LCs are significantly more likely than their less involved peers to show growth in intellectual interests and values, and apparently more likely to get more out of their college education. (p.7)

Andrade (2007) reported that while learning communities had positive effects on student achievement and satisfaction; it was difficult to discern which aspects of the learning communities (e.g., integrated courses and assignments, study skills training, or mentoring) actually affected the students most.

Reasons Graduate Students Drop Out of College

Gilliam and Kritsonis, (2006) recognized that doctoral student attrition is an invisible problem. Students often leave their programs without announcing their intentions and with no follow-up by faculty. Smallwood (2004) reported that humanities and social sciences programs have a higher attrition rate than the sciences.

Bowen and Rudenstine (1992) reported that 40 percent to 50 percent of carefully selected doctoral students drop out before completing their degree. Lovitts (2001) reported that underrepresented groups may exceed the 50 percent attrition rate. Berg and Ferber (1983) found that women tend to have higher attrition rates than men.

Tinto (1973) believed that student retention was related to: (1) students' background, (2) goals and commitment to education, (3) experiences at the institution related to interactions with academics, faculty, and peers, (4) external commitments while in college, and (5) integration both academically and socially. Lovitts' (2001) stated that students drop out of doctoral programs for many reasons other than academic, such as personal, financial, professional, and institutional influences. Her study showed no academic ability differences between completers and non-completers.

A study conducted by Lundquist, Spalding, and Landrum (2002) revealed that faculty attitudes and behaviors had a significant effect on students' decisions to drop out of college. Smallwood (2004) reported that dropout rates for Ph.D. students are related more to selection procedures than to students' ability to do the work. Smallwood stated:

While some students certainly leave Ph.D. programs because they can't do the work, deans say the problem is not usually students' struggling to measure up. A larger portion of the dropout total can be attributed to grad schools' having made bad admission selections. That doesn't mean the students aren't bright enough. Deans and researchers talk, instead, about that hard-to-define "bad fit." (p. 120)

Ph.D. students face many challenges during the period between completing course work and completing the dissertation. Few studies could be found that address admissions criteria and student success. However, Lovitts (2008) and Gardner (2008) noted that conducting independent research is difficult for many students. In other words, selecting an appropriate research topic, developing the proposal, and writing the dissertation are challenges that may prolong a student's time in a program or lead to the student's dropping out. The reasons that graduate students' drop out pose a complex issue with some responsibility on the universities and some on the students. For example, Golde and Dore (2001) reported that 35 percent of graduate students did not feel that their graduate course work prepared them for conducting independent research. The selection process may be biased; thus, failing some potential students. Results of a study by Attiyeh and Attiyeh (1997) showed that Graduate Record Examination (GRE) scores are highly significant determinants as to whether or not an applicant is admitted to graduate school; however, admissions committees may make adjustments on scores for the verbal portion of the GRE for applicants from non-English speaking countries. Attiyeh and Attiyeh noted:

A conjecture suggested by the empirical findings is that graduate programs used the admissions process to obtain diverse enrollments by adopting higher standards for applicants from relative large applicant groups. Overall, but not with uniform consistency, this behavior appears to have been responsive to the prevailing public policy that encouraged universities to increase participation of historically underrepresented groups and to give greater emphasis to serving U. S. citizens. (p. 547)

Lovitts (2008) suggested that admission procedures may be flawed in that GRE scores and grade point averages may not be valid predictors of graduate student success when these measures are used alone. She contends that practical and creative ability are important determinants as to whether a student can move from course work to independent research. Lovitts stated: “Above a certain threshold of demonstrated academic ability (e.g., undergraduate GPA and GRE scores), they [university admissions committees] might consider focusing more on measures or predictors of practical and creative ability and less on measures of analytical ability” (p. 323). Walpole, Burton, Kanyi, and Jackenthal (2002) found that graduate admissions committees desired more information on understanding students’ non-cognitive qualities, such as interpersonal skills, motivation, and persistence to assist in reducing attrition.

The interviewing process to ascertain prospective students’ career goals and interest in a specific program of study may not reveal indicators for potential success. For example, a student’s motivation to earn the Ph.D. degree may not indicate a student’s match to a program and his/her interest and dedication to a program.

When students are admitted into programs for which they discover later that they have little interest, they can become prime candidates for early attrition. For example, Walpole et al. (2002) reported that some graduate students leave their programs because they were "simply not enjoying the work as much as expected" (p. 20). Sadly, these students have already used valuable resources, their own and a university's. Walpole et al. stated:

> While some graduate programs are quite large, requiring relatively automated, impersonal admission procedures, many programs are relatively small and have hand-tailored admission procedures, meant to match each student with a mentoring faculty advisor. In this sense graduate admission procedures are strikingly different from undergraduate or professional school admission procedures. . . . A finely tuned match between discipline, student, faculty, and environment is desirable. (p. 21)

Results of over 100 interviews with graduate school faculty and staff conducted by Walpole et al. revealed that while provisions for financial support of graduate students is an important key to retention, other factors such as personal reasons, lack of academic success, lack of motivation or drive, and the inability to conduct research were also factors in attrition.

Models of Learning Communities

As a result of increased interest in LCs as incentives to maintain student retention, several different models of LCs have evolved. The researcher was unable to locate models of learning communities or studies addressing learning communities at the graduate level for career and technical education students. However, the following models, which have been shown to be effective at the undergraduate levels may offer guidance in forming learning communities for career and technical education students. Such practices are now being seriously considered by university faculty members as they strive to retain graduate students to program completion.

Smith (1991) and Tinto (1998) acknowledged that LCs can take many different forms. They suggested one type of learning community as a Freshman Interest Group where an advising component is included with thematically-related courses. In this kind of learning community, students would meet with an advisor to discuss issues related to college life and forming study groups. Laufgraben and Shapiro (2004) suggested a cohorts-in-large-courses model that is generally designed for freshman in large introductory lecture courses. The cohorts-in-large-courses model is similar to the freshman interest groups suggested by Smith and Tinto where students are organized into smaller interest groups or seminars that provide orientations to college life. This kind of learning community could be designed with the purpose and focus directed toward the needs of graduate students. For example, a Graduate Interest Group could be formed so that professors and doctoral students could discuss advisement procedures, program options, specific courses, program expectations, and timelines.

Another model proposed by Smith (1991) and Tinto (1998) links skill and content courses. For example, an English composition course and a history course could be coordinated. Coordinating courses in problem solving or critical thinking with a mathematics course, or a course in mathematics with a course in science are other examples of linking content courses.

Laufgraben and Shapiro (2004) promoted a model in which paired or clustered courses serve small groups of students (20 to 30). All students within a cluster would be enrolled together in the same block of courses. For example, four or five courses may be scheduled in the block, but only two of the courses may share curricular connections. In addition, a service learning component may be included in requirements for the block. Smith (1991) and Tinto (1998) suggested a clusters concept similar to that of Laufgraben and Shapiro; however, they recommended that three or four courses be linked that address a common theme, such as world progress linking courses in political science, history, sociology, and international relations; or a theme that relates health of body and mind to courses in human biology, human behavior, and sociology. Shapiro and Levine (1999) proposed a team-teaching model in which faculty members collaborate to develop curricula organized around a central interdisciplinary theme. Students may be divided into smaller groups to discuss specific aspects of the centralized theme. Smith and Tinto proposed a coordinated studies model in which a small cohort of students would participate in a fully integrated 16-credit hour program taught by a group of faculty members. A common theme would tie the courses together.

Characteristics of Learning Communities

Tinto (1998) recommended that nearly all LCs, regardless of their organization, should be organized around a shared or integrated body of knowledge so that students can interact and share as a community of learners. In addition to shared knowledge, Tinto introduced the idea of shared knowing. Shared knowing occurs when students who are enrolled in the same set of courses together cooperate and collaborate in learning the content.

Oertel (2001) reported five essential characteristics of LCs. These characteristics are (1) integrated and interdisciplinary curricula, (2) high level of faculty collaboration and participation in all aspects of the learning community programs, (3) collaborative and active learning, (4) continuous assessments and communication on student outcomes and program results, and (5) consistency of learning community programs with the mission, structure, processes, culture, and climate of the institution. It seems logical that career and technical education programs are natural environments in which such essential characteristics already exist.

Leving and Thompkins (1996) suggested that models for effective LCs include student-faculty interactions and interdisciplinary linkages. The academic and social integration of students with peers and mentors may increase student retention. Addressing a critical component of LCs, Lovitts (2001) stated:

> Working together on a common project appears to be among the best means of achieving academic integration. Thus, to the extent possible departments should do as much as possible to engage all students, especially new students, in the professional tasks of the discipline—paid or unpaid. New students need to work closely with faculty and advanced graduate students on common projects as early as possible in their graduate careers. (p. 269)

The research and literature indicate that social aspects and collaboration with groups provide vital support that enhances learning and encourages retention. Research has shown that doctoral students who are members of cohort groups persist at a higher rate than those not in cohort groups (Brien, 1992; Tinto, 1988). Imel (2002) suggested that learning in cohort groups is a natural arrangement for adult learners, given their focus on group dynamics, adult development, and adult learning theory. According to Gabelnick, MacGregor, Matthews, and Smith (1990), students who participate in LCs earn higher grades, are more satisfied with their educational experiences, feel deeper academic connections to faculty and peers and make healthier educational choices than those enrolled in traditional courses. Effective LCs promote shared learning and discovery, involve inclusive learning environments, and form connections that extend learning across the campus.

Historically, major goals of LCs were to increase undergraduate student recruitment, success, and retention; however, in the past several years, LCs are being studied as strategies to improve graduate student retention. The professional literature and research suggest the overall effectiveness of LCs. However, there is much work to be done in order to fully realize the potential of LCs and to appreciate their value across all educational levels for all academic disciplines. Implementation of LCs at the graduate level, including workforce education, may provide useful information related to attrition. In addition, follow-up studies that address the links between common existing graduate school admission criteria (e.g., letters of recommendations, professional accomplishments) other than GRE scores and GPA and successful doctoral program completion may prove helpful in the student selection process. Also, research on the identification of specific student attributes such as interpersonal skills and creativity may reveal effective indicators of graduate school success.

Development of standardized inventories and scales by which admissions committees can collect and evaluate information on prospective students may help to improve current practices in the admissions process. Finally, the use of electronic data bases on which to store the information collected via standardized inventories and questionnaires may help to ease the admissions process.

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Influencing Technology Education Teachers to Accept Teaching Positions

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Abstract

Technology education is facing a significant teacher shortage. The purpose of this study was to address the technology education teacher shortage by examining the factors that influence technology education teachers to accept teaching positions. The population for the study consisted of technology education teachers and administrators. A survey instrument was developed that asked participants to indicate their level of agreement on 28 factors influence on whether a technology education teacher accepts a teaching position. A five point Likert scale was used to determine level of agreement. The results of the study revealed that the factors believed to most influence a technology education teacher to accept a teaching position included having resources available for the classrooms and labs, having resources for professional development, and a collaborative work environment. Discussions include recommendations for the development of technology education teacher recruitment programs, as well as policies that positively impact recruitment.

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Introduction

For many years technology education, as well as other areas of education, have been experiencing a significant teacher shortage. Research conducted by Meade and Dugger (2004), Ndahi and Ritz (2003), Newberry (2001), Ritz (1999), and Weston (1997) have all indicated that technology education has been and will continue experiencing a significant teacher shortage unless action is taken to reverse this problem. Wicklein (2005) stated that technology education is facing no greater issue than the teacher shortage and indicated that in order to address this issue efforts need to be undertaken to recruit more technology education teachers. This study sought to identify effective recruitment techniques by determining the factors that influence technology education teachers to accept teaching positions. The study utilized the survey technique to gather perceptions from technology education teachers and administrators who were elected officials in state technology education associations.

Literature Review

Over the past few years, technology education has experienced a renewed emphasis within American schools. A major reason for this new emphasis is that a key component to technology education is the preparation of learners to be technologically literate (ITEA, 1996). With the No Child Left Behind legislation requiring technological literacy for all students, schools are developing new technology education programs to meet the students' needs. Meade and Dugger (2004) found that an increasing number of states are beginning to require technology education as a school subject for all students, and 43 states reported using the Standards for Technological Literacy developed by the International Technology Education Association (ITEA). New technology education programs have been implemented rather extensively in junior highs and high schools across the United States, with many states and districts still in the process of bringing technology education to the middle schools, and others reportedly expanding existing middle and high school programs (Daugherty, 1998; Weston, 1997). Technology education's emphasis on technological literacy and states' commitment to technology education standards for all students is increasing the number of students participating in technology education programs. This shift has created a new demand for technology education professionals, and this demand is exacerbated by the current and projected teacher shortages in technology education (Ritz, 1999).

At the same time increasing numbers of students are required to take technology education courses at the elementary, junior high, and high school level, the number of teachers entering the field is decreasing (Daugherty, 1998). The 2000 *Educator Supply and Demand in the United States* study developed by the American Association for Employment in Education (AAEE) reported the national need for technology education teachers was on the increase (AAEE, 2001). Studies conducted by Weston (1997), Ritz (1999), Newberry (2001), Ndahi and Ritz (2003), and Meade and Dugger (2004) have all indicated significant shortages of technology education teaching professionals.

Volk (1997 however pointed out that although the number of traditionally certified technology education teachers is decreasing, with alternative certification programs such as Troops to Teachers, there may be teachers available to help schools address their shortages. Therefore, by constructing effective recruitment programs, school district may be able to attract individuals to choose teaching over other available occupations (Guarino, Santibanez, Daley, & Brewer, 2005).

Teacher Recruitment

There are many reasons an individual chooses to accept a position. Understanding what might motivate an individual to accept a teaching position is an important aspect for school districts to consider when addressing the current teacher shortage. The most prominent theories related to career motivation include Maslow's hierarchy of needs theory (Maslow, 1943) and Herzberg's dual-factor motivational theory (Herzberg, 1966). Maslow's theory as it pertains to career motivation, states that individuals seek to satisfy five levels of needs from their job. These needs include physiological, safety and social needs to start, and ultimately the need to satisfy their self-esteem and self actualization (Maslow, 1943). Herzberg's theory builds on the needs identified by Maslow by separating them into two unipolar groups, hygiene factors and motivation factors. Hygiene factors include the extrinsic aspects of a job including salary, management, and working conditions, while motivation factors include such intrinsic aspects as recognition, responsibility, and the nature of the work (Herzberg, 1966). These theories provide an initial understanding of what could motivate a technology education teacher to accept a teaching position and lays the framework for addressing the issue of recruiting more technology education teachers.

States are responding to address the teacher shortage through a variety of measures (Hoepfl, 2001). In order to improve the quality and quantity of qualified teachers, expanded recruitment efforts are becoming an important and significant aspect for individuals involved in education and policy-making (Banks, 1999). Wicklein (2005) found that technology education professionals perceive the recruitment of individuals into technology education teacher education programs as the most critical issue in technology education. In making recommendations for addressing this issue, Wicklein suggests "undertaking significant efforts aimed at recruiting and preparing new technology education educators at all levels" (p. 9).

Research conducted by Elam (1990), Scarborough (1990), Sharpe (1992), and Daugherty (1998) point out that effective recruiting begins with the image of the field. They suggest that building an image campaign for technology education might be an effective starting point for a recruitment plan. Federal programs such as the Troops to Teachers program (Kuenzi, 2004) have also been enacted to attract new technology education teachers. This program is intended to recruit members of the military with expertise in mathematics, science, and technology-based fields into teaching positions after completing their military service. The program assists eligible members of the Armed Forces to obtain certification and facilitates their employment (Kuenzi, 2004). Schools also use a similar method to recruit teachers by offering alternative routes of teacher certification to qualified individuals. Alternative certification programs vary, and include those that offer certification to individuals that have already earned a bachelor's degree and have work experience, to those that train already certified teachers to teach technology education courses (Simmons & Linnell, 1998).

In order to address the teacher shortage and recruit those more qualified teachers, states have also implemented incentive programs to attract such individuals. One such recruitment strategy is the use of signing bonuses for new teachers. An example of such a program exists in Massachusetts. Between 1998 and 2001, the Massachusetts Institute for New Teachers (MINT) gave a $20,000 signing bonus to over 400 individuals who changed to teaching mid-career to address the state's teacher quality and supply issues (Kuenzi, 2004). About one-third of the participants in the program already had some form of teacher certification or teaching experience, and the rest were subject matter experts who were given a six-week teacher training program. The program also included weekly mentoring sessions for teachers. Many states experiencing significant teacher shortage in content areas such as math, science, bilingual education, and technology education are initiating signing bonuses in order to attract new teachers to fill positions (Marquez, 2002).

Another incentive program that states are using to recruit teachers is a loan deferral and forgiveness program for educators. According to the Wisconsin State Department of Public Instruction (2005), Missouri State Department of Elementary and Secondary Education (2004) and Iowa State Department of Education (2004) websites, each state offers loan deferment or forgiveness to teachers in areas of critical need. Loan deferment programs allow full-time teachers in areas of designated need to postpone the repayment of student loans that were borrowed between 1987 to the present. Loan forgiveness is only offered to teachers who initiated their loan after 1998. Teachers who initiated their loan before 1998 are not eligible for loan forgiveness, but are granted a reduced interest rate. Each of these three states offering loan deferment or forgiveness has designated technology education as an area of critical teacher shortage.

While many areas of education are experiencing teacher shortages, several studies have focused on reasons teachers leave the teaching profession. Few studies however have identified factors that influence teachers to accept teaching positions. Studies conducted by Puget Sound Educational Service District (PSESD) (2003) and Hare and Heap (2001) have examined factors influencing teacher recruitment within Washington State and selected Midwestern states respectively. Marquez (2002) conducted a study that examined the factors that influenced the recruitment of bilingual education teachers. Additionally, Barrows and Wesson (2003), Lee, Clery, and Presley (2001), and Weiss (1999) identified job satisfaction factors that may impact teacher recruitment. However, if the teacher shortage in technology education is to be addressed, specific studies addressing the factors that influence the technology education teacher labor supply are needed.

Hanushek, Kain, and Rivikin (2001) stated that without a full understanding of the factors influencing the teacher labor supply, effective policies and strategies to address the teacher shortage will not be developed. This study sought to expand the knowledge regarding the technology education teacher labor supply by focusing on the factors that influence technology education teachers to accept teaching positions. The purpose of the study was to determine the factors most influential in whether a technology education teacher accepts a teaching position. Based on the findings of this study, effective recruitment policies can be developed for technology education.

Methodology

The design of this study examined factors that influence technology education teachers to accept teaching positions. The study specifically utilized the survey method. The general purpose of survey research is to generalize from a sample population so that inferences can be made about the perceptions of the total population (Babbie, 2001). The study sought the perceptions of technology education teachers and administrators who served as elected officials in their respective state technology education associations. This population was defined as described for several reasons. First, a population was needed that involved both technology education teachers and administrators. These individuals were chosen because of their specific knowledge of technology education, and the factors that influence technology education teachers to accept teaching positions. Second, by the nature of their involvement in a technology education association as an elected officer, they may have a higher commitment to technology education resulting in a higher, more accurate response. Third, state technology education elected officers are elected to represent all of the technology education teachers and administrators in the state. Therefore the perceptions of those technology education teachers and administrators responding to the survey should represent other technology education teachers and administrators in the state. Finally, individuals in the state technology education associations elected positions were available to the researcher. The names, positions, and contact information were available on the state association websites or through contacting each association directly.

After extensive research of the International Technology Education Association website and state technology education association websites, 32 states were determined to have technology education associations with a total of 489 elected officers. The 489 elected officers consisted of approximately 401 technology education teachers and 88 technology education administrators. Elected positions in state technology education associations are voluntary positions which consist of board members including presidents, vice presidents, past presidents, president elects, secretaries, treasurers, and other state board positions including regional/district representatives. This study only surveyed technology education teachers and administrators. Board members who represented universities and community colleges were excluded.

The researcher developed a survey to determine the factors that influence technology education teachers to accept teaching positions. The initial survey development was guided by three instruments including The Job Satisfaction Survey (Spector, 1985), Recruitment and Retention Issues Survey (PSESD, 2003), and Retaining and Attracting High Quality Teachers Survey (Hare & Heap, 2001).

These surveys served as a guide in the development of the survey's broad categories and general factors influencing teacher recruitment. Factors specific to technology education were determined by the researcher through the review of literature.

The content validity of the survey instrument was established by means of a panel with expertise technology education (n = 5). The panel consisted of five technology education professionals from two regional Midwestern universities. They examined the instrument for grammar, clarity, and understanding. Additionally, the survey instrument was pilot tested with technology education teachers (n = 34) and technology education administrators (n = 10) at the Association of Career and Technical Education (ACTE) conference in December of 2005 to determine internal consistency reliabilities of the scales and to assess understandability. A Cronbach Coefficient Alpha test was conducted for the pilot test instrument to determine the internal consistency of the instrument and to establish reliability for the survey instrument. After eliminating two categories from the survey, a reliability index of .969 was determined for the instrument.

The survey consisted of a demographic section and a recruitment factors section. The section of the survey collected basic demographic and background variables of the technology education professional to provide a better understanding of the population sample. The second section listed 28 recruitment factors, which were categorized as pay, promotion, benefits, contingent rewards, operating conditions, nature of work, and communication. Table 1 lists the 28 factors.

The second section asked participants to respond to each factor, and rate each as to its influence on whether a technology education teacher accepts in a teaching position. A five-point Likert-type scale was used for each of the items with "1" representing strongly disagree that the factor is influential and "5" representing strongly agree that the factor is influential.

Table 1
Factors influencing technology education teachers to accept teaching positions

Factor	Category
	Pay
Factor 1	The salary offered is comparable to that of the national average ($30,000)
Factor 2	Technology education teachers are given salary schedule credit for relevant non-teaching experience
Factor 3	The school places higher demand teachers, such as technology education teachers, above entry-level on the salary scale
Factor 4	The school provides yearly raises for all teachers
	Promotion
Factor 5	There is a career ladder for technology education teachers in the school district
Factor 6	Technology education teachers are promoted based on performance
Factor 7	Technology education teachers can move up the career ladder quickly
Factor 8	Technology education teachers are promoted based on tenure procedures
	Benefits
Factor 9	There are resources available for professional development
Factor 10	The technology teacher is offered a student loan payoff
Factor 11	The technology teacher is offered a tuition waivers or reimbursement
Factor 12	The technology education teacher is given a signing bonus
	Contingent Rewards
Factor 13	Successful teachers are given non-financial rewards
Factor 14	Successful teachers are recognized within the district
Factor 15	Teachers are financially rewarded for school and program success
Factor 16	The school provides increased compensation for quality teaching

Table 1 (continued)

Table 1 (continued)

	Operating Conditions
Factor 17	Resources are available for the classroom and labs
Factor 18	Class sizes are average (20 to 25)
Factor 19	The school provides retraining of faculty and staff
Factor 20	The school has a university partnership to recruit, alternatively certify, and train teachers
	Nature of Work
Factor 21	The school is using the Standards for Technological Literacy
Factor 22	The technology education teacher is given the grade they prefer to teach
Factor 23	The technology education teacher is given the subject they prefer to teach
Factor 24	Technology education teachers are traditionally certified.
	Communication
Factor 25	There is a new teacher induction program to orientate new teachers to the school
Factor 26	There is a mentoring program in place to help new technology education teachers.
Factor 27	There is a collaborative work environment
Factor 28	Teachers are involved in the decision-making process

The data collection process began in January of 2006. The 489 participants selected for the study were each sent a personalized email introducing the project, describing the purpose of the study, providing instructions for completing the survey online, assured confidentiality, and directing them to the site where the instrument could be completed. The researcher attempted to increase the response rate by requesting the assistance of state technology education association presidents, president-elects, and executive directors. Each of these individuals was sent personalized emails asking for their assistance in the study and for them to encourage their board members and regional/district representatives to participate. A follow-up mailing was conducted exactly one week after the first and a final follow-up was sent two weeks after the first mailing. Of the initial 489 surveys sent, 95 were returned as undeliverable and 230 of the 394 participants receiving the mailing (58.4%) returned the survey.

Findings

Data collected were analyzed and used to determine the factors influencing technology education teachers to accept teaching positions. Descriptive statistics were calculated for both demographic information and the factors including means, standard deviations, frequencies, and percentages. Frequencies, means, and standard deviations were used to summarize and describe participant responses to the factors that influence technology education teachers to accept teaching positions.

An analysis of the demographic data received from the study indicates that participants from all 32 states surveyed responded to the study. The majority of those responding to the study (83.0%) identified themselves as technology education teachers (see Table 2).

While only 20 respondents classified themselves as administrator, an additional 7 respondents identified themselves as both teachers and administrators and 12 respondents identified themselves in the *other* category. Additionally, approximately 30.4% of respondents (n = 70) worked at the elementary/middle school level and 11.3% (n = 26) worked at the state/district level, while the majority of the respondents 54.8% (n = 126) indicated they worked at the high school level. Finally, respondents were more evenly split between locations with 22.6% of respondents in rural areas (n = 52), 29.1% located in towns or small cities (n = 67), 33.0% in suburban areas (n = 76), and 13.5% respondents in urban areas (n = 31).

Means ranged from 2.49 to 4.06 on a Likert-type scale (1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree) for the recruitment factors (see Table 3). There were a total of 13 recruitment factors rated with means of 3.5 and above (agree) on the scale. There were 15 recruitment factors rated with means below 3.5 (disagree or undecided) on the scale.

Table 2
Descriptive information about the respondents

Variable	*N*	%
Position Held		
Teacher	191	83
Administrator	20	8.6
Both	7	3
Other		
State Supervisor	8	3.4
Program Specialist	1	<.01
State Consultant	1	<.01
Department Head	2	<.01
Area of Work		
Elementary	70	30.4
High School	126	54.8
State/District Level	26	11.3
Other		
Both or K-12	8	3.4
Location		
Rural	52	22.6
Town or Small City	67	29.1
Suburban	76	33
Urban	31	13.5
No Response	4	1.7

Table 3
Responses to all factors relating to whether a technology education teacher accepts a teaching position

				Frequency of Response (Percentage)				
Factor	N	Mean	SD	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Factor 1	230	3.7	1.194	13 (5.7)	35 (15.2)	26 (11.3)	91 (39.6)	65 (28.3)
Factor 2	230	3.12	1.406	43 (18.7)	38 (16.5)	44 (19.1)	58 (25.2)	47 (20.4)
Factor 3	229	2.85	1.471	62 (27.0)	38 (16.5)	44 (19.1)	58 (25.2)	47 (20.4)
Factor 4	229	4.01	1.157	11 (4.8)	22 (9.6)	19 (8.3)	78 (33.9)	99 (43.0)
Factor 5	229	2.92	1.39	48 (20.9)	50 (21.7)	39 (17.0)	56 (24.3)	36 (15.7)
Factor 6	230	2.49	1.304	68 (29.6)	63 (27.4)	35 (15.2)	47 (20.4)	17 (7.4)
Factor 7	228	2.8	1.281	44 (19.1)	57 (24.8)	53 (23.0)	49 (21.3)	25 (10.9)
Factor 8	229	3.26	1.312	31 (13.5)	35 (15.2)	52 (22.6)	65 (28.3)	46 (20.0)
Factor 9	230	4.05	0.97	6 (2.6)	14 (6.1)	24 (10.4)	104 (45.2)	82 (35.7)
Factor 10	230	2.81	1.541	75 (32.6)	27 (11.7)	41 (17.8)	41 (17.8)	46 (20.0)
Factor 11	230	3.09	1.523	56 (24.3)	31 (13.5)	36 (15.7)	50 (21.7)	57 (24.8)
Factor 12	230	2.69	1.571	81 (35.2)	38 (16.5)	30 (13.0)	33 (14.3)	48 (20.9)
Factor 13	228	2.96	1.347	50 (21.7)	34 (14.8)	44 (19.1)	74 (32.2)	26 (11.3)
Factor 14	229	3.65	1.14	16 (7.0)	23 (10.0)	37 (16.1)	102 (44.3)	51 (22.2)
Factor 15	228	2.66	1.453	73 (31.7)	43 (18.7)	31 (13.5)	51 (22.2)	30 (13.0)
Factor 16	230	2.63	1.483	79 (34.3)	42 (18.3)	27 (11.7)	50 (21.7)	32 (13.9)
Factor 17	230	4.06	1.051	8 (3.5)	17 (7.4)	21 (9.1)	91 (39.6)	93 (40.4)
Factor 18	230	3.86	1.134	14 (6.1)	20 (8.7)	22 (9.6)	103 (44.8)	71 (30.9)
Factor 19	230	3.55	1.217	18 (7.8)	35 (15.2)	32 (13.9)	93 (40.4)	52 (22.6)
Factor 20	230	2.89	1.339	46 (20.0)	49 (21.3)	51 (22.2)	52 (22.6)	32 (13.9)
Factor 21	228	3.7	1.176	15 (6.5)	28 (12.2)	28 (12.2)	97 (42.2)	60 (26.1)

Table 3 (continued)

Table 3 (continued)

Factor 22	229	3.38	1.21	20 (8.7)	40 (17.4)	42 (18.3)	87 (37.8)	40 (17.4)
Factor 23	230	3.82	1.089	9 (3.9)	21 (9.1)	43 (18.7)	86 (37.4)	71 (30.9)
Factor 24	229	3.18	1.143	20 (8.7)	42 (18.3)	74 (32.2)	63 (27.4)	30 (13.0)
Factor 25	230	4.03	1.069	10 (4.3)	15 (6.5)	22 (9.6)	93 (40.4)	90 (39.1)
Factor 26	229	3.96	1.063	11 (4.8)	15 (6.5)	23 (10.0)	104 (45.2)	76 (33.0)
Factor 27	230	4.05	0.986	6 (2.6)	14 (6.1)	28 (12.2)	97 (42.2)	85 (37.0)
Factor 28	230	3.84	1.1	14 (6.1)	15 (6.5)	31 (13.5)	104 (45.2)	66 (28.7)

Five factors received mean ratings of 4.00 and above. The factors perceived by the respondents as most influential in whether a technology education teacher accepts a teaching position were that the school provided yearly raises for all teachers (4.01), the school has resources available for professional development (4.05), the school has resources available for the classroom and labs (4.06), the school has a new teacher induction program to orientate new teachers to the school (4.03), and the school has a collaborative work environment (4.05).

In addition to the above factors, respondents also perceived that having a salary comparable to that of the national average (3.70), having the school district recognize successful teachers (3.65), having average class sizes (3.86), providing retraining for teachers and staff (3.55), using the Standards for Technological Literacy (3.70), having the teacher teaching the subject they prefer (3.82), having teachers who are participating in a mentoring program in place to help new technology education teachers (3.96), and involving teachers in the decision making process (3.84) were also influential factors in whether a technology education teacher accepts a teaching position.

When these results are compared to other studies, similarities can be found in relation to factors such as operating conditions and communication. This study found similar results to PSESD (2003) and Hare and Heap (2001), which identified class size, technology resources in the classroom, and providing staff retaining to be effective recruitment strategies. This study also found new teacher induction programs, mentoring programs, a collaborative work environment, and involving teachers in the decision making process to be influential in whether a technology education teacher accepts a teaching position. Studies by Darling-Hammond (2003), PSESD (2003), Marquez (2002), and Hare and Heap (2001) present similar findings.

Along with indicating the factors perceived to be influential in whether a technology education teacher accepts a teaching position, this study also identified 15 factors that were perceived to have little to no influence on whether a technology education teacher accepts a teaching position. The four factors perceived to have the least influence were promoting technology education teachers based on performance (2.49), increased compensation for quality teaching (2.63), financially rewarding teachers for school and program success (2.66), and offering a signing bonus (2.69). Other factored identified as having little or no influence of note include offering teachers a student loan payoff (2.81), offering tuition waivers or reimbursement (3.09), paying a higher entry salary for technology education teachers (2.85), and offering a salary schedule credit for relevant non-teaching experience (3.12).

Research conducted by PSESD (2003), Marquez (2002) and Hare and Heap (2001) each found that factors relating to promotion and contingent rewards were not influential in whether a teacher accepts a teaching position. This study found similar results. The results relating to pay and benefits however were found to contrast with the finding of the other studies. Hare and Heap (2001) found paying more for non-teaching experience and placing new teachers on a higher pay scale to be effective recruitment strategies, while this study indicated that these were not influential. This study also found contrary results to research conducted by Marquez (2002) and Hare and Heap (2001) in relation to signing bonuses. The results of this study indicated that providing a signing bonus is not influential in recruiting teachers, while the previous studies found signing bonuses to be effective recruiting strategies.

Conclusions and Recommendations

When examining the results of the study, factors perceived as influential could be useful in developing programs and policies to recruit technology education teachers. For instance, the results of this study would indicate that policies could be developed to establish a more collaborative work environment, involve teachers in decision making, and recognize successful teachers. This study also shows that schools might benefit from adopting the standards for technological literacy. Schools that develop induction and mentoring programs for teachers have been shown to increase the likelihood of teachers accepting a teaching position in other studies (Brown, 2003), and the results here support those findings.

While some of the factors perceived as influential are related to financial resources, most do not indicate that the level of financial changes needed to address the factors are unreasonable. Even school districts that are currently underfunded may be able to address some of the following factors by reallocating funds to areas that are perceived to be more influential in attracting new teachers. For instance, the finding of this study indicated that the programs most widely used to recruit teachers in school districts including signing bonuses, tuition waivers, and student loan payoffs were all perceived to have little to no influence. This study also found that factors such as providing higher salaries and raises for just technology education teachers were perceived as having less influence. This would suggest that schools could better utilize these resources to recruit technology education teachers by acquiring technology resources for the classroom, paying teachers comparable to the national average, providing yearly raises, or providing resources for professional development.

While technology education continues to experience a teacher shortage, it is especially important to recruit as many teachers as possible. As other studies are needed to focus on recruiting new technology education teachers into teacher preparation programs, Volk (1997) pointed out that with programs like Troops to Teachers alternatively certifying other professionals, schools can begin addressing their teacher shortage by recruiting teachers already in the field. These findings could be helpful to school districts and states alike in providing a better understanding of the technology education teacher population and in developing programs and policies that actually entice more teachers to accept teaching positions. While more research is needed on addressing the technology education teacher shortage, we start the process by implementing effective recruitment strategies so that the technology education profession is not forgotten.

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BOOK REVIEW

Garmire, E., & Pearson, G. (Eds.). (2006).
Tech tally: Approaches to assessing technological literacy.
Washington: National Academy Press.
$43.16 (hardcover), 358 pp. (ISBN 0-309-10183-2).
Executive summary available: www.nap.edu

Since the 1980s, national organizations such as the National Science Foundation (NSF), the American Association for the Advancement of Science (AAAS), and the International Technology Education Association (ITEA) have strived to raise awareness for the understanding of technology and in more recent times, developing technological literacy. Although these organizations have had success in their efforts to an extent, there has been little, if any means of assessing the technological literacy of the American public. In hopes of developing a means of assessing technological literacy, the National Research Council (NRC) and the National Academy of Engineering (NAE) commissioned a panel of experts from across the country. This panel, known as the Committee on Assessing Technological Literacy was charged to "determine the most viable approach or approaches to assessing technological literacy in three distinct populations in the United States: K-12 students, K-12 teachers, and out-of school adults" (Garmire & Pearson, 2006, p. 25).

Tech Tally: Approaches to Assessing Technological Literacy offers a comprehensive report detailing how technological literacy assessments can be developed. Additionally, twelve recommendations, addressing five critical areas for technological literacy assessment are presented.

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Assessing Technological Literacy and its Benefits

The committee adopted an earlier construct of technological literacy in a document first published by the National Research Council. In *Technically Speaking: Why All Americans Need to Know More About Technology*, Pearson and Young (2002) defines technological literacy as having three major dimensions:

- Knowledge—both factual and conceptual understandings of technology;
- Capabilities—how well a person can use technology—problem solving;
- Critical thinking and decision-making—one's approach to a technological issue.
  (p. 36-37).

The benefits of assessing technological literacy greatly outweigh the negative connotations. Perhaps the most important benefit of assessing technological literacy may also be the ultimate reason for the National Academies involvement in this research study—fostering and enriching the global economy. By determining how technologically literate a population is, business enterprise can develop and market new technologically innovative products and resources which in turn grows that population's economy. Other benefits of assessing technological literacy include: developing an informed society, increasing citizen participation in discussion of technological developments, and helping to support a modern workforce, among others. The book also notes benefits to the assessment process. These benefits include: raising awareness and understanding the importance of technological literacy to its citizenry, and perhaps most important – assessing technological literacy in a rigorous way will help legislators and policy makers to become aware of the critical importance of technological literacy (Garmire & Pearson, 2006, p. 22).

Part of the research the committee undertook was to identify and critique a number of assessments already developed, both nationally and internationally. Twenty-eight instruments were identified that had direct pertinence to the study. Roughly two-thirds of the existing sets of assessments were geared towards K-12 students while the remaining third were designed for out-of-school adults. Only two of the assessments were targeted at assessing technological literacy among teachers. The committee concluded that no single assessment could identify all three dimensions of technology. However, the committee believed that some of the instruments that assessed a specific technological dimension could be combined and edited to produce an instrument that would be a comprehensive assessment of technological literacy (Garmire & Pearson, 2006, p. 39).

The Recommendations

After a thorough examination of two commissioned literature reviews—learning related to technology and learning related to engineering (Petrina et al. and 2004, Waller, 2004, as cited in Garmire & Pearson, 2006)—it was apparent to the committee that the assessment of technological literacy in the United States was in its infancy. The committee concluded that this may be due to the fact that relatively few students can take technology education courses, either due to choice or because the courses were not offered. In addition, the number of technology teachers is relatively small nationwide and little research has been conducted on understanding attitudes that people have towards technology. For these reasons, communication with other governmental, national, and international organizations to solicit research opportunities in assessing technological literacy should commence. The committee made twelve recommendations which address five critical areas (Garmire & Pearson, 2006). These critical areas and subsequent recommendations are:

Critical Area: Opportunities for Assessment

1. The National Assessment Governing Board (NAGP) should authorize studies of technological literacy along with other science and mathematics assessments.
2. The U.S. Department of Education (USDOE) and National Science Foundation (NSF) should encourage the International Association for the Evaluation of

Education Achievement and the Trends in Mathematics and Science Study (TIMSS) to include technological literacy items on their assessments.

3. NSF should commission and fund a series of sample-based studies of technological literacy in K-12 students.
4. The No Child Left Behind Act (NCLB) should be used as a vehicle to help make teachers more technologically literate.
5. NSF and USDOE should fund the development of and pilot test sample-based technological literacy assessments among pre-service and in-service teachers of science, mathematics, technology, English, and social studies.
6. The International Technology Education Association (ITEA) should continue to conduct research by polling adults on their technological literacy being certain to include the three dimensions of technological literacy.

Critical Area: Research on Learning

7. NSF or USDOE should fund a synthesis study focused on how children learn technological concepts.
8. NSF and USDOE should support a research-capacity-building initiative related to the assessment of technological literacy.
9. NSF should take the lead in organizing an interagency federal research initiative to investigate technological learning in adults.

Critical Area: Explaining Innovative Measurement Techniques

10. The National Institute of Standards and Technology should plan a major national meeting to explore the potential of innovative, computer-based techniques for assessing technological literacy in students, teachers, and out-of-school adults.

Critical Area: Framework Development

11. Assessments of technological literacy in K-12 students, K-12 teachers, and out-of-school adults should be guided by rigorously developed assessment frameworks, as described in the text.
    a. The National Assessment Governing Board should commission the development of a framework to guide the development of national and state-level assessments of technological literacy in K-12 students.
    b. NSF and USDOE should fund research to develop a framework for an assessment of technological literacy in K-12 teachers.
    c. NSF and USDOE should fund research to develop a framework for the assessment of technological literacy in out-of-school adults.

Critical Area: Expanding the Definition of Technology

12. USDOE, state education departments, private education testing companies, and education-related accreditation organizations should broaden the definition of technological literacy to include the study of technology. (p. 180-193).

Relevance to Career and Technology Education

One does not need to look far to understand the relevance this text has on career and technology education. Technological literacy is considered by many to be the essence of technology education. The reality that *Tech Tally* uses our discipline and professional organization to argue the need for technological literacy should certainly be encouraging and humbling to our profession. Career and technology educators at all levels should embrace the text and promote its recommendations to the fullest extent. Legislators who embrace career and technology education could see to it that *Tech Tally*'s recommendations are implemented at the state and national levels. Career and technology teacher educators could develop research projects to design and develop meaningful assessments of technological literacy by using research funding. Career and technology education teachers could use the assessments of the teacher educator's research to assess their student's technological literacy aptitude. Student assessment data could be synthesized to describe any deficiencies and/or disparities in the teaching of technological literacy which would drive curriculum and school reform that would ultimately foster a potent technologically literate society.

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BOOK REVIEW

Middleton, H. (Ed.). (2008). ***Researching technology education*****:** ***Methods and techniques.***
Rotterdam, The Netherlands: Sense Publishers.
$49.00 (paperback), 228 pp. (ISBN-10: 9087902603).

Abstract

Neophyte researchers in technology education or those looking for new methods to examine their core research issues will find an interesting mix of approaches for qualitative research studies in the collection presented by Howard Middleton in *Researching Technology Education*, (2008). Readers may detect a somewhat English spin to this collection since most of the contributors are from Australia or the United Kingdom. This international view emphasizes that technology teacher education and research are issues for countries across the globe. The chapter written by Richard Kimbell on Design Performance: Digital Tools: Research Processes provides an excellent description on anticipated and unexpected outcomes researchers using technology to assist in their assessments may encounter. This chapter alone may be worth the price of the book.

This collection of research techniques presented in, *Researching Technology Education: Methods and Techniques* (Middleton, 2008), points out "…that to understand technology education we need to use research methods that are appropriate for technology education" (p. 1), and presents several innovative tools for the researcher to consider. Researching Technology Education promises to make the

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technology educator more proficient in various methodologies which is as important as performing the actual research itself. Case studies, comparative analysis, researching design performance, application of the reparatory grid technique and researching expertise development are presented, according to the author, because, "the tools available determine what can be researched" (p. 2).

Lest the reader get lost in the various methodologies or purpose for this collection the introduction first describes the four purposes of this text.

1. Research methods will help educators write research proposals
2. All methods presented in this text will help in understanding knowledge and learning in technology education
3. Process is more important than content
4. The methods presented are appropriate for technology education

Each of the eleven research articles is summarized by Middleton along with a short explanation of why he selected the particular article. The collection of work presented covers various methodologies which provide a widespread of relevance and applicability to the goals of the text established by the author.

Middleton leads off with a strong qualitative analysis methodology for classroom case studies presented by Robert McCormick. McCormick (2008) provides the technology educator with a justification and understanding of this methodology by explaining how classroom case studies can be used to explore the *nature of knowledge*, the *use of knowledge,* the *social or moral issues* of knowledge followed by the *teacher's role* in and the strategies for dealing with these issues in the classroom. Starting with a background on case studies which leads into how to address design issues of external validity, construct validly, reliability and internal validity, a strong foundation is laid prior to examining the role of the researcher, ethics along with the strengths and weaknesses of classroom case studies. One would be hard pressed to argue that McCormick failed to meet the goals of this text.

The next article falls short of meeting both the goals of the book and the premise of the article of, *Developing Professional Thinking for Technology Teachers*. Banks (2008) using reminds the technology teacher of the importance of pedagogical and subject/content knowledge before introducing the concept of "school knowledge". This later type of knowledge is inherent to the particulars of the individual institutions and its common practice in the teaching of the subject(s). Using a Venn diagram developed by other researchers which illustrates the intersection and overlap of school knowledge, subject knowledge and pedagogical knowledge a group of thirteen student teachers in their final year at their university are asked to describe the importance of each type of knowledge in one of their courses. Surprising enough, all the students found the same framework provided by their professor, useful in describing their field experience. Given the suggestion by their professor that they could use the framework, one should not have been surprised that all of the students chose to follow his example. One might conclude that the behavior of the students could have been predicted but not the researchers in this study. So that the reader is not left wondering if these phenomena which appear to be some sort of Pavlovian condition response, where good grades are the student's reward for addressing all elements of the framework, could be duplicated in other schools a similar test is performed with multiple schools. The results in the multi-site study were much the same with the student teachers using the same framework presented by their professor to explain their teaching experience. To demonstrate that this was not a local or regional phenomena but one that could have transferrable possibilities, a multi-international site test was performed; similar number of student teachers resulted in similar results.

One is left wondering if using technology teachers with various levels of experience who had no direct tie to the research would have resulted in use of the same framework. Could there have been some inherit bias due to the student teacher-professor relationship? The assessment of technical competency emphasized by Zane (2008) and Testa (2008), along with development of "reflective practitioners, social critics and good citizens," (Star & Hammer, 2008) might provide a better insight into student teacher learning and attitudes than reciting or paraphrasing lessons learned in school.

Using self declared experts [Note: The expertise was verified by having them perform tests for the researcher]. Chester (2008) presents another methodology that is designed to determine the range of metacognitive processes used in constructing 3D-CAD models. Using the video capture of experts, the author points out technology instructors can replay the results with commentary and expert audio comments to facilitate the mastery by students of complex skills. In discussing one of the characteristics of an "expert" Chester indicates "…the inability to verbalize the 'know how' or procedural knowledge because much of it is tacit" (p. 47). This observation calls into question utility of verbal reports and think-aloud protocols discussed in researching expertise in complex computer applications (p. 73).

Measurement of mastery of skills by technology teachers is called into question by the methodology presented in Project E-Scape described by Kimbell (2008). In presenting the process, data and statistics for testing the model used in design performance Kimbell immediately established the credibility of his approach in dealing with the issues of reliability, validity, and manageability (p.110-113). Web-based portfolios were evaluated by judges who searched for voice, understanding and comments/reflections that suggested contemplation or thinking. Challenges of evaluating content and thematic analysis, along with the use of comparative analysis is examined (p.113-127), and logical frameworks are presented but no technology tools are identified for the technology educators who may be intrigued by the studies presented. One such tool to consider is a software product from Content Analyst (2008), which uses samples of relevant studies to compare documents/ portfolios to determine the coherence or content of the collection. This sort of tool eliminates the subtle, inherent bias or variability of all human subjects by researchers.

No recipes for research proposals are presented, nor will the reader find that all methods are appropriate for technology education but technology educators who are searching for different views or methodologies which might be applicable to their research will find this collection worth purchasing.

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BITS AND PIECES

Information for Authors

The *Journal of Industrial Teacher Education (JITE)* is issued three times annually by the National Association of Industrial and Technical Teacher Education (NAITTE). Published manuscripts are high-quality guest articles, refereed articles, “At Issue” essays, “Comments”, reviews of books/media and computer hardware and software in an “Under Review” section, and special feature issues that report scholarly inquiry and commentary broadly related to industrial and technical teacher education, military training, and industrial training.

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