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The Journal of Vocational Education Research

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Editor's Note

Joe W. Kotrlik
Louisiana State University

Once again, I wish to thank Jay Rojewski and Morgan Lewis for the excellent support and advice I have received from them. I am enjoying serving as Editor of *JVER* and this is due in large part to their assistance and support. I also want to thank the many reviewers who continue to serve *JVER*. Prompt, quality reviews are critical to the quality of *JVER* and the reviewers have served *JVER* and AVERA well.

Volume 28 Issue 2 contains four articles that are very diverse, yet are very important to the research mission in career and technical education. The first article by Alberto Arenas, "School-Based Enterprises and Environmental Sustainability," uses an educational framework of environmental sustainability to examine the production process and the final products and services delivered by School-Based Enterprises (SBEs). Existing literature in the area of SBEs extols their impact in the form of improving learning; however, research has been slow to address the importance of promoting ecological awareness through vocational, career and technical education. This article discusses the need to "green" SBEs in order to raise students' and teachers' consciousness about the importance of environmental stewardship, and it also explores key limitations faced by SBEs that attempt to follow such a framework. This environmental educational framework is used to analyze qualitatively the actual practices of SBEs in two public secondary schools in Colombia, South America.

Ernest Brewer and Jama McMahan examined job stress and burnout among industrial and technical teacher educators. Participants perceived that factors other than demographic characteristics explain a large amount of the variance in industrial and technical teacher educators' levels of job stress and burnout. Also, results indicate that industrial and technical teacher educators view stressors related to lack of organizational support as more severe than stressors related to job pressures. These findings have implications for addressing job stress in industrial and technical teacher education and could have implications for other teacher educators in career and technical education.

Farrell and Kotrlik found that traditional learning style instruments measure how students learn by interacting with their environments. Although these instruments are widely accepted, many are based on early theories and have

questionable reliability and validity. The goal of this research was to furnish educators with a high quality, easily administered self-assessment tool to determine individual differences in strategical information processing styles, which are a measure of the strategies that individuals use to process information transmitted by the senses. Based on the theories of individual differences and the information processing paradigm, Farrell and Kotrlik hypothesized five different strategical information processing styles (SIPS): visuo-spatial, analytical, social, categorical, and verbal. An instrument was developed containing specific measurable descriptors for each of the five constructs. In this study, the empirical evidence verified only four SIPS: visuo-spatial, analytical, social, and categorical. Although the study did not confirm the verbal style, there is strong theoretical evidence that this style exists and further research is needed to develop and evaluate new indicator variables that will measure this construct. These individual strategies should prove to be useful assets in the dynamic workplace of the twenty-first century.

Chris Zirkle's article completes this issue by presenting a review and synthesis of the distance learning literature in career and technical education. This research synthesis reviews previous studies on distance education in CTE, organizing them into topical categories and highlights the important aspects of these studies. Zirkle states that research on distance education in career and technical education reflects many of the concerns voiced by Phipps and Merisotis (1999), i.e., the research has been focused on individual courses, not programs, and has not examined differences between traditional and distance learners. Zirkle indicates that innovative programming in the use of distance learning in career and technical education is warranted.

As indicated earlier, these articles are diverse and are important to the research mission in vocational, career and technical education. These articles certainly provide solid foundations for further research in the areas studied.

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Journal of Vocational Education Research, 28(2), pp. 107-124.

School-Based Enterprises and Environmental Sustainability

Alberto Arenas
University of Arizona

Abstract

This article uses an educational framework of environmental sustainability to examine the production process and the final products and services delivered by School-Based Enterprises (SBEs). Whereas the fledging literature on SBEs has extolled their many benefits for improving learning, it has been slow to acknowledge the importance of promoting ecological awareness through vocational education. This article defends the importance of "greening" SBEs in order to raise students' and teachers' consciousness about the importance of environmental stewardship, and it also explores key limitations faced by SBEs that attempt to follow such a framework. This environmental educational framework is used to analyze qualitatively the actual practices of SBEs in two public secondary schools in Colombia, South America.

Introduction

The goal of production is to produce not commodities,
but free people in harmony with nature.
—Adapted from John Dewey (1916)

A School-Based Enterprise (SBE) is a student-led productive activity that provides a product or service for the school or the community. Sometimes an SBE constitutes a course independent of the academic curriculum; other times it serves as a generator theme for the entire curriculum. An SBE is important for several reasons: it provides relevance, context, and concreteness to abstract material learned in the classroom; it supplies a product or service that is lacking in the school or community; it challenges the individualized nature of modern education by engaging students in a cooperative endeavor; it increases students' awareness of the connections between work and community well-being; it enables students to take pride in their work; and it allows students to develop confidence in their leadership capabilities. Examples of SBEs include raising crops and farm animals, manufacturing household items, operating a radio station, selling beverages and pastries, managing a restaurant, repairing old homes, maintaining local parks, and providing child-care services.

This form of learning through production is not new. Schools in many countries, including in the United States, have used structures similar to SBEs for decades (Borstel, 1991, 1992). Among the literature on SBEs in the United States is an often-quoted book, *School-Based Enterprise: Productive Learning in American High*

Schools (Stern, Stone, Hopkins, McMillion, & Crain, 1994) that laid out some of the theoretical and practical considerations for starting and consolidating SBEs, based on the stories of 16 high schools (for other relevant literature, see Brown, 1995; Singh, 1998). In this article I seek to extend this discussion by considering the environmental consequences of the production process and the products and services delivered by SBEs. More generally, I present a broad educational framework to assist educators in restructuring their current vocational practices to promote environmental stewardship. Given the heightened global consciousness regarding environmental problems, the field of vocational education would appear ripe for this kind of exploration.

The inclusion of environmental concerns in vocational education is in fact a natural extension of the application of a social justice lens to work education (for examples see Dentith, 1997; Gregson, 1996; Kincheloe, 1995; Simon, Dippo, & Schenke, 1991). This lens has been identified as essential for teaching students from low-income backgrounds how to challenge oppressive systems of belief such as classism, racism, and sexism. Given that poor and ethnic minority students constitute a disproportionate percentage of the student population in vocational programs, it is essential for teachers to foster in them an understanding of the political nature of education. This political consciousness would allow students to see the connections among low-income communities, social problems, and environmental deterioration, which go hand in hand with poverty. People in poor communities are exposed to a wider array of environmental and social harms than are residents in higher socioeconomic areas, including mediocre air and water quality, homes with toxic levels of lead and asbestos, neighborhoods with few parks and poor sewage systems, land prone to erosion and heavy deforestation, substandard nutrition, and inadequate health care. Although vocational education (or any form of education for that matter) is incapable of directly solving these problems, a heightened social and environmental awareness may lead students to understand that these conditions are not inevitable, but rather result from political and economic decisions that can be reversed.

Given that vocational education provides one of the clearest links between learning and economic productivity, it is important for career and technical educators to ask themselves about the environmental impact of any line of production or service. All forms of production involve an exchange of matter and energy, which inevitably carries with it an environmental effect (see, for instance, Ashworth, 1995). If vocational education is designed to have the least possible impact on natural resources, these lessons can positively affect students' daily lives and perhaps even influence the type of employment they will seek after graduation. Borrowing from John Dewey (1916), the ultimate goal of production is to produce not commodities, but free people who live in harmony with nature. For instance, in the United States, the environmentally friendly trade programs at La Follette High School in Madison, Wisconsin, and Birmingham Seaholm High School in Birmingham, Michigan, are

two rare examples of vocational programs that take environmental concerns seriously (Wolf, 2001). At both schools, students build homes and adapt existing buildings following eco-architectural principles, addressing such issues as energy efficiency, resource conservation, and indoor air quality. Despite the success of these and other programs, very little research has been done on the connections between the natural environment and work education (Dippo, 1998; Lakes, 2000), leaving practitioners, even those with the best of intentions, at a loss about how and where to start. Thus, in this article I seek to contribute to this inchoate literature by assessing the strengths and weaknesses of environmental SBEs that enjoy very few financial resources.

The article is divided into four sections: first, it presents a framework of environmental education as it relates to the production of SBEs. Second, it focuses on the methodology used to explore two public secondary schools in Colombia, South America, that have for several years implemented SBEs with an environmental orientation. Third, it uses the educational framework developed in section 1 as an analytical tool to study the Colombian SBEs. And finally, it discusses the difficulties of fostering environmental protection in light of the obstacles schools encounter in implementing their vocational programs.

Conceptual Base for the Study

During the last two decades, several publications have made explicit the connections between Western schooling and the global ecological crisis (e.g., Bowers, 1987; Hutchison, 1998; Orr, 1994; Smith & Williams, 1999). Among other topics, these publications have focused on philosophical issues concerning the purpose of education, alternative curricular and pedagogical strategies, the links between school and community, the importance of local lore and trans-generational communication, and the green design of K-16 buildings. A ramification of this growing literature is the connection between environmental sustainability and vocational education, or for the purposes of this article, SBEs.

The following framework, adapted from the work of Smith and Williams (1999) and John and Nancy Todd (1984), may prove useful in guiding educators to design and implement environmentally sensitive SBEs. It consists of a series of principles that, without being mutually exclusive, can serve as a starting point for any school that wants to implement a green vocational program or modify an existing one. Not all principles are applicable to every SBE, and the list should not be followed dogmatically. Rather, it can stimulate educators to think about the most appropriate applications of these ideas. This framework need not be restricted to SBEs but could be applied to other forms of vocational education, including career academies, clusters, occupational high schools, and magnet schools (for a complete list of possibilities, see Grubb, 1996). The framework consists of the following principles:

1. Focus on local knowledge and skills that support ecological renewal.

2. Use nature as a model for design.
3. Employ sustainable methods of cultivation and management.
4. Integrate living systems.
5. Make products that are durable, repairable, remanufacturable, and recyclable.

Focus on Local Knowledge and Skills That Support Ecological Renewal

Prior to the widespread implementation of the Western model of schools and universities worldwide, it was common for villagers and townspeople to rely on local knowledge, skills, traditions, and technologies that emerged from the interaction of the locality with the surrounding ecosystem (Bowers, 1992). In pre-modern times, elders also played an important role in the maintenance of ancestral traditions and the propagation of local histories. With industrialization and Western schooling becoming common in most nations, local knowledge and skill have been gradually displaced and ignored, leaving elders feeling that they are inadequate contributors in guiding youth in their transition into adulthood. Moreover, increases in family mobility, electronic means of communication, and modern forms of transportation like the automobile have undermined young people's sense of belonging to a particular locality. To counteract these trends, it is imperative for educators to assist students in generating appropriate responses to local problems based on resources available in the local ecosystem and in the collective wisdom of the community.

Use Nature as a Model for Design

Barry Commoner, a leading environmentalist, has emphasized that ecosystems are the only systems humans are aware of that maintain stability and protect their members and interrelationships over a long period of time. Therefore, it makes sense to use the ecosystem as a guiding metaphor for changing the operation and structure of social systems and technologies (Commoner, 1992, p. 11). Although there is not complete agreement among ecologists regarding the basic principles that govern the behavior of ecosystems, most observers agree that ecosystems display at least the following six principles: interdependence, carrying capacity, diversity, resilience, relationships, and energy and matter flows. The last principle, energy and matter flows, can serve as an example for explaining nature as a model for design. All ecosystems are open systems that require a constant flow of energy and matter. Energy enters an ecosystem in the form of solar energy; matter enters as water and carbon dioxide, among other forms. Plants, which use these elements in their growth process, are eaten by primary consumers (e.g., cow), which are in turn eaten by secondary consumers (e.g., puma). After plants and animals die, their organic material decomposes. Decomposers, such as bacteria and fungi, release carbon dioxide and mineral salts. Plants absorb these inorganic compounds, and the whole cycle of energy and matter flows begins again. An important lesson gained from this

principle is the absence of waste. What for one organism is refuse for another is a feast, as in the case of manure decomposed by microorganisms.

Employ Sustainable Methods of Cultivation and Management

SBEs dealing with renewable resources, such as crops, livestock, trees, and the like, can play a vital role in motivating students to switch to sustainable methods of cultivation and management. In the case of agriculture, a sustainable approach uses biological controls, crop rotation, composting, mulching, and other low-input strategies to avoid the use of synthetic fertilizers and pesticides. This approach also uses less water, protects the biological richness of the soil, and prevents erosion. In the case of raising livestock, a sustainable approach uses feeds and forages free of synthetic chemicals, physical environments that allow animals ample movement to express normal patterns of behavior, and a diet free of hormonal growth promoters and antibiotics. In the case of forestry, the quantity of the renewable resource removed does not exceed the amount that grows in the interval between harvests, and an effort is made to maintain the habitats of all native plant and animal species. Sustainable methods of production provide win-win situations, where producers and consumers benefit and biological diversity is enhanced.

Integrate Living Systems

Human and nonhuman life constitute systems nested in larger systems that are fully integrated. As Barry Commoner stated succinctly in his 1971 classic *The Closing Circle*, "Everything is connected to everything else." Systems form web-like structures that are symbiotic and interdependent. A forest presents a good example. A tree is a living system composed of roots, a trunk, branches, and leaves. Each of these is composed of tissue, which in turn is made up of a collection of cells. Simultaneously, the tree is part of a larger ecosystem called a forest, which is part of a biome. Such interrelationships at the micro and macro levels could be elaborated endlessly. The point is that no living system can exist in isolation from other living systems. Social systems that follow this integration tend to be very resilient and to withstand outside pressures, just as an ecosystem does.

Make Products That Are Durable, Repairable, Remanufacturable, and Recyclable

This principle does not apply to SBEs that provide a service or a perishable good (e.g., a student-run radio station or a student-maintained orchard). Instead, it is applicable to SBEs that produce a consumer good for sale. An environmentally sustainable SBE should steer clear of the notion that disposable products are desirable because they are cheaper. Products that are durable, repairable, upgradable, remanufacturable, and recyclable must be the goal of any SBE. Extending the useful life of a product allows educators to send the critical message to students that any

form of production has an environmental impact. The throwaway quality of today's commercial products has the all too appealing incentive of a low price, making them attractive to producers and consumers. However, too often these products are of poor workmanship and require frequent replacement. Not only are natural resources squandered, but also human labor is denigrated. The educational function of SBEs places them in an ideal situation for promoting the concept that consumers benefit from paying a higher up-front cost for a durable product. Students can experiment with different materials and forms of production without fear of losing their "jobs" or losing customers, as workers in a real firm would.

Methodology

A qualitative research methodology was used by means of in-depth interviews, direct observations, and document analysis. This method was used to probe the following questions:

> "Do schools that foster environmental stewardship and have a vocational component follow the educational framework suggested by the literature? If so, how? If not, why not?"

To answer these questions, I contacted the Colombian Ministry of Education, which provided me with a list of schools considered models for the rest of the nation in terms of promoting environmental sustainability. I used four criteria in selecting schools from this list for examination: First, I chose only public schools because Colombian public schools tend to operate with small budgets and serve low-income students. These characteristics increase the potential for generalizing results. Second, I selected secondary schools. Although the literature is rich in descriptions of environmentally sensitive elementary school programs, there is a dearth of case studies of secondary schools with a similar philosophy and practice. Third, I sought one rural, one semi-urban, and one urban school (but I was only able to gain access to a rural and semi-urban school). Again, my rationale was to ensure the results were generalizable to as many settings as possible. Fourth, the schools had to have a vocational component. Based on these criteria, I obtained a purposeful sample of two schools: the Fernández Guerra Secondary School (better known as Ferguerra), located in southwestern Colombia, and the Tomás Herrera Cantillo Secondary School (better known as Peñoncito), located in the northern part of the country. During the 1990s both schools had set up one SBE per grade level to promote environmental awareness and protection.

After contacting the two schools and obtaining the appropriate permissions, I spent several months at each school in 1997 and 1998, conducting a qualitative study of various aspects of the schools (for an analysis of the schools' academic curricula, see Arenas, 2001). One key motivation for the schools to accept my presence was that I would provide information to help them improve various aspects of their schools, including their vocational programs. Prior to my arrival, administrators and

faculty were informed about the objectives of the study and the use of the educational framework for environmental protection. School officials liked the idea of using a deductive approach whereby a framework developed elsewhere could be used in assessing their SBEs. It was determined that a deductive approach would be superior to an inductive one given the broad theoretical literature that already exists regarding the greening of the economic system and production processes in general (albeit there is a dearth of literature connecting it to vocational education). This etic perspective, as it turned out, provided a starting point for systematically analyzing the environmental advances of their SBEs, something they had not previously done.

I chose a qualitative approach because each school had a unique model for providing experiential environmental education. At each school I conducted in-depth interviews of key stakeholders (i.e., students, parents, teachers, and administrators); direct observations of the various activities of the SBEs; participant observations of the entire vocational program; and an analysis of documentation, including the schools' mission statements and other administrative documents, articles from local newspapers, student homework, and reports prepared by the vocational teachers. Using several sources of data allowed me to triangulate key observations to strengthen the results of the study (Patton, 2002). Between the two schools I conducted a total of 18 formal interviews (based on open-ended questions) and about 40 hours of field observations. Prior to the observations, students were informed of the research objectives. The following are English translations of some of the questions asked of the teachers:

- Why were the SBEs started?
- Is there a relationship between the SBE and the academic curriculum? If yes, how is it manifested? If no, are there any plans to bring them together?
- What type of training, if any, did you receive to run the SBE?
- In what ways, if any, do you feel your SBE contributes to the larger environmental mission of the school?
- What are the main obstacles faced by your SBE?
- Do you feel your SBE should make a profit? Why or why not?
- Do you feel that you received adequate training at the university or SENA (equivalent to a community college) on issues related to environmental sustainability? If yes, in what ways? If no, in what areas would you like to learn more?

For the direct observations, I participated with the SBE instructors in the weekly classes for one month, sometimes as a co-instructor, other times as an observer. Generally, each class met for two consecutive hours per week. Whereas I looked specifically for examples of environmental sustainability during the formal interviews, I looked for the opposite in the field observations. Here the main focus was on locating and examining *negative cases* that disconfirmed my expectations and framework (Patton, 2002, p. 554–556). Specifically, I paid attention to conversations and aspects of the SBE that dealt with non-environmental issues (e.g., how to

increase student participation in the SBE, how to make the product more efficiently, or how to market it better). Just as with the triangulation of methods, this strategy helped to promote research validity. The negative cases were particularly important in understanding the many difficulties the SBEs encountered within the educational framework, and the limitations imposed by strict adherence to an environmental sustainability approach.

I analyzed my field notes at the end of each day or as soon as possible thereafter. I often shared my descriptions of events with teachers and administrators to verify their accuracy. At the end of the study, I delivered a written report and an oral presentation to the faculty, staff, and students of both schools. Following is a description of each school (for a summary, see the appendix).

Fernández Guerra Secondary School (hereafter Ferguerra)

Ferguerra is a semiurban secondary school inaugurated in 1941 as a private Catholic school and remaining so until the mid-1980s, when it became a public institution. The academically oriented school is located in southwestern Colombia in the town of Santander de Quilichao (pop. 50,000), department of Cauca (departments are equivalent to states or provinces). The town is near Cali (pop. 2 million), one of the most populous cities in the country. In the mid-1980s, feeling a general disenchantment with traditional methods of education, a small group of Ferguerra administrators and teachers proposed a new model of education that integrated the different disciplines around a theme of the local and regional ecology. They believed that by adopting a holistic approach revolving around environmental issues to which students could relate, they could encourage students to be more enthusiastic about learning and more willing to participate actively in improving their community. The rest of the faculty gradually embraced the model and slowly started to implement the new ideas—starting with 6th grade and adding a new theme to the next higher grade level with each successive year.

The afternoon session, where the environmental model was implemented, has 700 students and 30 teachers. In the mid-1990s, teachers decided to complement their educational model with an SBE for each grade level. Not all these SBEs meet the principles of environmental production, and for the most part they constitute an extra course unrelated to the other subjects.

Tomás Herrera Cantillo Secondary School (hereafter Peñoncito)

Peñoncito is a rural public school inaugurated in 1988 as a nonprofit private school, which it remained until the mid-1990s, when it became a public institution. The vocationally oriented school is located in northern Colombia in the village of Peñoncito (pop. 2,000), department of Magdalena. The village is near Mompox (pop. 25,000), one of Colombia's colonial gems. The school, started by local teachers and parents, was originally conceived with the goal of preparing students to understand,

protect, and care about the region's heritage in all its manifestations, social, cultural, and environmental. In comparison to Ferguerra, Peñoncito is an extremely poor school. It lacks the most basic services, including running water. The only source of water is an artesian well in the school compound that serves inadequately the needs of a school specializing in agriculture and livestock. Moreover, the school has no teachers' lounge, no cafeteria, only two makeshift toilets, insufficient desks for all students, and at most one textbook per classroom.

Peñoncito has 180 students and 12 teachers. As in Ferguerra, there is one SBE per grade, but unlike at Ferguerra, all SBEs meet several principles of environmental production. Moreover, the curriculum was developed around the SBEs, allowing for substantial integration among most subjects.

Results

To illustrate each principle of the educational framework, I present one SBE and some of the obstacles it encountered. In practice, each SBE could be used to illustrate more than one principle, which is not surprising given the overlap in the content of the principles. Therefore, the choice of SBE is merely expository rather than exclusionary.

Focus On Local Knowledge and Skills That Support Ecological Renewal

Peñoncito addresses this principle through the cultivation of a medicinal botanical garden by 6th grade students. The biology teacher began the botanical garden in the early 1990s. She had her students ask their mothers and grandmothers to list all the medicinal plants they knew, then to choose from the list those plants that were difficult to find. The teacher's assumption was that the rarer the plant, the greater the likelihood that it was becoming endangered, an assumption later corroborated by university botany students who were doing research in the region. The teacher, with the aid of some mothers, studied the lists and selected about 50 rare and common medicinal plants. Students found specimens of these species and planted them in the school garden. As part of the SBE, each student was charged with the care of several plants and two or three times a year goes to different towns in the region to sell them.

This SBE supports intergenerational communication by bringing together elders and students. The valuing of information that mothers and grandmothers have accumulated through generations brings to life an oral knowledge that is not codified in textbooks and is often neglected in the modern classroom. The SBE teaches students the skills of identifying and taking care of medicinal plants, and even protecting them from extinction. It also teaches students that they can rely on their own skill and knowledge, rather than the pharmaceutical industry, for palliatives for many common ailments.

One important obstacle for this and other SBEs at Peñoncito has been the lack of funds to improve them. Funds are scarce in great part because the municipal office (which under the decentralization process in Colombia is in charge of disbursing key funds for schools) has withheld much-needed funds as a way of punishing the school for acting as a watchdog in local politics. School officials see it as their responsibility to promote not only environmental awareness but also a larger sense of ethics in local politics. "The mayor sees in me an enemy," Peñoncito's principal said. "He even threatened me with jail if I kept pushing for our aqueduct. They [politicians] do not seem to understand that it's no longer business as usual. They're accountable to us now" (personal communication, November 25, 1998; I have translated all personal communications from the original Spanish).

Use Nature as a Model for Design

Ferguerra applies this principle in its 6th grade SBE, which transforms fruit waste into paper. Students obtain the waste from vendors of pineapple, banana, and *lulo* (a local fruit) juice and fruit in the town's main plaza. In the past, the skins, stems, and part of the pulp of these fruits would be thrown in the street as trash. Thanks to the cajoling of students and the local waste collector, vendors now put this refuse in plastic bags that are later retrieved by the garbage disposal company. Every two weeks the students collect the bags from the disposal company and take them to the school, where they manufacture paper, decorative boxes, and cards from the contents. The products are then sold at school bazaars and to local merchants. The SBE has become so successful that students have started to export their products to nearby towns.

Through this SBE the concept of waste acquires a new dimension. It is no longer seen as a nuisance but as an economic asset. Thanks to the students' efforts, the plaza remains clean, and the environmental consciousness of merchants and other citizens is increased. Given that the waste is free, students do not have to spend any money in acquiring the raw material. Moreover, students learn an innovative way to produce a basic product without destroying any natural resources.

A key obstacle for implementing this principle has been the lack of teacher training in sustainable development issues. The vocational education teachers received conventional vocational training and are therefore unaware of the various social and environmental dimensions related to production. Although the school provides professional development opportunities through the SENA (the Colombian national apprenticeship system, a postsecondary community college-type institution), these courses focus mostly on issues of efficiency and profitability, not on environmental sustainability. The teacher in charge of the papermaking SBE explained, "I knew about this project through my own experience as an artist, but not because of any knowledge of ecology or sustainability" (personal communication, October 13, 1998). Another vocational teacher said, "It has been really difficult to do stuff I wasn't trained for. I'm all for environmental education but frankly I learn as I

go along and I'm sure I make lots of mistakes" (personal communication, October 15, 1998). Teachers are thus forced to learn on their own or with other community members, which so far has been an inadequate substitute for more systematic training.

Employ Sustainable Methods of Cultivation and Management

Ferguerra has implemented an SBE that faithfully adheres to this principle. For their 9th grade SBE, students make plant pots and curtains from bamboo shoots that they cultivate themselves. This SBE started in 1995 when teachers at the school contacted a local environmental organization, which donated 5,000 bamboo starters on the condition that students would plant the starters and, once they grew to an appropriate size, would transplant half along the banks of the local Quilichao River. In exchange, the organization agreed to pay the school the equivalent of $0.20 US per stem planted along the river. The students cultivate the bamboo stems using organic methods, and with the half they keep, students make plant pots and curtains for sale. By cultivating their own bamboo, it is quite easy for students to harvest sustainably. At the same time, they combat erosion and protect the river from sedimentation. One student summarized what appeared to be a common sentiment: "I love this project because I have a great time planting bamboo with my classmates and I get to go to parts of the river that I generally wouldn't go to on my own" (personal communication, October 13, 1998).

Other SBEs at Ferguerra, however, do not follow this or any other ecological principle. For instance, the broom-making SBE managed by 7th graders is by and large a conventional enterprise with no concern for sustainability. To manufacture the brooms, students buy the wood sticks from a local lumber company and the whisks (made from synthetic fiber) from a regional wholesale company. Neither of these components is produced sustainably. When the teacher in charge was asked about this problem, she said, "We started this project because a local drug rehabilitation center offered to train our students how to make brooms. It was a great opportunity that we didn't want to miss and we don't feel we are in a position to suggest to them the use of sustainable materials. Also, it's difficult to find sustainable materials as substitutes" (personal communication, October 14, 1998). If the relationship prospers, the teacher concluded, then Ferguerra would be in a stronger position to suggest some changes.

Integrate Living Systems

Most of the SBEs at Peñoncito adhere to the cardinal rule of integrating living systems. For instance, the aquaculture (fish farming) SBE for the 10th and 11th grades uses waste from the organic garden. The vermiculture SBE, devoted solely to compost making, uses leftovers from the 6th, 7th, and 8th grade SBEs. Soil from the bottom of the aquaculture ponds—enriched with fish excrement—serves as an

excellent fertilizer for the greenhouse and the various gardens. This basic integration combines production and waste-elimination processes in a single system. Another advantage of integrating the different systems is that this reduces the costs of acquiring basic materials. In this case, compost and fish food is obtained for free from several SBEs.

The aquaculture SBE in particular has proven to be an extremely important experiment. Local residents practice mostly subsistence fishing, despite being surrounded by at least 11 marshes of colossal size. Fishermen tend to use nets with very small holes, catching adult and young fish alike and thus reducing the fish population in the waters, making the practice unsustainable. Realizing the enormous economic potential that aquaculture has for the region, the school has devoted the upper two grade levels to its study. The school started by building two large fish tanks—essentially by digging two large holes lined with clay to prevent water seepage, then waiting for the holes to fill with rainwater. The students added young fish of two different species *(mojarra* and *bocachico),* which they feed with plankton and organic waste. Not enough fish have been produced to allow for the marketing of any, but with greater experience and knowledge, fish production promises to become more successful in the future.

One aspect of integrating systems is the push to unite the academic and vocational curricula. At Peñoncito this has not been a problem given the original vocational orientation of the school and the fact that teachers and parents want both activities to be as closely aligned as possible. Plus, although academic schools enjoy more prestige than vocational ones, in the region around Peñoncito most schools are vocational, and thus there is little pressure to change. Ferguerra, in contrast, is an academic school and as one teacher said,

> I don't think it would be prudent for us to concentrate our curriculum around the SBEs because it could be perceived as the "vocationalization" of the school, and many parents would not see that in a good light. We've been able to secure parental support in part because we're academically rigorous, and parents hope that will translate into better jobs in the future. If we were to become more vocational, it could be perceived as a move in the wrong direction. (personal communication, October 14, 1998)

This impression was corroborated by several parents, who said they liked the school as it was. One parent said that although the SBEs were important, they "were not as important as academic courses" (personal communication, October 18, 1998).

Make Products That Are Durable, Repairable, Remanufacturable, and Recyclable

The 8th grade SBE at Ferguerra follows the principle of making durable products by making picture frames out of scrap metal. The material is acquired at landfills at no cost. Students help reduce the amount of waste in the landfill, thus

following the principle of viewing waste as an economic asset. Being made of metal, the picture frames are generally extremely durable and resistant to breakage. The making of picture frames also benefits from added value (i.e., the cost of labor, energy, and processed materials minus the cost of raw materials), just as a typical remanufacturing process does. In both schools the issue of quality is addressed by having producers (students working at the SBE) and other students at the school use the product. This testing system has led to several improvements along the way.

Durability needs to be contrasted with other sustainability factors, however. When 11th graders at Ferguerra decided to print T-shirts, they chose Disney motifs for the designs. Several questions related to sustainability were not asked: What values were being promoted through the Disney designs? Was it possible to use local motifs (e.g., the local river, the school's logo, an important town landmark)? Were the inks used in printing nontoxic? Could the wisdom of local indigenous groups be used to learn about natural dyes? (There are several indigenous reservations close to Santander de Quilichao, Ferguerra's hometown.) Was the cotton used to make the T-shirts cultivated organically? If not, are organically grown alternatives available? Clearly, for many of these questions there are no easy answers, but the mere attempt to answer them raises students' consciousness. When I posed these questions to the students and the teacher in charge, it became clear that there was great eagerness to investigate these issues. As an 11th grader said, "I do like the Mickey Mouse logo, but it would also be nice to have an indigenous design. And maybe those [T-shirts] will sell as well as the Mickey Mouse ones" (personal communication, October 5, 1998). Just as with any SBE, the more a teacher understands about sustainability issues, the greater the likelihood that these will become an integral part of the SBE.

Discussion: The Limits of Environmentally Sensitive Production

This article has applied an educational framework for environmental protection as a theoretical guide to explore SBEs in two secondary schools in Colombia. In addition, it identified various issues that have surfaced during the establishment and consolidation of these educational programs, including coping with minimal financial resources, improving the role of teachers, overcoming obstacles to the integration of SBEs into the general curriculum, and identifying the difficulties in attempting to make every SBE environmentally sustainable. Although the focus of this article has been environmental stewardship, I do not mean to imply that the social considerations of the production and the final product are less important. Clearly, social and environmental issues need to be considered in tandem. Both sets of issues have been underexplored in the field of vocational education, but environmental issues even more so, thus the focus of this article.

Based on these findings, several conclusions can be reached. First, given that the primary mission of an SBE is to foster an exciting learning environment rather than to turn a profit, SBEs have greater latitude to experiment with alternative

production and design processes that respect the integral interrelationship between human communities and surrounding environments. Although profit-making businesses can (and some do) engage in forms of production that are respectful of environmental systems, the reality of the marketplace often pressures businesses to relegate this consideration to a secondary position. On the other hand, although it is not necessary for an SBE to make a profit, eventually it needs to break even to recover costs. This is especially true for schools with limited resources that may find themselves in the quandary of having to close down SBEs due to a lack of funds. For example, Peñoncito faculty fear that its aquaculture projects may suffer this fate if an aqueduct is not built to maintain an adequate water level in the ponds.

Second, while both schools suffer from inadequate teacher training in environmental sustainability, Ferguerra has suffered more because none of its SBE teachers have received any postsecondary training in this area. They were trained in normal schools that focused on academic, classroom-based pedagogies. These teachers support the environmental mission of their school, but by their own admission have little understanding of how to translate this concern into environmentally sensitive SBEs. Training in this area is hard to come by, and this absence will inevitably continue to affect negatively the SBEs at Ferguerra. Several Peñoncito teachers, in contrast, did learn about organic and low-input forms of production at the university because they were trained as agricultural technicians (not as teachers), and they knew that eventually they wanted to put into practice some of these ideas in their region.

Third, environmentally sustainable production is easier to implement in the primary sector (e.g., agriculture) than in the secondary and tertiary sectors (e.g., service and manufacturing). The more the production uses natural, renewable-energy-based products, the less the environmental damage and the greater the possibility of recycling or composting the final product. The closer the production is to nature and the fewer synthetic products used, the easier it is to detect and correct unsustainable practices. The bamboo cultivation at Ferguerra, for instance, can be kept organic and synthetic-free relatively easy, whereas making the broom production (with a stick that comes from a conventional lumber company and synthetic fibers that are fossil fuel based) sustainable would require replacing the materials currently being used. High-tech production (e.g., computer manufacturing), which requires a myriad of components, most of which are fossil fuel based, is even farther removed from nature and consumes more resources. Engineers and technicians involved in the final production and assembly of tertiary sector products have little knowledge of the origin of most of the components. To minimize the environmental impact, producers should ensure that their products follow strict energy-saving standards, are durable, and contain mostly or exclusively recycled components. On the demand side, consumers need to be educated to demand environmentally sensitive goods.

A similar line of argument can be developed in favor of labor-intensive processes over capital-intensive ones. Schools like Peñoncito and Ferguerra tend to rely on labor-intensive processes given the relative affordability of these forms of production, an important consideration for any poor school. Beyond the cost savings, a key principle is that the less mechanized a workplace, the easier it is to follow environmental guidelines. For the sake of argument let us assume that Ferguerra's papermaking SBE becomes so successful that the school decides to buy a large mechanical press. With this new technology more paper can be made with fewer hands, which would have the unintended consequence of giving fewer students the opportunity to learn the craft of papermaking (not to mention that it may even glut the market). More directly related to our analysis, students and teachers will be hard-pressed to determine how the machine was manufactured, adding a new layer of ignorance to the production process and increasing the likelihood of nonsustainability.

By this argument I do not intend to advocate eliminating capital-intensive forms of production or synthetic fossil-fuel-based products. Rather, I seek to tease apart the production process and help schools decide when it makes sense to use one form of production over another. If a school decides to use a capital-intensive process, it would be useful for teachers and students to do a Life Cycle Assessment (LCA), a process that identifies and assesses the emissions that occur and the origin of the raw and manufactured materials used during the life of a product. Doing an LCA would be an extremely useful educational exercise even if it is imperfect due to the limited amount of information and experience available at the school.

This leads to the last consideration. It is unreasonable to expect any SBE, or any organization for that matter, to be completely sustainable. SBEs are part of unsustainable practices that permeate the world in the social, economic, and environmental spheres. Living in modern societies inevitably means making compromises, and it is not particularly surprising to find a self-proclaimed environmental vocational program engaged in a mix of sustainable and unsustainable practices. For example, even if Ferguerra's broom-making SBE were able to identify a timber company that follows sustainable harvesting—no small feat in itself—the synthetic fibers would still need to be replaced, and even then questions of economic viability and social justice would need to be addressed as well. The lesson here is that any vocational program needs to be cognizant of when a compromise is being made and to determine the consequences of such a compromise. Students and teachers must discuss these matters fully and transform as many aspects of their SBEs as realistically possible. Ultimately, the educational framework presented in this article is useful only insofar as it provides some general and flexible guidelines to follow, without falling prey to dogmatic or fundamentalist positions.

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Appendix. Characteristics of Two Colombian Secondary Schools

Characteristic	Ferguerra	Peňoncito
Location	Semiurban. Located in Santander de Quilichao (Department of Cauca), near the city of Cali (pop. 2 million).	Rural. Located in the village of Peñoncito (Department of Magdalena), near the town of Mompox (pop. 25,000)
Status	Public	Public
Type of school	Academic	Vocational
Number of students	700	180
Number of teachers	30	12

Characteristic	Ferguerra	Peňoncito
Socioeconomic level	Serves poor students	Serves poor students
Selection of topics for SBEs	By teachers, but seniors select their own SBE	By teachers
Administrative support for SBEs	Yes	Yes
Environmental principles followed in SBEs	Some	All
Products or services Provided by the SBEs:		
6th grade	Paper made from fruit waste. Fruit waste is obtained for free. With paper, students make cards and decoration boxes for sale.	Medicinal botanical garden. Medicinal plants are sold.
7th grade	Brooms. Students buy the sticks and synthetic fibers. Brooms are assembled and sold.	Organic garden and rabbit raising. Produce and rabbits are sold.
8th grade	Picture frames made from scrap metal obtained for free. Picture frames are sold.	Greenhouse and veterinary services. Produce is sold and veterinary services are provided to local farmers for free or a small fee.
9th grade	Plant pots and curtains made from bamboo shoots planted by students.	Vermiculture. Compost obtained is sold.
10th grade	Hydroponics. Project is in initial stages.	Aquaculture. Not enough fish is produced for sale.
11th grade[a]	T-shirts. Designs are printed or purchased. T-shirts are then sold.	Aquaculture. Not enough fish is produced for sale.

[a]Colombian secondary schools only go up to 11th grade

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Job Stress and Burnout among Industrial and Technical Teacher Educators

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Abstract

This study examined job stress and burnout among a random sample of 133 industrial and technical teacher educators. The Job Stress Survey (JSS) developed by Spielberger and Vagg (1999) measured stress; the Maslach Burnout Inventory-Human Services Survey (MBI-HSS) developed by Maslach and Jackson (1996) measured burnout. Stepwise multiple regression was used to determine the amount of variance in job stress and burnout levels predicted by demographic characteristics. Participants perceived stressors related to lack of organizational support as more severe than stressors related to the job itself. Also, participants reported an average degree of burnout. Demographic characteristics did not explain a large amount of variance in levels of job stress or burnout. Findings from this study have implications for designing interventions for job stress and burnout in industrial and technical teacher education.

Introduction

Numerous studies have examined job stress among postsecondary faculty (Barnes, Agago, & Coombs, 1998; Blackburn & Bently, 1993; Blix, Cruise, Mitchell, & Blix, 1994; Bowden, 2000; Dey, 1994; Gmelch, Wilke, & Lovrich, 1986; Lease, 1999; Marcy, 1996; Olsen, 1993; Seiler & Pearson, 1985; Smith, Anderson, & Lovrich, 1995; Thompson & Dey, 1998; Thorsen, 1996). This proliferation of research has focused much-deserved attention on the need to understand stress and its multifarious effects on postsecondary faculty. The current study contributes to the body of research by addressing a previously unstudied element of the population, industrial and technical teacher educators.

Studying stress relative to industrial and technical teacher educators has implications for improving understanding of job stress, as well as for enhancing the working life of industrial and technical teacher educators. Although considerable research has studied stress, further research is warranted to identify new factors that might mediate job stress. Examining previously unstudied populations within postsecondary education could help researchers identify such new factors. Because of differences among disciplines regarding salaries, class size, and publishing and tenure expectations, it is important to study samples from a single disciplinary type

(Biglan, 1973). Therefore, insights gained from examining stress among industrial and technical teacher educators have potential to impact staff development and retention strategies relative to the specific discipline, whereas previous insights might have limited applicability.

Theoretical Framework

The most widely accepted framework for conducting research on job stress has been person-environment (PE) fit theory (Edwards & Cooper, 1990; Spielberger & Vagg, 1999). Formalized by several researchers (French & Caplan, 1972; French, Caplan, & Harrison, 1982; French, Rogers, & Cobb, 1974; Harrison, 1978), PE fit theory asserts that the interaction between an individual and his or her environment determines whether or not a situation is stressful for that person. If the fit between an individual and environment is incompatible, stress results.

There are several distinctions relative to fit, the first obviously being between the individual and the environment (Edwards, Caplan, & Harrison, 1998). Other distinctions are between (a) objective representation and subjective representation and (b) demands and abilities. Stress can occur if there is a mismatch between the *reality* of the work environment (objective) and an individual's *perceptions* of the work environment (subjective). Likewise, lack of fit between the demands placed on individuals and their abilities to meet those demands can result in stress.

Review of Literature

Job Stress

Past research on job stress among postsecondary faculty has identified numerous sources and variables affecting stress levels. Among sources of stress identified by college faculty, certain patterns have emerged. For example, researchers have consistently reported time pressures (Astin, 1993; Barnes et al., 1998; Gmelch et al., 1986; Olsen, 1993; Smith et al., 1995; Thompson & Dey, 1998), high self-expectations (Gmelch et al.; Smith et al.), and research and publication demands (Astin; Blix et al., 1994; Smith et al.) as significant sources of job stress. In addition, the frequent technological advances of modern society along with the ongoing change that those advances spur have yielded increased stress. Approximately two thirds of United States college faculty members reported that keeping up with information technology (IT) was stressful for them (Sax, Astin, Korn, & Gilmartin, 1999).

In one notable study, Gmelch and colleagues (1986) examined dimensions of stress among 1,920 professors from 80 postsecondary institutions. Using factor analysis, they identified five dimensions of perceived stress: reward and recognition, time constraints, departmental influence, professional identity, and student interaction. The most important dimension was reward and recognition, which

accounted for 55% of common variance. This dimension highlights the effects of inadequate rewards and recognition on professors' stress levels. The results indicated a discrepancy between performance expectations placed on faculty and the amount of effort required to meet those expectations. Identification of this dimension of job stress is unique to postsecondary faculty.

Researchers also have identified several demographic variables that affect stress levels among postsecondary faculty members. Gender is one such variable. In general, female faculty members have reported higher levels of stress than their male counterparts (Blackburn & Bently, 1993; Blix et al., 1994; Sax et al., 1999; Smith et al., 1995; Thompson & Dey, 1998). Another variable accounting for differences in stress levels is ethnicity. In studies by Dey (1994), Smith and Witt (1993), and Thompson and Dey, non-White faculty members reported higher levels of stress than White faculty members. Tenure status also has accounted for differences in individual stress levels, with researchers such as Gmelch et al. (1986) and Marcy (1996) reporting that untenured faculty had higher levels of stress than tenured faculty members. Similarly, Blix et al. found that postsecondary faculty with less than 10 years of experience had higher stress levels than faculty with more than 20 years of experience. Smith et al. found that stress levels differed among faculty in different academic disciplines.

Effects of stress are detrimental to the well-being of postsecondary faculty. In a study by Blix et al. (1994), 48% of participants reported health problems related to stress, and 84% reported a decrease in productivity because of stress. Moreover, postsecondary faculty who have reported high levels of stress have also been more likely to report intent to leave academia than faculty with low levels of stress (Barnes et al., 1998). Barnes et al. suggested that higher education must combat stress-related problems if it is to attract and retain high-caliber faculty members.

Job Burnout

Excessive, prolonged stress can lead to *job burnout* (Maslach & Schaufeli, 1993). The concept of burnout emerged in the mid-1970s when Freudenberger (1974) noted a propensity among human service workers to experience a depletion of physical and mental resources. Burnout lacked definitional clarity until the development of a widely accepted instrument for its measurement, the Maslach Burnout Inventory (MBI; Cordes & Dougherty, 1993). The MBI conceptualized burnout as "a syndrome of emotional exhaustion, depersonalization, and reduced personal accomplishment that can occur among individuals who work with people in some capacity" (Maslach, Jackson, & Leiter, 1996, p. 4).

Verified by numerous researchers (Boles, Dean, Ricks, Short, & Wang, 2000; Green, Walkey, & Taylor, 1991; Lee & Ashforth, 1993), the three-dimensional (i.e., emotional exhaustion, depersonalization, and reduced personal accomplishment) structure of burnout is an integral component of the MBI definition. Each dimension

represents a different construct. Emotional exhaustion refers to a feeling of being unable to psychologically give of oneself due to a depletion of emotional resources. Depersonalization describes the development of impersonal, cynical feelings toward recipients of one's services. Reduced personal accomplishment indicates a diminished feeling of competence and achievement in working with others.

Instead of being viewed as a dichotomous variable, burnout—as conceptualized by Maslach and Jackson (1996)—is seen as a continuous variable ranging from a low to high degree of experienced feeling in each of the three dimensions. Whereas low degrees of emotional exhaustion and depersonalization and a high degree of personal accomplishment reflect a low level of burnout, high degrees of emotional exhaustion and depersonalization coupled with a low degree of personal accomplishment reflect a high level of burnout. Average degrees of all three dimensions represent a moderate level of burnout.

In studying burnout among postsecondary faculty, researchers have identified several significant variables. Among these were demographic characteristics; Byrne and Hall (1989) found that demographic variables had a stronger impact on postsecondary educators than they had on educators at other levels (i.e., elementary, intermediate, or secondary). However, differences exist among disciplines. For example, Dillon and Tanner (1995) found that members of the mass communications professorate did not report statistically significant differences in levels of burnout relative to demographic characteristics, but Jackson (1993) found significant differences in levels of burnout relative to such factors as gender, age, marital status, tenure status, academic rank, and predominant workload activity among pharmacy school faculty.

Purpose of Study

The purpose of this study was to explore job stress and burnout among industrial and technical teacher educators. Specifically, we addressed four research questions:

1. What is the level of job stress among industrial and technical teacher educators?
2. What is the level of burnout among industrial and technical teacher educators?
3. What demographic characteristics predict differences in levels of job stress among industrial and technical teacher educators?
4. What demographic characteristics predict differences in levels of burnout among industrial and technical teacher educators?

Method

Population and Sample

Industrial and technical teacher educators in the United States composed the population for the study. The sampling frame was the 2000-2001 *Industrial Teacher Education Directory* published by the National Association of Industrial and Technical Teacher Educators and the Council on Technology Teacher Education. The *Directory* listed 1,752 industrial and technical teacher educators, excluding department heads, coordinators, and other administrators. Using random procedures, we drew a sample of 347 industrial and technical teacher educators. This exceeded the sample size of 317 recommended by Krejcie and Morgan (1970) for a population of 1,800. A total of 133 respondents returned instruments for a response rate of 38.3%.

Instrumentation

Job Stress. We used the Job Stress Survey (JSS; Spielberger & Vagg, 1999) to assess stress levels. The JSS measures the severity and frequency of occurrence of 30 common workplace stressors. Respondents rate the severity of each stressor on a 9-point scale by comparing it to an event perceived as producing an average amount of stress (i.e., "Assignment of disagreeable duties"), which has been assigned the midpoint value of 5. Then, respondents report on a scale of 0 to 9+ days how often each stressor has occurred in the past 6 months.

The JSS consists of three scales: (a) Job Stress Index (JS-X) measures an individual's overall stress level; (b) Job Stress Severity (JS-S) represents an individual's average intensity rating for the 30 stressors; and (c) Job Stress Frequency (JS-F) indicates the average frequency of occurrence for the 30 stressors within the past 6 months. The JSS also has six subscales: (a) Job Pressure Index (JP-X) assesses the combined severity and frequency of 10 stressor events reflecting pressures directly related to the job's structure, design, or duties; (b) Job Pressure Severity (JP-S) measures an individual's average level of severity of the 10 stressors associated with job pressures; (c) Job Pressure Frequency (JP-F) indicates the average frequency of occurrence of the 10 stressors related to job pressures; (d) Lack of Organizational Support Index (LS-X) measures the combined severity and frequency of occurrence for 10 stressor events related to organizational policies or other people involved with the organization; (e) Lack of Organizational Support Severity (LS-S) indicates the average level of severity an individual perceives in regard to the 10 stressors related to lack of organizational support; and (f) Lack of Organizational Support Frequency (LS-F) reflects the average frequency of occurrence of the 10 stressor events involving lack of organizational support. Coefficient alphas for the scales and subscales of the JSS range from a low of .80 for JP-X and LS-X to a high of .89 for JS-S and JS-F.

Job Burnout. We chose the Maslach Burnout Inventory Human Services Survey (MBI-HSS; Maslach & Jackson, 1996) to measure burnout because it is the most widely accepted and frequently used burnout instrument in current research (Maslach & Schaufeli, 1993; Schaufeli, Enzmann, & Girault, 1993). The MBI-HSS contains 22 items comprising three subscales: emotional exhaustion, depersonalization, and personal accomplishment. Respondents indicate the frequency that they experience feelings related to each of the subscales on a scale from 0 (*never*) to 6 (*every day*). Maslach and Jackson recommended that scores from the three subscales be considered separately. The scores can be compared to normative data provided in the *MBI Manual*, or they can be correlated with other variables. Schaufeli and Van Dierendonck (1993) determined that the MBI-HSS was a reliable and valid indicator of burnout, and Cronbach's coefficient alphas of .90, .79, and .71 have been reported for the emotional exhaustion, depersonalization, and personal accomplishment subscales, respectively (Maslach & Jackson).

Instead of using the Human Services Survey, we could have chosen another version of the MBI, such as the Educators Survey (MBI-ES; Maslach, Jackson, & Schwab, 1996), which also has been found to be a valid and reliable measurement tool for burnout (Gold, 1984; Iwanicki & Schwab, 1981). As the name indicates, the Educators Survey is intended for use with individuals in educational professions. Thus, it might seem that the MBI-ES would be a better choice for a study involving industrial and technical teacher educators. However, we selected the MBI-HSS rather than the MBI-ES for two primary reasons. One, the MBI-HSS provides criteria for categorization of scores into high, average, or low levels of burnout relative to postsecondary educators (Maslach & Jackson, 1996). Two, the current study's population did not match the intended population of the MBI-ES. The MBI-ES addresses educators on the elementary, middle, and high school levels rather than those on the postsecondary level. Maslach et al. (1996) acknowledged, "Probably the most valuable use of the MBI-ES is at the school district level" (p. 29).

Demographics. Data on the demographic characteristics of respondents were gathered via a demographic questionnaire developed by the researchers. Characteristics addressed by the questionnaire were (a) age, (b) gender, (c) marital status, (d) ethnicity, (e) years in current position, (f) years working in industrial/technical teacher education, (g) tenure status, (h) academic rank, (i) employment status, and (j) typical workload during last year. These characteristics were chosen based upon a review of related literature.

Data Collection

The sample population received via mail the JSS, the MBI-HSS, the demographic questionnaire, a cover letter, and a pre-addressed, stamped return envelope. The cover letter contained an explanation of the purpose of the study and a description of procedures used to facilitate tracking of feedback. Questionnaires were

numerically coded to limit follow-up notifications, per procedures recommended by Dillman (2000). Survey responses were kept confidential. Three weeks after the initial mailing, members of the sample who had not returned instruments received an email request for completion and return of survey instruments; individuals for whom no working email address could be located received follow-up letters through the mail.

Data Analysis

Completed surveys were scored according to the directions in each instrument's user manual. Analysis procedures included generation of descriptive statistics to identify levels of job stress and burnout experienced by industrial and technical teacher educators and stepwise multiple regression to determine variables that predicted differences in levels of job stress and burnout. In cases where respondents did not answer a question, data were treated as missing values.

Results

Respondents were mostly men (84.5%, *n* = 109) and employed on a full-time basis (98.5%, *n* = 128). The most common age range of respondents was 51-60 years of age (43.6%, *n* = 58), followed by 41-50 years of age (27.1%, *n* = 36), 60+ years of age (20.3%, *n* = 27), and 31-40 years of age (6.0%, *n* = 8). Three percent (*n* = 4) of respondents did not indicate their age. The most common ethnicity of respondents was White (83.5%, *n* = 106), followed by African American (4.7%, *n* = 6), Hispanic (3.1%, *n* = 4), and Native American (2.4%, *n* = 3). In addition, 3.1% (*n* = 4) of respondents marked "Other" for ethnicity. Regarding years in current position, responses were distributed fairly evenly: 4.5% (*n* = 6) of respondents reported being in their current position for 2 years or less, 12.0% (*n* = 16) for 2-5 years, 18.8% (*n* = 25) for 6-10 years, 21.1% (*n* = 28) for 11-15 years, 12.0% (*n* = 16) for 16-20 years, 11.3% (*n* = 15) for 21-25 years, and 17.3% (*n* = 23) for 26+ years. Three percent (*n* = 4) of respondents did not report the number of years they had been in their current positions. Regarding typical workload, the average percentage of time devoted to teaching was 58.6%, to service 13.8%, to research 12.2%, to administration 11.5%, and to other activities 3.9%. Table 1 contains other demographic characteristics of respondents.

Responses from the JSS were analyzed using descriptive statistics. Table 2 displays the means and standard deviations for each scale and sub-scale. A score of 5 represents a moderate amount of stress for JS-S, JS-F, JP-S, JP-F, LS-S, and LS-F. The possible score range for the JS-X is 0-79.8, and the possible score range for JP-X and LS-X is 0-81 (Spielberger & Vagg, 1999).

Table 1

Respondents' Demographic Characteristics

Category	*n*	%
Marital status		
Married	113	85.0
Divorced	10	7.5
Widow/er	2	1.5
Single	4	3.0
Missing values	4	3.0
Years working in industrial/technical teacher education		
2 years or less	1	0.8
2-5 years	7	5.3
6-10 years	17	12.8
11-15 years	22	16.5
16-20 years	16	12.0
21-25 years	22	16.5
26 years or more	41	30.8
Missing values	7	5.3
Tenure status		
Tenured	101	75.9
On tenure track	24	18.0
Non-tenure track	5	3.8
Missing values	3	2.3
Academic rank		
Instructor	1	0.8
Assistant professor	20	15.0
Associate professor	58	43.6
Full professor	49	36.8
Other	2	1.5
Missing values	3	2.3

To determine the level of burnout among industrial and technical teacher educators, responses from the MBI-HSS were analyzed using descriptive statistics. The mean score for emotional exhaustion was 19.28 (*SD* = 11.33). The mean score for depersonalization was 6.15 (*SD* = 5.75). The mean score for personal

Table 2

Means and Standard Deviations for the JSS

Scale/sub-scale	*N*	*M*	*SD*
Job Stress Index (JS-X)	130	20.67	12.68
Job Stress Severity (JS-S)	133	4.64	1.54
Job Stress Frequency (JS-F)	130	3.66	1.80
Job Pressure Index (JP-X)	128	24.37	15.65
Job Pressure Severity (JP-S)	129	4.59	1.63
Job Pressure Frequency (JP-F)	129	4.64	2.36
Lack of Organizational Support Index (LS-X)	128	21.53	18.57
Lack of Organizational Support Severity (LS-S)	129	5.18	1.79
Lack of Organizational Support Frequency (LS-F)	129	3.31	2.26

Note. The possible score range for the JS-X is 0 (low degree of stress) to 79.8 (high degree of stress), and the possible score range for JP-X and LS-X is 0 (low degree of stress) to 81 (high degree of stress). A score of 5 represents a moderate amount of stress for JS-S, JS-F, JP-S, JP-F, LS-S, and LS-F.

accomplishment was 37.27 (*SD* = 7.75). Maslach and Jackson (1996) provided criteria for categorization of MBI-HSS scores into low, average, and high degrees of experienced burnout for postsecondary educators. For emotional exhaustion, scores $\leq$ 13 represent a low degree of burnout; scores 14-23 represent an average degree of burnout, and scores $\geq$ 24 represent a high degree of burnout. Scores of $\leq$ 2, 3-8, and $\geq$ 9 in depersonalization represent, respectively, low, average, and high degrees of burnout. Scores of $\geq$ 43, 36-30, and $\leq$ 35 in personal accomplishment represent, respectively, low, average, and high degrees of burnout. Using these criteria, industrial and technical teacher educators reported an average degree of burnout for all three dimensions of burnout.

Stepwise multiple regression analysis was used to determine which demographic characteristics predicted differences in levels of job stress among industrial and technical teacher educators and how much difference each predicted. The predictor variables for this analysis were the demographic characteristics reported on the demographic questionnaire; the dependent variables were the scales and sub-scales of the JSS. Although no significant predictors were found for LS-X or LS-F, significant predictors were identified for all of the other scales and sub-scales. The significant predictors and the amount of difference they predicted are presented in Table 3.

Stepwise multiple regression analysis was also used to determine which demographic characteristics predicted differences in levels of burnout among

industrial and technical teacher educators and how much difference each predicted. The predictor variables for this analysis were the demographic characteristics reported on the demographic questionnaire; the dependent variables were the sub-scales of the MBI-HSS. Only gender and amount of time devoted to research significantly predicted burnout, predicting differences in emotional exhaustion and personal accomplishment, respectively. Gender explained 4.2% (*SE* = 11.02) of the variance in emotional exhaustion, and research activity explained 2.7% (*SE* = 7.59) of the variance in personal accomplishment.

Table 3

Model Summaries for JSS Sub-Scales

Predictor variable	Predictor(s)	*R*	R^2	Adjusted R^2	*SE*
JS-X	Yrs current position	.22	.05	.04	12.50
JS-S	Yrs current position	.19	.04	.03	1.57
JS-F	Age	.26	.07	.06	1.74
	Age, teaching	.31	.10	.08	1.71
JP-X	Age	.37	.14	.13	14.72
	Age, gender	.43	.13	.17	14.37
	Age, gender, administration	.47	.22	.20	14.09
JP-S	Yrs current position	.28	.08	.07	1.62
	Yrs current position, tenure	.34	.11	.10	1.59
	Yrs current position, tenure, gender	.38	.14	.12	1.57
JP-F	Teaching	.37	.14	.13	2.17
	Teaching, age	.47	.22	.21	2.07
LS-S	Employment status	.21	.04	.03	1.78

Note. JS-X = Job Stress Index, JS-S = Job Stress Severity (JS-S), JS-F = Job Stress Frequency, JP-X = Job Pressure Index, JP-S = Job Pressure Severity, JP-F = Job Pressure Frequency, LS-X = Lack of Organizational Support Index, LS-S = Lack of Organizational Support Severity, LS-F = Lack of Organizational Support Frequency.

Discussion

Among the subscales of the JSS, LS-S had the highest mean (*M* = 5.18), indicating that respondents perceived that stress relative to lack of organizational

support was more severe than stress related to job pressures as measured by JP-S (M = 4.59). Stressors reflecting lack of organizational support include difficulties with supervisors or coworkers and organizational policies and procedures (Spielberger & Vagg, 1999). In contrast, stressors related to job pressures reflect specific aspects of the job itself. Interestingly, although respondents rated stressors relative to lack of organizational support as the most severe, they also indicated that those stressors occurred less frequently (as measured by LS-F; M = 3.31) than stressors related to job pressures (as measured by JP-F; M = 4.64). Thus, while lack of organizational support stressors may not occur frequently, when they do occur, they are perceived as severe.

In the context of PE fit theory, findings relative to severity of lack of organizational support stressors could indicate a mismatch between an individual and the environment. Findings regarding job pressure stressors—which respondents indicated occurred more frequently than lack of organizational support stressors but were perceived as being less severe than lack of organizational support stressors—could indicate presence of fit between demands and abilities. Although the job itself exerts numerous demands, industrial and technical teacher educators feel prepared and competent to meet those demands.

Regarding the level of burnout among industrial and technical teacher educators, respondents scored in the average range for all three subscales of the MBI-HSS relative to the normative sample of postsecondary educators (Maslach & Jackson, 1996). This finding has both positive and negative implications. On the positive side, it suggests that industrial and technical teacher educators do not suffer from high levels of burnout. However, as it also suggests that they do not have low burnout, there could be factors within industrial and technical teacher education that put faculty at-risk for developing burnout.

Regarding the demographic characteristics that predicted job stress among industrial and technical teacher educators, several variables were significant. Years in current position was first in the regression equation for JS-X, JS-S, and JP-S. Likewise, age entered the regression equation first for JS-F and JP-X and second for JP-F. This finding was in line with results from other studies that indicated that stress among postsecondary faculty decreased as faculty members aged (Gmelch et al., 1986; Marcy, 1996), perhaps indicating that faculty members develop increased skills to deal with job pressures as they spend more time in a position and as they age. Furthermore, gender was found to be a significant predictor for JP-X and JP-S, which supports other findings relative to the relationship between stress and gender (Blackburn & Bently, 1993; Blix et al., 1994; Sax et al., 1999; Smith et al., 1995; Thompson & Dey, 1998). Interestingly, ethnicity did not enter the regression equation as a significant predictor of job stress in any of the JSS' subscales, which contradicts earlier findings (Dey, 1994; Smith & Witt, 1993; Thompson & Dey).

Although demographic characteristics predicted variance relative to job stress, the amount of predicted variance was relatively small. The model accounting for the most difference in any of the JSS subscales—teaching followed by age for JP-F—had an adjusted R^2 value of only .207. Thus, nearly 80% of the variance can be attributed to factors other than demographic characteristics. For the other subscales, the percentage of unexplained variance was even greater. The relatively small amount of explained variance might be good news for administrators seeking to address job stress issues among industrial and technical teacher educators. Whereas little could be done to address demographic characteristics, other factors accounting for variance might be amenable to intervention.

Regarding demographic characteristics predictive of burnout among industrial and technical teacher educators, the study yielded a paucity of significant results. This paucity was reflected in the number of demographic characteristics that were significant predictors of burnout as well as by the amount of variance predicted by those characteristics. Only gender predicted variance in emotional exhaustion (adjusted R^2 = .042), and only amount of time devoted to conducting research predicted variance in personal accomplishment (adjusted R^2 = .027). No demographic characteristic predicted variance in depersonalization. Therefore, factors accounting for over 95% of the variance in burnout levels among industrial and technical teacher educators have yet to be identified.

Conclusions and Recommendations

Results from this study indicate that factors other than demographic characteristics explain a large amount of the variance in industrial and technical teacher educators' levels of job stress and burnout. Also, results indicate that industrial and technical teacher educators view stressors related to lack of organizational support as more severe than stressors related to job pressures. These findings have implications for addressing job stress in industrial and technical teacher education.

Because demographic characteristics do not explain a large amount of variance in industrial and technical teacher educators' levels of job stress and burnout, other variables should be examined for their effects on job stress. Since respondents reported that they perceive lack of organizational support stressors as more severe than any other type of stressor, a logical starting point for identifying factors impacting job stress is at the organizational level. This assumption is supported by research on job satisfaction among industrial and technical teacher educators that also indicates that organizational policies and procedures could benefit from review (Brewer & McMahan-Landers, 2003). Administrators should investigate how lack of organizational support affects industrial and technical teacher educators. Do industrial and technical teacher educators perceive lack of organizational support resulting from lack of communication from supervisors? Or, is there discord among

coworkers? Are there specific policies and procedures that cause stress for industrial and technical teacher educators? When administrators know the answers to those questions, they can eliminate, change, or create policies and procedures aimed at having a positive effect on job stress levels. Moreover, they can use answers to those questions to implement staff development strategies and to design interventions to assist industrial and technical teacher educators in dealing with job stress.

Relative to burnout, this study determined that industrial and technical teacher educators experience an average degree of emotional exhaustion, depersonalization, and personal accomplishment. Furthermore, demographic characteristics account for little of the variance in burnout scores among this population. Therefore, additional research is warranted to gain an increased understanding of burnout among industrial and technical teacher educators. Because burnout has been viewed as the result of chronic stress (Maslach & Schaufeli, 1993), findings from this study relative to job stress among industrial and technical teacher educators could be used to guide future research endeavors regarding burnout in this population. Thus, effective interventions might be designed around organizational policies and procedures.

On the positive side, industrial and technical teacher educators indicated that, although stressors related to job pressures occur more frequently than stressors related to lack of organizational support, job pressure stressors are not perceived as severe. This suggests that industrial and technical teacher educators are successful at coping with the demands placed on them by the job itself. However, while industrial and technical teacher educators are competent at handling the pressures associated with the job itself, stressors stemming from lack of organization support could undermine that competence, thus causing industrial and technical teacher education to lose some of its most valuable resources—its faculty.

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Design and Evaluation of a Tool to Assess Strategical Information Processing Styles

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Abstract

Underpinned on the theories of individual differences and the information processing paradigm, the author hypothesized five different strategical information processing styles (SIPS): visuo-spatial, analytical, social, categorical, and verbal. An instrument was developed containing specific measurable descriptors for each of the five constructs. In this study, the empirical evidence verified only four SIPS: visuo-spatial, analytical, social, and categorical. The final instrument was evaluated using a sample of 514, which was split into two groups. A confirmatory factor analysis was performed on the first group to develop a model. The model was confirmed using the second group. The analysis of the final model revealed acceptable convergent and discriminate validities. The SIPS assessment provides a measure of the strategies that individual students prefer to employ when processing information. These individual strategies should prove to be useful assets in the dynamic workplace of the twenty-first century.

Introduction

The traditional learning style instruments measure how students learn by interacting with their environments. Although these instruments are widely accepted, many are based on early theories and have questionable reliability and validity. The goal of this research was to furnish educators with a high quality, easily administered self-assessment tool to determine individual differences in strategical information processing styles, which are a measure of the strategies that individuals use to process information transmitted by the senses.

In spite of the inundation of research in the area of individual differences in information processing, there are no simple, group self-assessments designed to measure strategical information processing styles. Most of the assessments are based on abilities rather than styles. There is a need in the educational system for a valid instrument that can be used easily and efficiently to determine a student's strategical information processing style. Educators could benefit from an assessment that would aid them in discerning individual differences in their students and planning program curricula

accordingly. Students' awareness of their styles could enable them to perform better in the classroom, to become self-directed learners, and to succeed in the dynamic workplace. Thus, a valid, reliable instrument for appraising strategical information processing styles would be an asset for both educators and students (Gagne, 1989).

In order to assist students in their educational quests, educators must be attuned to the individual differences in students' strategical information processing styles. The information processing paradigm consists of stages of input and transformation of information such as encoding, rehearsal, storage, and retrieval. Individual differences have been recognized in the processes of pattern recognition, rehearsal, working memory, memory encoding, memory search, declarative and procedural memory stores, self-schemata, and retrieval (Gagné, 1989). Researchers have been unable to establish a correlation between general intelligence or general knowledge and the cognitive abilities such as the speed of information processing and working memory capacity (Sternberg, 1997; Shepard, Fasko, & Osborne, 1999). Perhaps a student's strategical information processing style could provide a link between general intelligence, general knowledge, and cognitive abilities. Regardless of cognitive abilities, general intelligence, or general knowledge, an undergraduate college student's success seems to depend on his/her strategical information processing style or his/her preferred method of utilizing his/her cognitive resources (Sternberg, 1997). Therefore, awareness of a student's style would enable educators to design educational experiences that tap into the student's cognitive resources.

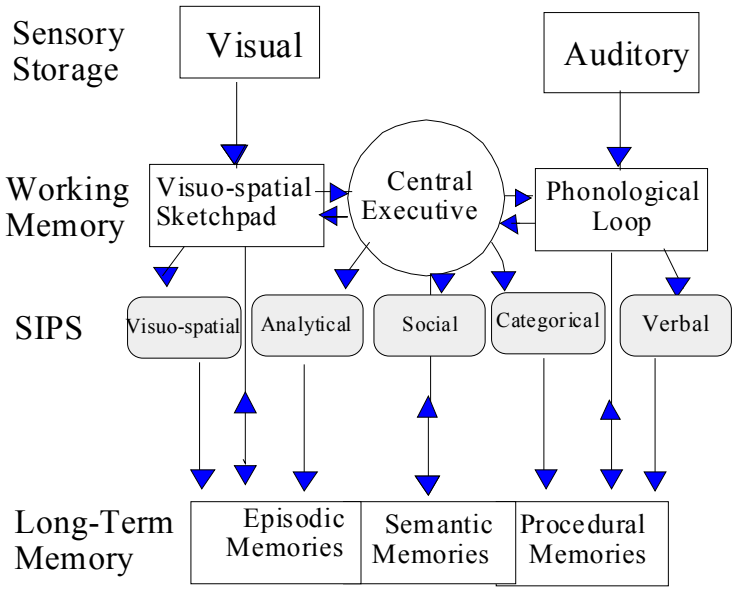
Once a student is aware of his/her information processing style, he/she is better able to evaluate his/her learning abilities, to improve classroom performance, to become a self-directed learner, and to be successful in the workplace. General knowledge such as measured by standardized test scores can sometimes predict academic success but it cannot always predict how well an individual will perform as a learner or in the work environment. Success in the classroom and the workplace requires more than high performance on standardized tests. Generally, college students are considered successful in the classroom and after graduation in the workplace if they possess motivation, self-efficacy, and self-esteem (Shepard, Fasko, & Osborne, 1999). These graduates have the ability to adapt to the real world environment and to accomplish goals. They have a repertoire of cognitive strategies that they skillfully employ in a workplace setting (Sternberg & Kaufman, 1998). A college student's cognitive style is influenced by his/her cognitive abilities, repertoire of cognitive strategies, learning style, general intelligence, and general knowledge. However, the student's success depends on how he/she chooses to employ these resources. His/her choice is influenced by motivation, self-efficacy, self-esteem, and emotional intelligence (Averill, 1999). Thus a student's classroom and workplace success are influenced by individual differences, which can be measured by the SIPS instrument.

Theoretical Framework

Underpinned on Craik and Lockhart's (1972) information processing theory, Baddeley and Hitch's 1974 model of working memory (as cited in Baddeley & Hitch, 1977), and Torgesen's Model (1996) of the information processing system, the researcher hypothesized that there are five different strategical information processing styles (SIPS) that individuals prefer to use when processing information. Based on experience and an extensive literature review, the researcher hypothesized that the SIPS model was composed of five constructs: visuo-spatial, analytical, social, categorical, and verbal. In order to validate this hypothesis, the researcher developed an instrument to measure these five constructs. The researcher modified Torgesen's Information Processing Model (1996) to include the five styles as part of the information processing system. Each style depends on the systems within working memory that the individual prefers to use when processing a stimulus.

The SIPS are identified in Figure 1 in the shaded boxes. The shaded boxes containing the terms visuo-spatial, analytical, social, categorical and verbal were added to Torgesen's original model to form the SIPS model. The model illustrates the relationships among the five strategical styles and the elements of the information processing system.

Figure 1. Hypothesized Model of the Five Strategical Information Processing Styles (SIPS)



Visuo-spatial style. Visuo-spatial processors selectively attend to the global characteristics of stimuli that involve imagery. These tasks sustain the attention of the visuo-spatial processors enabling them to arrive at accurate solutions. Individuals who are visuo-spatial processors prefer to use their visuo-spatial sketchpads to encode information for short and long-term memory storage. However, they are good strategists and are able to select the best strategy for the task (Roberts, Gilmore, & Wood, 1997). They are parallel, continuous processors. Visuo-spatial processors encode information simultaneously and they can store it in continuous networks (Clark & Paivio, 1991; Massaro & Cowan, 1993). Visuo-spatial individuals are continuous processors who make decisions based on a small amount of information. They have a well-developed procedural memory and referential connections (Paivio, 1991; Tulving, 1993).

Analytical style. Analytical processors selectively attend to stimuli that are presented in a logical order. When tasks make sense and require logical thinking, they sustain the attention of the analytical processor. Analytical processors prefer to use their executive function to do quick mental calculations and perform tasks requiring analytical reasoning. Their emotions have very little influence on their executive function and analytical processors rely heavily on analytical strategies to solve problems. They are serial discrete processors who encode information in a logical step-by-step fashion (Rotenbery & Weinberg, 1999). As discrete processors, they store information in discrete packages until they have what they need to make a carefully calculated decision (Clark & Paivio, 1991; Massaro & Cowan, 1993). They have well-developed procedural and semantic memories (Tulving, 1993).

Social style. Social processors selectively attend to global stimuli that involve relationships and emotions. Group and social tasks sustain the attention of the social processor. Their executive function is strongly influenced by the limbic system. As a result of this influence, social processors encode information for short and long-term memory storage with emotional connections. As emotionally creative individuals, they are able to evaluate their own emotions as well as those of others. They have the ability to express emotions appropriately and can express their own perceptions of a situation through emotions (Averill, 1999). Social processors are adept at solving complex emotional problems. They are parallel continuous processors who encode and store information simultaneously (Clark & Paivio, 1991; Massaro & Cowan, 1993). They have well-developed episodic autobiographical memories (Gathercole, 1998; Sehulster, 1995; Tulving, 1993).

Categorical style. Categorical processors selectively attend to the detailed characteristics of either visual or verbal stimuli. These individuals are attentive to tasks that require detailed, organized strategies. Individuals who are categorical processors prefer to use their executive function to plan, set goals, select strategies, and evaluate and revise their plans. They have a large repertoire of organization strategies that they

use to encode and retrieve information. As serial, discrete processors, they encode information in a linear, organized manner and they reorganize their semantic memory as they encounter new stimuli. Similar to the verbal processors, they store information in discrete packages until they have what they need to make a decision or to reorganize their stores (Clark & Paivio, 1991; Massaro & Cowan, 1993).

Verbal style. Verbal processors selectively attend to stimuli that involve lexical and semantic tasks. Lexical and semantic tasks sustain their attention. Individuals who are verbal processors prefer to use their phonological loops to encode information for short and long-term memory storages and rely on verbal strategies to learn new information and to solve problems. They are serial discrete processors (Rotenbery & Weinberg, 1999). They encode information one word at a time and they store it in discrete packages until they have what they need to make a decision (Clark & Paivio, 1991; Massaro & Cowan, 1993; Sanders, 1990). These individuals have large semantic and episodic memories (Sehulster, 1995; Tulving, 1993).

Literature Review

The purpose of this literature review was to identify stages in the information processing paradigm that are affected by individual differences in students and to apply this knowledge to the development of a strategical information processing style assessment. Educators could use such an assessment to predict and improve their students' academic performance. According to Jacobson (1998), ". . . the current education system is in dire need of modification in order to keep pace with current technological advancement of society. As educators, we must consider the research and create an educational system that will meet the needs of a progressive society" (p. 579).

This literature review aspired to bridge research from the fields of cognitive psychology, neuropsychology, and educational psychology to the field of education. Using a reductionist approach, the first step in this endeavor was to review the theoretical foundation of the information processing paradigm that originated with the cognitive psychologists (Baddeley, 1993; Broadbent, 1958). Synchronously, the author will present research findings from the fields of neuropsychology (Posner & Raichle, 1994) and educational psychology (Bonner, 1988; Kalyuga, Chandler & Sweller, 1998). Cognitive psychologists postulate how the information processing system functions, the neuropsychologists attempt to identify the neurological structures that are responsible for these functions, and the educational psychologists attempt to discover ways to improve these functions in students. Researchers in all of these fields have identified areas of individual differences in the information processing system. The application of this empirical data to the area of education can assist educators in identify and evaluating individual differences in their students. Educators can use assessments of individual differences to improve the student's academic performance (Paivio, 1991).

The information processing system theory (Craik & Lockhart, 1972), which is the nucleus of cognitive psychology, explains how individuals receive and process information for memory encoding, rehearsal, storage, and retrieval. The theory includes the senses, the sensory registers, short-term (working) memory, and long-term memory. The senses are important as information receptors. They receive stimuli from the environment. Not all stimuli received are processed--some of them are lost or discarded. Information that is not discarded enters the sensory registers and is transmitted as discrete or continuous transmissions (Massaro & Cowan, 1993). Sanders (1990) posited that discrete transmissions require serial processing and continuous transmissions involve parallel processing. Serial processing occurs when one item is handled at a time and parallel processing involves handling multiple items at one time (Clark & Paivio, 1991; Massaro & Cowan, 1993).

The sensory registers are like collection bins. As the information enters the sensory registers, some of the data moves into short-term memory and some is discarded. From the sensory registers, information travels to working memory (Blanton, 1998; Craik & Lockhart, 1972; Parker, 1993). Working memory has a small capacity and processes a limited amount of information (Baddeley, 1992, 1993, 1996; Broadbent, 1958; Craik & Lockhart, 1972; Kalyuga, Chandler, & Sweller, 1998; Parker, 1993). Working memory is composed of three systems: the executive control, the phonological loop, and the visuo-spatial sketchpad (Baddeley, 1992, 1993, 1996). Once in working memory, the information is processed. It is connected to information stored in long-term memory, rehearsed, or discarded. Information that receives attention and that is meaningful is encoded for storage in long-term memory. Long-term memory has an unlimited capacity. Once information is stored in long-term memory, it is there permanently (Craik & Lockhart, 1972; Parker, 1993; Tulving, 1993). However, it must be retrieved into working memory for processing (Baddeley, 1992; 1993; Broadbent, 1958; Massaro & Cowan, 1993; Torgesen, 1996). Craik and Lockhart (1972) posited that the format of information in long-term is largely semantic. Parker (1993) contended that items are encoded in memory as words or pictures. The researchers agreed that long-term memory has no known limit or capacity and that information is never lost; however, over time the accessibility to the information is lost (Craik & Lockhart, 1972; Parker, 1993). Teaching strategies can serve as cues that enhance retrieval or accessibility to stored items (Parker, 1993).

Purpose

An extensive literature review revealed that there were no existing instruments designed to measure information processing styles as proposed in this research. Therefore, the purpose of this study was to develop an instrument with demonstrated reliability and validity that will assess strategical information processing styles of undergraduate college students. The researcher theorized that there were five different strategical styles that were based on individual differences in the information-processing

paradigm. The objectives of the study were to (1) develop a self-assessment instrument with demonstrated validity and reliability that measured the strength of preference of strategical information processing in each of the following five styles: visuo-spatial, analytical, social, categorical, and verbal and (2) describe the sample of undergraduate students employed in this study on the selected demographic characteristics of age, gender, ethnicity, credit hours completed, and college major.

Method

Population

The population used in this study consisted of students enrolled at Our Lady of the Lake College (OLOL College) and Louisiana State University (LSU). The researcher collected data from a convenient sample of 514 undergraduate students. The mean age of the students in the final sample was 19.7 years (*SD* =3.72), the youngest student was 18-years old and oldest student was 57-years old. The majority of undergraduate students who participated in this study were females (*n* = 300 or 58.4%). The majority of the students designed their ethnic background as White (*n* = 395 or 76.8%). Other ethnic categories indicated by the students were Black or African American (*n* = 69 or 13.4%), Asian (n =21 or 4.1%), Hispanic (*n* = 14 or 2.7%), Native American (*n* = 2 or .4%), and other (*n* = 10 or 1.9%). Three students (.6%) did not designate any ethnic origin. The numbers of majors in each category were: Business (*n* = 53 or 10.3 %), Arts and Sciences (*n* =266 or 44%), Medical Sciences (*n* = 46 or 8.9%), Agriculture (*n* = 15 or 2.9%), Engineering (*n*= 48 or 9.3%), Communication (*n* = 28 or 5.4%), Design and Music (*n* = 18 or 3.5%), Education (*n* = 47 or 9.1%), undecided (*n* = 26 or 5.1%), and no response (*n* = 7 or 1.4).

The mean for the number of credit hours completed by the undergraduates in the student sample was 43.7 (SD = 38.2). The number of credit hours ranged from 0 – 210. The majority of the students in the study completed 26 or fewer credit hours.

Instrumentation

In the first SIPS instrument used in this research, there were 20 indicators in each data set or 100 variables. Each data set was designed to measure an individual construct. Using the data from a pilot study and three field studies, the researcher revised the SIPS instrument for the final data collection. The final instrument contained 65 variables and employed an absolute ranking scale. The instrument consisted of 13 questions and each question had five possible solutions. Based on the statistical findings of the three field studies, the situations and the solution items composing the instrument were modified to evaluate individual differences in the four strategical processing of information styles. For example, individuals who prefer to use the visuo-spatial SIPS are parallel, continuous processors and rank solutions that involve learning

by using imagery higher than other items. Students who prefer to use the categorical information processing style chose items that involve linear processing such as solutions using outlines to summarize information. Analytical processors select solutions that involve planning and details since they are serial linear processors. Given the following situation: "When I act on the lecture information given in one of my courses, I", the analytical processors would rank the following solution as most often preferred: ' take detailed notes.' The visuo-spatial processors would rank 'use pictures to illustrate the information' as the most preferred and the categorical processors would rank 'outline the information' as the most preferred solution.

The respondents were required to rate each solution item from least preferred to most preferred. The respondents ranked their five choices by using a 1 (least prefer), 2 (seldom prefer), 3 (prefer), 4 (more often prefer), and 5 (most often prefer). To ensure an absolute data scale, the researcher stated the directions as follows: "Each response (number) can be used more than once for each situation." The example question in Figure 2 illustrates how each question was designed. The directions for completing the questionnaire and example responses are also illustrated in Figure 2.

Figure 2. An Illustration of a Strategical Information Processing Style Query Using the Absolute Scale.

DIRECTIONS

For handling each situation listed below, five strategies are provided. Using the scale below, indicate your level of preference for using each strategy in each situation. Each response (number) can be used more than once for each situation.

Level of Preference Scale
5 = most often prefer
4 = more often prefer
3 = prefer
2 = seldom prefer
1 = least prefer

1. When I am presented with a new concept in one of my courses, I:

3 a. Verbalize the concept.	1 b. Write down the details. and questions.	4 c. Interact with discussion	5 d. Visualize the concept.	1 e. Analyze the concept.

Data Collection

The empirical data collected in this study indicated that there were four rather than five strategical information processing styles. The four strategical information-processing styles verified by experimental data are visuo-spatial, analytical, social, and categorical. The variables designed to indicate the verbal style did not prove to be statistically valid. Thus the variables in the final SIPS instrument were revised to measure four rather than five constructs.

The number of observations required in each sample group was determined using a five to one ratio of individuals in the sample to variables in the instrument (Hair, J. F., Anderson R. E., Tatham, R. L., & Black, W. C., 1998; Hatcher, 1994; Kerlinger & Lee, 2000). As a result of the third field test, the number of items in the instrument was reduced to 65. The sample size of the final data collection was 514 and larger than the 325 necessary to validate the 65 items in the instrument. Therefore, the sample was randomly split into two groups. The first group contained the necessary 325 participants and the second group contained the remaining 189, which was enough observations to validate the final model containing only 22 items.

A confirmatory factor analysis (CFA) was performed on the data from group one in order to formulate a theoretical model. The model was then confirmed via a second confirmatory factor analysis using the data from the sample containing 189 students.

Analysis

The SAS system's PROC CALIS procedure described in Hatcher (1998) was used to analyze the data. The models tested were composed of four latent variables or constructs and multiple indicator variables. A two-step process was used to accomplish the analyses. First, a measurement model was generated using confirmatory factor analysis. Then the model was modified using the criteria outlined by Hatcher (1994). The procedure involves deleting insignificant variables, variables with high-normalized residuals, and problematic variables. Once the measurement model revealed an acceptable fit to the data, it was changed so that it represented the theoretical model. Finally, the measurement model and the theoretical model were compared for goodness-of-fit and parsimony (Hatcher, 1994).

Measurement model. The measurement model describes the nature of the relationship between the constructs (latent variables) and the indicator variables that measure the constructs. The model presented in this study contained four constructs: visuo-spatial, analytical, social, and categorical. A minimum of three indicator variables was used to measure each construct (Hatcher, 1994).

The structure of the original measurement model was modified by deleting variables with insignificant factor loadings, variables with high normalized residuals, and variables indicated to be problematic by the Lagrange Multiplier and Wald test

modification indices. According to Hatcher (1994), insignificant variables are those with the absolute value of the *t* statistic for factor loadings less than 1.96 ($p < .05$). The null hypothesis states that the relationship between each variable and its construct is zero. All variables with *t* statistics below 1.96 or low standardized factor loadings were eliminated from the model.

After eliminating the insignificant variables, the researcher examined the normalized residuals to determine which variables had residuals that were outside of the acceptable limits. Hair et al. (1998) contends that the acceptable limit for residuals is ± 2.58 standard deviations. Since a sample of 325 was used for this study, 16 residuals may exceed ± 2.58 standard deviations (95% is one out of 20 observations) strictly by chance. Variables with high residuals were eliminated from the model. Nine residuals in the model were outside of the acceptable limits indicating that the distribution of normalized residuals was symmetrical. Kerlinger and Lee (2000) contend that the smaller the residuals, the better the data fits to the model.

The Lagrange Multiplier test was used to evaluate the decrease in chi-square that would occur by adding a new path to the model. The variables with high Lagrange values on two factors were eliminated because the theoretical model does not account for indicator variables to measure more than one latent variable (Hatcher, 1994).

The Wald test identifies unimportant paths or covariances that can be eliminated without affecting the chi-square significantly. Most of the problematic variables identified by the Wald test results also had insignificant or low standardized factor loadings (Hatcher, 1994). These variables were automatically dropped from the model. The original model contained 65 indicator variables. However, modification of this model resulted in a revised model containing 22 variables. According to Hatcher (1994), one of the necessary conditions for confirmatory factor analysis is that the model contains "a maximum of 20 - 30 indicator variables" (p. 260).

The problematic variables were eliminated from the model one variable at a time. Each time a variable was eliminated, the model was reconfigured. Once all of the problematic variables were eliminated, the model was evaluated for reliability, validity, and goodness-of-fit. The composite reliabilities for the factors were determined. This index indicates the internal consistency of the variables measuring a given construct and is parallel to the coefficient alpha (Hair et al., 1998; Hatcher, 1994). The composite reliabilities were: visuo-spatial .72, analytical .73, social .75, and categorical .78. All of the values were greater than .60 and were within acceptable limits (Hatcher, 1994).

Convergent validity was determined using the standardized factor loadings for each remaining variable and the *t* statistic. Significant *t*-tests and factor loadings illustrated that the indicator variables were actively appraising the designated construct. The ranges of the factor loadings for the latent constructs and their indicator variables were: visuospatial .407 to .751, analytical .390 to .751, social .420 to .834, and categorical .392 to .797. The ranges of the *t* values were all highly significant: visuo-

spatial 6.85 to 10.84, analytical 6.41 to 13.65, social 7.14 to 15.85, and categorical 7.36 to 15.75.

The discriminant validity of the model was determined by reviewing the covariance between the pairs of constructs. An examination of the covariances among exogenous variables (latent constructs) revealed that none of the confidence intervals between constructs include 1.0; therefore, the correlation between the constructs was weak and discriminant validity is demonstrated (Hatcher, 1994). The covariances among the exogenous variables are summarized in Table 1.

Table 1
Covariance among Exogenous Variables

Parameter	Estimate	Standard Error	Confidence Intervals	t^a
Visuo-spatial/Analytical	.085	.076	-.067 to .237	1.12
Visuo-spatial/Social	-.015	.074	-.163 to .133	-0.21
Visuo-spatial/Categorical	-.181	.071	-.323 to -.039	-2.54
Analytical/Social	-.308	.065	-.438 to -.178	-4.71
Analytical/Categorical	.439	.059	.321 to .557	7.41
Social/Categorical	-.253	.064	-.381 to -.125	-3.94

[a] *t*-tests verify that the relationship between the variables is zero. For the *t*-test to be significant, the confidence interval must include 1.0 (Hatcher, 1994).

After determining the reliability and validity of the model, the next step was to ascertain the goodness-of-fit of the model. Evaluating the overall goodness-of-fit of the model involved determining the absolute fit of the model, the incremental fit, and the parsimony. The absolute fit of the model is the degree to which the covariance matrix is predicted by the structural and measurement models (Hair et al., 1998). Indices used to evaluate the absolute fit of the model are the chi-square, the normed chi-square, and the Goodness of Fit Index (*GFI*). The chi-square for the model was χ^2 (203, n = 325) = 365.7, $p < .0001$. The normed chi-square, which is the ratio between chi-square and the degrees of freedom, was 1.80. According to Hatcher (1994), the p values for the chi-square test should be greater than .05 and the ratio of chi-square/*df* should be less than 2. However, Hatcher (1994) contends that the chi-square/*df* ratio is affected by sample size and that the ratios for a model can vary based on sample size. Data sets containing more than 20 to 30 variables produce large chi-square values and result in a ratio that is greater than 2 indicating a lack of fit of the model and the data (Hatcher, 1994).

The other index that can be used to measure absolute fit is the *GFI*. The *GFI* is not dependent on sample size and is a comparison of the estimated residuals squared to

the actual data. According to Hair et al. (1998), there is no threshold level for this value, although higher is better. The *GFI* for the measurement model was .911 and is listed in Table 2.

Table 2

The Goodness-of-fit and Parsimony Indices of the Combined Models

Model	χ^2	*df*	*GFI*	*CFI*	*NNFI*	*PR*	*PNFI*
Null	1772.5	231					
Theoretical	362.49	207	.910	.899	.887	.896	.713
Measurement	365.70	203	.911	.900	.887	.879	.702

Note. GFI is the goodness of fit index; *CFI* is the Bentler Comparative Fit Index; *NNFI* is the Bentler & Bonett (1980) Non-normed Index; the *PR* is the parsimony ratio of the *df* of the Model divided by the *df* of the Null; and the *PNFI* is the James, Mulaik, & Brett (1982) Parsimonious Index.

The indices that are used to measure the incremental fit of the model are the Bentler Comparative Fit Index (*CFI*) and the Bentler & Bonett (1980) Non-normed Index (*NNF*I). The incremental fit of the model compares the model to the null model. For the measurement model, the *CFI* was .900 and the *NNFI* was .887. These values were equal or close to the desirable value of .90 and indicated an acceptable fit (Hair et al., 1998; Hatcher, 1994) and are listed in Table 2.

Next, the parsimony of the measurement model was tested using the parsimony ratio (*PR*) and the parsimonious normed-fit index (*PNFI*). These indices signify the simplicity and the fit of the overall model. The *PR* value is determined by dividing the degrees of freedom of the model of interest by the degrees of freedom of the null model. According to the null model, there are no relationships between any of the variables. The *PR* of the model was .879 and the *PNFI* was .702. The higher the value for the *PR*, the greater is the parsimony of the model. According to Hatcher (1994), the larger the *PNFI* the more acceptable the data and the minimum acceptable values are between .50 and .60. The *PR* and *PNFI* are listed in Table 2.

Theoretical model. The theoretical mode is a combined model that consists of the measurement model and a structural model. The measurement model examines the constructs and the indicator variables that successfully measure these constructs. The structural model examines the relationships between the constructs themselves. The theoretical model is the same as the revised measurement model. Except in the theoretical model, the parameters of the variables with the highest factor loadings for each construct are fixed at one to ensure that the indicator variables best represent the construct. The construct is an unobserved variable and it has no established unit of measurement. "However, by fixing at one the path from the *F* variable to one of its

manifest indicators, the unit of measurement for the *F* variable becomes equal to the unit of measurement for that indicator variable (minus its error term)" (Hatcher, 1994, p. 357).

Thus parameters for variables 9d (visuo-spatial), 7c (analytical), 4d (social), and 1b (categorical) were all set at 1.0. No other changes were made in the model. Table 2 summarizes the goodness-of-fit parameters for the theoretical model. The values of the *CFI* (.899), the *NNFI* (.887), and the *GFI* (.910) were acceptable (Fletcher, David, Stuebin, Shaywitz, Shaywitz, Shankweiler, Katz, & Morris, 1996; Hair et al., 1998; Hatcher, 1994; Barry Moser, personal communication March, 2001).

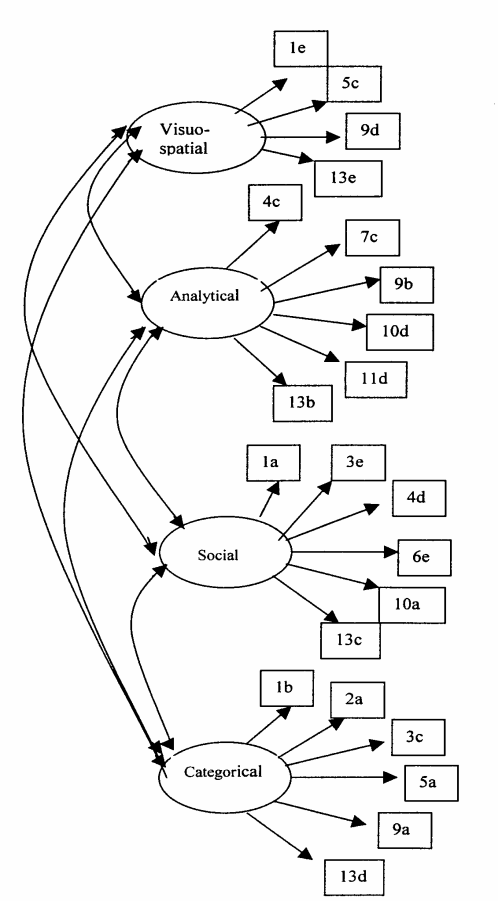
The chi-square difference test, which is determined by subtracting the chi-squares of the two models, was used to evaluate the validity of the theoretical model by comparing this model to the measurement model. If there is no significant difference between the two models, then the observed relationships between the constructs is successfully illustrated in the theoretical model. The chi-square for the measurement model was subtracted from the chi-square for the theoretical model: 365.70 - 362.49 = 3.21. The degrees of freedom for the difference tests were determined by subtracting the degrees of freedom of the models: 207 - 203 = 4. The critical value for chi-square at 4 degrees of freedom was 9.49 ($p = < .05$). Therefore, the theoretical model was effective in justifying the relationships between the constructs. The theoretical model provided a fit to the data that was the same as the measurement model (Hatcher, 1994).

Findings

Confirmatory Factor Analysis of the Model. The theoretical model developed using the sample of 325 was confirmed using the final sample of 189. Twenty-two indicator variables and four latent constructs composed the final model. Thus a sample of 189 was adequate to maintain the five to one ratio of samples collected to variables in the instrument (Hair et al., 1998; Hatcher, 1994). No modifications were made to this final measurement model (see Figure 3).

Following the same procedure used in the confirmatory factor analysis of data from the sample of 325, the researcher determined the reliability and validity of the final model. The composite reliabilities ranged from visuo-spatial .60, analytical .75, social .80, and categorical .81. The reliability for the visuo-spatial construct was low but within acceptable limits (Hatcher, 1994). The reliabilities for the analytical, social, and categorical constructs were all acceptable. The convergent validity of the model was acceptable and was determined by examining the standardized factor loadings and the *t*-tests. The ranges for the standardized factor loadings for each construct were: visuo-spatial .342 to .695, analytical .407 to .744, social .512 to .706, and categorical .463 to .795. All of the *t*-tests were significant ($p < .05$) and ranged by construct as follows: visuo-spatial 3.81 to 7.11, analytical 5.2 - 10.53, social 5.12 to 9.99, and categorical 6.22 to 12.15.

Figure 3. The Measurement Model for the Final SIPS Instrument



The discriminant validity of the model was acceptable and is illustrated in Table 3. The covariance between the constructs was very weak. The highest covariance was between analytical and categorical. However, a quick determination of the confidence interval between the two constructs revealed that the interval did not include 1.0. According to Hatcher (1994), if the confidence interval does not include 1.0 then ". . . it is very unlikely that the actual population correlation between F1 (any two factors) and F5 is 1.0" (p. 339). Therefore, the analytical construct did not measure categorical data.

The goodness-of-fit indices and the parsimony indices for the measurement and theoretical models are listed in Table 4. The absolute fit of the measurement model was acceptable with a χ^2 (203, n = 189) = 366.48, $p < .0001$, a normed chi-square value of < 2.0, and a *GFI* of .852. The incremental fit of the model was marginally acceptable with

a *CFI* of .850 and a *NNFI* of .824. The parsimony of the model was acceptable, since the PR was .879 and the PNFI was .629.

Table 3

Covariance Among Exogenous Variables

Parameter	Estimate	Standard Error	Confidence Intervals	t^a
Visuo-spatial/Analytical	-.394	.096	-.586 to -.202	-4.10
Visuo-spatial/Social	.041	.103	-.165 to .247	0.39
Visuo-spatial/Categorical	-.304	.095	-.494 to -.114	-3.19
Analytical/Social	-.285	.087	-.459 to -.111	-3.28
Analytical/Categorical	.543	.067	.409 to .668	7.79
Social/Categorical	-.098	.088	-.274 to .078	-1.12

[a] The *t*-tests verify that the relationship between the variables is zero. For the *t*-test to be significant, the confidence interval must include 1.0 (Hatcher, 1994).

The chi-square of the theoretical model was χ^2 (207, n = 189) = 368.70, $p <$ .0001, the normed chi-squared was < 2.0, and the *GFI* was .851 indicating an acceptable absolute fit of the data to the theoretical model. The incremental fit of the model was marginally acceptable with a *CFI* of .847 and a *NNFI* of .830. Both of the parsimony indices were within acceptable limits (*PR* = .896 and *PNFI* = .640). The indices for the measurement and theoretical models are also listed in Table 4.

Table 4

The Goodness-of-fit and Parsimony Indices of the Combined Models

Model	χ^2	*df*	*GFI*	*CFI*	*NNFI*	*PR*	*PNFI*
Null	1289.6	231					
Theoretical	368.70	207	.851	.847	.830	.896	.640
Measurement	366.48	203	.852	.850	.824	.879	.629

Note. GFI is the goodness of fit index; *CFI* is the Bentler's Comparative Fit Index; *NNFI* is the Bentler & Bonett's (1980) Non-normed Index; the *PR* is the parsimony ratio of the *df* of the Model divided by the *df* of the Null; and the *PNFI* is the James, Mulaik, & Brett (1982) Parsimonious Index.

The chi-square difference test, comparing the theoretical model fit to the measurement model fit, was 368.70 - 366.48 = 2.22. At 4 degrees of freedom, the

critical value of chi-square at $p < .05$ is 9.4877. Thus the chi-square was not significant at $p < .05$ and the theoretical model validly accounted for the relationship between the latent variables in the model.

Summary and Conclusions

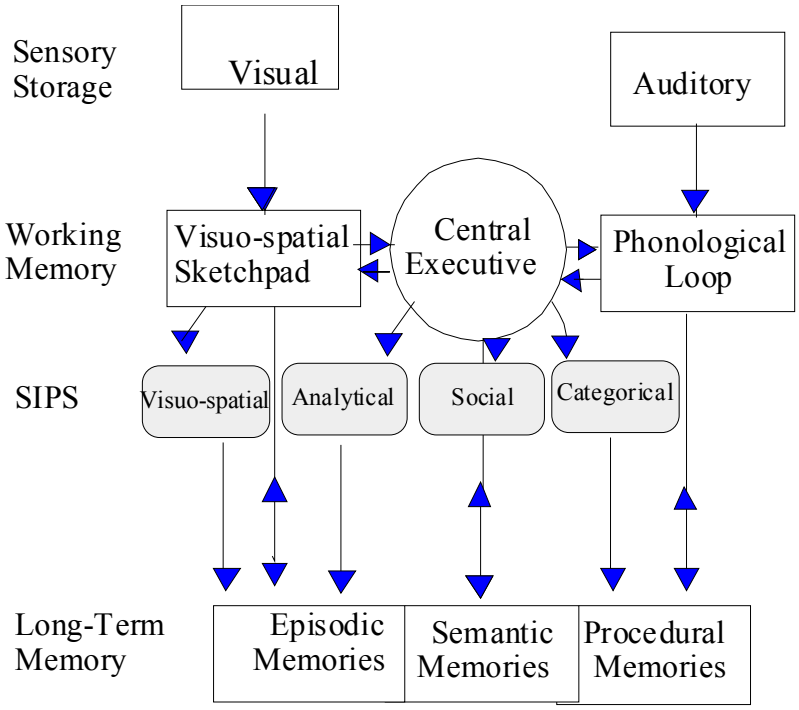
In order to achieve the purpose and the objectives of this study, the researcher developed an instrument to measure individual differences in preferred strategical information-processing styles. Originally, the researcher theorized that there were five information-processing styles: visuo-spatial, analytical, social, categorical, and verbal. However, as the study progressed empirical data validated only four information-processing styles: visuo-spatial, analytical, social, and categorical. Although the verbal style is theoretically appealing (Baddeley, 1993; Logie, 1999; Posner & Raichle, 1993; Torgesen, 1996), the indicator variables designed to measure this style did not load significantly on a common construct. Therefore, the final instrument design excluded indicators for the verbal style. According to Nicholls and Wood (1998), word recognition takes place in both hemispheres of the brain. Perhaps, this explains why the verbal indicator variables loaded indiscriminately on the other four constructs.

The final sample of 514 participants was randomly split and a confirmatory factor analysis was performed on each group. A confirmatory factor analysis was performed on the data from group one ($n = 325$) in order to formulate a model. The model was then confirmed via a second confirmatory factor analysis using the data from the sample containing 189 participants. The model developed using the first data set was confirmed using the second data set. Some of the indices for the second data set were marginally acceptable but the chi-square difference test comparing the theoretical model fit to the measurement model fit was not significant at $p < .05$. These results indicated that the theoretical model was validly accounting for the relationships between the construct variables in the paradigm.

The most important finding in this study was the outcome of the confirmatory factor analysis resulting in an instrument to measure four out of the five strategical information-processing styles. Although the study did not confirm the verbal style, there is strong theoretical evidence that this style exists and further research is needed to develop and evaluate new indicator variables that will measure this construct. Figure 4 is a revision of the original hypothesized model minus the verbal style.

Reducing the number of indicator variables and strengthening the visuo-spatial indicator variables can improve the SIPS instrument. The SIPS instrument used in the final test contained 65 variables. However, the confirmed model, which was developed by deleting variables from the larger model, contained 22 indicator variables and four latent constructs. The efficiency of the larger instrument could be improved by reducing

Figure 4. Revised Hypothesized Model of the Four Strategical Information Processing Styles (SIPS)



the number of indicator variables in the assessment. Once the number of variables is reduced, confirmatory factor analysis should work very smoothly. According to Hatcher (1994), confirmatory factor analysis should be performed on models containing between 20 and 30 indicator variables.

Further Research

Continued research with the confirmed instrument is necessary to improve the indicator variables and to produce a smaller more efficient instrument. Once the SIPS instrument is amended, further research is needed to determine what influence the preference for a strategical information processing style has on cognitive abilities, visual processing abilities, general knowledge, and academic performance. Establishing a relationship between the SIPS and cognitive and visual processing abilities is important

because they share the same theoretical basis in cognitive psychology, as illustrated in the revised hypothesized SIPS model. Cognitive abilities involve the ability to process information through the senses, short-term memory and long-term memory. The information-processing style is based on the individual's preferred method of processing information, which has its roots in processing abilities. If a relationship could be established between the SIPS and general knowledge, then the SIPS could be used as a predictor of standardized test results. As a predictor of academic performance, the SIPS results could be used by educators to enhance the students' educational experiences and by undergraduate college students to improve their quality of learning.

Underpinned on the theory of the information processing paradigm and validated by confirmatory factor analysis, the strategical information processing style assessment should prove to be a useful tool for determining the strategies that individual students prefer to employ when processing information. The instrument could be used in the classroom, as a counseling tool, or as a screening device for selective programs, such as those found in the health care field. Use of this instrument will enhance the students' self-awareness and allow them to participate in their own learning. Once students are aware of their preferred strategical information processing styles, they may become cognizant of the different types of strategies that are available for success in the academic environment. After developing these strategies in the academic environment, the students will be able to continue to use these tools as they move into the dynamic workplace of the twenty-first century.

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Distance Education and Career and Technical Education: A Review of the Research Literature

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Abstract

Distance education, due to recent technological innovations, can provide almost the same instructional contact and interaction for the student as traditional settings. The growth of distance learning opportunities has allowed students to access courses and degree programs at their convenience. Educational institutions are creating new approaches to course delivery and degree requirements and to improving their programs with new technological tools. These issues have begun to affect career and technical education (CTE) programs, primarily at the postsecondary level.

Research studies on distance education have been criticized on a variety of fronts. Research on distance education in CTE is in its beginning stages. To date, there has been no collective analysis of this distance education research in CTE. This research synthesis reviews previous studies on distance education in CTE, organizing them into topical categories. This synthesis highlights the important aspects of these studies and provides recommendations for further research.

Introduction

The methods utilized to deliver education are constantly affected by technology; therefore students have many options available to them. Distance education, particularly those programs utilizing telecommunications technology, can have almost the same instructional contact and interaction for the student as traditional settings (Galusha, 1998). Technology has driven the growth of distance learning opportunities, as students who are "time bound" due to job or travel difficulties, or "place-bound" due to geographic location, can now access courses and degree programs at their convenience (Zirkle, 2002a).

Parallel with these technological changes, colleges and universities have recently faced changes impacting the nature of courses and degree programs they offer. Increasing competition for students and calls for improved "ease of access" have driven institutions to create innovative approaches to course delivery and degree requirements (Lewis, Snow, Farris & Levin, 1999). Students want to pursue degrees without relocating due to family responsibilities or in order to retain current employment. Cries for accountability from legislators and taxpayers have energized a focus on quality. In response, many educational institutions are seeking to improve their programs with new technology tools (Zirkle & Shoemaker, 1999). These issues

have begun to affect career and technical education programs, primarily at the postsecondary level.

Problem Statement

Determining the impact of distance education on career and technical education presents many challenges. Despite its long history, distance education has not been the subject of extensive educational research (Zirkle, in-press). Early forms of distance education utilized written correspondence and instructional radio and television and played a relatively small part in the educational process. Therefore, most researchers paid little attention to distance education efforts. With the growth of the Internet as an educational resource (Paloff & Pratt, 1999; Simonson, Smaldino, Albright, & Zvacek, 2003) and the resulting explosion in distance education, this situation is changing.

To date, the research that has been conducted on distance education has been somewhat less than systematic. Phipps and Merisotis (1999) found much of the research on distance education to be of questionable quality, with poor validity and reliability, and a lack of control of extraneous variables and "reactive effects". According to the study, research in distance education also tends to focus on individual courses, rather than entire degree programs, and does not address the differences between the distance and non-distance student. Distance education research also has yet to investigate many of the areas defined by various leaders in the field (Birnbaum, 2001: Holmberg, 1987).

Research on distance education in career and technical education has been limited, despite recommendations for research direction more than two decades ago (Oliveira & Rumble, 1982). More recently, Wonacott (2001) discussed the implications of distance education for career and technical education and found many issues related to research, including access, costs, and effectiveness/appropriateness.

In addition to the lack of a clearly articulated strategy for research on distance education in career and technical education, there has been no comprehensive analysis of what research has been conducted on the subject. The problem, the absence of a compilation and analysis of research on distance education in career and technical education, is the focus of this research synthesis.

Overview of Distance Education

While the Internet and other technologies have created interest in distance education, it is not a new phenomenon: it has been a mode of teaching for over a century (Moore & Kearsley, 1996). Correspondence schools have been operating in the U.S. since 1910. Launched in the early 1920's, educational radio was an early medium for instruction in the U.S. In 1969, the opening of Great Britain's Open University ushered in a new era utilizing television and related media for

instructional delivery. In the U.S., recent estimates calculate distance education courses in the academic year 1997-98 at 54,470 with about 1.66 million enrollments (Lewis, Snow, Farris, & Levin, 1999). Countless colleges and universities are engaged in distance education; some of the more notable ones include Penn State University's World Campus, Nova Southeastern University, The University of Wisconsin, and the University of Texas TeleCampus.

Distance education is generally described as a process in which the learner is not physically present in the same location as the instructor (Distance Learning Resource Network, 2003; Steiner, 1995). This separation of teacher and learner is fundamental to distance education (Keegan, 1983) and differentiates distance education from all other forms of traditional instruction (Holmberg, 1978). Distance education also has been defined by its component characteristics. Clark and Verduin (1989) listed the following:

- The separation of teacher and learner during at least a majority of each instructional process;
- The use of educational media to unite teacher and learner and carry course content;
- The provision of two-way communication between teacher, tutor, or educational agency and learner (p. 25).

As technology continues to evolve, the definition of what constitutes distance education is likely to do so as well, along with the various descriptors of its component parts. However, the fundamental principle of the physical separation of teacher and learner mentioned in one form or another by various writers (Distance Learning Resource Network 2003; Holmberg, 1978, 1987; Keegan, 1996; Moore & Kearsley, 1996; Picciano, 2001; Simonson, et. al. 2003; Steiner, 1995; Willis, 1993) will likely stay at the heart of any future definition of distance education (Zirkle, in-press).

Distance education can occur in a synchronous or "real time" mode that requires the simultaneous participation of all students and instructors (Distance Learning Resource Network, 2003). This interaction can also occur in an asynchronous mode, which does not take place simultaneously.

The technology utilized in distance education can take many forms. These forms generally fall within four options: voice, video, data and print (University of Idaho College of Engineering, 2003). Voice includes audiotapes, radio and audio/teleconferencing. Options within video can encompass videotape/videodisc or satellite video. The data (computer-driven) option includes email, Internet Relay Chats (IRC) and Internet applications such as course software. The print option includes print materials such as study guides, textbooks, workbooks and case studies, usually transferred through traditional mail.

Method

This study is designed as an integrative research review, otherwise known as a research synthesis (Cooper, 1998). This self-contained review offers an overview of the research and provides direction for future research (Merriam & Simpson, 1995; Strike & Posner, 1983).

Cooper (1985) listed six characteristics of literature reviews:

1. Focus - defines the material that is of central interest to the researcher;
2. Goals – determines what the researcher hopes the review will accomplish;
3. Perspective – the point of view the researcher takes, either a neutral or advocacy position;
4. Coverage – the extent to which the researcher locates and includes relevant works in the literature review;
5. Organization – how the paper is arranged, either in an historic, conceptual/thematic, or methodological manner, or in some combination thereof;
6. Audience – defines the intended group for the literature review (pp. 9-14).

The characteristics listed above helped frame the inquiry for the literature review. The focus of this literature review was defined as all the research related to the utilization of distance education in career and technical education to meet the goal of providing an initial analysis. This review takes a neutral position, seeking to describe, "What is". An exhaustive review (Cooper, 1985) was conducted, designed to locate all research on the topic. This review is organized according to themes reflected by the types of research conducted to date on distance education in the discipline of career and technical education, which is also the audience for the literature review.

Also guiding the structure of this literature review was the work of Phipps and Merisotis (1999), who conducted an extensive research synthesis on the effectiveness of distance education. The synthesis categorized the research on distance education into four approaches: descriptive research, case studies, correlational studies and experimental research.

A variety of strategies were utilized to provide a comprehensive focus on distance education in career and technical education. Databases, such as ERIC, Master's Abstracts, Dissertation Abstracts and Education Abstracts were searched. Professional journals, specifically those with foci in distance education and/or career and technical education, were also searched. Proceedings from conferences and meetings were examined as well. Relevant information and studies were categorized and the findings were summarized.

Research on Distance Education in Career and Technical Education

As a result of the literature search, a total of 71 articles and presentations addressing research relevant to the use of distance education in career and technical education were located. Much of the research conducted on distance education in career and technical education is descriptive in nature. Studies that examined student access to distance education, their demographic characteristics, and their perceptions of their distance education experience, as well as faculty utilization and perceptions of distance education typically utilized questionnaires, attitude scales or interview to collect data. Case studies comparing a traditional, on-campus class to a distance education class are common. There are only five studies that are correlational in nature and examine the relationship between two or more quantifiable variables. Experimental studies in distance education and career and technical education were not located in the literature search.

The research on distance education in career and technical education can be categorized into three fairly distinct areas: issues of access to distance education courses and programs: characteristics and performance of students in distance education: and the involvement of instructors/faculty in distance education (Zirkle, in-press). This finding is similar to that of the research synthesis conducted by Phipps and Merisotis (1999). Several of the studies and articles addressed more than one issue (i.e., a student's ease of access to a distance education course and their resulting academic performance), while others addressed only a single issue (student perceptions of the distance education experience, for example). Still other studies addressing distance education were a part of a larger study, such as recent studies on the characteristics of teacher educators and teacher education programs in career and technical education Bruening, Scanlon, Hodes, Dhital, Shao, Liu 2001a; 2001b).

Access Barriers to Distance Education

A major attraction of distance education is the ability to learn "anytime and anyplace". While seemingly eliminating the access barriers experienced by traditional students, distance education has its own set of constraints for students. Distance education may be widely available, but it is not necessarily widely accessible, which has sparked much discussion and research into "information haves and have-nots" (Kerka 1989, p. 2).

Much of the research in distance education has condensed access barriers into two categories: student barriers and institutional barriers (Zirkle, 2001). Student access barriers are those difficulties experienced by students while attempting to take courses at a distance, while institutional barriers are those obstacles often constructed by educational entities offering courses at a distance.

Institutional Access Barriers.

With respect to institutional barriers, Garland (1993) and Yap (1996) listed several barriers impeding distance education efforts, including:

- program costs
- lack of equipment & support
- scheduling
- resource availability
- instructional concerns
- technical assistance

These institutional barriers have been highlighted in selected career and technical education studies. Program costs have been identified as a barrier to implementation of distance education in agricultural education (Miller & Miller, 2000; Murphy & Terry, 1998) and cited in efforts to implement distance education programs in adult and vocational education (McClelland & Fouza, 1986). Equipment availability and support are also related to program costs, and were identified by Ndahi (1999) as a factor in the unwillingness by trade and industrial education faculty to teach at a distance.

Simply offering courses can be a significant barrier. Zirkle (2002b) described trade and industrial education majors who were able to access courses in their major, but were unable to schedule university general education courses they needed to graduate to offering courses at a distance. Scheduling courses at specific times can be a difficulty as well. Classes taught with satellite technology may have limited channels availability on which to broadcast. Finding faculty to teach at "off" times can also be a challenge (Zirkle, 2001). Institutions offering courses and programs at a distance must make certain resources such as advising, library services, and scheduling/registration are available for distance learners. Having information available about programs and courses and competent advising are particularly critical. Flowers (2001), in a study of technology education teachers, described the need for institutions to better advertise course offerings to facilitate awareness. Trade and industrial education majors, taking courses at a distance, perceived themselves as not as important as on-campus students (Zirkle, 2002b).

Instructional issues permeate distance education. Faculty, accustomed to traditional, on-campus, can be resistant to offering distance courses (Dillon & Walsh, 1992). This resistance may be a result of the significant time constraints associated with offering career and technical education courses and programs at a distance (Miller & Miller, 2000; Murphy & Terry, 1998b; Ndahi, 1999; Ragothaman & Hoadley, 1997; Zirkle, 2002c). Many faculty need training in order to move an on-campus class to a distance environment and this training may be scarce (Ko & Rossen, 2001; Murphy & Terry, 1998a). Some course content—such as the specific

psychomotor "hands-on" skills found in many trade and industrial (Zirkle, 2000) and agriculture programs (Miller, 1997) may not be easily taught through distance education. The "soft skills" associated with many business education programs (Fann & Lewis, 2001) may also be difficult to teach at a distance.

Distance education programming relies heavily on technical assistance. The lack of an effective institutional network of technical assistance is a significant barrier. Capable technical support to students when problems arise, assistance for faculty to deliver course material via distance methodologies, and issues of copyright and intellectual property were identified in a study by Zirkle (2002b) that examined both institutional and student barriers to distance education.

Student Access Barriers

The characteristics and personal situations of students enrolled in distance education courses can present barriers to effective learning and success in distance education environments (Hillsheim, 1998). These student access barriers can be defined as follows (Galusha, 1998):

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

While financial issues may affect students' ability to take classes, many students taking courses at a distance may have full-time jobs and/or tuition reimbursement from an employer (Zirkle, 2001). Some students may be more affected by job conflict, since many were employed full-time, and by family time constraints than financial issues (Zirkle, 2002b). The personal time required to take classes was more significant than the monetary cost.

Feedback and instructor contact is an integral part of distance education programming in career and technical education (Dooley, Patil, & Lineberger, 2000; Flowers, 2001; Murphrey & Dooley, 2000; Swan & Jackman, 1996; Zirkle, 2002b). The interaction between instructor and student has been perceived as positively related to student learning (Miller & Webster, 1997).

Without interaction, a sense of student isolation is a likely result. As much as possible, students want to be a part of the larger school community (Galusha, 1998). Flowers (1991) and Zirkle (2002b) noted students' sense of isolation, and the lack of interaction with fellow students, respectively, in their distance education programs.

The availability of student support services to the distance learner is essential (Birnbaum, 2001). In studies of career and technical education programs in teacher

education, Irani, Scherler, Harrington, and Telg (2000) and Zirkle (2002b), effective advising was cited as a key to students at a distance getting appropriate courses needed for graduation and teacher credentialing.

Characteristics and Performance of Students in Distance Education

Studies have found that postsecondary distance education students were more likely to be older and female, and to have significant family and work responsibilities (Halsne & Gatta, 2002; Ross & Powell, 1990; Rovai, 2002; Sikora & Carroll, 2002). Distance students are also more likely to be pursuing an associate degree primarily through a community/technical college (Sikora & Carroll, 2002).

Several career and technical education studies have examined various demographic attributes of learners in distance education. Thompson, Orr, Brooks and Thompson (2000) found the majority of the students in their distance Bachelor's degree program in Vocational Education to be female. Wright and Thompson (2002) described students in their distance education program for two-year nursing and allied health professions as older, adult learners with family and work commitments. In a study of a Master's degree program in Continuing and Vocational Education, Oehlkers (1999) found all the students to be female, with an average age of 38. Zirkle (2002b) found 60% of the respondents in his survey of inservice and preservice trade and industrial teachers to be between the ages of 32-45 and pursuing a bachelor's degree. Tucker (2000) noted a significant age difference between students on campus (average age 23 years) and distance students (average age 37 years) in the two groups of students in her business communications course.

Student Perceptions of the Distance Education Experience

Studies have documented both the favorable perceptions of students involved in distance education (Bozik, 1996; Hilgenberg & Tolone, 2000; Wagner, Werner, & Schramm, 2002) and the unfavorable (Bower, Kamata, & Ritchie, 2001; Rivera, McAlister, & Rice, 2002; Thomerson, 1995). Studies in career and technical education have attempted to measure student satisfaction with distance education courses. Many have reported positive student experiences with distance education (Dooley, Patil, & Lineberger, 2000; Misko, 2000; Mudge & Way, 1999; Pool, 1996; Pucel, 1987; Swan & Jackman, 1996; Thompson, Orr, Brooks, & Thompson, 2000; Thompson, Thompson, & Orr, 2002). Some studies have reported mixed results. Kelsey, Lindner, and Dooley (2002), in their study of a collaborative doctoral program in agricultural education between Texas A&M University and Texas Tech University found that students were satisfied with the instructional design, faculty, and other students in the program, whereas they expressed dissatisfaction with isolation, inaccessible resources and materials, the registration process, and the amount of time to complete course requirements. Early childhood special education

majors (Gallagher & McCormick, 1999) were also satisfied with distance courses, but expressed a preference for the traditional classroom.

Student Performance in Distance Education Courses and Programs

Student academic performance in distance education has sparked much discussion and debate. For the past two decades, research in distance education has been conducted on comparisons among the different media types available for the delivery of distance education, i.e., print, instructional television, the Internet, etc., and traditional in-class instruction (Simonson, et. al. 2003). The delivery medium itself appears to make no difference in the learning results in students (Clark 1983, 1994; Verduin & Clark, 1991). This finding has been supported by a number of studies (Cheng, Lehman, & Armstrong, 1991; Fallah & Ubell, 2000; Gagne & Shepherd, 2001; Johnson, 2002; Johnson, Aragon, Shaik, & Palma-Rivas, 2000; Rovai, 2002)

In career and technical education, this issue has not been extensively studied. Misko (2000) reported satisfactory performances by vocational education distance students on their course assessments. Tucker's (2000) study of a business communications course, noted distance students did as well or better than their on-campus counterparts. Swan and Jackman (2000) compared the success of students enrolled in distance education courses in a variety of subjects, including vocational marketing, animal science, and agricultural business management, and found no differences in grade point average between the two groups. . In a slightly different examination of student performance, Willis and Joyner (2000) found no differences between on-campus students who took an information technology class online and off-campus students who also took the class online. Petty and Brewer (2002) reported student perceptions of the transfer of training to be equivalent for web-based courses and traditional on-campus courses.

Instructors/Faculty Involvement in Distance Education

Faculty Use of Distance Education. Bradburn and Zimbler (2002) examined the use of distance education by postsecondary faculty. Approximately six percent reported they taught at least one course via a distance education methodology. Two-year college faculty were more likely to teach courses at a distance, as were part-time and temporary faculty. The study also described the percentage of faculty, by teaching discipline, who taught at a distance. Under the category "vocational," 13.6% of faculty reported teaching at least one course via non face-to-face means.

In K-12 education, very few teachers use technology for distance education purposes (Kleiner & Farris, 2002). While 75% of all K-12 schools had a website, it was used for the school calendar and other information. K-12 teachers use the Internet primarily for research purposes (Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000). A search of two Internet course developers, WebCT

(http://www.webct.com/) and Blackboard (http://www.blackboard.com/), reveals a number of K-12 school systems that are using this method to deliver portions of instruction online. However, research on K-12 teacher use of distance education is extremely limited.

There have been very few studies in career and technical education on faculty use of distance education. Recent studies by Bruening, Scanlon, Hodes, Dhital, Shao, and Liu (2001a; 2001b) have examined the use of distance learning in course and program delivery but did not explore specific faculty utilization of distance education. In secondary career and technical education, there is little specific knowledge of school and teacher use of the Internet and distance education. Zirkle (2002c) described career and technical teachers who, as a result of completing an online course, created online courses for their own secondary programs. As with the rest of K-12 education, however, little is known about secondary career and technical education teacher use of distance education.

Faculty Perceptions of the Use of Distance Education. Converting a traditional on-campus course to a distance education model requires significant modification (Birnbaum, 2001; Paloff & Pratt, 1999; Picciano, 2001). The time constraint and increased workload associated with this conversion frequently appears as a concern in research focused on faculty perceptions of the use of distance education (Bennett, Priest, & McPherson, 1999; Bower, 2001; Cyrs & Conway, 1997; Graf, 1993; Mortera-Gutierrez & Beatty, 2000; Schifter, 2001).

The significant time required to develop courses has also been a consistent finding in studies involving distance education in career and technical education programs. Studies in agricultural have identified time as a major obstacle in the adoption of distance technologies for program delivery education (Miller & Miller, 2000; Murphrey & Dooley, 2000; Murphy & Terry, 1998b). Studies of trade and industrial/technical educators have also cited a lack of time as a faculty concern (Ndahi, 1999; Zirkle, 2002b).

Professional development has also been identified as a significant issue with faculty who utilize distance education (Fender, 2001; Milheim, 2001; Picciano, 2001; Thach & Murphy, 1995). Developing courses for distance delivery requires technical knowledge and expertise (Booker, 2000; Cyrs, 1997; Fender, 2001; Lee, 2001; Phipps & Merisotis, 1999). Institutional models for professional development and training for faculty have been suggested (Carter, 1995: Irani & Telg, 2001; Olcott & Wright, 1995), but as technology continues to evolve, training for faculty will need constant revision.

Studies in career and technical education have addressed faculty training and professional development for distance education. (Miller & Carr, 1997; Murphy & Terry, 1998; Ndahi, 1999; Schofield, Walsh, & Melville, 2000; Zirkle, 2000). Franklin and Kaufman (1999) described Indiana State University's Course Transformation Academy, a professional development program for faculty teaching at a distance. The impetus for this program came from Indiana State's initiative to

develop a number of career and technical education-related degrees at a distance, in an articulation agreement with the state's system of two-year colleges (Indiana State Commission for Higher Education, 1997). Programs of study included industrial technology, automotive technology, mechanical technology and career and technical education (Zirkle, in-press).

Compensation and incentives for involvement in distance education efforts have been mentioned as a faculty concern (Lynch & Corry, 1998; Picciano, 2001; Saba, 1998, 2000; Wolcott, 1999). This is likely due to the time constraints associated with developing courses for distance delivery and the need for continual professional development.

The compensation and incentives issue has also been described in career and technical education studies on distance education. Murphy and Terry (1998) noted the lack of reward system for using distance technologies as an obstacle to their use in an agricultural education program. In a study of the diffusion of distance education technologies in the College of Agriculture at Texas A&M University, Murphrey and Dooley (2000) listed incentives as a critical issue.

Conclusions and Recommendations for Research on Distance Education in Career and Technical Education

Through the past two decades, the dearth of research on distance education has been fairly well documented (Holmberg, 1987; Phipps and Merisotis, 1999; Simonson, et al. 2003). In addition, as noted by Phipps and Merisotis (1999), much of this research has been limited to case studies of a particular distance education course, examinations of student or faculty perceptions in a particular distance education course, or barriers to accessing distance education courses. Very little specific research has addressed learning outcomes and student achievement in distance education courses, especially when compared to traditional courses. (Zirkle, in press).

This review of literature found that research on distance education in career and technical education reflects many of the concerns voiced by Phipps and Merisotis (1999), i.e., the research has been focused on individual courses, not programs, and has not examined differences between traditional and distance learners. Also, little is known about career and technical education instructor/faculty use of distance education. Additionally, there has been little research regarding the use of distance education in career and technical education teacher education, an area where innovative programming would seem to be warranted.

From a methodological perspective, most of the studies were descriptive in nature, again reflecting the findings of Phipps and Merisotis (1999). Case studies of a single course were common, and very few attempts have been made to conduct correlational research. No experimental research was located.

This shortage of all types of research on distance education in career and technical education may be attributed to relatively recent interest on the subject by career and technical education researchers (Wonacott, 2001). Also, distance education efforts in all types of educational institutions are still in their beginning stages. However, growth is likely.

Based on this literature review, some recommendations can be made:

- With respect to access, those institutions offering career and technical education programming at a distance, should determine what, if any, institutional barriers exist that may keep students from accessing these courses and programs
- Begin to conduct rigorous, structured research of the effects of distance education on student performance and achievement at all educational levels, including
    - K-12 education
    - Two-year community and technical colleges
    - Baccalaureate education
    - Teacher education
    - Graduate education

On a methodological level, this research should begin to address the concerns voiced by Phipps and Merisotis (1999) and others, by moving toward correlational and experimental research where appropriate and possible.

- Examine the effects of distance education effects at the individual course, program of study, and institutional level (if applicable)
- Compare these effects to similar courses and program levels offered through traditional methods (i.e., in-class, on-campus settings)
- With respect to faculty involved in distance education in career and technical education, studies examining the extent that faculty actually utilize distance education would be welcome. There are very few studies addressing this issue, and information regarding the extent of use would provide insight into how (and perhaps why) faculty do or do not use distance education.

Perhaps more than any of the academic disciplines, career and technical education programs utilize technology to a high degree. It would appear distance education and career and technical education are a good match (Zirkle, 2002a). However, as this review demonstrates, more research needs to be conducted to determine the most effective ways to utilize distance education in the delivery of career and technical education programming.

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