At-Risk Students and Technology Education: A Qualitative Study

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Recently, there has been a resurgence of interest regarding at-risk students in secondary education. Most studies, in the area of retaining at-risk students in school, focus on vocational training, innovative academic programs, and learning styles (Boutin & Chinien, 1998; Engman, 1989; Friedenberg, 1999). Some studies discuss the importance of schools meeting the needs and interests of these students through interesting programs in order to retain them in secondary education (Ainley, Batten, & Miller, 1984a, 1984b; Ainley, Foreman, & Sheret, 1991). Other studies discuss the importance of teaching students according to their learning styles (Dunn, Dunn, & Price, 1989; O'Neil, 1990). Although there has been much research performed regarding at-risk students in secondary education, few studies address the reasons why at-risk students want to remain in school (Damico, 1989; Taylor-Dunlop & Norton, 1997).

To clarify the word "at risk," the following definition of an at-risk student was given by McCann and Austin (1988) who define the at-risk student with three characteristics:

- First, they are students who are at risk of not achieving the goals of education, of not meeting local and state standards of high school graduation, and of not acquiring the knowledge, skills, and dispositions to become productive members of society (receiving less than 2.00 grade point average).
- Second, they are children who exhibit behav iors that interfere with themselves and others attaining an education, requiring disciplinary action (at least three incidents).
- Third, they are those whose family back ground characteristics may place them at risk (low income to below poverty level, non-English native speaker, etc.). (p. 1-2)

Batsche (1985) successfully compiled the common characteristics that define at-risk students.

Characteristics of the Individual

- history of school absenteeism,
- poor grades,
- low math and reading scores,
- low self-concept,
- history of behavioral problems,
- inability to identify with other people,
- employed full time while in school,
- low socioeconomic background,
- more males than females,
- feel alienated and isolated. (p. 1)

Characteristics of the Family

- family with several siblings,
- father absent from the home,
- father unemployed,
- father did not complete high school,
- mother absent from the home in early adolescence,
- little reading material in the home. (p. 1)

The preceding characteristics were utilized in identifying the at-risk students to be used in the study.

According to Damico (1989), social learning factors affect the at-risk student's desires to remain in school. These factors include the at-risk student's determination to succeed, the student's relationship with his or her teachers, and extracurricular activities in which the student participated. At-risk students who had good social support, both from within and from without school, showed interest in remaining in school. This is supported by Ainley, Foreman, &

Sheret (1991) who mentioned that successful educational experiences and a positive view of the school assisted at-risk students to remain in school. A study regarding the reasons why at-risk students remain in school was performed by Power (1984). This study found that the at-risk student's individual achievement level and academic performance was directly related to the student's decision to remain in school. Additional studies found that achievement and satisfaction with school had a significant impact on at-risk students' decisions to remain in school (Ainley, 1994; Ainley & Sheret, 1992; McMillan & Reed, 1993; Rosier, 1978; Williams, Clancy, Batten, & Girling-Butcher, 1980).

The previous studies are supported by a study performed by Taylor-Dunlop and Norton (1997) that included eleven at-risk female students aged 15 to 17 in New York State. The three Latino, two Caucasian, and six African-American at-risk students participated in focus groups, individual interviews, and small group meetings.

The results of Taylor-Dunlop and Norton's study supported the concept of having supportive links between at-risk students and school. These links include relationships between at-risk students and their teachers, counselors, and friends. The students also indicated that they came to school because they enjoyed math and hands-on courses (i.e. art). Taylor-Dunlop and Norton explained that

> The students' criteria for a favorite course appeared to depend on the amount of self-expression they could achieve in the class, whether it offered practical application, and whether the subject matter came to them easily, giving them a feeling of mastery or being smart. (p. 277)

The study performed by Taylor-Dunlop and Norton (1997) supported this study since at-risk students showed a desire to attend math and hands-on courses like art. Although centered around a curriculum of construction, manufacturing, communication, and transportation/power/ energy, technology education courses are similar to art courses because they focus on teaching students through hands-on activities.

Although technology education programs have historically attracted at-risk students, they have received little attention regarding their influence on at-risk students (Cottingham, 1990). In addition, there have been no studies performed regarding at-risk students' views of technology education and why they desire to take technology education courses.

Purpose of the Study

The enrollment of at-risk students in technology education courses is pervasive throughout the country. However, little is known about why at–risk students would want to take technology education courses, how they value these courses, and the value of technology education courses helps them remain in school. Therefore, the purpose of this qualitative case study was to explore, describe, and examine how at-risk students experience and interact with the technology education curriculum.

Conceptual Framework

Learning within the technology education environment includes three primary learning theories: construction of knowledge, problem solving, and hands-on learning theories (Herschbach, 1998). According to Nuthall (1997), the construction of knowledge learning theory is an important part of education. Piaget (1978) argued that what is internalized is not the behavior but the system that organizes the specific acts involved. In the technology education perspective, Herschbach (1998) stated that,

> The design of instruction based on cognitive the ory shifts instructional emphasis from the passive learning of formally organized, specific content to the active acquisition and use of knowledge. Instructional interventions are designed to assist students to construct meaning, not to memorize information – hence, its usefulness in designing integrative and higher-order learning. (p. 55)

Herschbach describes how important it is for students to actually work with the knowledge and see how it relates to previous knowledge they have gained, and make sense of it and how it fits into their lives (Idol & Jones, 1990; Resnick, 1989; Streibel, 1995; Winn, 1991).

Closely associated with the construction of knowledge, the problem-solving learning theory plays an important role in the contemporary technology education curriculum. The problem-solving learning theory comprises the cognition, guided practice, and automated behavior stages of expertise in problem solving (Johnson, 1988). Through interaction with problems in technology education curricula, students achieve learning and satisfaction

(Johnson, 1988).

Finally, hands-on learning theory plays an important role in technology education curriculum (Korwin and Jones, 1990). As a hands-on subject, technology education demands that students interact with their learning environment. Gokhale (1996) defined hands-on learning theory as follows: "The basic premise of this theory is that students learn as a result of doing or experiencing things in the world, and learning occurs when mental activity is suffused with physical activity" (p. 38). Dewey (1900) believed that, through hands-on activities, students could combine intellectual stimulation with activities that expanded learning.

Method of Research

This research was performed using case study, participant-observation qualitative research methodology. A pilot study was performed for the development of observation techniques and questions for the study, and for me to see some of the views of at-risk students regarding technology education. Support for the case study design used in this study included first, the detailed examination of at-risk students in a technology education environment (Merriam, 1988). Second, I needed to see and understand the interactions between the at-risk students and the technology education curriculum.

After reviewing various sampling techniques used in qualitative research, purposeful sampling was chosen for this study (Merriam, 1998; Patton, 1990). The location was different from the one used for the pre-study, supporting a one-teacher technology education program. The eight at-risk student participants in the study were chosen from a survey of technology course and a power/energy/transportation course containing mostly at-risk students. If the student in question demonstrated most of the characteristics listed by Batsche (1985), then he or she was considered a possible candidate for the study.

Procedures

In this study, I refer to "data" as "evidence." Participant observation and interviews (interactive methods) and document evaluation (non-interactive method) were utilized in obtaining the evidence for the study. These three methods helped to triangulate or check the accuracy of the evidence (Lincoln & Guba, 1985). Other methods used in the study to assist in the triangulation of evidence include member checking (Lincoln & Guba, 1985; Bogdan & Biklen, 1998; Scheurich, 1996) and the establishing of credibility through patterns (Scheurich, 1996). This was done to counteract the novelty effect and observer bias (Gay, 1996).

The evidence was obtained during observations and interviews through the use of instruments developed from the pre-study and from the literature review. The observations were performed daily for six months, with interviews performed at times convenient to each student participant. The satisfaction of evidence collection was completed, as described by Lincoln & Guba (1985), when the sources of information were exhausted, new categories of information were unavailable, and evidence became predictable. Following the study, the evidence was organized and compiled into the NUD*IST(r) qualitative evidence evaluation program.

Evidence Evaluation Procedures

In the evidence evaluation phase of the project, the NUD*IST(r) software was used to search for emerging themes and compile the evidence according to these themes. Three categories, construction of knowledge, problem solving, and hands-on learning, became evident. Under the construction of knowledge category, the subcategories of clarification, association, and knowledge development were established. The problem-solving category contained the subcategories of novice, intermediate, and advanced problem solver. The third category, hands-on learning, contained the subcategories of facilitating learning, learning styles, and life skills. From these categories, three theories of learning, the construction of knowledge theory, the problem-solving learning theory, and the hands-on learning theory, were linked to the at-risk students' experiences. A fourth category, integration of subjects, was also apparent in the evidence, and contained subcategories of mathematics, science, and technology. A fifth category, remaining in school, was also evident, but was not considered to be purposefully influenced by the technology education program. The subcategories of remaining in school include hands-on curriculum, successful educational experiences, and reasons for remaining in school.

These categories were formed according to guidelines set forth by Merriam (1988). These guidelines suggest that 1) the purpose of the research is reflected in the categories, 2) all related items can be put in a category, 3) no items are included in more than one category, 4) each category is separate and independent of the others, and 5) the categories came from a common base of classification. Once the categories were formed, the evidence was then placed in its relative category within the NUD*IST(r) program (Scheurich, 1996).

Establishing Credibility

Credibility is based on the validity and reliability of the instrument or instruments used and the internal validity of the study. Credibility is supported by prolonged engagement, persistent observation, and triangulation (Lincoln & Guba, 1985). All three of these factors were used to increase the credibility of this study. First, the study was performed over a six-month period of time. Second, intense observation and evidence collection was performed once the subjects were identified and secured. Finally, evidences from observations, interviews, and document evaluation were used to help support the trustworthiness of the findings.

Findings

As a theoretically-based study, the evidence, evaluated according to the construction of knowledge, problem solving, and hands-on learning theories, contained consistencies found among the at-risk students. Findings indicated that the construction of knowledge was a part of the curriculum in helping the at-risk students to learn the concepts regarding planning, materials, and processes, and to give the students the experience of working with these concepts (Dewey, 1900; Towers, Lux, & Ray, 1966). Evidence to support the problem-solving theory was not as consistent among the participants as the construction of knowledge or hands-on learning theories, but the evidence did demonstrate the importance of learning the concepts of planning, materials, and processes. The evidence was consistent among the at-risk students with regard to the hands-on learning theory. The students indicated that they learned better through hands-on learning methods than through book work or lecture methods (Dewey, 1900, 1916, 1938; Herschbach, 1996). Examples of evidence from each student in Table 1 helped support the finding, and demonstrated consistency among the students.

As the evidence was evaluated according to theories, consistency was found between the at-risk students in both the construction of knowledge and hands-on learning theories. There was inconsistency found in the problem-solving theory between two students in the survey of technology education course and three students in the power/energy/transportation course. It was determined that the difference was partially due to the fact that the two students in the survey of technology education course did not have

Table 1. Cross–theory Analysis.

Theories	Evidence from the Students				
	Rick	John	Henry	Nick	Price
Construction of Knowledge	"Ah. So the different drawings represent different views or perspectives."	"Well, I learned how to do things a little better... I know how to fix something."	"I changed the drill bit to a smaller size so that the walls of the base will not crack."	"But it doesn't show how far the holes are from the sides."	"How to use a lot of stuff that can help you if you want to make somethin'."
Problem Solving	"If I could just get the fenders to stay on the car."	When the robotic arm wasn't working, "I sat down with my partner to find a solution."	"If Mr. Harman would let me do what I wanted, I'd make it smaller and lighter."	"I thought that we should design and use a robot hand that has split fingers."	"It's kinda like you gotta know math. If you don't learn math, you won't able to do nothin' in here."
Hands-on Learning	"We do more, like, hands–on work, and, like, you get to work in the shop and work with tools and stuff."	"We do more hands-on . . . special curricular or whatever. I think we do more of that than just (reading) text books."	"Hey man, it's real interesting. I mean, here's lots of things to learn and do with your hands."	"You get a lot of hands–on experience. It's not one of those classes where they just tell you to look at the book."	"Information like and electricity. A lot of stuff that can help you if you want to make somethin'."

as good of a foundation of planning, materials, and processes as the students in the power/energy/transportation course (Berkemer, 1989).

From the evidence, there seemed to be a clear link between the construction of knowledge theory and the problem-solving theory. This link was described by Berkemer (1989) and Johnson (1988), who explained that the knowledge of planning, materials, and processes was vital for the success of students in problem-solving activities. In addition, while engaged in a problem-solving activity, students were constantly constructing new knowledge as they work through problems (Brown, Collins, & Duguid, 1989, Dewey, 1900).

The link between the problem-solving theory and the hands-on learning theory was also apparent in the evidence and in the literature. The technology education curriculum in the study required students to work interactively with tools, planning, materials, and processes as they solve problems (Sanders, 1993; Gokhale, 1996).

The evidence helped to establish a link between the hands-on learning theory and the construction of knowledge theory. It was found that knowledge construction for students in the technology education program involved the use of hands-on methods in order to learn how to work with the materials and processes of industry (Dewey, 1900; Herschbach, 1996). Also during the study, there was evidence of the integration of knowledge between these subjects, and the influence of the technology education program in assisting students to understand mathematics and science concepts (Korwin and Jones, 1990).

Evidence was obtained during the study that emphasized the importance of life skills in the lives of the students. During interviews and observations, the students indicated that one of the reasons they took the technology education course was to obtain knowledge and skills regarding technology that could help them in life. Much of the evidence reflected the students' desires to know how to maintain a home or a vehicle (Dewey, 1900, 1916, 1938; Shield, 1996).

In the study, the at-risk students found school in general to be boring and academically focused. Although the students in the study had difficulty experiencing achievement and success in their other subjects, they saw success and achievement in the technology education program.

Not only did the students enjoy school more when they had successful experiences, they also indicated that the technology education program had a profound influence in their decision to remain in school. In the interviews, five of the eight students mentioned they would not be in school if it were not for successful experiences and hands-on learning activities they experienced in the technology education program.

Discussion

Questions of the Study

There were two primary questions that guided this study of how at-risk students view technology. These are "How do at-risk students respond to a technology education program?" and "Why do at-risk students enroll in technology education courses?" The first question related not only to the experiences and knowledge the students gained while in the present technology education course, but also was related to their previous knowledge and experiences. Most of the students had some experience with technology education in junior high or middle school, and reflected on this knowledge in their interviews.

The knowledge they obtained from the high school technology education program in the study allowed the students to construct new knowledge and build upon the knowledge they had previously obtained. This knowledge was used to help the students to perform better during problem-solving activities.

The responses of the students to the problem-solving activities in the power/energy/transportation course were very positive. The students demonstrated a sincere desire to work hard and complete their projects, competing for the best designed robotic hand or the highest flying water bottle rocket. The literature regarding at-risk students revealed they perform better when they are in an environment that helps them to be successful (Midkiff, 1991).

The observations and interviews revealed that the students preferred hands-on learning in a curriculum to the traditional book and lecture method. The students performed well in the technology education courses. However, the students did not perform as well in the other school subjects. Evidence from the students indicated the possibility that a lack of hands-on experiences in other courses could hinder their performance in those courses (Midkiff, 1991).

The second question of the study focused on the reasons behind a student's decision to enroll in a technology education course. Responses included (1) they had a positive experience in a junior high or middle school technology education course and wanted to enroll in another technology education course (Midkiff, 1991), (2) they wanted to learn more about technology, and (3) five of the eight students said that if they had not been allowed to enroll in the technology education course, they would have dropped out of school.

Practical Implications

What do the findings in this study tell us about teachers of at-risk students? Teachers of at-risk students could consider including hands-on and problem-solving learning methods in their curriculum. This would allow the at-risk students to achieve success.

What do the findings in this study tell us about the curriculum in schools? Evidence exists from studies that indicates curriculum factors may influence at-risk students to remain in school (Ainley, 1989). According to Ainley, Batten, and Miller (1984b), schools that offer hands-on learning programs demonstrate higher graduation rates than schools who focus on lecture-and-examination subjects geared to university entrance.

The findings in this study corroborated with the evidence from existing research regarding at-risk students and the use of hands-on learning curriculum in the classroom. Developers of curricula could consider including hands-on learning theory in the curricula they develop in order to assist at-risk students in learning the material and performing better in the courses (Dunn, Dunn, & Price, 1989; Midkiff, 1991).

The evidence in this study also suggested that the integration of mathematics, science, and technology education should be considered when developing curricula for each of these subjects. This is supported by extensive research in the fields of mathematics, science, and technology education curricula (Bredderman, 1985; Johnson, 1989; Korwin & Jones, 1990; LaPorte & Sanders, 1995; Simon, 1991)

What do the findings in this study tell us about the curriculum in technology education programs? Evidence from this study regarding at-risk students and technology education programs suggested that technology education curriculum should continue to include hands-on learning methods associated with problem-solving activities. In this type of curriculum, at-risk students would be able to engage in units of study that would allow them to have successful experiences (Cole & Griffin, 1987; Van Haneghan, Barron, Williams, Vye, & Bransford, 1992). Evidence relating to the influence of the technology education program on students' performance in other subjects suggested that the technology education curriculum could play an important part in the instruction of students regarding other subjects, such as mathematics and science.

As discussed in the review of literature, at-risk students remained in school longer when given opportunities to experience success and achievement (Ainley, Foreman, and Sheret, 1991; Beck & Muia, 1980). Evidence from the students in the study corroborated with the literature and demonstrated that at-risk students did enjoy school more when they experienced success. In this light, technology education programs may be able to fill a role to provide incentive for at-risk students to remain in school.

Theoretical Implications

Limitations of the Study. As with all research studies, there are limitations that exist. This research study was qualitative in nature and focused on eight at-risk students in a technology education program. Therefore, the study is limited to the male at-risk students in the study, in the technology education program in which the study was conducted. In addition, the subjects were not randomly selected, so they were not representative of the class. In other words, the results of the study are not generalizable to any at-risk students outside the study.

Although the findings are limited to the population of this study, generalizations may be made by the individual readers. Fraenkel and Wallen (1996) discussed the generalizations made in a qualitative study.

> In a qualitative study, . . . the researcher may also generalize, but it is much more likely that any generalizing to be done will be by interested practitioners–by individuals who are in situations similar to the practitioner, rather than the researcher, who judges the applicability of the researcher's findings and conclusions, who deter mines whether the researcher's findings fit his or her situation. (p. 465)

Another limitation of the study deals with the manner in which I distanced myself from the students in the observations and activities. I kept myself aloof from the students in order to maintain a more objective description of the evidence. This may limit the amount of in-depth information obtained regarding the experiences of the students.

A last limitation of the study is that I was limited in the number of courses that I could observe. Due to my schedule, I was limited to observing students in the third and fourth periods. I was unable to view at-risk students in courses scheduled in the fifth through ninth periods.

Implications for Further Research. Longitudinal research should be conducted regarding the utilization of hands-on learning and problem-solving methods for teaching at-risk students, not only in technology education, but in other academic subjects as well. Further research is needed to help determine curricula that can assist at-risk students to experience success in school.

Another method for studying this issue would be to ask teachers in the school to participate in hands-on activities that relate to their subject. Through a study of the way at-risk students respond to hands-on learning activities in regular school subjects, teachers could increase the number of at-risk students retained in school. Also, more research needs to be performed regarding the ways in which at-risk students view technology education programs and other school subjects. This would add to the existing literature and research base, and assist teachers, administrators, and college professors in the development of curricula for at-risk students. Further research needs to be performed regarding the enrollment of at-risk students in technology education courses with regard to their prior experience and possible future experiences. This could assist parents and counselors with helping at-risk students to select courses that will help them to learn through hands-on learning methods.

Also, research regarding the integration of mathematics, science, and technology education as curriculum for at-risk students should be explored. Evidence from this study suggests that the integration of subjects in a hands-on learning environment could benefit at-risk students. The duplication of this research study in another part of the country would help to confirm the evidence found in this study. In addition, a duplication of this study might reveal evidence that was not obtained in this study. On a grander scale, quantitative local, area, and national research regarding curricula for at-risk students should be performed. This would help to determine the influence of technology education programs with regard to at-risk students. In addition, it would assist curriculum developers in the technology education field to consider at-risk students when developing technology education curriculum.

Phillip Cardon's research centers on at-risk students and their efficacy in school. this is Cardon's second publication in The Journal of Technology Studies.

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