PERCEPTIONS OF MATHEMATICS, SCIENCE, AND TECHNOLOGY TEACHERS OF AN INTERDISCIPLINARY CURRICULUM IN A MIDDLE SCHOOL

by

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ABSTRACT

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The purpose of this study was to obtain the attitudes and perceptions of mathematics, science, and technology teachers in the White Bear Lake Middle Schools about an interdisciplinary curriculum. All teachers participating in this study taught in one of the above disciplines in the middle school.

The study explored why education continues to teach traditional curriculums. First and foremost, it examined how disciplines within education were formed and how they have remained isolated from each other. It continued by explaining how educational reform prevents schools from using unique curriculums due to requirements placed on them. Next, the study detailed the confusion of what exactly an interdisciplinary curriculum is and what the curriculum brings to students. Finally, a rationale was formed why an interdisciplinary curriculum should be implemented in the White Bear Lake Middle Schools.

A survey was used to gather information from the teachers. Data was collected, analyzed, and reported. The research data determined teachers were more comfortable teaching their current curriculum. Further studies are recommended to determine how others within education view an interdisciplinary curriculum.

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To finish this study took the support of so many. The first person I would like to recognize is my research advisor, Dr. Amy Gillett. Amy made me feel at ease while working on this study and she was there 24/7. Next, the professors in the technology education department for polishing my skills as a teacher and for pushing me to think differently about education. I can not forget the guys I met and shared thoughts with during my schooling at Stout, especially Rick Conrad. Rick is a credit to educators. Finally and not forgotten my wife Dana. Dana showed me so much patients throughout my schooling. Your support was unbelievable. Thank you!

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CHAPTER 1

Introduction

The goal of every public school in the United States is to provide all students with a sound education throughout their school years. Goals for schools have been so expanded that today's schools may be attempting to achieve too many things for all students and may not be doing many of them well enough (Ornstein & Levine, 1989). Ornstein and Levine continued by suggesting that curriculum is continuously modified as the goals and objectives of the school are revised, as student populations have changed, as issues are debated, as interest groups are activated, and as society has changed.

This is reflected in curriculum design and development as a process that needs to be continuously changing. These changes occur because society evolves, and education changes to meet the needs of a technologically advancing society. In education, change is not always coordinated, but rather occurs within individual disciplines of study. Wicklein and Schell (1995, p. 59) stated the following thought: "Here in lies the crux of the matter, the school curricula is a segregated approach to instructional topics which does not adequately address the reassemblage of topics into a coherent body of knowledge to be used by students."

From the Greeks' idea of sound mind in a sound body to the European inquiry-oriented traditions of Coenius, Pestalozzi, and Montessori to the present, educators have called for teaching and learning that integrates disciplines and fields (Tchudi & Lafer, 1996). Most educational reform reports since the mid 1980's call for higher standards for curricula, higher standards for student achievement, and new approaches to teaching and learning (Childress, 1996). Recent years have witnessed serious efforts by national organizations, state education departments, and local school districts to restructure education from within the classroom by developing new standards for what students learn and how teachers teach (Council for Citizenship Education, 1997). Periodically

this process must occur if classroom knowledge and behavior is to adapt to new ideas, information, and expectations that arise out of the content disciplines, the field of education, and our society . Teachers need to communicate, plan, and have a common theme, even if they don't actually teach side by side (Stoehr & Buckey, 1997).

Interdisciplinary curriculum, or otherwise known as integrated curricula, is a curriculum design and a method of instruction that can foster all disciplines under one umbrella (Maurer, 1994). The integrated curricula is planned and organized to enable learners to better connect interrelated concepts, contents, and processes and seek relationships between past, present, and future experiences and learning (Wisconsin Department of Public Instruction, 1999). A course such as Materials Science and Technology is a course that uses problem solving as the basis to its approach for studying science and technology (Whittaker, 1994). Another course that uses an integrated approach is PHYS-MA-TECH (Scarborough & White, 1994). This is a course that integrates physics, mathematics, and technology so students are taught in a relevant fashion. Interdisciplinary units could be designed in such a fashion that students are participating in activities in each of their classes dealing with a common theme, such as Space Exploration (Stoehr & Buckey, 1997). These courses would be applied classes where students would get a holistic education (Flowers, 1998).

Successful curriculum development in our nation's schools and colleges relies on compromise and interplay from a number of interested parties, some of whom are competing for recognition and resources (Shield, 1996). It is critical that the integrated disciplines enter the relationship as equal partners to ensure students study technology in a balanced way (Wright, 1996). Wright and Foster (1997) followed up by noting that students learn that technology is the thread of society and that all subjects are intrinsically connected.

Whittaker (1994) shed some light on the lack of innovated curriculum students are experiencing in mathematics, science, and technology education. Student enrollment is

declining yearly in these classes beyond the state required courses. Whittaker cited a report from the National Center for Improving Science Education (NCISE), " at least two-thirds of the nation's high school students typically do not elect science courses or achieve well in those courses they are required to complete" (1994, p. 53). The NCISE went on to say the methods of teaching science produces boredom amongst students because the courses generally have very little hands-on activity for students to experience live science (Whittaker, 1994).

Technology education is a discipline that involves knowledge and study of human endeavors in creating and using tools, techniques, resources, and systems to manage the man-made and natural environments for the purpose of extending human potential and the relationship of these to individuals, society, and the civilization process (Sterry & Wright, 1987). Technology education should indeed hold an equal place with science and math according to Wright (1996). He suggested that all three have commonly held features including a body of knowledge, mode of inquiry, and a history that holds both personalities and significant events. Technology education has the knowledge of practice, the mode of inquiry that is focused on creating new technologies, and a long history beginning with the Stone Age leading us to present day. All technology is dependent on the creativity and ingenuity of the human mind.

Curriculum integration and application has been an important part of education reform strategies throughout the 1990's ; however, very few schools have adopted this reform (Wisconsin Department of Public Instruction, 1999). White Bear Lake Area Schools in Minnesota is a school district rich in educational reform. The school district was one of the first in the state to implement the educational reform, The Minnesota Graduation High Standards. The district consists of seven elementary, two middle, 9-10, and 11-12 schools which serve approximately 5700 students. At this time White Bear Lake does not practice interdisciplinary education.

Statement of the Problem

Mathematics, science, and technology education curriculum is set up to prepare students for our technological society. An interdisciplinary curriculum of mathematics, science, and technology would combine all three disciplines, giving the students a richer experience. The implementation of an interdisciplinary curriculum incorporating mathematics, science, and technology has never been proposed in the White Bear Lake Public Schools. At this time there is no sequential data to determine if the mathematics, science, and technology teachers have an interest in the curriculum reform of interdisciplinary curriculum at the White Bear Lake Middle Schools. White Bear Lake Middle Schools would be confronted with many challenges, including the organization of the classroom, nature of assessment, teacher training, and the role of the students in their own learning.

Purpose of the Study

The purpose of this study is to determine the interest of the mathematics, science, and technology teachers in the White Bear Lake Middle Schools in the implementation of an interdisciplinary curriculum at their buildings. A survey will be distributed in January of 2002 to Central and Sunrise Park Middle Schools to mathematics, science, and technology teachers to measure their attitudes and opinions towards the implementation of an interdisciplinary curriculum.

Research Questions

This study should answer the following questions:

1) What is the main concept of an interdisciplinary curriculum?

2) What are the elements of an interdisciplinary curriculum?

3) Does your current curriculum contain elements of an interdisciplinary education?

4) Does your current curriculum give students a holistic learning experience?

5) What is the attitude of the teachers toward the implementation of an interdisciplinary curriculum?

6) Is there a difference in attitude between the mathematics, science, and technology teachers toward the implementation of an interdisciplinary curriculum?

7) Does an interdisciplinary curriculum of mathematics, science, and technology improve upon the traditional curriculums of mathematics, science, and technology education?

8) Does the lack of resources make it difficult to implement an interdisciplinary curriculum?

9) Does required curriculum such as graduation standards make it difficult to implement an interdisciplinary curriculum?

10) Would an interdisciplinary curriculum serve our Middle School's Mission Statement?

Significance of the Study

The following information will be derived from this study. Such as:

1) This study will recognize the amount of interest of mathematics, science, and technology education teachers in White Bear Lake Middle Schools have of the implementation of an interdisciplinary curriculum. Teachers of each discipline will be able to convey thoughts and ideas of an interdisciplinary curriculum of mathematics, science, and technology education. The findings will be used in the planning of the implementation of mathematics, science, and technology interdisciplinary curriculum**.**

2) The study will state the difference between a traditional curriculum and an interdisciplinary curriculum**.** It will show how an interdisciplinary approach develops the student as a whole because of the active learning that takes place, whereas traditional curriculum pours the knowledge into the students like empty vessels (Tchudi & Lafer, 1996; Illich, 1970). This information will be useful in planning the implementation of mathematics, science, and technology interdisciplinary curriculum**.**

Limitations of the Study

Several limitations have been identified by the researcher. They are:

1) The sampling of teachers was limited to mathematics, science, and technology teachers at the White Bear Lake Middle Schools.

2) The survey was developed by the researcher.

3) Two sampling sites might hinder the thoroughness of the survey.

4) Retirements, resignations, layoffs, new hirings, and transfers of teachers might create skewed results in the research.

Definitions of Terms

For clarity of understanding, the following terms need to be defined**.**

Holistic Student- A student who takes up their learning as wholes, without fragmentation of learning skills or knowledge (Tchudi & Lafer, 1996).

Integrated Curriculum- Two or more teachers from different disciplines working together to coordinate their course instruction, develop materials, link academic and occupational skills, and develop varied instructional strategies (Wisconsin Department of Public Instruction, 1999).

Interdisciplinary Curriculum**-**The process teachers use to organize and transfer knowledge under a united theme (Maurer, 1994).

Technology- The use of critical thinking skills, resources, and the devices people have invented to solve problems (Thode,1994).

Technology Education- Technology education is a discipline that involves knowledge and study of human endeavors in creating and using tools, techniques, resources, and systems to manage the man-made and natural environments for the purpose of extending human potential and the relationship of these to individuals, society, and the civilization process (Sterry & Wright, 1987).

Thematic Education- Education that uses a theme or topic to form a disciplinary discussion (Allee, 1993).

Methodology

This study is examining the interest of mathematics, science, and technology teachers in the White Bear Lake Middle Schools on the implementation of an interdisciplinary curriculum**.** In the following chapters of the study will indicate findings from surveys and look at the viability of implementing such a curriculum.

CHAPTER 2

Review of Literature

Introduction

This chapter will briefly examine both discipline (subject area) and current curriculum reform movements within American public schools. Next, it will take a detailed look at an interdisciplinary curriculum, also known as an integrated curriculum, and how it works. Finally, it will rationalize why an interdisciplinary curriculum of mathematics, science, and technology is a sound curriculum.

Disciplines in Education

The Webster's new encyclopedia of dictionaries (Allee, 1993) "defines discipline as the training of the mind, or body, or the moral faculties; to train." Some scholars will say that the above definition is the goal of the public school system in America, to train the mind. In the eighteenth century, Horace Mann, known as the father of modern education to many, introduced scientific knowledge for schooling, the basis, train children's minds (Goldberg, 1996). Mann's reforms led to the expansion of disciplines, and schoolmasters were trained to teach all disciplines, much like modern elementary teachers. Today's colleges and universities train secondary teachers specifically for different disciplines. Higher education institutions dictate what and how teachers are trained. Gaff (1989) accurately described the dominant role of "disciplinary" learning in higher education:

> The influence of the academic discipline is pervasive. Colleges are organized by departments of separate disciplines; faculty are trained, hired, and promoted by colleagues within the discipline; the identity, professional development, and career paths of faculty are provided by disciplinary guilds and national associations; and students are expected to specialize in a discipline as well as sample from other specialization in order to graduate from college. (p. 58)

Disciplines are deductive fields of studies, meaning that disciplines start out as a general topic, let's say science, then it branches out to specific studies such as geology or astronomy. Frequently these disciplines have "walls" or barriers that keep other disciplines out. Brazee (2000) pointed out that often times exploratory teachers are excluded from essential decision making and discussions by core teachers. Disciplines in education create pecking orders.

The National Commission on Excellence in Education (1983) report, A nation at risk, explained that there was a crisis in education in this country and there was need to improve academic achievement in mathematics, science, and English . This made schools across America shift their curriculums to abide by the findings of the report. Critics of the report felt that the years of effort that had been made by many to break down academic, or discipline walls, were lost because of the wording of the report. If the report would have described schools as having low expectations, and unorganized curriculum rather than in "crisis," disciplines would have been open to new ideas (Ravitch, 2000). Disciplinary education in the public schools began to flourish. Schools have divided disciplines by categories: core disciplines- science, mathematics, history, and English; and exploratory disciplines- art, music, physical education, family and consumer science, and technology education (George, 2000).

The National Center for Educational Statistics (2000) released their findings from the Third International Mathematics and Science Study, TIMSS. This study's population was eighth grade students from forty-one countries, including the United States. The TIMSS revealed the following:

1) From the perspective of relative standing in mathematics, the United States is not among the top 50 percent of countries; they placed lower than 20 of 41 countries and were the same as 13 countries and were better than only 7 countries.

2) United States students achieved better scores in science, they outperformed their peers in 15 nations, are the equal of students in a further 16 countries and 9

countries scored higher.

Even with all the curriculum shake ups due to the report, Nation at risk, nearly two decades earlier, the TIMSS findings show that a disciplinary education system has not improved education.

School Curriculum Reform

Zais (1976, p.1) termed curriculum as; "to indicate, roughly, a plan for the education of learners, and to identify a field of study." The aforementioned definition of curriculum has been a plan to educate the youth of our country. However, the sticking point of a curriculum has always been what the teachers should be planning. For centuries there have been movements toward curriculum reform, or a "tinkering" with the curriculum at all levels of government- national, state, and local (Tyack & Cuban, 1995). Through the years, curriculum reform has been triggered by such events as population growth, both by migration and immigration, war, economic growth, and society's expectations. More times than not, reforms targeted to the classroom have failed to change what is taught or how it is taught (Adams, 2000).

As we start the twenty-first century, there is a major movement towards curriculum reform. National education standards are emerging for each educational discipline and their goal is to make students literate throughout all disciplines. This study is focused on the three curriculum educational standards of the disciplines of middle school mathematics, science, and technology education.

The National Council of Teachers of Mathematics, NCTM, (1997) published standards for mathematics curriculum. Historically there have been three reasons to formally adopt a set of standards: 1) to ensure quality, 2) to indicate goals, and 3) to promote change. As stated earlier, the publication Nation at risk insisted that schools across the nation were failing academically. Schools in America quickly changed their mathematics curriculum so students would have better mathematics skills.

The goals for school mathematics that underlie the NCTM are to educate students

who are able to: 1) learn to value mathematics, 2) become confident in their ability to do mathematics, 3) become mathematical problem solvers, and 4) learn to communicate mathematically. These goals imply that students should be exposed to numerous and varied interrelated experiences that encourage them to value the mathematical enterprise, to develop mathematical habits of the mind, and to understand and appreciate the role of mathematics in human affairs.

The NCTM Middle School curriculum outline attempts to give all students the opportunity to appreciate the full power and beauty of mathematics and acquire the mathematical knowledge and intellectual tools necessary for it's use in their lives. The NCTM thirteen national content standards indicates:

1) "mathematics as problem solving: the curriculum should expand the students opportunities to solve problem by using team work, technology, mathematical theories and knowledge mathematical applications" (p. 75).

2) "mathematics as communication; the curriculum should expand the students opportunities to understand the meanings of words and terminologies associated with mathematics" (p. 78).

3) "mathematics as reasoning; the curriculum should expand the students opportunities to develop logical reasoning skills" (p. 81).

4) "mathematics as connections; the curriculum should expand the students opportunities to make connections with other disciplines and the real world" (p. 84).

5) "number and number relationship; the curriculum should expand the students opportunities to recognize that numbers have multiple meanings" (p. 87).

6) "number systems and number theory; the curriculum should expand the students opportunities to recognize different types of numbers and numbering systems" (p. 91).

7) "computation and estimation; the curriculum should expand the students opportunities to understand the relationships between fractions, decimals, integers,

rational, and whole numbers." (p. 94)

8) "patterns and functions; the curriculum should expand the students opportunities to recognize patterns and functions used mathematics" (p. 98).

9) "algebra; the curriculum should expand the students opportunities to gain an awareness of algebra to build a base for later studies" (p. 102).

10) "statistics; the curriculum should expand the students opportunities to be able to gather and analyze small pieces of information" (p. 105).

11) "probability; the curriculum should expand the students opportunities to investigate problems and to predict outcomes" (p. 109).

12) "geometry; the curriculum should expand the students opportunities to understand shapes and their spatial relationships" (p. 112).

13) "measurements; the curriculum should expand the students opportunities to understand the usefulness and practical applications of mathematics" (p. 116).

The standards are a broad framework to guide reform in school mathematics to make students more literate in the use of mathematics. Each standard uses guidelines of what students should study.

Much like mathematics, science has implemented national standards. The American Association for the Advancement of Science noted a need for improved science literacy by all students. Project 2061 is an effort to improve science education in a way that would result in a scientifically literate society by the year 2061 (Maurer, 2000). To achieve this goal, the National Research Concil, NRC, (1996) released goals and guidelines for improving K-12 science education. The goals for school science that underlie the NRC are to educate students who are able to:

> 1) experience the richness and excitement of knowing about, and understanding the natural world; 2) use appropriate scientific processes and principles in making personal decisions; 3) engage intelligently in public discourse and debate about matters of scientific and technological concern; 4) increase their economic

productivity through the use of knowledge, understanding, and skill of the scientifically literate person in their careers. (p. 13)

Science is a discipline that branches out into many content areas. For this study we will look at what the NRC (1996) content standards are for a middle school curriculum. The seven national standards for science content indicates:

1) "science as inquiry; the curriculum should expand the students opportunities to question, design an investigation, gather evidence, formulate an answer to the original question and communicate the results" (p.143).

2) "physical science; the curriculum should expand the students opportunities to understand how to recognize, measure, and distinguish differences of physical properties" (p. 149).

3) "life science; the curriculum should expand the students opportunities to understand living systems and their ecosystems" (p.155).

4) "earth and space science; the curriculum should expand the students .opportunities to understand components of the earth and the earth within the solar system" (p.158).

5) "science and technology; the curriculum should expand the students opportunities to understand the relationships between technology and science and capabilities of technology" (p.161).

6) "science in a personal and social perspective; the curriculum should expand the students opportunities to understand natural forces and how science affects society" (p.166).

7) "history and nature of science; the curriculum should expand the students opportunities to understand how science has evolved" (p.170).

The national standard for science content is designed so that each student receives a broad knowledge of science. Each content area is designed to build on the other. Within each content area there are benchmarks that indicate what the students should be

learning.

Final, technology education followed the reform movement of mathematics and science and created standards. The International Technology Education Association (ITEA) (2000) with the support of National Science Foundation and the National Aeronautics and Space Administration have constructed technology education national standards. Unlike the mathematics and science standards, the technology standards have basically one goal, and that is to make all students technologically literate. That is no small task, however, because of the vast spectrum of what technology education covers. Our communication, transportation, and medical systems, just to name few, all rely on the study of technology.

Technology educational standards were derived from the ITEA's project Technology for all Americans (1995). This project urged that all students should have the benefit of some formal education about our technological world. Technology education standards are lagging behind the mathematics and science standards at the present time. However, with the help of mathematics and science associations, technology standards are gaining steam. The twenty ITEA (2000) national technology content standards indicates:

1) the characteristics and scope of technology; the curriculum should expand the students opportunities to understand that technology solves problems and technology was a result of need and creativity.

2) the core concept of technology; the curriculum should expand the students opportunities to understand the processes of technology and its functions.

3) the relationships among technologies and the connects between technology and the fields of study; the curriculum should expand the students opportunities to understand how technological systems interact with each other and the knowledge you gain from the study of technology.

4) the cultural, social, economic, and political effects of technology; the

curriculum should expand the students opportunities to understand how technology affects humans in various ways and the issues within technology.

5) the effects of technology on the environment; the curriculum should expand the students opportunities to understand how to manage waste materials from natural and human-made disaster.

6) the role of society in the development and use of technology; the curriculum should expand the students opportunities to understand the basis for inventions and innovations of technology.

7) the influence of technology on history; the curriculum should expand the students opportunities to understand the developments that lead to the inventions or innovations.

8) the attributes of design; the curriculum should expand the students opportunities to understand how to creatively plan and design using criteria.

9) knowledge of engineering design; the curriculum should expand the students opportunities to understand how to model, brainstrom, modify, and test ideas.

10) the role of trouble shooting, research and development, invention and innovation, and experimentation in problem solving; the curriculum should expand the students opportunities to understand how to come up with solutions through the means of troubleshooting, using innovations, and experimenting.

11) the abilities to apply the design process; the curriculum should expand the students opportunities to understand: the curriculum should expand the students opportunities to understand sketching, drawings, computer assisted design to make a plan of a product or system.

12) the ability to use and maintain technological products and systems; the curriculum should expand the students opportunities to understand the use of various tools, manuals, and machines within technology.

13) assessing the impact of products and systems; the curriculum should expand

the students opportunities to understand how to gather, analyze, and interpret technological developments.

14) to be able to select and use medical technology; the curriculum should expand the students opportunities to understand medical technologies and their use.

15) to be able to select and use agricultural and related bio-technologies; the curriculum should expand the students opportunities to understand technologies that are used to produce and store food sources.

16) to be able to select and use energy and power technologies; the curriculum should expand the students opportunities to understand sources and uses for power and energy systems.

17) to be able to select and use information and communication technologies; the curriculum should expand the students opportunities to understand sources and uses for communication systems.

18) to be able to select and use transportation technology; the curriculum should expand the students opportunities to understand sources and uses for transportation systems.

19) to be able to select and use manufacturing technology; the curriculum should expand the students opportunities to understand sources and uses for manufacturing systems.

20) to be able to select and use construction technology; the curriculum should expand the students opportunities to understand sources and uses for construction systems. (International Technology Education Association, 2000)

Much like the national standards for science, the technology education content standards are designed so that each student gets a broad knowledge and understanding of technology. Each content area is designed to build on the others so students can find connections between technologies. Within each content area there are benchmarks that indicate what the students should be learning. These standards do not attempt to define a

curriculum for the study of technology, instead it provides the standards of what the content of technology education should be in the public schools.

Interdisciplinary curriculum

According to Fogarty (1991), interdisciplinary has many names including: integration, multidisciplinary, transdisciplinary, thematic, connected, nested, sequenced, shared, webbed, threaded, immersed, networked, blended, unified, coordinated, and fused. Each meaning of interdisciplinary is a little different; however, each term is focused on providing students a whole learning experience. Jacobs (1989) defined interdisciplinary as a different way of learning and innovated curriculum approach that purposefully applies methodology and language from more than one discipline to examine a central theme that may include issues, problems, topics, or experiences. Lederman and Niess (1997) offered a similar definition to an interdisciplinary curriculum by defining it as a blend of disciplines in which coherent associations are made between the subjects, while the subjects keep their identities. Unlike other reform strategies that have attempted to mend curriculum, the conception of interdisciplinary curriculum will foster many opportunities to allow teachers to work together in making the classroom an exciting place for students to learn (Wineburg & Grossman, 2000). In this study, the researcher will often refer to the content as an interdisciplinary or integrated curriculum.

American education systems have used an interdisciplinary approach to educate their youth in the past. Puritan settlers in New England in the late 1620's used a text, the Primer, to teach salvation. Religion and reading were core subjects and were almost always combined or "integrated" when taught (Zais, 1976). Benjamin Franklin proposed making an academy where students had choices in the type of curriculum they could take. Students could choose from the "classical" curriculum or the "new" curriculum which included physical education, drawing, mechanical arts, mathematics, history, geography, civics, horticulture, science, and other studies (Willis, Schubert, Bullough, Kridel, & Holton, 1993). Students would choose their curriculum based on vocational

interests. For instance, a student interested in bookkeeping would take mathematics for its practical applications rather than its abstract views, or a student interested in business might elect French, German, or Spanish over Latin for communication reasons (Ornstein & Levine, 1989). This reform used curriculum integration by incorporating business education together with mathematics and foreign language. In 1838, Henry Benard agonized with the problem of what the curriculum of the common school should be. He thought that the curriculum should be comprehensive, including directly utilitarian subjects. Conversely, he also indicated that the quality of teaching and learning of such basic subjects as spelling and writing had often suffered because of efforts to include a multitude of subjects in the curriculum. His solution was to integrate the teaching of various subjects around the development of the child (Willis, Schubert, Bullough, Kridel, & Holton, 1993). These are just a few examples to show that interdisciplinary education has been with the American schools since they were established.

Like any other educational reform, there is debate: what should a given curriculum hold? Tchudi and Lafer (1996) believe the following eleven content areas should be part of an interdisciplinary curriculum:

1) integrated thematic education; education that builds on a theme of discourse.

2) holistic instruction; education that focuses on the whole learner.

3) constructivist learning; education that teaches small bits and then applies the learning.

4) whole language teaching; education that teaches language arts through real life or applied methods.

5) math, science, history, and everything else across the curriculum; disciplines are not a narrow focus of study.

6) hands-on active learning; learning concepts and then applying them.

7) global and multicultural education; teaching materials from other cultures.

8) multimedia education; teaching with a variety of media.

9) student-centered teaching; teaching is centered around the students.

10) education for critical thinking and problem solving; allow the students to develop higher level thinking skills.

11) community-directed or real world education; teach real world experiences.

Curriculum integration has long been proposed as a way of organizing the "common learnings" or life skills considered necessary for all people in public schools. Integrated curriculum is arranged around real life problems and issues important to both young people and adults, applying appropriate content and skills from many subject areas or disciplines. The intent is to help students make sense out of their life experiences and learn how to participate in a democracy (Beane, 1997).

Fogarty (1991) explained how her model for interdisciplinary curriculum works. A rich theme is "webbed" to curriculum contents and disciplines; subjects use the theme to sift out appropriate concepts and ideas. This thematic approach to curriculum development begins with a theme such as transportation or invention. Once a cross-disciplinary team has made this decision, it uses the theme as an overlay to the different subjects: inventions lead to the study of simple machines in science, reading, and writing in language arts, designing and building models in technology education, and looking at ratios in mathematics. Fogarty goes on to explain that in departmentalized situations, her model is often achieved through the use of fairly generic, but fertile themes such as "patterns" or "cycles." This conceptual theme provides rich possibilities for the inherent diversities of various disciplines.

Vars (1991) used the term "fused" to describe an interdisciplinary curriculum. Fused teaching tears down the discipline barriers. Instead of teaching subjects in a narrow path, teams of teachers or an individual teacher chooses a topic or problem and addresses the topic or problem from different perspectives. If the team or teacher chooses bridges as the topic, they might have the students create a scaled down model of a bridge. Students would use physical science, mathematics, and technology education

together to determine the best design for a bridge and how much weight it can hold. Other disciplines could engage in this unit, such as geography, having the students explore bridges of different countries. The fused or interdisciplinary unit would draw intelligently on disciplinary knowledge on a need-to-know basis.

Andrea Foster, a sixth-grade science teacher at Sal Ross Middle School in San Antonio, Texas, taught an integrated unit. This unit included mathematics, science, technology, social studies, art, and language arts. While studying Italy and about the Leaning Tower of Pisa in a social studies unit, she had her students perform an integrated, hands-on activity. They constructed a tower made from uncooked spaghetti and hardened marshmallows. The children paid in simulated dollars for their "raw materials" and built the tallest tower they could. Towers were judged on the basis of height, use of raw materials, and construction techniques. This type of activity shows one way that interdisciplinary instruction can be brought into the classroom (Foster, 1991).

The British have built interdisciplinary instruction into their national curriculum standards, and have chosen to do so in fields that are in themselves interdisciplinary (exploratory) as well as in traditional (core) school subjects (Wineburg & Grossman, 2000). Davis, Hawley, McMullen, and Spilka (1997) reviewed the British experience in depth and presented a very strong case for the value of the interdisciplinary design in children's education. Over the last decade, the movement to define national subject standards and get them in place throughout the country has taken the wind out of the interdisciplinary sails (Wineburg & Grossman, 2000). Vars and Beane (2000) agreed that national standards are a deterrent to curriculum integration due to the fact that most state standards and proficiency tests are set up in terms of science, reading, mathematics, or social studies. They argued that there are too many competencies for each standard. Their study team estimated that it would take even a very competent student an additional nine years in school to reach acceptable performances in all of the standards

recommended by national organizations. Vars and Beane suggested that educators should rethink the national standards and incorporate lists of generic competencies that cut across discipline and subject lines. They pointed to three educational groups who have compiled lists of generic competencies. They are:

1. The National Study of School Evaluation proposed Schoolwide Goals for Student Learning. They examined the proposals of the various academic professional organizations and identified goals that are common across several specific subject standards. Schoolwide Goals for Student Learning are divided into: 1) learning to learn skills; 2) expanding and integrating knowledge; 3) communication skills; 4) thinking and reasoning skills; and 5) interpersonal skills (Fitzpatrick, 1997).

2. The Center for Occupational Research and Development (Edling & Loring, 1996), CORD, proposed the Core Standard. CORD identified common learning embedded in standards proposed by both academic organizations and also by groups advocating workforce education, businesses, industries, and vocational educators, and created a database of 38 sets of proposed standards. From these, they pulled out 53 core standards that describe a broad array of competencies, from general housekeeping to statistical analysis and computer literacy to ethics and self-concept.

3. Mid-continent Research for Education and Learning, McREL, proposed Life Skills. McREL began their search for essential knowledge by building a standards database incorporating 116 national standards documents in 14 content areas. In the process, they identified a set of life skills which they described as a category of knowledge that is useful across content areas as well as important for the world of work in four areas: 1) thinking and reasoning; 2) working with others; 3) self-regulation; and 4) life-work (Edling & Loring, 1996). An interdisciplinary curriculum should emphasize these common learnings and would support the generic standards (Vars & Beane, 2000).

Interdisciplinary curriculum is not without problems. Many of the foundations of curriculum can get lost in an integrated curriculum. O'Tuel and Bullard (1993) had these

questions about an integrated curriculum:

1) Do the skills transfer to content areas and real life situations?

2) Will the students recognize the appropriateness of a skill when confronted with a specific situation not like the material with which he or she was working in the thinking skill activities?

O'Tuel and Bullard (1993) concluded that transfer of such skills, learned in nonacademic and sometimes nonreal-life activities, probably had little chance of happening. In fact, transfer from one academic area to another seldom happens unless the teacher

consciously presents examples and illustrations of appropriate skill usage in other subjects, and situations are specifically mentioned or are generated by the students. Gardner and Boix-Mansilla (1994) also pointed out that prerequisite skills are often needed before students can use an integrated curriculum, and schools may not have time to teach skills and put them in an integrated curriculum at the same time. Mason (1996) backed this notion by indicating that there were logistical problems that may be disadvantages for using an integrated curriculum. Mathematics is sequential, and adding mathematics concepts here and there in the curriculum could confuse students if they do not have prerequisite knowledge and skills.

Other factors generated issues with an interdisciplinary curriculum. Lehman (1994) found although teachers had positive perceptions about integrated curriculum, the perceptions do not carry over into practice. Teachers felt they did not have time to add integrated ideas into an already full curriculum. Jacobs (1989) noted the structure of the school day as a major problem, because the structure does not allow enough time to integrate. Unless teachers team teach, they typically do not have opportunity to work with other teachers (Mason, 1996). O'Tuel and Bullard (1993) noted that a teacher must be untrained and then retrained to teach an integrated course. Loepp (1999) summed up the feeling of many educators by stating that just because a curriculum is integrated does

not automatically mean that it is relevant.

Rationale for Implementation of an Interdisciplinary Curriculum in a Middle School

As stated in this literature review, there are many national organizations that feel as if we need curriculum reform in our schools. Their solution has been to raise academic standards, and increase high school graduation requirements. However, some students are not able to learn well when complex materials are presented abstractly or disconnected from recognizable applications, allowing these students to struggle academically and usually leaving the students relegated to a considerably less demanding "elective" curriculum that often were narrow and lack academic concepts (Hoachlander, 1999). Gardener (1993) also suggested that by making traditional curriculum more rigorous and delivering it to all students is not likely to produce the prized outcomes of educational reform. There has been building evidence that many students are able to master much higher levels of knowledge and skills when educators pay more attention to the wide range of students' learning styles and modify instruction to accommodate them. With educational reform we are getting away from the goals of every public school in the United States, to provide all students with a sound education throughout their school years.

To make sure schools provide sound education to all students within their walls, mission statements are developed for all school districts. Like most middle schools around our nation, White Bear Lake middle schools use a mission statement as the framework for their academic curriculum. The White Bear Lake mission statement states the following:

> Our middle schools will provide quality education which meets the academic, social, emotional and physical needs of sixth through eighth grade students in a caring environment where uniqueness and diversity are valued, lifelong learning is modeled, and all can be successful. (Independent School District #624, 1993, p.1)

If schools are to live up to their mission statements and strive for higher standards for all their students, an innovated curriculum must be in place that accommodates all students.

Research in the area of education as well as in cognitive science suggests that some form of an interdisciplinary curriculum is likely to promote more learning (Loepp, 1999). An interdisciplinary curriculum is designed to appease both college and "non-college" bound students. Bailey (1997) suggested that students who have success in traditional curriculums and are planning to attend college generally succeed in school regardless of the type of curriculum. They may have a greater aptitude for abstraction, as well as perhaps a greater tolerance for a curriculum that does not offer immediate understanding of the subject's usefulness. However, Bailey concluded that these students can benefit from an interdisciplinary curriculum because the instruction solidifies and deepens their understanding of academics.

Wicklein and Schell (1995) constructed a case study on an integrated mathematics, science, and technology course of "at risk" and/or non-college bound students. The goals of the course were to increase the interest level of the students in these subject areas and to improve student's attendance in school. Through the application of "hands-on and minds-on" curriculum, the students were encouraged to develop an interest in the practical uses of the three instructional areas. The study revealed that students demonstrated more motivation by reducing their absences from school and discipline problems based on the school records from the previous year. Further, in this study students demonstrated an appreciation for the structured learning activities, an improvement in student self-esteem, and the development of the use of teamwork when trying to solve problems. The findings from this case study backed the findings of Vars (1965) and Jacobs (1989). Vars reported that motivation for learning is increased when students work on "real-problem" elements. Students are actively involved in planning their learning and in making choices, they are more motivated, reducing behavior problems. Jacob noted that an integrated curriculum is associated with

better student self-direction, higher attendance, higher levels of homework completion, and a better outlook towards school. Interdisciplinary education curriculum with its ability to make connections to solve problems by using multiple activities, and to incorporate information from different fields, is the essential ingredient for all students success in school (Lake, 1994).

The above rationale for an interdisciplinary curriculum supports the mission statement for White Bear Lake middle schools. This curriculum provides a quality education to all students that supports national and state standards. Students will be academically challenged while maintaining their self-worth. The curriculum will provide opportunities for students to place a relevancy to life experiences allowing them to become lifelong learners and able to model their experiences. However, the most important aspect of an interdisciplinary curriculum is that all can be successful.

CHAPTER 3

Methodology

Introduction

The purpose of this research was to determine the perceptions and attitudes of middle school mathematics, science, and technology teachers in the White Bear Lake school district towards an interdisciplinary curriculum within their disciplines. A survey was used to obtain information from every mathematics, science, and technology teacher from the two middle schools located in White Bear Lake school district. The information obtained will be used to determine whether an interdisciplinary curriculum could be incorporated in the middle schools or replace the current traditional curriculum of mathematics, science, and technology in the middle schools. In the following chapter, information concerning the subjects and sample selection, instrument, data collection, method of analysis of the results, and limitations will be presented.

Subjects and Sample Selection

Upon getting permission from the White Bear Lake School District in Minnesota, an educational research study was conducted. This style of research was used because it dealt with attitudes of a sample of teachers toward a theme of interdisciplinary curriculum. The population in this study consisted of teachers from two middle schools located in White Bear Lake- Central and Sunrise Park Middle Schools. The criteria to be included in the sample was:

1) Must be a mathematics, science, or technology teacher teaching at the middle schools.

2) Must be at least .5 full time equivalent at either middle school.

There were sixteen mathematics, sixteen science, and four technology teachers who met the criteria which formed a group cluster of thirty-six subjects.

Instrument

A confidential survey was designed by the researcher with the aid of his advisor in December of the 2001-2002 school year. The survey consisted of three pages. Page one acted as a cover page that explained four different items: 1) the research being conducted; 2) how to return the survey to the researcher; 3) a consent form informing the participants of their rights; and 4) the name and number of the contact at the University of Wisconsin-Stout if there were any concerns or questions about the research being administered. Because two middle schools were used as survey sites, the cover pages for each school had slightly different return instructions. See Appendix A for the cover pages. Pages two and three consisted of nominal questions that mainly focused on the subject's demographics as a teacher and ordinal questions dealing mainly about the participant's attitudes and perceptions of an interdisciplinary curriculum. See Appendix B for the survey. This style of survey was selected based on two factors:

1) The research noted most studies researching attitudes and opinions of a theme used a Likert scale as a measuring instrument.

2) The population of the subjects would not guarantee a total of thirty responses to do a correlational study.

Due to the fact the survey was generated by the researcher, it lacked documented validity and reliability.

The majority of the questions on the survey used a five point Likert scale measuring system because it allowed for a wide range of attitudes and opinions. The Likert scale asked the teachers to choose one of the following responses for each question: 1) strongly disagree, 2) disagree, 3) no opinion, 4) agree, or 5) strongly agree. Information and instructions were provided about how the Likert scale works and how to use the Likert scale. The survey also had an area for any further comments.

Data Collection

On January 2, 2002 the researcher placed a survey along with a self-addressed envelope each subject's school mail box. The participants in this study were given until January 11, 2002 or nine days to complete the survey. Upon completion, the survey was to be placed into the researcher's school mail box. Because of having two test sites and the researcher located at one, school mail was used to deliver the surveys from the other site. On January 10, 2002 the researcher e-mailed all subjects to thank them for taking part in the study and reminded them that if they forgot or misplaced the survey, that they still had time to turn in the survey by January 16, 2002. See Appendix C for survey notification.

Data Analysis

On January 23, 2002 data collected from the subjects in this study was analyzed by the researcher and his advisor using a computer program. Mathematics, science, and technology teacher's responses were tabulated for frequencies, percentages, and crosstabulations from the twenty questions on the survey. This was done by placing values for each question. Nominal questions were given a number to identify such things as gender, discipline currently teaching, years teaching current discipline, years in the school district, level of education, and grade level taught. For example, the question dealing with gender, female was given (1) and male was given (2). Ordinal questions, Lickert scale items, were measured the following way; strongly disagree value was (1), disagree value was (2), no opinion had no value (0), agree value was (4), and strongly agree value was (5), thus responses having a range between 0-5. The teacher's responses were used to answer the ten research questions.

Limitation

Several limitations have been identified by the researcher. These limitations are similar to the limitations found in Chapter One. These are:

1) The sampling of teachers was limited to mathematics, science, and technology teachers at the White Bear Lake Middle Schools, resulting in a small sampling group.

2) The survey was generated by the researcher making it lack documented validity and reliability.

3) Two sampling sites might delay the delivery of the surveys from one site to the other.

4) Retirements, resignations, layoffs, new hirings, and transfers of teachers may create a low survey percentage .

5) Lack of knowledge or confusion of an interdisciplinary curriculum may alter the results of the survey.

6) The unbalanced ratio of technology to mathematics and science teachers may provide skewed results.

CHAPTER 4

Results

Introduction

This chapter will present the results of this study, the perceptions of mathematics, science, and technology teachers of an interdisciplinary curriculum in a middle school**.** The primary purpose of this study was to ascertain the teacher's perceptions and attitudes about the implementation of an interdisciplinary curriculum in the White Bear Lake Middle Schools, Central and Sunrise Park.

Demographics

The subjects in this study were mathematics, science, and technology education teachers from the two White Bear Lake middle schools. The following is the information gathered by surveys that were returned.

Of the 36 surveys sent out, 32 were returned: mathematics teachers returned 16 of 16 surveys, totaling 50% of the subjects; science teachers returned 12 of 16 surveys, totaling 37.5% of the subjects; and technology teachers returned 4 of 4 surveys, totaling 12.5% of the subjects.

Years of teaching their discipline and years in the White Bear Lake schools varied amongst teachers. Thirteen teachers (40.6%) have 0-5 years teaching their current discipline, eight teachers (25%) have 6-10 years teaching their current discipline, three teachers (9.4%) have 11-15 years teaching their current discipline, three teachers (9.4%) have 16-20 years teaching their current discipline, and five teachers (15.6%) have 20+ years teaching their current discipline.

Fourteen teachers (43.8%) have been in the school district 0-5 years, seven teachers (21.9%) have been in the school district 6-10 years, seven teachers (21.9%) have been in the school district 11-15 years, two teachers (6.3%) have been in the school

district 16-20 years, and two teachers (6.3%) have been in the school district 20+ years.

Level of education obtained by the teachers in this study was: thirteen teachers (40.6%) currently have a BA/BS degree and nineteen (59.4%) have a MS/MA degree.

The gender breakdown in this study was nineteen (59.4%) were female and thirteen (40.6%) were male.

Finally, twelve teachers (37.5%) taught the sixth grade, nine teachers (28.1%) taught the seventh grade, five teachers (15.6%) taught the eighth grade, and six (18.8%) taught a combination of seventh and eighth grade.

Research Questions

1) What is the main concept of an interdisciplinary curriculum?

Approximately 53% of the subjects surveyed felt that an interdisciplinary curriculum was a curriculum that used a central topic in mathematics, science, and technology classes simultaneously to enhance student's learning, 43.8% of the subjects said an interdisciplinary curriculum was designed to integrate mathematics, science, and technology skills into a topic to enhance student's learning, and 3.1% of the subjects viewed the curriculum as no more than using applied activities while studying a topic to enhance student's learning.

2) What are the elements of an interdisciplinary curriculum?

A majority of the teachers believed that an interdisciplinary curriculum should contain cross-discipline themes, roughly 97%, exploratory activities, 84.4%, and cooperative learning, 78.1%. About half of the subjects believed that an interdisciplinary curriculum should have instruction that is goal oriented,65.6%, emphasize problem solving and also a broad range of assessment strategies,62.5%, use laboratory instructed activities 59.4%, and cognitive strategies, 53.1%. Asked if the curriculum should contain verbal and hypothesis driven activities, less than 50% thought that verbal activities (43.8%) and hypothesis driven activities (28.1%) belong in an interdisciplinary curriculum.

3) Does your current curriculum contain elements of an interdisciplinary education?

Twenty-four teachers agreed and one teacher strongly agreed (78.1%) that their current curriculum contained elements of an interdisciplinary. Likewise, five teachers disagree and one strongly disagreed (18.7%) that their current curriculum contained elements of an interdisciplinary. One teacher (3.1%) had no opinion whether the current curriculum contained elements of an interdisciplinary.

4) Does your current curriculum give students a holistic learning experience?

Eighteen teachers agreed and three strongly agreed (65.7%) that their current curriculum gave students a holistic learning experience. Three teachers (9.4%) disagreed that their current curriculum gave students a holistic learning experience. Eight teachers (25%) had no opinion on whether their current curriculum gave students a holistic learning experience

5) What is the attitude of the teachers toward the implementation of an interdisciplinary curriculum?

Responses from teachers about their attitude toward the implementation of an interdisciplinary curriculum ranged from 1 to 3.50 out of a range of 1 to 5. Of the the thirty-two teacher responses, the mode was 2.50, five teachers. Using the range in the question with the minimum at 0 and the maximum at 5, the median is at 2.50, twelve teachers, 37.5%, are below, five teachers, 15.5%, are at the median and fifteen teachers, 47%, are above the median.

6) Is there a difference in attitude between the mathematics, science, and technology teachers toward the implementation of an interdisciplinary curriculum?

In a crosstabulation breakdown between mathematics, science, and technology, the survey yielded the following results:

Of the sixteen mathematics teacher's responses, modes were found at 2.25 and 3.00 with three teachers each and ranged from between 1.50 and 3.50, with an overall

average of 2.62.

Of the twelve science teacher's responses, modes were found at 2.50, 3.13, and 3.50 with two teachers each and ranged from between 1.38 and 3.50, with an overall average of 2.73.

Of the four technology teacher's responses a mode was found at (1) with two teachers and ranged from between 1.00 and 2.50, with an overall average of 1.69.

7) Does an interdisciplinary curriculum of mathematics, science, and technology improve upon the traditional curriculums of mathematics, science, and technology education?

Eighteen teachers agreed and one teacher strongly agreed (59.4%) that an interdisciplinary curriculum of mathematics, science, and technology would improve upon a traditional curriculum. Likewise, three teachers disagree and one strongly disagreed (12.5%) that an interdisciplinary curriculum of mathematics, science, and technology would improve upon a traditional curriculums. Nine teachers (28.1%) had no opinion whether an interdisciplinary curriculum of mathematics, science, and technology would improve upon a traditional curriculums.

8) Does the lack of resources make it difficult to implement an interdisciplinary curriculum?

Sixteen teachers agreed and thirteen teachers strongly agreed (90.6%) that the lack of resources would make it difficult to implement an interdisciplinary curriculum. Likewise, one teacher disagreed (3.1%) that the lack of resources would make it difficult to implement an interdisciplinary curriculum. Two teachers (6.3%) had no opinion whether a lack of resources would make it difficult to implement an interdisciplinary curriculum.

9) Does required curriculum such as graduation standards make it difficult to implement an interdisciplinary curriculum?

Fourteen teachers agreed and five teachers strongly agreed (59.4%) that required

curriculum such as graduation standards would make it difficult to implement an interdisciplinary curriculum. Likewise, nine teachers disagreed and two teachers strongly disagreed (34.4%) that required curriculum such as graduation standards would make it difficult to implement an interdisciplinary curriculum. Two teachers (6.3%) had no opinion whether a required curriculum such as graduation standards would make it difficult to implement an interdisciplinary curriculum.

10) Would an interdisciplinary curriculum serve our Middle School's Mission Statement?

Fifteen teachers agreed and eight teachers strongly agreed (71.9%) that an interdisciplinary curriculum would serve our Middle School's Mission Statement. Two teachers disagreed (6.3%) that an interdisciplinary curriculum would serve our Middle School's Mission Statement. Seven teachers (21.9%) had no opinion whether an interdisciplinary curriculum would serve our Middle School's Mission Statement.

CHAPTER 5

Summary, Conclusions, and Recommendations

Summary

This study was developed to obtain mathematics, science, and technology teachers' perceptions and attitudes towards an interdisciplinary curriculum in the White Bear Lake's Middle Schools. A survey was developed by the researcher and his advisor and placed in school mailboxes to thirty-six mathematics, science, and technology teachers by the researcher. The majority of the questions on the survey used a five point Likert scale measuring system because it allowed for a wide range of attitudes and opinions. Thirty-two teachers returned the surveys via school mail and participated in this study. Responses to various questions pertaining to an interdisciplinary curriculum were analyzed and recorded by the researcher. While analyzing the data, an understanding was developed of how teachers from each discipline viewed such a curriculum. Data was recorded using two different methods; 1) by percentages, and 2) cross-tabulations.

Conclusions

Although the sample was relatively small in size, several common themes were shared among the teachers and results from the study did correspond with some of the research.

Interdisciplinary education is an educational reform suffering from an identity crisis. Subjects were given three descriptions of an interdisciplinary curriculum and asked to choose the one that best matched their definition. Slightly over half of the subjects in this study described an interdisciplinary curriculum one way, slightly under half described it a different way, and roughly five percent described it a third way. Two of the three definitions were chosen each by about fifty percent of the subjects. This study supports Fogarty's (1991) suggestion that the confusion with an interdisciplinary

curriculum lies within the name. To make this educational curriculum work, a clear definition must be in place and teachers in the district must come to a consensus of what an interdisciplinary curriculum really entails.

However difficult it is to define what an interdisciplinary curriculum is, the teachers in this study agreed on the elements that should be within the curriculum. Nearly every subject agreed with Vars (1991) and Windberg and Grossman (2000) studies that an interdisciplinary curriculum should contain a cross-discipline theme. Tchudi and Lafer (1996) listed elements that should be found in an interdisciplinary curriculum, among the elements is the aforementioned cross-discipline theme, problem-solving, exploratory activities, cooperative learning, and constructivist learning. The majority of the teachers in this study agreed with Tchudi and Lafer that these elements belonged in an interdisciplinary curriculum. Further, most subjects felt as if elements of an interdisciplinary curriculum already existed in their current curriculum which provides their students with holistic learning experiences. These findings set up a good framework for teachers of the three disciplines in the White Bear Lake middle schools to design a curriculum with elements of interdisciplinary studies.

For some time researchers such as Vars (1965), Illich (1970), Jacobs (1989), Wicklein and Schell (1995), and Loepp (1999) have all suggested that an interdisciplinary curriculum will improve upon all students' ability to learn. Bailey (1997) pointed out that this style of curriculum does not favor students going to college or students who have other aspirations. In fact, a curriculum using an interdisciplinary tends to reach at-risk students and keep them in school and solidifies the understanding of academic subjects to the college bound students. Teachers in this study concurred with the above statements, with the majority agreeing that an interdisciplinary curriculum would enhance student learning in their classroom and that this type of curriculum aligns with the district's mission statement. Once again these findings reinforce the value of an interdisciplinary curriculum.

As school budgets seem to be shrinking, more requirements are placed on school districts. The Minnesota Graduation Standards are an example of a requirement that school districts must implement. The majority of the teachers surveyed felt that they can only deal with so much "tinkering" with their curriculum and that it would be difficult to implement a new curriculum. This thought coincided with Vars and Beane (2000) study which indicated that there were too many required standards placed on education to allow for curriculum reform. Likewise, Jacobs (1989) suggested that curriculum implementation can be a costly process and trying to implement an interdisciplinary curriculum would be no different. Teachers in this study overwhelmingly agreed that trying to add any curriculum would be too costly for the White Bear school district. Time and money can be a teacher's best ally or their worst enemy. Unfortunately, the teachers in this study suggested that the lack of time and money was against their best interests of trying to incorporate a new curriculum. The consensus was: the implementation of a new curriculum would be very time consuming and too costly.

George (2000) explained how schools disciplines are divided into two categories, core and exploratory disciplines. Core disciplines, mathematics and science and an exploratory discipline, technology education were the disciplines used in the study. All three disciplines as a whole were not in favor of an interdisciplinary curriculum. On a scale, 0 to 5, two disciplines were slightly above the medium of 2.5, indicating very little an interdisciplinary curriculum. Interesting enough, science and mathematics, core disciplines, scaled at 2.73 and 2.62 respectively, whereas technology education, an exploratory discipline, scaled at 1.69. This conformed with Brazee (2000) statements, about how there are different values between the core and exploratory disciplines, held true in this study. The mathematics and science showed far more interest in an interdisciplinary curriculum than did technology education. This concured with the notion of the pecking order among the different types of discipline and indicateed there may be barriers between core and exploratory disciplines.

Recommendations

It is the recommendation of this researcher to use this study as a reference for further studies dealing with the implementation of an interdisciplinary curriculum in the White Bear Lake Middle Schools. The overall scope and processes of an interdisciplinary unit of mathematics, science, and technology education reaches far beyond the perceptions of these teachers. More studies need to be conducted due to the fact that all elements of public education were not addressed in this study because of the narrow focus towards the teacher's perceptions. The findings in this study resulted in the following recommendations:

- Conduct a similar study in which school administrators are asked their perceptions of an interdisciplinary curriculum of mathematics, science, and technology education.
- Conduct a similar study in which students are asked their perceptions of an interdisciplinary curriculum of mathematics, science, and technology education.
- Conduct a cost analysis study which compares an interdisciplinary vs.traditional curriculums of mathematics, science, and technology education.
- Create a series of inservices that educate teachers about interdisciplinary education.
- Rewrite the Minnesota Graduation standards from each discipline to fit in an interdisciplinary curriculum.

REFERENCES

Adams, J. E. (2000). *Taking charge of curriculum: Teacher networks and curriculum implentation*. New York: Teachers College Press.

Allee, J. (1993). *Webster's new encyclopedia of dictionaries* (23rd ed.). St. Louis: Ottenheimer Publishers, Inc.

Bailey, T. (1997). *Integrating academic and industrial skill standards*. Berkley: National Center for Research in Vocational Education, University of California.

Beane, J. A. (1997). *Curriculum integration: Designing the core of democratic education*. New York: Teacher College Press.

Brazee, E. (2000). *Exploring curriculum in the middle school* (EDO-PS-00-16). Washington, DC: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED 447 970)

Childress, J. (1996). Does integration technology, science, and mathematics improve technology problem solving? A quasi-experiment. *Journal of Technology Education, 8* (1), 16-28.

Council for Citizenship Education. (1997). *Connections: An interdisciplinary team approach to professional development*. Albany, NY: New York Department of Education.

Davis, M., Hawley, P., McMullen, B., & Spilka, G. (1997). *Design as a catalyst for learning*. Alexandria, VA: Association of Supervision and Curriculum Development.

Edling, W. H., & Loring, R. M. (1996). *Education and work: Designing integrated curricula*. Waco, TX: Center for Occupational Research and Development.

Fitzpatrick, K. A. (1997). *Indicators of schools of quality: Vol.1*. Schaumburg, IL: National Study of School Evaluation.

Flowers, J. (1998). Photography: An integrated technology education approach. *The*

Technology Teacher, 58 (3), 23-26.

Fogarty, R. (1991), *Integrate the curricula*. Palatine, IL: IRI/Skylight Publishing, Inc.

Foster, A. (1991). Tower of spaghetti. *The Instructor,101* (2), 24-25.

Gaff, J. G. (1989). Interdisciplinary studies in high education. *Education Digest, 55* (2), 57-61.

Gardener, H. (1993). *The unschooled mind: How children think and how schools should teach*. New York: Basic Book

Gardner, H., & Boix-Mansilla, V. (1994). Teaching for understanding within and across the disciplines. Educational Leadership, 51, 14-18

George, P. (2000). The evolution of middle schools. *Educational Leadership, 58* (3), 40-44.

Goldberg, B. (1996). *Why schools fail*. Washington, DC: Cato Institute.

Hoachlander, G. (1999). *Integrating academic and vocational curriculum-Why is theory so hard to practice*? Washington, DC: Office of Vocational and Adult Education. (ERIC Document Reproduction Service No. ED 433 454)

Illich, I. (1970). *Deschooling society*. New York, NY: Harper and Rowe.

Independent School District #624. (1993). *The middle school mission statement*. White Bear Lake, MN: Author.

International Technology Education Association. (1995). Technology for all Americans. *Journal of Technology Education, 6* (2), 1.

International Technology Education Association. (2000). *Standards for technological literacy: Content for study of technology*. Reston, VA: Author.

Jacobs, H. H. (1989). *Interdisciplinary curriculum: Design and implementation*. Alexandria, VA: Association for Supervision and Curriculum Development.

Lake, K. (1994). *Integrated curriculum*. Portland, OR: Northwest Regional Labortory.

Lederman, N. G., & Niess, M. L. (1997). Integrated, interdisciplinary, or thematic instruction? Is this a question or is it questionable sematics? *School Science and Mathematics, 97* (2), 57-58.

Lehman, J. (1994). Integrating science and mathematics: Perceptions of preservice and practicing elementary teachers. *School Science and Mathematics, 94* (2), 58-64.

Loepp, F. L. (1999). Model of curriculum integration. *Journal of Technology Studies, 25* (2), 45-49.

Mason, T. C. (1996). Integrated curricula: Potential and problems. *Journal of Teacher Education, 47* (4), 263-270.

Maurer, M. J. (2000). *Integrating science education and career and technical education*. Columbus, OH: National Dissemination Center for Career and Technical Education.

Maurer, R. (1994). *Designing interdisciplinary curriculum in middle, junior high, and high schools*. Boston, MA: Allyn and Bacon.

National Association for Core Curriculum. (2000). *A bibliography of research on the effectiveness of block-time, core, and interdisciplinary team teaching programs*. Kent, OH: National Association for Core Curriculum.

National Center for Educational Statistics. (2000). *Mathematics and science in the eighth grade: Findings from the third international mathematics and science study* (NCES 2000-014). Washington, DC: US Department of Education.

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform*. Washington, DC: Author.

National Council of Teachers of Mathematics. (1997). *Professional standards for teaching mathematics* (11th printing). Reston, VA: Author.

National Research Council. (1996). *National science education standards* (4th printing). Washington, DC: Author.

Ornstein, A., & Levine, D. (1989). *Foundation of education*. Boston, MA: Houghton Mifflin Company.

O'Tuel, F. S., & Bullard, R., K. (1993). *Developing higher order thinking in the content areas k-12*. Pacific Grove, CA: Critical Thinking Press & Software.

Ravitch, D. (2000). *Left back: A century of failed school reforms*. New York: Simon & Schuster.

Scarborough, J., & White, C. (1994). PHYS-MA-TECH: An integrated partnership. *Journal of Technology Education, 5* (2), 31-39.

Shield, G. (1996). Formative influences on technology education: The search for an effective compromise in curriculum innovation. *Journal of Technology Education, 8* (1), 50-61.

Sterry, L., & Wright, T. (1987). *A guide for developing contemporary industrial arts / technology education*. Lansing, MI: Technical Foundation of America.

Stoehr, J., & Buckey, S. (1997). *Getting started, project for the integrated curriculum*. Tucson, AZ: Zepher Press.

Tchudi, S., & Lafer, S. (1996). *The interdisciplinary teacher's handbook*. Portsmouth, MA: Boynton/Cook Publishers, Inc.

Thode, B. (1994). *Technology*. New York: Delmar Publisher Inc.

Tyack, D., & Cuban, L. (1995). *Tinkering toward Utopia: A century of public school reform*. Boston, MA: Harvard College.

Vars, G. F. (1965). *A bibliography of research on the effectiveness of block-time programs*. Ithica, NY: Cornell University.

Vars, G. F. (1991). Integrated curriculum in historic perspective. *Educational Leadership, 49* (2), 14-15.

Vars, G. F., & Beane, J. A.. (2000). *Integrative curriculum in a standard-based world* (EDO-PS-00-6). Washington, DC: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED 441 618)

Whittaker, G. (1994). Materials science and technology: What do the students say? *Journal of Technology Education, 5* (2), 52-67.

Wicklein, R., & Schell, J. (1995). Case studies of multidisciplinary approaches to integrating mathematics, science and technology education. *Journal of Technology Education, 6* (2), 59-74.

Willis, G., Schubert, W. H., Bullough, R. V., Kridel, C., & Holton, J. T. (1993). *The American curriculum: A documentary history*. Westport, CT: Greenwood Press.

Wineburg, S., & Grossman, P. (2000). *Interdisciplinary curriculum: Challenges to implementation*. New York: Teachers College Press.

Wisconsin Department of Public Instruction. (1999). *Selected integrated and applied curricula in Wisconsin secondary schools 1999* (No. 99110). Madison, WI: Lifework Education Team Department of Public Instruction.

Wright, M., & Foster, P. (1997). Multiple approaches to technology education: Which do our leaders believe are best? *The Technology Teacher, 57* (3), 31-35.

Wright, T. (1996). Technology: An intellectual discipline. *The Technology Teacher, 56* (2), 33-34.

Zais, R. S. (1976). *Curriculum principles and foundations*: New York: Thomas Y. Crowell Company, Inc.

Appendix A

January 2, 2002

Dear Colleagues,

I am pursuing a master's degree in technology education at the University of Wisconsin-Stout. The topic of my thesis is perceptions and attitudes of middle school mathematics, science, and technology teachers towards an interdisciplinary curriculum. This survey is a requirement to the completion of my thesis.

Your involvement in this study is meaningful and sincerely appreciated. Please complete all three pages of this survey and place it in my mailbox in the staff's lounge by January 11th. Obviously, the success of my research depends upon your cooperation.

I understand that by returning this survey, I am giving my informed consent as a participating volunteer in this study. I understand the basic nature of the study and agree that any potential risks are exceedingly small. I also understand the potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that no identifiers are needed and so that confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

Thank you for your interest in my thesis. Should you have any questions, please call me at extension 2908 or at home 651-784-3357. Thank you once again for your cooperation.

Sincerely,

Daniel J. Rossiter
Central Middle School

NOTE: Questions or concerns about participation in the research or subsequent complaints should be addressed to Dr. Amy L. Gillett, Chair, Department of Education; School Counseling; School Psychology, College of Human Development, 427 Education and Human Services Building, UW-Stout, Menomonie, WI, 54751, phone (715) 232-2680.

Appendix B

Please complete the following questions by placing a check in the space provided to the left of the best choice.

1. What discipline do you currently teach?
_____ Mathematics _____ Science _____ Technology

2. Years teaching in current discipline?
_____ 0-5 _____ 6-10 _____ 11-15 _____ 16-20 _____ 20+

3. Years teaching in the White Bear Lake School District?
_____ 0-5 _____ 6-10 _____ 11-15 _____ 16-20 _____ 20+

4. Highest level of education attained?
_____ BA/BS _____ MS/MA _____ PhD/EdD

5. What is your gender?
_____ Female _____ Male

6. What grade level do you teach? (Check all that apply).
_____ 6th _____ 7th _____ 8th Other (Please note): _____

7. Which statement **best** describes an interdisciplinary curriculum?
_____ To study a topic and use applied activities to enhance learning.
_____ To study a topic and integrate math, science, and technology skills to enhance learning.
_____ To study a central topic in math, science, and technology simultaneously to enhance learning.
_____ Other (Please explain):

8. Based on your professional experience, an interdisciplinary curriculum **should include/have**? (Check all that apply).
_____ Exploratory activities. _____ Emphasis on problem solving. _____
Instruction that is goal oriented. _____ Cooperative learning.
_____ Verbal activities. _____ Cognitive strategies.
_____ Broad range of assessment strategies._____ Hypothesis driven activities.
_____ Laboratory instructed activities. _____ Cross-discipline themes.

Read the following statement and circle the best response.

9. My current curriculum contains elements of interdisciplinary education.
Strongly Disagree Disagree No opinion Agree Strongly Agree

10. My current curriculum gives students a holistic learning experience.
Strongly Disagree Disagree No opinion Agree Strongly Agree

11. An interdisciplinary curriculum would enhance student's learning.
Strongly Disagree Disagree No opinion Agree Strongly Agree

12. My professional training did not prepare me to use an interdisciplinary approach in the classroom.
Strongly Disagree Disagree No opinion Agree Strongly Agree

13. I feel uncomfortable implementing curriculum change in my classroom.
Strongly Disagree Disagree No opinion Agree Strongly Agree

14. I am willing to be trained/re-educated on the basic concepts of an interdisciplinary curriculum.
Strongly Disagree Disagree No opinion Agree Strongly Agree

15. I would find it difficult to work with teachers from other disciplines.
Strongly Disagree Disagree No opinion Agree Strongly Agree

16. Required curriculum, such as graduation standards, make it difficult to implement new ideas in the classroom.
Strongly Disagree Disagree No opinion Agree Strongly Agree

17. Lack of resources, such as money and time, makes an interdisciplinary curriculum very hard to implement.
Strongly Disagree Disagree No opinion Agree Strongly Agree

18. An interdisciplinary curriculum is just another "educational reform" that will not work.
Strongly Disagree Disagree No opinion Agree Strongly Agree

19. An interdisciplinary curriculum would improve upon my current curriculum.
Strongly Disagree Disagree No opinion Agree Strongly Agree

20. An interdisciplinary curriculum would fulfill the mission of our middle schools.
Strongly Disagree Disagree No opinion Agree Strongly Agree

Please include additional comments below. Thank you for completing the survey.

Appendix C

Dear Colleague,

Last week a survey about perceptions and attitudes of mathematics, science, and technology teachers towards an interdisciplinary curriculum was placed in your school mailbox. If you have already returned your completed survey, please accept my sincere thanks. If not, please take the time to answer the questions and return it to me within the next week. It is extremely important that your opinions are included in my study so all mathematics, science, and technology teachers are represented. If you did not receive the survey or it has been misplaced, please e-mail me back or call me at ext. 2908 and I will get a survey to you.

Thank you once again for your time.

Your Colleague,

Dan Rossiter - Central Middle School