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The impact of the interdisciplinary mathematics and science program on students' attitudes at Oakcrest High School

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THE IMPACT OF THE INTERDISCIPLINARY MATHEMATICS AND SCIENCE PROGRAM ON STUDENTS' ATTITUDES AT OAKCREST HIGH SCHOOL

By
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Professor

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ABSTRACT

Norma J. Boakes
The Impact of the Interdisciplinary Mathematics and Science Program on Students' Attitudes at Oakcrest High School
2000
Dr. Eric Milou
Master of Arts in Subject Matter Teaching Mathematics

The purpose of this study was to determine the effects on students' attitudes of an interdisciplinary program at a rural high school in southern New Jersey.

The interdisciplinary mathematics and science program of Oakcrest High School that began in 1998 involved teaming a non-college prep ninth grade mathematics course with the same level general science course. A group of 30 students who had participated in this program were selected; then a Likert-style 22 question attitude survey was developed and implemented to determine the impact the program had on students' attitudes. An analysis of the survey included a one-sample t-test on all questions, two-sample t-tests, an analysis of variance, and a correlation of means to determine significant differences between major areas.

The analysis revealed significant differences related to all research questions. Student attitudes significantly differed when compared to their attitudes from previous mathematics courses. The interdisciplinary course impacted their choice of future mathematics classes. Attitudes of students were not significantly different based on age,

gender, or ethnicity. And finally, students' home environments impacted their attitude towards the interdisciplinary mathematics and science program.

MINI ABSTRACT

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The Impact of the Interdisciplinary Mathematics and Science Program on Students' Attitudes at Oakcrest High School
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The purpose of this study was to determine the impact an interdisciplinary mathematics and science program being implemented at a rural high school in southern New Jersey had on students' attitudes. An attitude survey revealed that the program had a positive impact on attitudes of students who participated in the program.

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Chapter 1

Introduction & Statement of Problem

Integration of mathematics and science is by no means a new innovation, yet it remains more a notion than a reality in today's schools. However, as the nation begins a new millennium, math and science reform have again focused on the topic of integration. The reason for this lies within "... the need to develop a scientific and technological literacy among all students that will enable them to function effectively in the modern world" (Haney, 1990, p.1). In the *Educating Americans for the 21st Century* report the main thesis focuses on the fact that the "...nation is failing to provide its students with the intellectual tools needed for the 21st century" (Sharp,1984, p.1). So, now as an educational community we need to find ways to deal with this problem.

If this sounds familiar, it's because this has been something we've dealt with before. One of the most memorable events was the launch of Sputnik in 1957. With this launch, the public became aware of and concerned about the educational programs of the United States, specifically in mathematics, science, and technology (House, 1990). The educational community reacted with a movement referred to as "alphabet soup" curricula that gave us such projects as the University of Illinois Committee on School Math [UICSM] and the School Math Study Group [SMSG] (House, 1988, p.202).

With the changes in education including newly written curricula, new textbooks, more teacher training programs, and the United States successfully landing on the moon, the nation breathed a sigh of relief until the 80's when once again our teaching practices and outcomes were scrutinized. Americans began to realize that we were being edged out of world markets, particularly by Japan. International reports published showed United States' educational achievement to be "mediocre" at best when compared to other countries (House, 1988). Once again, a flurry of educational reforms took place particularly in the areas of math and science. Reform documents included *Project 2061-Science for All Americans*, *Reshaping School Mathematics-A Philosophy and Framework for Curriculum*, and *Everybody Counts- A Report to the Nation on the Future of Mathematics Education*. Each of these reports "...endorse[d] the integration of science and mathematics teaching and learning as a means of improving achievement and attitudes within both disciplines" (Berlin, 1991, p.1). The National Science Foundation [NSF] /School Science and Mathematics Association [SSMA] Wingspread Conference: *A Network for Integrated Science and Mathematics Teaching and Learning* focused specifically on ways to improve science and mathematics education through integration. Writers including Berlin (1991), Dossey (1994), House (1988), and Huntley (1998) also explored integration topics and the impact that it would have on curricula. House (1990) reported that "...the need for curricula integration was the number one issue among respondents..." in an ASCD poll of members and others within the education field (p.2). Huntley (1998) and House (1990) recognized the traditional separation of the subjects and saw the need for the combination of the subjects. Berlin and White (1991) in a paper reporting the results of the Wingspread Conference repeatedly referred to integration as a necessary component for science and math education.

Now we stand at the start of a new millennium. Reports again focus on how to improve math and science education. Publications include *National Council of Teachers of Mathematics [NCTM] Principles and Standards 2000 for School Mathematics* (1998) and *New Jersey Mathematics Curriculum Framework* (1995). Within both documents under the standard "Connections", there is an emphasis on the need to recognize, use, and learn about math in context outside of mathematics. Math and science are specifically focused upon for the richness of connections that exist between the subjects in content and process.

At this point it's obvious that integration of mathematics and science is a useful tool to improve the achievement level and understanding of students. As the *Everybody Counts Report* (1989) pointed out "...the failure of school math [and science] is due to a tradition of teaching that is inappropriate to the way most students learn" (National Research Council, 1989, p.6). This is what motivated Oakcrest High School to implement a new integrated math and science curriculum. To give you some background, Oakcrest High School lies in a rural district in Southern New Jersey. The school houses approximately 1200 students with 35% minority students and 20% special education students. Oakcrest also has 32% of its' students on free or reduced lunch. Thus, the school serves a wide variety of students of varying economic levels and backgrounds. The interdisciplinary program the school chose to implement to help serve such a mix of students began with two non-college prep classes written primarily for ninth graders. The math course, entitled "Integrated Math I" includes basic arithmetic, algebra, and geometry concepts. The science course, entitled "General Science", includes basic units introducing the many branches of science. The school then scheduled the classes in such a way that it was possible to combine the classes together for group projects, which was favored among Wingspread Conference participants (Berlin & White, 1991). Both of the curriculums were also reworked to align common topics and to aid in making connections. Tinker in his article <u>Integrating Mathematics and Science</u> (1994) states that a "...school that makes a real commitment to student project activities must rethink the entire mathematics and science curriculum both to create time for a healthy injection of project activities and to reorient the remainder of the curriculum to support project work" (p.50). Steen (1994) agreed in her article on integration of the subjects, also emphasizing the need for "team-teaching" where teachers are paired together to help teach the integrated curriculum. The school included this approach by teaming two math instructors with two science teachers. This allowed for the sharing and developing of ideas for use in the classroom. Thus, the interdisciplinary team set off to do interdisciplinary projects throughout the school year.

This new curricular structure carries its roots in the concept of constructivism in the classroom. Literature from "...both science and mathematics educators value a constructivist view of learning (Piaget, 1970; Vygotsky, 1978) and the need to construct meaningful knowledge (Ausubel, 1963; Novak and Gowin, 1993)" (Berlin & White, 1995, p.23). Within the interdisciplinary approach, there is an emphasis on project work and on students developing their own knowledge by being placed in problem solving situations. Teachers are facilitators, seeing that students have the problem solving strategies and the background they need. By working through the projects, students get the chance to construct their own understanding of the material. This constructivist approach is supported by the report, *Everybody Counts,* published by the National Research Council, which indicated that research has shown that students involved in this type of learning approach will improve their intellectual abilities (1989).

A full year has passed since Oakcrest High School has begun this new interdisciplinary program. This thesis' goal was to determine what impact this has had on the students involved by conducting an attitude study. The reasons for choosing this focus linked to existing research on attitudes of students and the impact it had on students' education.

> The development of a positive attitude toward the subject being studied is probably one of today's most prevalent educational goals. Teachers as well as parents believe that a student's attitudes toward a school subject will affect that student's achievement in the subject (Tapia,1996, p.1).

This was summarized by Tapia after conducting an extensive literature review for her paper that was presented at the Annual Meeting of the Mid-South Educational Research Association in 1996. Tapia also summarized that "...research has indicated that attitudes toward mathematics are very important in the achievement and participation of students in mathematics" (p.4). Tapia was not alone in her findings. Aiken (1972) did similar research in the area of attitudes and concluded that a student's attitude toward mathematics was important in determining the math courses he or she would take and in which mathematical activities the student would choose to engage. More recently, in 1993, Berlin and White made similar statements in their work after reviewing reform documents saying that "...this integration may improve student understanding and performance and develop realistic and positive attitudes related to both math and science" (p.3). Thus, attitudes of students have a far-reaching impact and are a good indicator of mathematical achievement and further participation within the subject.

Within the research that has been described it can certainly be summarized that an interdisciplinary program such as Oakcrest High School's had an impact on those students involved. The goal then, of this thesis, was to determine what effects this integrated mathematics and science curricula had on student attitudes. More specifically:

1. Do student attitudes of those who have participated in the interdisciplinary program differ significantly when compared to their attitude of previous mathematics courses experienced?

2. Do student experiences in this interdisciplinary curriculum have an impact on their choice of math courses in the future?

3. Does the effect of students who have participated in the interdisciplinary program differ significantly based on age, gender, or ethnicity?

4. Do backgrounds from a student's home environment make a significant difference on his or her attitude towards the interdisciplinary program?

The stage was set for the research, but why do it? With so much educational research, one must ask what the need was for the study. For one, as the NCTM Curriculum and Evaluation Standards 2000 indicated, there is a need for mathematical instructional programs that "...emphasize connections to foster understanding of mathematics"(p.50). Tinker (1994), Kullman (1966), Wilson and Blank (1999) also saw the need for new approaches to teaching mathematics and science as a way to better prepare students and more effectively bring out the interrelationships of the subjects in the classroom. In addition, Berlin while creating a collective bibliography of work on integration stressed in her summary that "...there is a critical need for more attention to the assessment of the effect of [integrated math and science programs] as related to student science and mathematics achievement and attitude"(1991, p.4). Berlin, along with White, in an article from the NCTM 1995 Yearbook focusing on the connection of mathematics across the curriculum specifically identifies the "lack of research" on the benefits of a mathematics and science curriculum (p.22).

Limitations

As in any research, there were limitations that had an impact on the results of this study. The limitations to this thesis included:

1. The interdisciplinary program was in effect for one year. With the newness of this program the results may not have been as pronounced.
2. Time constraints on the thesis included limited amount of time taken to conduct the study and calculate the results, as well as the inability to run a pilot study.
3. The lack of previous attitude data available on students prior to integration.

Definitions

1) Interdisciplinary course: Course in which connections between different subjects are explored through group lessons, projects, and units.
2) Attitude: As defined by Dutton & Blum (1968), attitude is "...a learned emotionally toned predisposition to react in a consistent way, favorable or unfavorable, toward a person, object, or idea" (p.259).
3) Integration: As defined by the New Jersey Curriculum Framework (1995) involves the focusing on overlapping topics and concepts within different subject areas.
4) Constructivism: This is the theory that learners are active participants in the learning process. Learners actively construct their own knowledge by connecting new information and concepts to what they already know. (Leino, 1994)

Chapter 2

Review of the Literature

Mathematics and science have been recognized as a critical part of a student's education for decades. They are emphasized as key subjects for preparing students for the technological and scientific challenges of the 21^{st} Century (Haney, 1990; Sharp, 1984). Not only was their importance noticed, but also the strong connections between the subjects were seen. It was only natural for educators and researchers to realize that the best way to prepare students for the future was to integrate the subjects.

The relationship between the two subjects was acknowledged as far back as the early 1900's. At that time, the Central Association of Science and Mathematics Teachers was formed. Later to be renamed in the 1970's as the School Science and Mathematics Association, this organization published a journal, School Science and Mathematics, that reflected the developments in science and math teaching in the United States for more than ninety years (House, 1990).

Discussion remained mainly among educators until 1957, the legendary year of the launch of Sputnik. "That occurrence shattered our national ego and created an outbreak of doubt and criticism of our technological strength. It was further accompanied by widespread public awareness of, and concern for, the educational process, especially in science and mathematics as these related to our competitive position in world affairs" (House, 1988, p.202). This caused a flurry of curricular reform particularly in math and science. Projects such as the University of Illinois' Committee on School Mathematics, Minnesota Math & Science Project, and the School Math Study Group attempted to reform our educational programs. Of particular interest was the Cambridge Conference on the Correlation of Science and Mathematics in Schools held in the 1960's. This conference produced a report calling for the development and implementation of an integrated mathematics-science curriculum (Dossey, 1994).

Mathematics and science were again thrown into the limelight in the 1980's. It was at this point that "America began to recognize we [were] being edged out of world markets by nations we once took for granted, notably Japan, and recently-published international comparisons of educational achievement [had] shown the United States to be mediocre at best when compared to other countries" (House, 1988, p.203). As a result, a number of reports were released on the state of education. One of the first and most compelling reports was *A Nation at Risk: The Imperative for Educational Reform* released by the National Commission on Excellence in Education in 1983. "A Nation at Risk warned of a national education crisis and urged reform of the entire system" (American Association for the Advancement of Science, 1989, p.6). Once again, the wheels of educational reform began to turn in an attempt to remedy the failure of our education system. There was a particular focus on mathematics and science, viewed as the most critical subjects in becoming a more technologically and scientifically advanced nation (Haney, 1990; Sharp, 1984). Donna Berlin, in a bibliography she accumulated on mathematics and science education, identified the following educational reform documents during these times of reform: *Science for All Americans, Project 2061, Reshaping School Mathematics,* and *Everybody Counts: A Report on the Future of Mathematics Education*. Berlin found that all of these reports "...endorse[d] the integration of science and mathematics teaching and learning as a means of improving achievement and attitudes within both disciplines" (1991, p.1).

Other educational reforms that saw integration as a way to improve mathematics and science education included the National Science Teachers Association Scope, Sequence, and Coordination and the National Council of Teachers of Mathematics Curriculum and Evaluation standards (Berlin & White, 1991; Dossey, 1994). Curriculum projects were also created including School Science and Mathematics Integrated Lessons found in *School Science and Mathematics*, Lawrence Hall of Science's (1984) Great Explorations in Math and Science Project (GEMS), Fresno Pacific College's Activities that Integrate Math and Science (AIMS Educational Foundation, 1986,1987), and University of Chicago's TIMS (Institute for Mathematics and Science Education, 1995) (Czerniak, Weber, Sandmann, and Ahern, 1999).

Organizations also did their own research on integration. The Association for Supervision and Curriculum Development, for one, conducted a poll in 1988 of members and related members of the educational community and determined that "the need for curriculum integration was identified as the number one issue among respondents" (Jacobs, 1989). In 1991, a Wingspread Conference held by the National Science Foundation (NSF) and the School Science and Mathematics Association (SSMA), funded by the federal government, focused specifically on the integration of mathematics and science. Again, the need for this curricular change was seen and a number of benefits related to integration of school science and mathematics were identified (Berlin & White, 1993). Such benefits included promotion of achievement and personal development, more enrichment opportunities for able students and more concrete experiences for slower learners, more opportunities for problem solving, the promotion of independent learning by students, and the addressing of real life concerns of students (Czerniak et al, 1999).

Now we embark on a new century. We have seen over the years a continuous trend in mathematics and science education towards their integration. Yet with all the research that has been done, educational systems remained relatively unchanged. For example, Huntley (1998), Haney (1990) and House (1990) all recognize the "traditional separation" of the subjects. We continue to separate the subjects even though there is a widespread support to integrate the curriculum "...as a way for students to acquire conceptual, as opposed to, procedural knowledge of mathematics and science" (Huntley, 1998, p.1-2). In fact, Beane (1995) reports that students who experience an integrated curriculum do as well if not better than students who experience a separate-subject curriculum. The NCTM Principles and Standards 2000 for School Mathematics (1998) and the NJ Mathematics Curriculum Framework (1995) also call for the need for schools to change their curriculums. Both documents under the standard "Connections" emphasize the need for students to recognize, use, and learn about math in contexts outside of mathematics. They specifically refer to mathematics and science for the richness of connections and content that existed between the subjects. Dossey (1994) agrees and connects this to all of the basic standards noting that "all four standards- problem solving, communication, reasoning, and connections- can thrive in a situation providing for both student growth in mathematics and science focused about the areas mentioned above" (p.17). Robert Tinker (1994), in his article *Integrating Mathematics and Science,* remarks:

> The desire to integrate the two disciplines must come from, and be part of, a desire to re-fashion mathematics and science instruction in light of our

> persistent and catastrophic failure to prepare students for the future. Any solution to these failures will have to involve new approaches to teaching and the will to overcome minor scheduling difficulties (p.49).

So, Tinker also sees the need to change what we have traditionally done to educate students. The "new approaches" that he refers to includes the integration of the subjects, as well as infusion of student projects. He notes:

> Student project activities are all but absent from mathematics and science education, and with that absence there is a lack of reality to mathematics and science education, a lack of connection to problems of concern to students, and necessarily, a lack of interest, solid learning, and desire to learn more (p.50).

Berlin and White are similar in their statements reporting that most participants in the NSF/SSMA Wingspread Conference prefer a "project approach" to connect science and mathematics. In addition, besides these more structural aspects of change, there is also a change needed in way the subjects are taught. In the national report *Everybody Counts* (1989) it is emphasized that "...failure of school math is due to a tradition of teaching that is inappropriate to the way most students learn" (p.6). Steen (1994) recognizes this in her article on integration suggesting a blending of not only content, but of methodologies as well. Specifically, she remarks:

> In school, teachers could engage in paired teaching, or team teaching, with the science teacher helping the mathematics teacher learn how to make productive use of exploratory assignments, while the mathematics teacher helps the science teacher see how to introduce quantitative, logical methods into science teaching. The systems as a whole then builds on the strengths of the corps of teachers as a whole, rather than floundering on the inevitable weakness of individual teachers when confronted with the task of teaching an integrated science and mathematics curriculum (p.12).

Overall, there is undeniable support to change how we teach students mathematics and science, as well as a number of effective ways to go about it.

If it has not become apparent yet, the idea of integration has a strong relationship to the learning theory known as "constructivism". This is the theory that "...children learn by doing, their actions help construct their personal knowledge" (Steen, 1994, p.12). Throughout the literature reviewed, there was an undercurrent of support for this belief. Berlin and White (1995) stated "...both science and mathematics educators value a constructivist view of learning and the need to construct meaningful knowledge..." giving credit to such authors as Piaget, Vygotsky, Ausubel, and Novak & Gowin (p.23). Berlin and White (1991) also noted while summarizing finding from the NSF/SSMA Wingspread Conference that conference participants valued a constructivist perspective. Other authors as well, including Steen (1994), Tinker (1994), and Czerniak et al (1999), recognized that the methods used in integration, such as project work and showing connections, allowed students to construct their own knowledge and enabled them to be active participants in the learning process. Research has also shown that by using this constructivist view, positive results could be seen. For instance, "Involvement in learning increases as does long-term retention" (Berlin & White, 1991, p.3). In addition, in Everybody Counts (1995), it is reported that mathematics becomes useful when "...it has been developed through a personal intellectual engagement that creates new understanding" (p.6).

The literature reviewed thus far has shown the history behind integration of mathematics and science, what educational goals integration can achieve, and the connections this method has to constructivism. So there has been plenty of evidence on why the school of this thesis would choose integration of mathematics and science to improve students' understanding and knowledge. However, there still remains a lot to be learned about the integrated curriculum. Berlin and White (1991) remarked that "...there is clearly a need for careful conceptualization and additional research on integrated science and mathematics teaching and learning" (p.2). Berlin's bibliography accumulating literature on the topic of integration specifically highlights a lack of research documents. In particular, under the Curriculum-Evaluation section of her work, Berlin stresses that "...there is a critical need for more attention to the assessment of these programs as related to student science and mathematics achievement and attitude" (1991, p.4). In 1995, again Berlin & White co-authored a paper for the NCTM 1995 Yearbook on connecting school science and mathematics. They continue to stress the need for research exploring the benefits of such a program. As well, in 1999, in an article on science and math integration, it is specifically stated that "...research is critical to determine whether [the benefits of integration] actually exist..." (Czerniak et al, p.427). This thesis' purpose was to help in this regard by establishing what impact this school's curriculum had on students who have participated in the program.

With the purpose clear, a specific focus had to be chosen for this thesis. After reading through numerous educational documents, what had the most impact on a student was their attitude towards the subjects being studied. Tapia (1996) in her writing on student attitudes towards mathematics recognized this stating:

> Educators have become more concerned with the affective outcomes of educational programs. The development of a positive attitude toward a subject being studied is probably one of today's most prevalent educational goals (p.3).

Not only did she note student attitudes as a common educational goal, but also later in her work she indicated that research has shown that attitudes were very important in the achievement and participation of students in mathematics (p.4). Berlin and White (1993) concurred in their work noting:

> [Reform] documents suggest that the integration may improve student understanding and performance and develop realistic and positive attitudes related to both mathematics and science (p.2-3).

Looking farther back into research on attitudes, the work mimics what had been said above. Aiken, well-known for his writing in this area, remarked that students' attitudes were particularly important in determining whether a student would choose to take a mathematics course, what mathematics courses a student would engage in, and whether they would put forth the effort to continue their math studies (1972). In addition, the home environment of a student was noted as a consequential part of the student's learning process. Specifically, parents' support or lack of support of student was considered an important factor in student participation in mathematics and attitudes towards mathematics (Kenschaft, 1991; Tapia, 1996). Thus it could be said that by studying student attitudes and the relationship they have to their home environment and future plans, we could determine how programs such an interdisciplinary mathematics and science curricula was effecting students.

To determine a student's attitude, similar to much research done in this area, a survey was designed and conducted. The survey was created based on some of this research. In particular, within the work of Aiken (1972), a Mathematics Attitude Scale containing 20 items utilizing a Likert scale was helpful. Similar work done by Callahan (1971) and Dutton & Blum (1968) was used as a reference in the construction of an attitude survey. Finally, the work of Sandman (1941) also played a key role here. He, in fact, used much of the research above to create a "multi-dimensional attitude instrument" in an effort to "...investigate how attitudes interact[ed] with other variables to affect mathematics learning..."(p.2). Although many of these surveys dealt within the area of mathematics, these authors' surveys were crucial in the development of a survey that could accurately determine how student's attitudes were impacted by this interdisciplinary program.

Summary

In summary, the topic of integrating mathematics and science has been recognized time and time again in research as a way to better prepare students for the scientific and technological world they face. Authors, researchers, and professional mathematics and science organizations at the state and national level all agree that integration is an excellent method to break from a tradition of teaching that continues to prove to be mediocre in its' impact on students. However, integrated mathematics and science curriculums remain more a good idea than a common practice. Particularly, there is a need for more research on how these programs are effecting students. Of major importance is how it effects student attitudes. From the research reviewed it can be said that student attitudes are critical in the participation and achievement of students. The objective of this study was to determine the effect Oakcrest High School's interdisciplinary mathematics and science program had on the attitudes of students who had participated in this program.

Chapter 3

Methodology

Oakcrest High School's interdisciplinary mathematics and science program has been in existence since the 1998-1999 school year. To determine how this program impacted students' attitudes, those that have participated in this program for a full year were asked to participate in the survey of this study. These students totaling 30 ranged from grade 10 to grade 12 and were of varying ethnic and economic backgrounds, as well as regular education and special education students.

To determine face validity of the survey based on what was described above, the survey was read and validated by the school's Principal and math supervisor.

The survey, after receiving final approval from the Principal, was given in February 2000. The students who were asked to participate were brought together to take the survey. The survey results were then accumulated and a statistical analysis was done.

The survey was designed using elements from the work of Sandman (1941), Aiken (1972), Callahan (1971), Dutton & Blum (1968). Similar to the work of these authors, a Likert-type attitude scale was utilized. The survey was 22 questions in length. Each of the questions of the survey were weighted from 5 to 1, 5 for the most favorable student response and 1 for the least favorable response. The first section of the survey consisted of four basic questions used to obtain information on the student's grade, gender, ethnic background, and current mathematics class. The next two sections of the survey were used to determine students' attitudes toward the interdisciplinary program. The first of these two (questions 5-10), referred to as the interdisciplinary attitude section, examined students' attitudes as a result of taking the interdisciplinary course using a 5 point Likert scale: strongly agree, agree, neutral, disagree, and strongly disagree. The second portion (questions 11-14), referred to as the attitude comparison section was designed to evaluate their attitudes when compared to previously taken courses utilizing a similar system with the choices: much better, slightly better, same, slightly worse, and much worse. Following this the home environment section (questions 15-18) was written to determine the support students received in their homes. The response choices for each of these statements were very often, often, sometimes, rarely, and very rarely. The last portion of the survey, referred to as the future plans section (questions 19-22), focused specifically on the students' reasoning for their choice of math course for the current school year. The responses included strongly agree, agree, neutral, disagree, and strongly disagree.

Each section of the survey corresponded to the research questions posed in Chapter 1. Listed below are each of the research questions posed and the questions corresponding to each:

Research Question #1: "Do student attitudes of those who have participated in the interdisciplinary program differ significantly when compared to their attitude of previous mathematics courses experienced?" is answered by the interdisciplinary attitude section, questions 5-10, and by the attitude comparison section, questions 11-14. A one-sample t-test with a .05 significance level was used to compare the response of each question of these sections to '3', a neutral response.

Research Question #2: "Do student experiences in this interdisciplinary curriculum have an impact on their choice of math courses in the future?" was answered by the future plans section, questions 19-22. A one-sample t-test with a

.05 significance level was used to compare the response of each question of this section to a '3', a neutral response. A two-sample t-test was done on the future plans section (question 19-22) with respect to the course they were enrolled in. In addition, the overall means for the future plans, interdisciplinary attitude, and attitude comparison sections was checked for correlation.

Research Question #3: "Does the effect of students who have participated in the interdisciplinary program differ significantly based on age, gender, or ethnicity?" was answered by questions 1 to 3 of the survey. For questions 1 and 3, an analysis of variance was done on the interdisciplinary attitude section (questions 5-10) with respect to age and ethnicity. For question 2, a two-sample t-test with a .05 significance level determined gender differences using the group means of the interdisciplinary attitude section (questions 5-10).

Research Question #4: "Do backgrounds from a student's home environment make a significant difference on their attitude towards the interdisciplinary program?" was answered by the home environment section, questions 15-18. For each question a one-sample t-test with a .05 significance level was used to compare the response to '3', a neutral response. In addition, the overall means for the home environment section, interdisciplinary attitude section, and the attitude comparison sections of the survey were checked for correlation.

Chapter 4

Results of the Study

The survey group consisted of 30 students. The breakdown of the demographics, determined from the first part of the survey (see Appendix A) of this group is listed in Table 4.1 below. The majority of students surveyed were male students (60%) and the greatest number of students were in grade 10 (76.7%). The most commonly taken class was the second level of the Integrated Math class on which the survey is based on (73.3% in Integrated Math II). Students that took Algebra A (which is the first year of a two-year algebra course) and Algebra I (a one-year algebra course) were placed together into one category due to the similar nature of the courses. For ethnicity, due to the low number of students in the Hispanic and other category, these two categories were also combined for the survey analysis.

Table 4.1 *Demographics*

Gender			**Grade**		
	Percent	**# of**		**Percent**	**# of**
Male	60%	18	10^{th}	76.7%	23
Female	40%	12	11^{th}	13.3%	4
			12^{th}	10%	3
Ethnicity			**Current Mathematics Course**		
	Percent	**# of**		**Percent**	**# of**
Caucasian	30%	9	Integrated Math II	73.4%	22
African American	56.7%	17	Algebra A or I	23.3%	7
Hispanic & Other	13.3%	4	Consumer Math	3.3%	1

Analysis of Research Questions

Research Question #1: Do student attitudes of those who have participated in the interdisciplinary program differ significantly when compared to their attitude of previous mathematics courses experienced?

The interdisciplinary attitude section (questions 5-10) and the attitude comparison section (questions 11-14) were used for this question. For each of these questions a 5-point Likert scale was used. A one-sample t-test with a .05 significance level was used to compare the response of each question to the neutral response. The results from these sections are listed in Tables 4.2 and 4.5.

Table 4.2 *Frequency of Responses, Mean, Standard Deviation, and t-Value of the Interdisciplinary Attitude Section*

Item	5	4	3	2	1	Mean	Standard Deviation	*t*-value
	Strongly Agree				Strongly Disagree			
Q5	4	19	5	2	0	3.83	.75	6.11**
	13.3%	63.3%	16.7%	6.7%	0%			
Q6	5	15	10	0	0	3.83	.70	6.53**
	16.7%	50%	33.3%	0%	0%			
Q7	8	10	9	3	0	3.77	.97	4.32**
	26.7%	33.3%	30%	10%	0%			
Q8	8	14	6	1	1	3.90	.96	5.14**
	26.7%	46.7%	20%	3.3%	3.3%			
Q9	8	12	6	4	0	3.80	1.00	4.40**
	26.7%	40%	20%	13.3%	0%			
Q10	8	10	8	3	1	3.70	1.09	3.53**
	26.7%	33.3%	26.7%	10%	3.3%			

$^{**}p<.01$

All of the items of the interdisciplinary attitude section produced significant results at the .01 level, indicating that the students agreed with all of the statements.

Question 5. Students' math skills have improved after participating in the interdisciplinary course, $t(30)=6.11$, $p<.01$. Specifically, noted in Table 4.3, over 75% of those surveyed felt strongly about this statement choosing either agreed or strongly agreed.

Table 4.3 *Responses to Question 5: "After taking the Integrated Math I and General Science interdisciplinary courses, my math skills have improved."*

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
# of responses	4	19	5	2	0
Percent	13.3%	63.3%	16.7%	6.7%	0%

Question 6. Students felt more comfortable talking about mathematics after taking the interdisciplinary course, $t(30)=6.53$, $p<.01$.

Question 7. Students' math grades were better than in other math classes taken after taking the interdisciplinary course, $t(30)=4.32$, $p<.01$.

Question 8. As illustrated below in Table 4.4, 73.4% of students agreed or strongly agreed that after taking the interdisciplinary course they realized how math was useful in their life and future, $t(30)=5.14$, $p<.01$.

Table 4.4 *Responses to Question 8: "After taking the Integrated Math I and General Science interdisciplinary courses, I realized math is useful in my life and future."*

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
# of responses	8	14	6	1	1
Percent	26.7%	46.7%	20%	3.3%	3.3%

Question 9. Students felt more confident in their math classes after participating in the interdisciplinary course, $t(30)=4.40$, $p<.01$.

Question 10. Students would like to participate in another interdisciplinary course, $t(30)=3.53, p<.01$.

All of the items of the attitude comparison section also produced significant results at the .01 level, indicating that the students felt positively about all statements. Results are noted below in Table 4.5.

Table 4.5 . *Frequency of Responses, Mean, Standard Deviation, and t-Value of the Attitude Comparison Section*

Item	5	4	3	2	1	Mean	Standard Deviation	*t*-value
	Much Better		Same		Much Worse			
Q11	13	11	5	1	0	4.20	.85	7.76**
	43.3%	36.7%	16.7%	3.3%	0%			
Q12	9	10	10	1	0	3.90	.88	5.57**
	30%	33.3%	33.3%	3.3%	0%			
Q13	9	11	9	1	0	3.93	.87	5.89**
	30%	36.7%	30%	3.3%	0%			
Q14	13	9	7	1	0	4.13	.90	6.90**
	43.3%	30%	23.3%	3.3%	0%			
***p<.01*								

Question 11. Illustrated in Table 4.6 below, 23 students out of 30 (80%) felt their math grades were better (36.7%) or much better (43.3%) when comparing their experience with the interdisciplinary course with other courses taken, $t(30)=7.76, p<.01$.

Table 4.6 *Responses to Question 11: "When I compare the interdisciplinary math and science class to other classes I've taken, my grade in math was..."*

	Much Better	Better	Same	Slightly Worse	Much Worse
# of responses	13	11	5	1	0
Percent	43.3%	36.7%	16.7%	3.3%	0%

Question 12. Students' confidence levels were better when comparing their experience with the interdisciplinary course with other courses taken, $t(30)=5.57$, $p<.01$.

Question 13. Student interest in math was better when comparing their experience with the interdisciplinary course with other courses taken, $t(30)=5.89$, $p<.01$.

Question 14. Student enjoyment of math was better when comparing their experience with the interdisciplinary course with other courses taken, $t(30)=6.90$, $p<.01$. In fact, illustrated in Table 4.7, 73.3% reported feeling that they had slightly better or much better enjoyment in the interdisciplinary math class.

Table 4.7 *Responses to Question 14: "When I compare the interdisciplinary math and science class to other classes I've taken, my enjoyment of math was..."*

	Much Better	**Better**	**Same**	**Slightly Worse**	**Much Worse**
# of responses	13	9	7	1	0
Percent	43.3%	30%	23.3%	3.3%	0%

Research Question #2: Do student experiences in this interdisciplinary curriculum have an impact on their choice of math courses in the future?

The future plans section of the survey, questions 19-22, was used for this research question. A one-sample t-test with a .05 significance level was used to compare the response of each question to the neutral response. Table 4.8 on the following page lists the results of this analysis.

All of the items of the future plans section produced significant results.

Table 4.8 *Frequency of Responses, Mean, Standard Deviation, and t-Value of the Future Plans Section*

Item	5	4	3	2	1	Mean	Standard Deviation	*t*-value
	Strongly Agree				Strongly Disagree			
Q19	11	7	8	3	1	3.80	1.16	3.79**
	36.7%	23.3%	26.7%	10%	3.3%			
Q20	8	9	9	4	0	3.70	1.02	3.75**
	26.7%	30%	30%	13.3%	0%			
Q21	5	15	6	4	0	3.70	.92	4.19**
	16.7%	50%	20%	13.3%	0%			
Q22	3	1	13	3	10	2.47	1.28	-2.28*
	10%	3.3%	43.3%	10%	33.3%			
*$p<.05$ **$p.01$								

Question 19. Students agreed that they took the math class they were in currently because they did well last year, $t(30)=3.79, p<.01$.

Question 20. Students agreed that they took the math class they were in currently because they liked the Integrated Math I class, $t(30)=3.75, p<.01$.

Question 21. Students agreed that they took the math class they were in currently because they felt more confident about their math skills, $t(30)=4.19$, $p<.01$.

Question 22. Students disagreed with the statement that their reason for taking the math class they were in currently was because it was a graduation requirement, $t(30)=-2.28, p<.05$.

A two-sample t-test was also completed on the future plans section with respect to the course they were currently enrolled in. This analysis was done for the Integrated Math I and Algebra categories only, since there was only one respondent who was currently taking Consumer Math. The results of this analysis are detailed in Table 4.9. Significant results were found for two of the four questions.

Question 19. Students currently in Algebra more strongly agreed that they were in their current class because they did well last year in the interdisciplinary program. $t(30)=-3.68, p<.01$.

Question 21. Students currently in the Algebra courses more strongly agreed that they were in their current class because they felt more confident with their math skills. $t(30)=-2.60, p<.05$.

Table 4.9 *Mean, Standard Deviation, and t-Value for each Question of the Future Plans Section with Respect to the Course the Student is currently Enrolled In.*

Item		Mean	Standard Deviation	*t*-value
Q19	Integrated Math I	3.59	1.14	-3.68**
	Algebra	4.71	.49	
Q20	Integrated Math I	3.73	.94	-.26
	Algebra	3.86	1.22	
Q21	Integrated Math I	3.59	.91	-2.60*
	Algebra	4.29	.49	
Q22	Integrated Math I	2.64	1.33	1.00
	Algebra	2.14	1.07	
$^*p<.05$ $^{**}p<.01$				

In addition to this analysis, the overall means of the future plans, interdisciplinary attitude, and attitude comparison sections were checked for a correlation. For correlation purposes, the interdisciplinary attitude and attitude comparison sections were combined for an overall attitude mean. The Pearson correlation (r=.77) revealed that there was significance at the .01 level found between the overall mean of the attitude sections (mean=3.9) and the mean of the future plans section (mean=3.4). Thus, students' future plans impacted their attitudes toward the interdisciplinary program.

Research Question #3: Does the effect of students who have participated in the interdisciplinary program differ significantly based on age, gender, or ethnicity?

The demographics of this survey, questions 1 – 3 were analyzed in reference to the interdisciplinary attitude section, questions 5-10. For questions 1 and 3, an analysis of variance (ANOVA) was done with respect to the Interdisciplinary Attitude Section. The results using question 1 are listed in Table 4.10. There were no significant differences found between grade levels (10^{th}, 11^{th}, and 12^{th}).

Table 4.10 *F-values and Significance Levels for the Interdisciplinary Attitude Section with Respect to Grade Enrolled*

Item	F	P-value
Q5	2.84	.08
Q6	.91	.42
Q7	.02	.98
Q8	1.17	.33
Q9	2.11	.14
Q10	.18	.84

The results for question 3, dealing with ethnicity, are listed in Table 4.11. There were no significant differences found in attitude with respect to a student's ethnic background (Caucasian, African American, or Hispanic and Other).

Table 4.11 *F-values and Significance Levels for the Interdisciplinary Attitude Section with Respect to Ethnicity*

Item	F	P-value
Q5	.58	.57
Q6	2.15	.14
Q7	.10	.91
Q8	2.41	.11
Q9	.78	.47
Q10	2.33	.12

To determine gender difference, a two-sample t-test using question 2 and the interdisciplinary attitude section, questions 5 – 10, with a .05 significance level was used to compare the response to the neutral response.

Table 4.12 *Mean, Standard Deviation, t-Value, and Significance Level of the Interdisciplinary Attitude Section with Respect to Gender*

Item		Mean	Standard Deviation	*t*-value
Q5	Male	3.83	.71	.00
	Female	3.83	.83	
Q6	Male	3.78	.65	-.51
	Female	3.92	.79	
Q7	Male	3.67	.97	-.68
	Female	3.92	1.00	
Q8	Male	3.56	1.04	-3.00**
	Female	4.42	.51	
Q9	Male	3.78	.94	-.14
	Female	3.83	1.11	
Q10	Male	3.50	1.04	-1.23
	Female	4.00	1.13	
Male (n=18), Female (n=12) **p<.01				

Looking at the results in Table 4.12, there was a significant difference only for question 8 of the survey.

Question 8. Female students, with a mean of 4.42 in comparison to the male's mean of 3.56, more strongly agreed that after taking the Interdisciplinary course they realized that math was useful in their lives and futures, $t(30)=-3.00$, $p<.01$.

Research Question #4: Do backgrounds from a student's home environment make a significant difference on their attitude towards the interdisciplinary program?

The answers of questions 15 – 18, the home environment section, were analyzed for this research question. A one-sample t-test with a .05 significance level was used to compare the response to the neutral choice for each of the survey questions. The results of this section of the survey are detailed in Table 4.13.

Table 4.13 *Frequency of Responses, Mean, Standard Deviation, and t-Value of the Home Environment Section*

Item	**5**	**4**	**3**	**2**	**1**	**Mean**	**Standard Deviation**	***t*-value**
	Very Often	Often	Some-times	Rarely	Not at All			
Q15	2	2	8	7	11	2.23	1.22	-3.43**
	6.7%	6.7%	26.7%	23.3%	36.7%			
Q16	11	10	4	5	0	3.90	1.09	4.51**
	36.7%	33.3%	13.3%	16.7%	0%			
Q17	22	5	3	0	0	4.63	.67	13.38**
	73.3%	16.7%	10%	0%	0%			
Q18	3	6	5	7	9	2.57	1.38	-1.72
	10%	20%	16.7%	23.3%	30%			
$^{**}p<.01$								

All but one of the items of the home environment section produced significant results at the .01 level.

Question 15. Students did not often get help with homework at home, $t(30)=-3.43$, $p<.01$.

Question 16. Table 4.14 illustrates that 21 of the 30 students (70%) were asked often by their parents/guardians how they are doing in school, $t(30)=4.51$, $p<.01$.

Table 4.14 *Responses to Question 16: "My parents/guardians ask about how I'm doing in school."*

	Very Often	Often	Some-times	Rarely	Not at All
# of responses	11	10	4	5	0
Percent	36.7%	33.3%	13.3%	16.7%	0%

Question 17. Students' felt strongly that parents/guardians stressed often or very often that school was important, $t(30)=13.38$, $p<.01$. Noticably, all thirty students at least sometimes were told of the importance of an education and 22 of these 30 felt this occurred very often (shown in Table 4.15).

Table 4.15 *Responses to Question 17: "My parents/guardians stress that school is important."*

	Very Often	Often	Some-times	Rarely	Not at All
# of responses	22	5	3	0	0
Percent	73.3%	16.7%	10%	0%	0%

Question 18. Insignificant results were found for this question that asked if students got help from their parents with schoolwork and projects.

In addition to this analysis, the overall means of the home environment, interdisciplinary attitude, and attitude comparison sections were checked for a correlation. For correlation purposes, the interdisciplinary attitude and attitude comparison sections were combined for an overall attitude mean. The Pearson correlation (r=0.437) revealed that there was significance at the .05 level found between the overall mean of the attitude section (mean=3.9) and the mean of the home environment section (mean=3.3). Thus, a student's home environment impacted their attitude toward the interdisciplinary program.

Chapter 5

Summary & Recommendations

The integration of mathematics and science in the classroom has been a topic visited many times over the years by the education community. However, as noted in Chapter 1, it remains more a good notion than a common practice in today's schools. With increasing pressure to "...develop a scientific and technological literacy among all students that will enable them to function effectively in the modern world", it is time to make this kind of change to our curricular structure (Haney, 1990, p.1).

Over and over again, integration has been recognized as a more realistic and relevant way of presenting students with material. From the launch of Sputnick in 1957 to the publication of an international report documenting the low achievement of American students in the 80's, numerous educational reforms have been attempted. The University of Illinois' Committee on School Mathematics, the School Math Study Group, the Central Association of Science and Mathematics Teachers formation, and Cambridge Conference of Science and Mathematics in Schools were examples of reforms taking place in the 50's and 60's. Later, in the 80's, integration was again suggested as an amendment to our educational mathematics and science ills through reform documents such as *A Nation at Risk: The Imperative for Educational Reform*, *Science for All Americans*, *Reshaping School Mathematics*, and *Everybody Counts: A Report on the Future of Mathematics Education*. As well, organizations including NCTM and NSTA were publishing new standards for mathematics and science education. In particular, at a Wingspread Conference held by the NSF and SSMA, integration of mathematics and science was their focus topic. Once more the need for this curricular change was seen and a number of benefits related to integration were identified (Berlin & White, 1993).

Even with thousands of hours of time spent on this idea of integration, the education process still remains relatively unchanged. We continue to put walls between related topics regardless of the evidence that clearly states that we need to change. Huntley (1998), Haney (1990), House (1990), Czekniak (1999), and Beane (1995) all recognize this traditional separation of mathematics and science. They also concur that integration is key in allowing students to acquire conceptual knowledge instead of just procedural knowledge of the subjects. Likewise, NCTM, NSF, SSMA, and NSTA suggest the blending of the subjects using a project approach and team teaching as methods of implementation.

Oakcrest High School began this interdisciplinary program in 1998 acknowledging the numerous studies, reports, and conferences done on the need for curricular reform. The Integrated Math I and General Science course were chosen to pilot this new approach. Teachers and students were then teamed during the school year for joint mathematics and science projects and activities. After completing a school year with this new curriculum, the question was how this was truly impacting students. The purpose of this thesis was to respond to this. Four main research questions were determined and answered.

Attitudes of students were chosen as the main focus of the survey created to answer the proposed questions. As Tapia pointed out in her work, "…research has indicated that attitudes toward mathematics are very important in the achievement and participation of students in mathematics" (1996, p.1). Aiken did similar research and found that student attitudes were important in determining the math courses that students will take and what mathematical activity students will engage in. Berlin and White's work (1993) also remarked that integration would improve student understanding and performance, as well as develop realistic and positive attitudes.

Once the decision was made to determine the effect integration had on attitudes of students participating in Oakcrest's new program, a survey was created to gather the opinions of these students. The works of Aiken (1972), Sandman (1941), Callahan (1971), and Dutton & Blum (1968) were used as models for the survey. A Likert-type attitude scale was utilized to write the 22-question survey. (See Appendix.) Four distinct sections were made including the interdisciplinary attitude section, attitude comparison section, future plans section, and the home environment section. The survey, once approved by the school, was given to 30 students who had participated in the interdisciplinary program. The statistical analysis was then done with the completed surveys.

The first question to be answered was "Do student attitudes of those who have participated in the interdisciplinary program differ significantly when compared to their attitude of previous mathematics courses experienced?". The results from the survey clearly show the answer is yes. The one-sample t-test results on each of the survey questions from the interdisciplinary attitude section and the attitude comparison section were at the .01 significance level on all questions in both sections. Students reported in the interdisciplinary attitude section that their math skills had improved, they were more comfortable talking about math, had a better math grade, were more confident of their skills, would like to participate again, and that math was useful. At least 60% of students (and in some cases as high as 76% of students) responded with "agree" or "strongly agree" for every question of this section. Student responses in the attitude comparison section mirrored these results. At least 63% and as high as 80% of students felt their grades, confidence level, interest, and enjoyment were "slightly better" or "much better" as a result of participating in this new program. These results were in agreement with Tapia's work (1996) where she remarked that according to reform documents integration improved student understanding and performance as well as developed positive attitudes. Likewise, in Aiken's work (1972) the results proved that by associating math with things that the learner views as pleasant, interesting, or of potential value to him, student attitudes are improved.

The second question asked "Do student experiences in this interdisciplinary curriculum have an impact on their choice of math classes in the future?". A one sample t-test was used to analyze the responses in the future plans section along with an analysis of variance on the group means of the future plans section with respect to the course the student was currently enrolled in. Once again, the results were overwhelming with all the questions of the future plans section at the .01 significance level. Of the students that participated, 60% of students agreed or strongly agreed that they took the class they're in currently because they did well last year. As well, more than half of the students (57%) agreed or strongly agreed that they took the class they're in currently because they liked the interdisciplinary course. Again, over half of the students (67%) agreed or strongly agreed that they were in their current class because they felt more confident. Finally, the most significant of all the results, 87% of students disagreed or strongly disagreed that they took their current math class because they were required to. Once again, the results provided proof for the claims of Aiken (1972), Tapia (1996), Berlin & White (1993), and Sandman (1941). Students' attitudes impacted students' choices of mathematics classes just as these authors had stated. To further investigate this, the group mean of the future plans section and the current course the student was enrolled in were analyzed. Again, significance at the .01 or .05 level surfaced on two questions. One of these questions revealed that students in Algebra felt more strongly that they took the class they're in because they did well in the interdisciplinary program. The other question dealt with confidence level. Students currently in Algebra once again more strongly agreed that they chose the course they're in because of their increased confidence level after taking the interdisciplinary program. Just as Aiken had noted in his work, "...one would expect that a student's attitude toward mathematics would be important in determining whether he elects to take courses in mathematics..." (1972, p.231). The analysis of variance verified this statement, as well as showed that the interdisciplinary program motivated students to take more advanced levels of mathematics, not because it was a graduation requirement but because they felt more confident, had better grades, and enjoyed the interdisciplinary program.

"Does the effect of students who have participated in the interdisciplinary program differ significantly based on age, gender, or ethnicity?" was the third question that was answered through the survey. After completing an analysis of variance on current grade level and ethnic background, it was exposed that there were no significance differences between students' attitudes in the interdisciplinary attitude section when compared to the above demographics. In addition, a two-sample t-test was done to determine if there were differences in attitudes based on gender. Only one significant response was found. Female students more strongly agreed that after taking the interdisciplinary course, they realized that math was useful in their lives and futures.

Tapia in her work hints towards a need to test the relationship between attitude and demographic data (1996). Overall then, in response to Tapia's comments, the interdisciplinary program had little or no impact on genders, ethnic backgrounds, or ages. One would hope for such a result proving that this program works for all students at all levels.

The final research question, "Do backgrounds from a student's home environment make a significant difference on their attitude towards the interdisciplinary program?", was investigated in two ways. First, a one-sample t-test was done on each of the questions in the home environment section. Significant responses were found for 3 of the 4 questions in this section. Specifically it was found that students did not often get help with homework at home. However, parents/guardians often asked how they were doing in school and stressed the importance of doing well in school. An analysis was also done on the overall mean of the attitude sections of the survey and the overall mean of the home environment section. The Pearson correlation revealed that there was significance at the .05 level. Thus, it can then be said that a student's home environment impacted their attitude of the interdisciplinary program. This was consistent with Tapia's (1996), Kenschaft's (1991), and Aiken's (1972) work that remarked that the parents' support was considered an important factor in attitudes toward mathematics.

As stated at the start of this thesis, there was a need for more research of the impact of interdisciplinary programs on students, noted over and over again by authors such as Berlin & White (1991), Czerniak et al (1999), and Tapia (1996). This study gave clear-cut evidence that there was a very positive impact on student attitudes regardless of age, gender, or ethnicity as a result of participating in Oakcrest's interdisciplinary program. In addition, this study has found that a student's home environment and their future plans impacted their attitudes about the program. Thus, the study of attitudes is a useful and valuable tool in determining how students benefit from such an interdisciplinary program. As it has been said by many authors such as Tapia "The development of a positive attitude toward a subject being studied is probably one of today's most prevalent educational goals" (1996, p.3).

By implementing this interdisciplinary program, Oakcrest has begun to end the traditional isolation of mathematics and science teaching and has followed the suggestions of such important educational documents as the NCTM and NSTA national standards. They have also begun to create positive attitudes among students participating in this program. These positive attitudes can lead students to improved student understanding and achievement (Berlin & White, 1993; Aiken, 1972; Tapia, 1996; Czerniak et al, 1999; Huntley, 1998). This reform is the first step in creating technologically and scientifically literate students who can handle the challenges of the 21st century.

Although this is just one study on the effects of an interdisciplinary program on high school student attitudes, it is important as evidence that this interdisciplinary idea works. Recommendations for future studies would be to tie in a statistical analysis of student achievement and determine how this correlates to students' attitudes in such an interdisciplinary program. One would suspect that a positive attitude would positively effect student achievement. As well, a study of a program in existence for a number of years would also be useful. The limitation of this study was that the program had only been implemented for one year, so other data was not available. Thus a long-term study including an attitude pre-test and surveys conducted yearly on attitude and achievement could assist in determining the long-term impact of interdisciplinary programs on students.

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Appendix

Interdisciplinary Program Survey

You have been asked to take this survey because of your participation in our new interdisciplinary mathematics and science program last year. This survey is *completely confidential and is meant to find out how you feel about this new program*. For this reason, your name is not needed on the survey. Please read each of the questions carefully and be honest with your responses.

In advance, thank you for taking part of this survey!

For each, circle your response.

1. What grade are you in currently? 9 10 11 12
2. What is your gender? Male Female
3. What is your ethnic background? Caucasian African American Hispanic Native American Asian Other
4. What class are you currently taking? Integrated Math II Algebra A Algebra I Other ____________________

SECTION I

Choose the response which best describes how you feel about each statement.

5. After taking the Integrated Math I and General Science interdisciplinary courses, my math skills have improved.
   Strongly Agree Agree Neutral Disagree Strongly Disagree
6. After taking the Integrated Math I and General Science interdisciplinary courses, I feel more comfortable talking about math.
   Strongly Agree Agree Neutral Disagree Strongly Disagree
7. After taking the Integrated Math I and General Science interdisciplinary courses, my math grade was better than grades I had in other math classes.
   Strongly Agree Agree Neutral Disagree Strongly Disagree
8. After taking the Integrated Math I and General Science interdisciplinary courses, I realized math is useful in my life and future.
   Strongly Agree Agree Neutral Disagree Strongly Disagree
9. After taking the Integrated Math I and General Science interdisciplinary courses, I feel more confident in math class.
   Strongly Agree Agree Neutral Disagree Strongly Disagree
10. After taking the Integrated Math I and General Science interdisciplinary courses, I would like to participate in the class again.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

SECTION II

Choose the response which best describes how you feel about each statement.

11. When I compare the interdisciplinary math and science class to other classes I've taken, my grade in math was…
    much better *slightly better* *same* *slightly worse* *much worse*
12. When I compare the interdisciplinary math and science class to other classes I've taken, my confidence level was…
    much better *slightly better* *same* *slightly worse* *much worse*
13. When I compare the interdisciplinary math and science class to other classes I've taken, my interest in math was…
    much better *slightly better* *same* *slightly worse* *much worse*
14. When I compare the interdisciplinary math and science class to other classes I've taken, my enjoyment of math was…
    much better *slightly better* *same* *slightly worse* *much worse*

SECTION III

Choose the most appropriate response to each of the following statements.

15. I get help at home with my homework.

    very often *often* *sometimes* *rarely* *not at all*
16. My parents/guardians ask about how I'm doing in school.

    very often *often* *sometimes* *rarely* *not at all*
17. My parents/guardians stress that school is important.

    very often *often* *sometimes* *rarely* *not at all*
18. I go to my parents/guardian for help with school-work and projects.

    very often *often* *sometimes* *rarely* *not at all*

SECTION IV

Choose the response which best describes how you feel about each statement.

19. I took the math class I'm in this year because I did well last year.

    Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree*
20. I took the math class I'm in this year because I liked the Integrated Math I class.

    Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree*
21. I took the math class I'm in this year because I felt more confident about my math skills.
    Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree*
22. I took the math class I'm in this year because it is a graduation requirement.

    Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree*