What Teachers Want To Know: A Systematic Review Of Action Research Theses Related To K-8 Mathematics And Science

2006

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WHAT TEACHERS WANT TO KNOW: A SYSTEMATIC REVIEW OF ACTION RESEARCH THESES RELATED TO K-8 MATHEMATICS AND SCIENCE

by

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B.S. Bowie State University, 2003

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Education
in the Department of Teaching and Learning Principles
in the College of Education
at the University of Central Florida
Orlando, Florida

Summer Term
2006

ABSTRACT

The research conducted was a systemic review of 88 action research masters theses from a teacher enhancement program for K-8 mathematics and science at the University of Central Florida and the teachers that performed the studies. The purpose of this study is to synthesize existing research results of a collection of master's theses from a teacher enhancement program for K-8 mathematics and science teachers in order to arrive at meaningful conclusions regarding teachers' research interests and classroom practices. Also, the study will help teacher educators who deliver the teacher enhancement program to improve the effectiveness of the program. A summary sheet was filled out for each thesis and teacher, and then entered into a spreadsheet that was later analyzed for reoccurring themes in the data. The results showed themes in topics of action research studies, questions in action research studies, and results of action research studies. There were no trends in characteristics of teachers performing the action research studies.

ACKNOWLEDGMENTS

First and foremost I would like to thank God, who has brought me a long way through this thesis process. Along with my committee, Dr. Hynes, Dr. Dixon and Dr. Jeanpierre for all their hard work and mentoring through this process, I would also like to acknowledge other professors who have devoted their time to help me with this thesis. I would also like to thank my family and friends for their everlasting support and encouragement.

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CHAPTER ONE: INTRODUCTION

In the realm of research many studies are conducted on mathematics and science education. Some of the research is performed by teacher educators and some is performed by classroom teachers. Some teachers feel they cannot relate to the research that is done by teacher educators, thus making the "gap" in research between research and practice. One way to help in closing this gap is to look at what proactive teachers who perform research in their classroom feel is important to research.

While teaching high school mathematics, I noticed a lot of frustrations from my teaching colleagues. One of the main causes of the frustration was the emphasis being placed on teachers for accountability related to student progress. Many different facets of student performance affected how the schools would be rated as well as affected the job security of teachers and administrators. This phenomenon is one of the main effects of the current education reform in the United States of America. Briscoe stated (2002)

> Changes in state and national standards and the call for reform suggest that in the twenty-first century greater demands will be placed on teachers to be problem-solvers rather than classroom technicians carrying out tasks set by others. Clearly, there is a need for proactive involvement by teachers in the research process to become problem solvers and decision makers who feel empowered in their own work (p. 432).

One way teachers can be proactive in the empowerment process is through action research (Briscoe & Wells, 2002). When performing action research teachers inquire about a problem, reflect on it, and improve their teaching practice based on their findings. By performing action research studies teachers can improve upon their practices and aid

other teachers to also improve upon their practice. Also teachers who engage in action research activities in their classrooms will be better consumers of information from the educational research field (Cox & Craig, 1997) where more purposeful and large-scale research projects are reported. Therefore, a connection between teachers and teacher educators can be made by teacher educators seeing what research teachers feel is valuable.

The purpose of this study is to synthesize existing research results of a collection of master's theses from a teacher enhancement program for K-8 mathematics and science teachers in order to arrive at meaningful conclusions regarding teachers' research interests and classroom practices. Also, the study will help teacher educators who deliver the teacher enhancement program to improve the effectiveness of the program.

Research Question #1

- What types of questions were important to K-8 mathematics and science teacher researchers?

Research Question #2

- What ways did teachers examine the questions they asked?

Research Question #3

- What were the themes and patterns in the problems posed by mathematics and science teachers and what caused these themes to be posed?

Research Question #4

- What were some patterns in the conclusions made by mathematics and science teachers who have performed action research?

Significance

Burnaford (2001) provides strong support for action research when saying,

> We might *think* we know how we teach, but until we actually collect data on our teaching and reflect on what that [*sic*] data might mean, we often are ignorant of many of our real strengths and real failings as teachers (p. 370).

Action research is designed around teachers presenting their own problems and drawing conclusions from their studies. In the education field, action research is an organized process where teachers/administrators research posed questions to analyze their teaching practices. Then they do independent studies researching these questions in their own classrooms. Through their data and reflection they learn how they teach and how their students learn. Also, administrators and principals engaged in action research to study the learning environment of the students to determine if different plans of action can improve their school (Tillotson, 2000). To center on my field of interest, I specifically looked at the action research studies that focused in the area of mathematics and science.

Focusing on these action research theses will help the Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA) program and other mathematics and science teachers in various ways. The LMA is a masters teacher enhancement program for K-8 mathematics and science teachers. It will specifically help this program by evaluating the effectiveness of the program as measured by both teacher attributes and student achievement. The study will also assist by determining certain questions that are important to current practicing teachers. Themes in these questions could then be studied more systematically by faculty and graduate student participants in LMA. Teachers can grow professionally from the results of this study. From studying

themes in the questions, the teachers will be able to focus on key and reoccurring issues and concerns of the classroom. Therefore, helping the teachers to adapt and implement the steps to improve and to enhance their classrooms and teaching experience. The study will also help teacher educators to focus on the important topics that teachers feel are relevant to their practice. The study will provide an analysis of 88 action research studies that will serve, if continued over many years, as a guide of how major focuses and topics in mathematics and science education change over time.

Chapter two is the literature review which focused on action research dealing with education, a brief history of action research, who benefits from action research, purposes of action research, action research procedures, the importance of reflection, professional development, problems with perceptions of action research and commonalities for mathematics and science action research projects. Chapter three is the description of the methods. It includes how my research was organized, the studies involved and how they were selected, and how the data were analyzed. Chapter four contains the analyzed data and its relevance to the outcomes the teachers made about their study. In closing, chapter five contains the conclusion and recommendations for further study in relation to action research for K-8 teachers.

Definition of Terms

Action Research	A form of teaching; a form of reflective practice and professional learning founded on an ethical commitment to improving practice and realizing educational values. Action research involves individuals and groups identifying areas for improvement, generating ideas, and testing these ideas in practice (Arhar, Holly, & Kasten, 2001, p. 285).
Systematic Review	A review of educational research that aims to answer specific review questions from publish research reports by identifying relevant studies, characterizing such studies to form a systematic map of research in the area, extracting relevant data to establish the value of the findings, and synthesizing and reporting the outcomes (Bennett, Lubben, Hogarth, & Campbell, 2005, p. 387).
Traditional Research	Research that is conducted by university professors, scholars, and graduate students on experimental and control groups in controlled environments (Mills, 2003, p. 4).

CHAPTER TWO: LITERATURE REVIEW

Introduction

> Transformational understandings derived from research can provide people with new concepts, ideas, explanations, or interpretations that enable them to see the world in a different way, and, therefore to do things in a different, hopefully better, way (Stringer, 2004, p. 3).

Teacher's who perform action research activities in their classrooms encompass transformational understandings about their practice. Action research is a growing practice in today's education system. The purpose of action research is "to provide educational practitioners with new knowledge and understanding enabling them to improve educational practice or resolve significant problems in classroom and schools" (Stringer, 2004, p. 13). From observing their practices teachers and teacher educators can help each other to improve upon teacher practices. This leads to the following conceptual framework of this study.

The conceptual framework begins with the teachers taking the Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA) masters program. During this program they are required to do an action research study. Then the studies were analyzed through a systematic review that showed common themes and results. Theses results lead to the teachers growing professionally by their reflections and change to their practice. Teacher educators will grow professionally by seeing what questions and topics teachers feel are important, and the results of their studies that are completed during the time of the program. Then depending on these results the teachers

will make necessary changes to the program, if any, to continue its success for assisting teachers in becoming better educators.

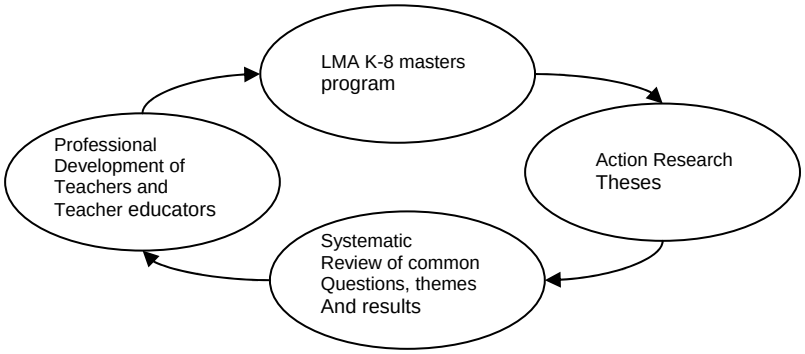

Figure 1: Conceptual Framework

Action research has many different facets. This review of the literature will focus on aspects of action research in education, a brief history of action research, who performs action research, action research procedures, action research in relationship to professional development, issues and concerns with action research and commonalities for mathematics and science action research studies. These sections will give a necessary background for teachers and teacher educators to encompass the purpose of this thesis. These elements of action research not only provide teachers reasons and methods to reflect and improve upon their practices, but also allow them to be able to share their findings with other educators in a formal way.

The process that the action research theses will be examined is through a systemic review. A systematic review is

> a review of educational research that aims to answer specific review questions from published research reports by identifying relevant studies, characterizing such studies to form a systematic map of research in the area, extracting relevant data to establish

> the value of the findings, and synthesizing and reporting the outcomes (Bennett, Lubben, Hogarth, & Campbell, 2005, p. 387).

Therefore, it is important to discuss this type of methodology and the various systematic reviews that have been performed dealing with mathematics and science education. These studies will also be discussed in the review of the literature.

Action Research in Education

Many definitions of action research exist (Anderson, Herr, & Nihlen, 1994; Arhar, Holly, & Kasten, 2001; Atweth, Kemmis, & Weeks, 1998; Burnaford, Fischer, & Hobson, 2001; Costello, 2003; Glanz, 1998; Hubbard & Power, 2003; McNiff & Whitehead, 2002; E. Stringer, 2004; E. T. Stringer, 1996; Sweeney & Tobin, 2000; Tomal, 2003). Two of these definitions of action research are listed below. Action research can be implemented in various fields. These include social and caring sciences, management organization and administration studies, and education (McNiff & Whitehead, 2002). The overall or big picture definition is taken from Stringer (2004),

> A participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities. (p. 4)

Since this thesis focuses specifically on action research in relation to educators, a definition more specific to action research for educators is,

> A form of teaching; a form of reflective practice and professional learning founded on an ethical commitment to improving practice and realizing educational values. Action research involves individuals and groups identifying areas for improvement, generating ideas, and testing these ideas in practice. (Arhar, Holly, & Kasten, 2001, p. 285).

This definition will be used in this study when referring to action research.

Before further discussion of action research, it is important to discuss the difference between action research and traditional research. Traditional research is conducted by university professors, scholars, and graduate students on experimental and control groups in controlled environments (Mills, 2003, p. 4). The main reason for the research is to report and publish conclusions that can be generalized to larger populations. Action research is conducted by teachers or administrators on students in schools and classrooms. The main purpose is to make a change in their practice in the classroom or at the school level that is being studied (Tillotson, 2000). No matter whether one is doing traditional or action research, the overall objective is for the researcher to provide information that makes a difference in his/her and/or others lives (Stringer, 2004).

Brief History of Action Research

Only within the last two decades has action research been widely used in the education setting (Sagor, 1992). There have been a few people that largely contributed to the practice of action research. One of the earliest philosophers to give a basis for action research was John Dewey. He believed that teachers should never stop reflecting and making improvements upon their practice (Tomal, 2003). He also outlined the scientific process: problem identification, developing a hypothesis, collecting and analyzing data

and drawing conclusions. His views and ideas were at the forefront of the action research concept.

In the 1940's, Kurt Lewin, a social psychologist, was the first to develop a theory of action research used in the social sciences. He researched discrimination against minority groups, mainly women, in the production factories (Lewin, 1946, 1948). In most action research literature he is known for coining the term action research. He founded the Research Center for Group Dynamics at Massachusetts Institute of Technology. Here group dynamics and action research models and theories were developed.

During the early 1950's, action research was promoted in the field of education principally by Stephen Corey who was at Columbia Teachers College (Corey, 1949, 1953, 1954). He believed that teachers would be more interested in their own research instead of research done by outsiders (Anderson, Herr, & Nihlen, 1994). Even though Corey used action research in the 1950's, it did not have widespread popularity in education until the 1970's. This status grew in the 1970's "when management consultants began using the principles of action research to improve organizational effectiveness" (Tomal, 2003, p. 8). From the efforts of Dewey, Lewin, and Corey action research is being practiced by many educators today.

Participants of Action Research

One might ask exactly who benefits from action research and why the action research procedure is important. As stated earlier, action research can be used in various occupations. Action research done by educators is a very practical and efficient method for conducting research (Tomal, 2003).

Many reasons as to why teachers conduct action research have been established. These reasons include problem solving, improvement of the classroom, other teacher perspectives, gaining relationship with other teachers, and learning that will be used toward future experiences. Teachers develop skills that empower them to solve problems, which lead to personal and professional growth (Oja & Pine, 1987). Richard Sagor reminds teachers that action research is for them to study their practices and make improvement, not to generalize to a broader group (Sagor, 1992). Ultimately, what teachers' value in their work is represented by their focus for action research. And from this study they receive professional fulfillment, success and satisfaction (Burnaford, Fischer, & Hobson, 2001). Teachers who do action research gain satisfaction in resolving their own problems and talking with their colleagues instead of listening to the "experts." Many techniques and practices in education are learned from colleagues. They believe their colleagues can give them more practical help than experts (Burnaford, Fischer, & Hobson, 2001). After conducting action research studies the teachers can support the claims they are making about their teaching practices. Also, after an action research study teachers are more likely to continue the examination of their classroom practice (Carr & Kemmis, 1986). All in all, Burnaford, Fischer, & Hobson, (2001) state it best by saying that until one collects data on his/her actually teaching practice, one will not be able to truly see his/her strengths and weaknesses.

Procedures for Action Research

Many different procedures for action research exist. Nixon suggests that the first step to successful research is the "felt need" concept where teachers want to develop a

practice in response to a classroom situation (Nixon, 1981). Kurt Lewin, gave the following stages for conducting action research (Tomal, 2003, p. 11).

Stage 1: Problem Statement (Initial Diagnosis)

Stage 2: Data Collection

Stage 3: Analysis and Feedback

Stage 4: Action Planning

Stage 5: Taking action (Implementation)

Stage 6: Evaluation and Follow-up

Like Lewin, some believe that action research follows specific steps, while others believe it to be a more informal process. For example, it can be thought to be a spiral of self-reflective cycles where the researcher plans a change, acts and observes the process and consequences of the change, reflecting on these processes and consequences, and re-planning (Atweth, Kemmis, & Weeks, 1998). The literature suggests that the general conception of the action research procedure has the teacher to pose a problem, the teacher gaining information and expertise of the issue, mapping out actions required to solve the problem, observing the results of the actions and reflecting then making changes to their profession.

Even though the procedures differ slightly, one of the most agreed upon parts of action research is reflection. Reflection helps the teachers to make sense of the many aspects of teaching (Freese, 2006). It also helps to depict ways to solve their posed problem. Whether following formal steps or an informal process, the end results involve re-planning and acquiring knowledge to solve a problem.

The process of action research is sometimes looked upon as representative of what should be common in the practice of teaching. It is different from what we generally think of as the practice of teaching because it is deliberate. Participation in formal action research causes the teacher to be aware of the procedures and acquire evidence to support the conclusions that are reached.

Professional Development Benefits of Action Research

Not only is action research a way for teachers to improve upon their practices, it also can be categorized as professional development. In almost every career professional development is required. In the last decade, there has been an increased emphasis on action research as a professional development activity (Cochran-Smith & Lytle, 1990, 1999; Kincheloe, 1991). Some school districts view action research as professional development rather than as just research (Anderson & Herr, 1999). Educational professional development programs can use action research to provide a way for relevant and effective growth in teachers (E. Stringer, 2004). By reflecting and taking action teachers are gaining a better understanding of their profession. These understandings can provide the teachers with new ideas, concepts or explanations that lead to them doing things in a different way (E. Stringer, 2004). This can then lead to teachers helping other teachers and teacher educators on current questions about teaching practices. Also, by looking at what teachers choose to investigate, outside professional developers can get a clear sense of what teachers find important and can plan their professional development for a wider audience accordingly.

Issues and Concerns Related to Action Research

One main concern teachers face is they think action research will take too much time. Another concern is they do not see the purpose of action research (E. Stringer, 2004). An additional issue is that the researcher is an active participant in the research. Trying to make the familiar seem strange is not easy. The researcher might have biases that someone who was looking from an outside perspective would not have. (Anderson, Herr, & Nihlen, 1994; J. Elliott, 1991). The last concern is the collaboration between education researchers and teachers. Some teachers feel the research done by these "experts" are irrelevant and out of touch (Zeichner, 1995). This can cause the teacher to not learn how action research can be constructed effectively. But just as the teachers have concerns with the researchers, researchers have concerns about teachers doing action research.

Because action research is called research, it has come under the scrutiny of those termed "expert" researchers (Foshay, 1998). Many of educational researchers question the qualification of the teachers to conduct action research. Because teachers had little training in designing and conducting research, the data they collected were often flawed. Because of this, the action research movement was ridiculed in the publications of American Educational Research Association (AERA), and it did not spread (Anderson, Herr, & Nihlen, 1994). As Stringer shares, "A recent proposal of a paper on action research that I submitted for a presentation at a national educational research conference, for instance, was rejected after one reviewer commented, 'There may be a place for this nonsense, in AERA, but not, hopefully, in this [the Research] division'" (Stringer, 2004, p. 144). Since action research is such a broad concept, problems are created given that it can be reshaped over and over again (Cochran-Smith & Lytle, 1999). A good question

was posed by Anderson and Herr. They asked, "If we can't use current validity criteria to evaluate practitioner research, how do we evaluate it?" (Anderson & Herr, 1999, p. 15). He goes on further to discuss how can you tell good practitioner research from bad? And who should develop these criteria? Since education researchers and teachers performing action research are attempting to challenge the normalizing tendencies, it makes sense to acknowledge differences and work together to improve education practices. The issues and concerns of action research are valid. However, action research is not about to disappear because teachers are finding this approach valuable to improving their instruction.

Commonalities for Mathematics and Science Action Research Studies

Action research is a "systematic form of inquiry carried out by teachers and administrators who seek answers to classroom based problems and issues" (Mills, 2003, p. 31). It has served to improve school organization through problem solving (Corey, 1953; Lewin, 1948), individual reflection on practice (J. Elliott, 1991), staff development (Oja & Smulyan, 1989), and teachers' professional development (Sagor, 1992).

Only a small number of research projects have been conducted on the types of action research pursued by science and mathematics teachers. Therefore, this study will bring new information to the literature. This thesis will be very beneficial because "educational researchers are now beginning to focus more closely on how studies in the classroom can inform their work in academic content areas such as science, mathematics, language arts, and social science" (Sweeney & Tobin, 2000, p. 163). Below are a few action research project summaries dealing with mathematics and science that many have some of the common themes found in this systematic review.

Thinking about ways to make geometry more relevant and satisfying for her 10th graders, Jan DeStefano decided to try out discovery and collaborative learning strategies with her class. She sought to find ways to help students learn geometry through more of an inductive than a deductive approach (Burnaford, Fischer, & Hobson, 2001). Another study resulted in Mullin's third-grade class increasing their ability to create mathematical word problems on the simple-and-complex-translation levels. The students' attitudes toward the problem-solving process also improved (Hildebrand, Ludeman, & Mullin, 1999). Teachers have also examined the use of technology as it relates to mathematics learning and attitudes (Doerr & Zangor, 2000; Sardo-Brown, 1995; Tinto, Shelly, & Zarach, 1994). Other action research studies found in the mathematics education literature were focused on the following topics: problem solving (Holton, Anderson, & Thomas, 1999; Tinto, Shelly, & Zarach, 1994), cooperative learning (Tinto, Shelly, & Zarach, 1994), writing (Sigel, Borasi, & Fonzi, 1998; Tinto, Shelly, & Zarach, 1994), reading (Borasi, Sigel, & Fonzi, 1998) and multiple intelligence (Goodnough, 2001).

Action research is more prevalent in the science education field. An eight grade science class integrated mathematics into science through the use of technology which resulted in a positive effect on students' achievement (Judson & Sawada, 2000). Zion examined the effect that learning by inquiry has on student achievement (Zion, Slezak, & Shapira, 2004). Studies have also focused on examining the learning process of teachers using science, technology and society (STS) in their action research projects (Pedretti, 1996; Pedretti & Hodson, 1995). These multitudes of themes show the vast amount of information that teachers find important to research.

Through action research the teachers might not determine the best method for teaching a concept or come to the expected conclusion, but they will be able to make specific conclusions based on practice and increase the predictability of what happens in their classrooms. By studying different action research studies, this systematic review examines and reflects on the different questions posed by K-8 mathematics and science teachers' action research studies presented through their graduate theses.

Systematic Reviews

There are various types of research that consist of reviewing many studies to answer a question about a common relationship among the studies. These types of research include narrative reviews, meta-analyses and systematic reviews. The purpose of a narrative review is to map out a an area (Bennett, Lubben, Hogarth, & Campbell, 2005) and a meta-analysis is comprised of statistical results from relatively similar studies (Andrews, 2005). A systematic review "limit bias in the assembly, critical appraisal, and synthesis of all relevant studies on a specific topic" (Torgerson, 2003, p. 8).

A systematic review can be identified as a key strand in educational research. "There is a drive towards forging closer links between research, policy and practice" (Bennett, Lubben, Hogarth, & Campbell, 2005, p. 389). By conducting a systematic review this relationship can be built for the Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA). In a speech at American Educational Research Association (AERA) Whitehurst (2006), the director of the Institute of Educational Sciences, discussed the four levels of research. These levels are (a) Identification: What are themes from existing data in collections and databases? (b) Development: Do identified themes and patterns work in an experimental setting? (c) Efficacy: Do tested

ideas work in the real world? (d) Scale Up: Can ideas that work in particular settings be scaled up for general use? This systematic review characterizes the first level of the research he described by Whitehurst. Since educational findings are fragile and vary in irregularity between events, students and other factors (Glass, 1976), this study seeks to describe patterns and themes from many researchers and many classroom settings where mathematics and science are taught.

Systematic reviews have been used for many years. They existed in the medical field in the early 1970s (Cochrane, 1972). In the 2000s they began to be used for educational purposes. The first use for education was the setting up of the Campbell Collaboration to review evidence from randomized controlled trials in education, criminology and other social sciences (Petrosino, Boruch, Rounding, McDonald, & Chalmers, 2000). The reviews that have been used for educational purposes aim to answer specific questions, forming those studies in systematic way, obtaining relevant data and reporting the outcomes (Bennett, Lubben, Hogarth, & Campbell, 2005).

Very few systematic reviews have been done concerning mathematics and science education. One review provided observations of how the effective use of daily mathematics lessons developed confidence and competence in students (Kyriacou, 2005). It is an in-depth analysis of evidence that the introduction of daily mathematics lessons has led to improvement in pupil confidence and competence in early mathematics. The analysis also highlighted some shortcomings in the way this approach has impacted classroom practice. Wang and Lin (2005) did a review of the relationship between Chinese students' and U.S. students performance and the contributing factors that lead to their performance. The study found that literature did not provide enough evidence to

support conclusively a direct positive relationship between the implementation of curricular and pedagogical features and high performance by students. Another study reviewed the impact of technology on the learning and teaching of mathematics (Galbraith, 1998). The results of the study identified attributes that are important where mathematics and computing interact. Since there are so few systematic reviews on mathematics and science this study will add to this body of literature.

The reviews have a general process and are beneficial to researchers who are interested in the topic of the review. All systematic review methods share a number of common features in that they make a specific criteria that they use to perform a systematic search and generate an overview on the research studies by looking at coded data and then they look at specific details of the studies and report these findings (Bennett, Lubben, Hogarth, & Campbell, 2005). Hemsley-Brown and Sharp (2003) give the following approach for a systematic review:

- Addresses explicit research questions
- Documents the methods used for literature searching
- Carry out exhaustive searches
- Establish explicit criteria for assessing the quality of studies
- Establish explicit criteria for including or excluding studies, based on the scope of the review
- Adopt a consistent approach to combining information across different studies
- Produce a clear statement of the findings of the review

There are strengths of systematic review methodology. "They help with the reporting of research findings, contribute to existing research, improve clarity and rigor of research

reports, and closing the gap between research, policy, and practice" (Bennett, Lubben, Hogarth, & Campbell, 2005).

Summary

"It has often been observed that most of what teachers learn about teaching is learned from the teacher down the hall or from one's own experience of success and failure" (Foshay, 1998, p. 3). Many teachers learn different teaching techniques from the teacher down the hall or their own experiences. Action research allows teachers to support claims they make about their teaching practices to their peers. Also, the findings in reviews influence classroom teachers the most if teachers are involved in the review process (Bennett, Lubben, Hogarth, & Campbell, 2005). In the education system today, more and more teachers are being held accountable for their classrooms, therefore action research can help in teachers improvement of their classrooms (Cochran-Smith & Lytle, 1999). By conducting a systematic review of common themes and results of 88 action research studies, more knowledge about what teachers feel are important topics in their practice will be available to teachers and educators.

CHAPTER THREE: METHODS

The purpose of this study is to synthesize existing research results of a collection of master's theses from a teacher enhancement program for K-8 mathematics and science teachers in order to arrive at meaningful conclusions regarding teachers' research interests and classroom practices. Also, the study will help teacher educators who deliver the teacher enhancement program to improve the effectiveness of the program. The research questions which guided the study were:

- What types of questions were important to K-8 mathematics and science teacher researchers?
- What ways did teachers examine the questions they asked?
- What were the themes and patterns in the problems posed by mathematics and science teachers and what caused theses themes to be posed?
- What were some patterns in the conclusions made by mathematics and science teachers who have performed action research?

One way to answer these questions is to perform a quantitative systematic review of teachers' action research studies. Systematic reviews are summaries of research activity, that provide knowledge and should therefore be considered a valuable tool within outcome research (Zoe & Thomas, 2006). This chapter focused on the methods used to answer the research questions and provided information on the design of the study, settings, data collection and method of analysis.

Limitations

The main limitation of this research is the data were collected only from the master's theses of graduates of the Lockheed Martin/University of Central Florida Academy for Mathematics and Science. This review might have different results if it encompassed a broader search method. Another limitation is that I did not study the methodology of the theses were not studied because action research is prescribed by the program.

Design of Study

Hemsley-Brown & Sharp (2003) give the following model for conducting a systematic review:

- Addresses explicit research questions
- Documents the methods used for literature searching
- Carry out exhaustive search
- Establish explicit criteria for assessing the quality of studies
- Establish explicit criteria for including or excluding studies
- Adopt a consistent approach to combining information across different studies
- Produce a clear statement of the findings of the review

There is the limitation of only using the theses from the aforementioned program; therefore, the steps described need more explanation. This study followed the systematic review model in the following ways. The Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA), teacher enhancement program for K-8 teachers of mathematics and science, was founded nearly 15 years ago. Throughout the history of this program, an emphasis has been placed on evaluating the effectiveness of

the program as measured by both teacher attributes and student achievement. This research project is another way to examine the program of the Academy. Action research has been one of the key features of LMA. Purposively, teachers involved in LMA examined their classroom practices relative to mathematics and science teaching. The research questions for this study were developed through consultation with the director and faculty of LMA. The particular aspect of the LMA Program which this study focused on was teacher's completed action research theses. Four explicit research questions were developed for the study.

This review focused on 88 science and mathematics action research studies. These are all the these that were completed from 2001-2006. Since the completed theses during this time period 2001 to 2006 comprised the data set for the study, many of the criteria in the Hemsley-Brown and Sharp (2003) model were met immediately. The theses were examined during this five year period because theses were not a requirement of the program until 2001. All theses were available from the UCF Library; thus, all available literature within the parameters of the study were examined. The time periods was selected to coincide with the years when a thesis was required from each student to complete the graduate program. Since the theses are published material, an IRB is not relevant for the systematic review.

The rationale for the methodology is to quantitatively systematically review, analyze and synthesize action research projects to enhance knowledge about reoccurring themes and findings of current educational practices. This is important because frequently there is a mismatch between what education research provides and what the teachers and administrators can use. Teachers and administrators want something they can use in the

classroom and not just philosophy, theory and points of view (Whitehurst, 2003). This thesis might help to bridge this gap.

Settings

Nearly all of studies performed by the teachers were located in the central Florida area. Central Florida is generally considered to be composed of the counties: Brevard, Lake, Orange, Osceola, Seminole, and Volusia. This area ranks 2nd in the nation in terms of overall population growth and the area is expected to grow at 23.2% from 2004 to 2014. According to the 2000 Census the population of the state of Florida is 15,982,378 and the population for central Florida is 1,655,561. The total number of schools in Central Florida is 403. The number of students enrolled in central Florida is well over 300,000; taught by 40,961 full time staff. Of this full time staff, 18% have masters degrees. Since this area has such a high rate of population growth and serves over 300,000 students it is essential that education of teachers continues to grow.

School districts in central Florida are large, and Orange County Public Schools (OCPS) is the largest. It is a minority majority school district and across central Florida 45% of students receive free and reduced lunch. At this time OCPS is the 12th largest school district in the nation. Not only are the districts large, but the schools are large as well. Typical elementary school serve up to 900 students, and middle schools often serve 1500 or more students. The largest high school within OCPS next year will have over 4200 students. Within the school districts there are urban, suburban and rural schools. English as a second language is an important topic in central Florida schools as well. Recently, central Florida was designated as having the second fastest growing Hispanic population in the nation.

The action research studies varied in regards to school settings, classroom settings and instruments that were used. The grade levels that were studied were from K-9. School grades that were studied ranged from "A" to "F" schools. The school grades include three measures of student achievement and three measures of student learning gains. Each year each school receives a grade that is calculated by the accumulation of percentage points for the six methods of achievement. The grade is also taken into consideration when the schools are ranked. The social economic status (SES) of the schools varied between low and high. Forty-four percent focused on mathematics instruction and learning, 47% involved science instruction, 5% involved both mathematics and science, and 4% focused other topics. Gender and ethnicity were also noted, along with other special characteristics. Instruments that were used to collect the data were audio tape, checklist, class discussions, ethnographic reviews, field notes, interviews, journals, oral presentations, parent surveys, portfolios, report cards, researcher reflection, rubrics, student artifacts, student surveys, teacher conferences, test and video tapes. The summaries of each study were then analyzed to build up an evidence-base in relation to each of the review questions. Criteria used to determine the research findings included the pertinence of the research to the review.

The Lockheed Martin/University of Central Florida Academy for Mathematics and Science program that the teachers completed consists of 36 semester hours and requires five semesters to complete. The teachers proceed through the two-year program in cohorts. The qualifications to enter the program are three or more years of teaching experience, to be a teacher of mathematics and/or science in grades K-8, a valid teaching certificate for Elementary, Science 5-9, Science 6-12, Mathematics 5-9, or Mathematics

6-12 and to qualify for admission to the graduate program at University of Central Florida. Over the last five years the program has made slight changes, but the current programs, with descriptors directly from the University of Central Florida (UCF) website are:

- SCE 5825 - Space Science for Educators

  This course is designed to provide students with experiences that promote effective science education in the elementary/middle schools. It focuses on principles of air and space flight with particular emphasis on rocketry.

- IDS 6934 - Using Technology in Mathematics and Science

  This course emphasizes the learning and use of technology in the teaching of mathematics and science.

- IDS 6937 - Reflecting on Instruction of Mathematics and Science

  This course is designed to provide experiences and understandings that promote effective science and mathematics education in schools. The focus of the course is rooted in the work of Dewey and Piaget, who urged active, inquiring education, through which students construct meaning in successive phases and develop scientific habits of mind.

- IDS 6933 - Seminar in Teaching Mathematics and Science

  The focus of this course is to learn about change from both a personal and institutional perspective. The goal is to synthesize the institutional knowledge and personal educational growth of each student to develop a holistic view of their continued participation, support, and commitment to self-renewing learning communities.

- MAE 6641 - Problem Solving and Critical Thinking Skills

  In this course teachers learn to become proficient problem solvers, become writers of problems appropriate for school children, and develop knowledge about when and how to integrate problem solving into the curriculum.

- MAE 6899 – Seminar in Teaching Mathematics

  This course is designed to provide development of historical and current issues, forces, and individuals and their impact on the teaching of mathematics K-12.

- EDF 6481 - Fundamentals of Graduate Research in Education

  This course involves the review and critique of research literature, use of library resources for educational research, and introduction to the concepts of research design and data analysis.

- SCE 6146 - Environmental Education

  This course is designed to provide experiences and understandings that promote effective science and mathematics education in schools through the study of Florida's ecosystems and habitats.

- Elective

- IDS 6971 Thesis - Planning, Completion Action Research Paper

While observing the courses that these teachers take, it is also a good idea to give information about the faculty that teaches these courses. The information about the faculty is also directly taken from the UCF website. *Juli K. Dixon, Ph.D.* is an Associate Professor of Mathematics Education. The classes she has taught in the LMA program include Seminar in Teaching Mathematics, Problem Solving and Critical Thinking Skills, and Science and Seminar in Teaching Mathematics. Her research interests include

integrating technology in mathematics instruction and exploring pre- and in-service teachers' choices regarding the tools they use to facilitate conceptual development in mathematics. *Michael C. Hynes, Ph.D.* is a Professor of Mathematics Education. Professor Hynes is the founding director of the Lockheed Martin/University of Central Florida Academy for Mathematics and Science endowed program. In the program he has taught Using Technology in Mathematics and Science. Dr. Hynes professional interests relate to mathematics education, science education, the use of technology in instruction, problem solving, and the improving the preparation of teachers. *Dr. Bobby Jeanpierre, Ph.D.* is an Assistant Professor of Elementary/Middle School Science Education. She has taught the courses Reflecting on Instruction of Mathematics and Science and Environmental Education. Her research and evaluation interests focus on the areas of mathematics, science, and technology education. Her research passion is to inquire into ways to improve science teaching and learning by connecting research-to-practice. *Enrique S. Ortiz, Ed.D.* is an Associate Professor of Mathematics Education. The courses he has taught in the program include Problem Solving and Critical Thinking Skills. His current educational research interests include the use of technology and manipulatives to teach mathematics concepts and skills, and the assessment of students strengths and weaknesses in mathematics. *Mary K. Romjue, Ph.D.* teaches Space Science for Educators in the LMA program. She is an Associate Professor of Science Education. Her research interests consist of current reform pursuits dealing with hands-on/minds-on science programs.

The teachers who performed the action research had various characteristics. The teachers had various years of teaching experience ranging from 2-30 years, with and

average of 7 years. Eleven percent of the teachers were male and 89% were female. The ethnicity breakdown is as follows: 80% Caucasian, 5% African American, 2% Asian, and 13% Hispanic. In the areas that the teachers taught 65% taught elementary, 23% taught middle school science, 10% taught middle school math, and 2% taught other. The instruments that were used to collect data on the teachers were the UCF database and the theses.

Data Collection

Information for this study was gathered from mathematics and science action research theses produced by graduates of the Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA). Each study was coded for several independent variables that depicted design features. Design features included information about the thesis such as title, author, year of thesis, subject, topics, school settings, classroom settings, instruments, data collected, results, recommendations, and why the topic was selected. Also design features about the teachers who performed the research were recorded. These features included years of teaching experience, ethnicity, sex, what subject were taught, area of certification and undergraduate major. By using these features, themes and variables were documented on each thesis and recorded on a spreadsheet. Then an examination of common themes, findings and other pertinent information were reported.

Method of Analysis

The summary sheets were color-coded according to subject. This helped when looking at if there was a balance of mathematics and science studies. Patterns and themes within

the data emerged once the spreadsheets were sorted according to the research question. The data was sorted by columns according to topics, year, subject, data collection methods, types of posed questions, results of study and teacher characteristics. The teacher characteristics were sorted by columns on years of teaching experience, ethnicity, sex and the grade level, elementary or secondary, that the teacher taught. Charts were constructed from the spreadsheets to provide a visual display of data. Then the findings of the most researched themes were analyzed by sorting what was measured and if the students showed positive or negative actions. Then the types of questions posed by teachers and their findings were examined.

Summary

This systematic review is an examination of action research theses that were completed over a five-year period in central Florida mathematics and science classrooms. The methods that were used to collect data were the UCF student database, files on the teachers kept by the staff of the Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA) and copies of the theses. The data taken from the theses were analyzed for reoccurring themes reported in chapter four.

CHAPTER FOUR: DATA ANALYSIS

Introduction

The purpose of this study is to synthesize existing research results of a collection of master's theses from a teacher enhancement program for K-8 mathematics and science teachers in order to arrive at meaningful conclusions regarding teachers' research interests and classroom practices. Also, the study will help teacher educators who deliver the teacher enhancement program to improve the effectiveness of the program. One way for teachers to reflect and improve upon their practice is through performing an action research study (J. Elliott, 1991). By examining action research studies, other teachers and teacher educators can acquire knowledge about action research studies from the results. There are many different topics from which teachers can select and pose questions. Through a systematic review of action research theses, common themes emerged from the work completed by teachers in central Florida in the last five years. This chapter described the results of those emerging questions, topics and outcomes as they relate to the research questions.

In order to complete the analyses, results of each thesis were summarized and compiled onto spreadsheets. Charts were constructed from the spreadsheets to provide a visual display of data. Color-coding the summary sheets and sorting the spreadsheets allowed patterns and themes within the data to emerge.

Research Question #1- What types of questions are important to K-8 mathematics and science teacher researchers?

Students Attitude and Achievement

In order to understand what types of questions teachers had when performing action research, information on what the teachers based their results on must be analyzed. The methods of data collection used along with the practices and questions being examined must also be investigated.

Sixty-two teachers examined both students' attitude and achievement and therefore, the results that were analyzed focus only on the effects on attitude and achievement. Other elements examined included participation, conflict resolution, language acquisition, culture, teacher practice, gender and social norms. Figure 2 shows the trends that teachers observed in studies that focused on student attitude and achievement.

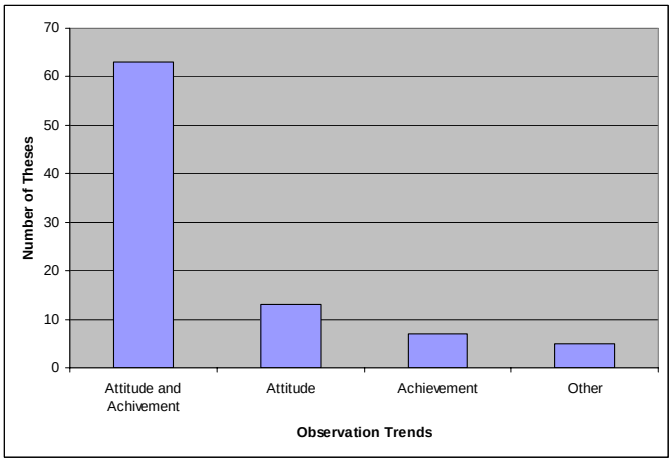

Figure 2. Teacher Observation Trends

The figure shows a majority of teachers researched how their practice affected both students' attitude and achievement. The combination of teachers who studied only

attitude, only achievement and other elements, were still lower that the teachers who asked questions about both attitude and achievement.

Research Question #2-In what ways did teachers examine the questions they asked?

Trends in Data Collection

It is essential to examine methods and techniques that teachers used for action research because it will help teacher and teacher educators in their practice. Analysis of the types of methods of data collection used in research helps teachers to select those that are most commonly used when studying various aspects of education practice.

The theses were comprised of 16 qualitative, 4 quantitative and 68 of both qualitative and quantitative studies. The data were collected from sources including audio taped discussions, checklists, class discussions, ethnographic reviews, field notes/observations, focus groups, interviews, journals, oral presentations, parent surveys, portfolios, report cards, researcher reflections, rubrics, student artifacts, student surveys, teacher conferences, tests and video tapes of small and whole groups. Figures 3 illustrates the trends in the use of the sources of data to observe student attitude. The only methods represented in the chart had at least 10 theses that used this method.

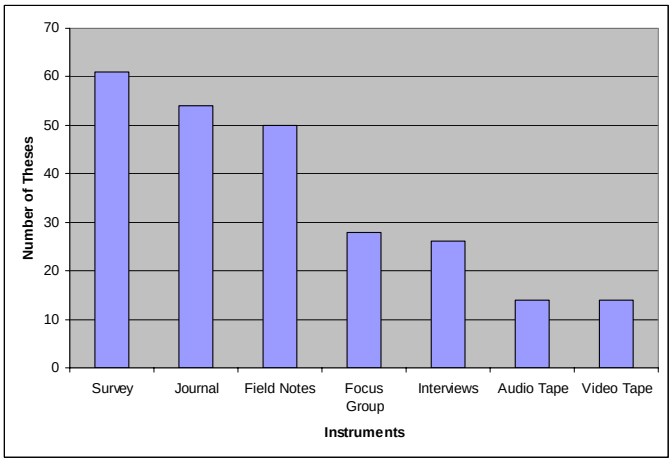

Figure 3. Instruments to Observe Student Attitude

The results showed 61 teachers used student surveys, 54 teachers used journals, and 28 teachers used field notes to look at student attitude.

Figure 4 illustrates the trends in the use of the sources of data to observe student achievements. The only methods represented in the chart had at least 10 theses that used this method.

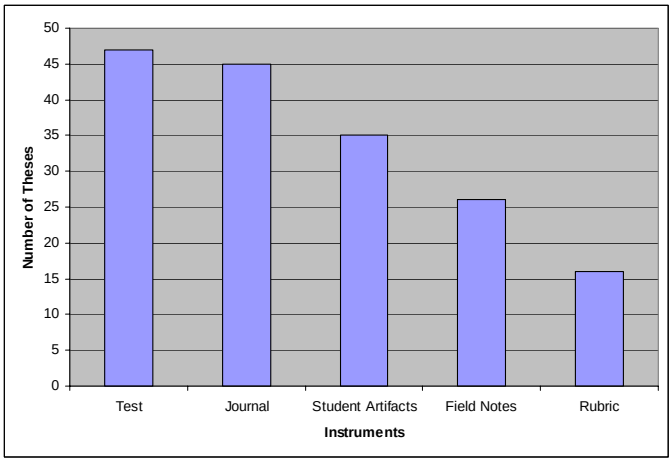

Figure 4. Instruments to Observe Student Achievement

The results also show 47 teachers used tests, 45 teachers used journals, and 35 teachers used student artifacts to look at achievement. It is interesting that teachers used

journals to look at both attitude and achievement. This finding showed that journaling was a largely used method for acquiring information about attitude and achievement of students.

Research Question #3-What were the themes and patterns in the problems posed by mathematics and science teachers and what caused these themes to be posed?

Topics of Theses

Patterns in the topic analysis will provide information about the frequency that topics were used as well as the relative interest in topics over the five-year period. The topics in this study were derived from a compilation of each thesis summary sheet (Appendix A) and were input on a spreadsheet. Below is a graph of the topics in the study.

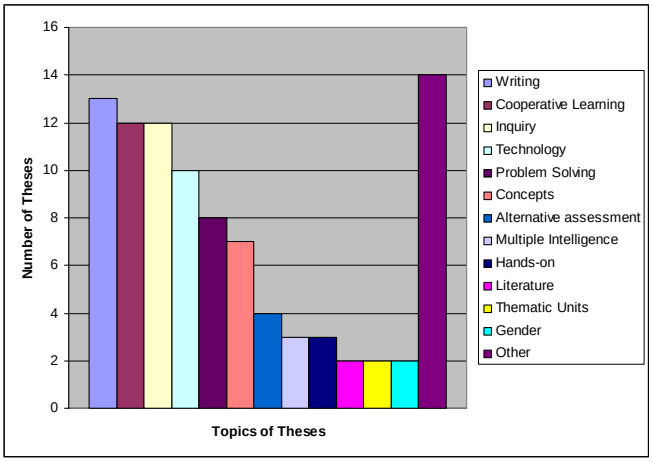

Figure 5. Topics of Theses

There were a total of 26 different topics. As shown in Figure 5, topics used most frequently were writing to enhance learning in mathematics and science, cooperative learning in both mathematics and science, inquiry-based science teaching, using

technology to teach mathematics and science, problem solving concepts, alternate assessment, multiple intelligences, and hands-on learning. The topics that only had one thesis were categorized as other. These studies included parent conferences, constructivist learning, cultural background, integration of mathematics and science, learning centers, manipulatives, music, peer learning, real-world applications, special needs, spatial reasoning, storytelling, teacher collaboration, and effects of social norms.

Topics by Content Areas

Commonly explored topics also emerged from specific subject areas. Figures 6 and 7 show the topics that emerged from science and mathematics. Figure 6 portrays data related to topics according to science.

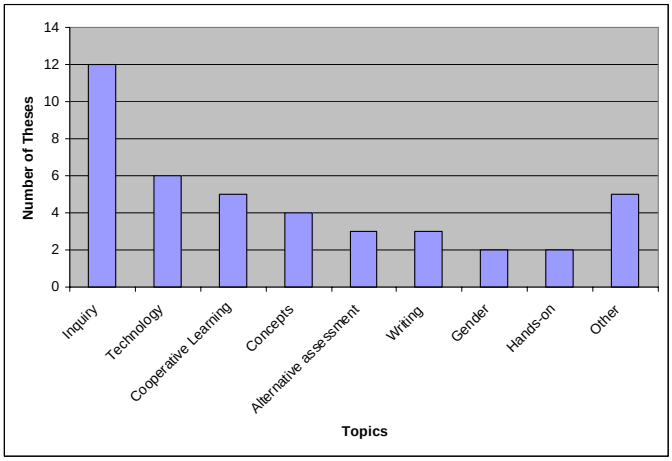

Figure 6. Topics of Science Theses

The above figure illustrated that 33 theses were focused on the top six science topics. Theses topics were inquiry, technology, cooperative learning, concepts, alternative assessments and writing. Five studies only had one thesis on a topic. These were categorized as other. They were the topics of, cultural background, multiple intelligences, peer learning, storytelling and thematic units.

Figure 7 shows the most frequently addressed six of 17 topics related to theses on mathematics.

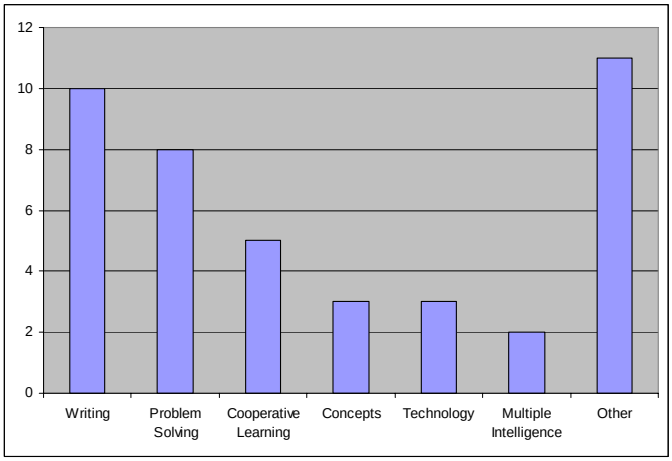

Figure 7. Topics of Mathematics Theses

Of the 42 theses on mathematics, 30 focused on writing, problem solving, cooperative learning, concepts, and technology. The following topics only had one mathematics thesis and were categorized as other: alternative assessment, hands-on learning, learning centers, integrating literature, using manipulatives, music, real-world investigations, social norms, spatial reasoning, teacher collaboration and thematic units.

Topics by Years

Two themes emerged from an analysis of the years in which theses were completed. Table 1 shows the topics of theses completed in 2001.

Table 1: Topics of Theses in 2001

Author	Topic	Subject
Austin	Alternative Assessment	M
Jenkins	Alternative Assessment	S
DiFabio	Constructivist Learning	M/S
Bell	Cooperative Learning	M
Kells	Cooperative Learning	M/S
Mahony	Cooperative Learning	S
McCue	Cooperative Learning	M
Tumbleson	Cooperative Learning	M
Whidden	Cooperative Learning	S
Barbella	Inquiry	S
Huntzinger	Manipulatives	M
Cooper	Problem Solving	M
Johnson	Technology	TECH
DaCosta	Writing	M
Shipley	Writing	M

The topics chosen in 2001 were alternative assessment, constructivist learning, cooperative learning, inquiry, manipulatives, problem solving, technology, and writing. Six out of a total of 15 theses researched cooperative learning.

Table 2 depicts the years in which writing was a topic.

Table 2: Years Where Writing was the Topic

Name	Subject	Year
DaCosta	M	2001
Shipley	M	2001
Connaughton	S	2002
Apple	M	2003
Gibson	M	2003
Smith	M	2003
Avila	M	2003
Dunn	S	2003
Stickle	S	2003
Lindsey	M	2004
Culbert	M	2005
Quinones	M	2005
Rose	M	2005

The table shows that six out of the 13 students whose topic was writing were completed in 2003. This is 26% of the total number of theses completed in 2003. Observing the

trends in years of research shows how during certain times, one topic might be the focus of many questions.

Cause of Topic Selection

Different reasons exist as to why teachers choose to study a certain topic. These reasons were generally found in the introduction of their theses. The teacher might have chose the topic because of past experiences, courses taken in the LMA program, observations in literature and dissatisfaction with the norm, to name a few. Of the 86 theses that reported a reason why a topic was selected, 16 teachers wanted to see how his/her teaching practice would affect the students in general, 16 teachers had a dissatisfaction with the normal way that the subject was being taught, seven wanted to motivate the students as they were learning the subject, seven wanted to observe his/her teaching practice in general, five chose the topics because of courses taken in the LMA program, five picked his/her topic because of past life experiences, four chose the topic because of past teaching experience and four just wanted to help students in general. Other reasons also existed, but less than three studies chose those reasons. Some are an explanation such as integration of mathematics and science, implementation of new mathematics program, proof that current teaching practice was effective, the Florida Comprehensive Assessment Test (FCAT), and to integrate technology.

There was one trend in the data relating to the year the thesis was written, but none in relation to the subject. Sixty-nine percent of the teachers that wanted to see how his/her teaching practice would affect the students in general did so between 2001 and 2003.

Themes among Teachers

In analyses to discover if there were any trends between the teachers who performed the studies, none prevailed. The data were inputted into a spreadsheet and sorted by different information that was obtained about the teachers. When sorting the data by columns with imputed information about the teachers no patterns emerged between years of teaching experience, gender, ethnic group or grade level taught in the types of studies done by the teachers.

Research Question #4-What are some patterns in the conclusions made by mathematics and science teachers who have performed action research?

Positive Results in Student Performance

Essential elements of the action research study were analysis of the results which inform future practice of the researcher. Whether the results were positive, negative or inconclusive, the researcher can acquire knowledge about his/her practice. The theses that were analyzed in this study demonstrated emergence of common topics. Figures 8 illustrates the topics whose outcomes were in the results of the studies regarding attitude.

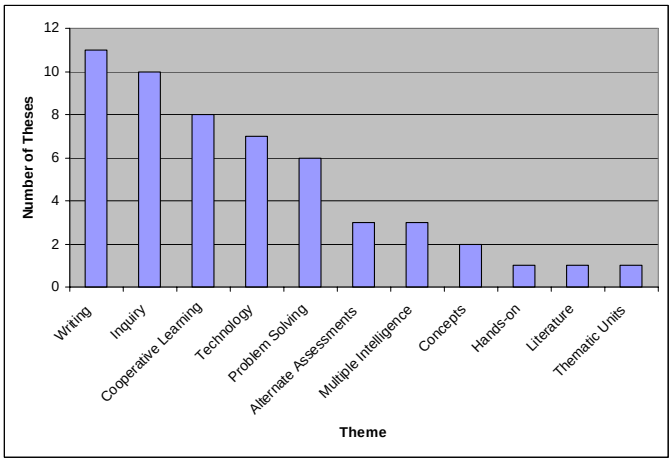

Figure 8. Topics with Positive Attitude Results

A large number of the topics that were chosen to determine if students gained a positive attitude were writing, inquiry, cooperative learning, and technology.

Figure 9 illustrates the topics whose outcomes were in the results of the studies regarding achievement.

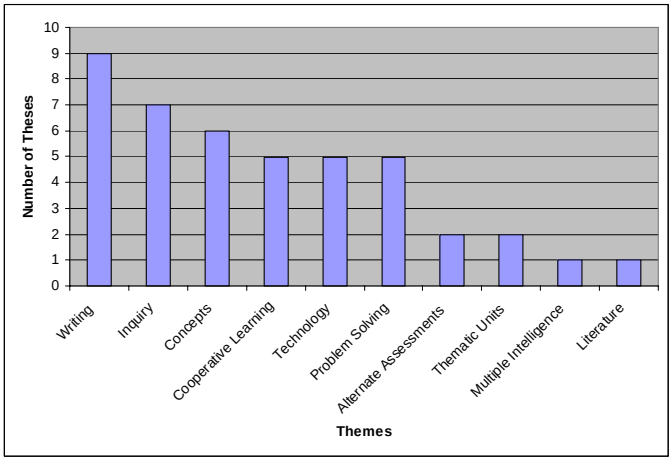

Figure 9. Topics with Positive Achievement Results

The top three topics that were used to examine students with positive attitude were writing, inquiry, concepts, and cooperative learning.

Some action research studies produced negative and inconclusive results on attitude and achievement. The two theses that produced a negative effect on students' achievement focused on technology and problem solving. None of the studies that were analyzed resulted in a negative impact on student attitudes. Emerging topics such as, hands-on learning, technology, conceptual understanding, problem solving and thematic units had one thesis in each category that produced inconclusive results about students' attitudes. Figure 10 shows results that were inconclusive about student achievement.

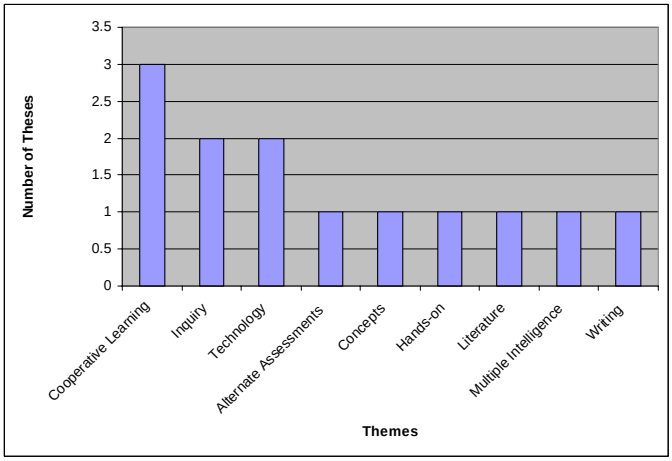

Figure 10. Theses with Inconclusive Achievement Results

Of the 58 theses that were analyzed that examined achievement, 13 had inconclusive results. The most common reason for having inconclusive results was when the teacher had conflicting data. For example, during an interview the teacher believed the students' achievement was improving, but the hand written test would show a decline in achievement.

Summary

Seventy-five of the 88 action research studies analyzed in this study examined student attitude and achievement when examining what types of questions are important to K-8 mathematics and science teacher researchers. There was no relationship between teachers in years of teaching experience, gender, ethnicity or grade level they taught in relationship to the themes of the theses. Overarching themes of 60% of 88 theses included cooperative learning, inquiry, problem solving, technology, and writing. Results in both mathematics and science emerged when observing in what ways the teacher examined their question. The most frequent data sources used to measure achievement were tests, journals and student artifacts. Student surveys, journals, and field notes were used to measure attitude. When accessing the results of the study the data showed that according to the teacher researchers, the educational practice of the teacher researchers resulted in positive effects on students' attitude and achievement.

Chapter five will conclude my study on the action research theses. It also further elaborates on the findings and includes recommendations to future studies of action research.

CHAPTER FIVE: CONCLUSION

If we knew what it was we were doing, it would not be called research would it?

Albert Einstein

The purpose of this study is to synthesize existing research results of a collection of master's theses from a teacher enhancement program for K-8 mathematics and science teachers in order to arrive at meaningful conclusions regarding teachers' research interests and classroom practices. Also, the study will help teacher educators who deliver the teacher enhancement program to improve the effectiveness of the program. This chapter will elaborate on the results, revisit the literature review, and make recommendations for future studies.

Discussion

Examination of the common themes and findings of teachers in this study will help support teacher education in this dynamic fast growing area in central Florida. Based on the emerging patterns from the data, themes surfaced. The following themes emerged from the analysis of the data:

- most action research studies examined students' attitude and achievement
- the collection of action research studies had themes in topics
- results of the action research studies showed improvement in students' attitude and achievement.

Themes where related to research questions and discussion in the findings in relation to the literature will bring cohesiveness to the study.

Research Question #1-

What types of questions are important to K-8 mathematics and science teacher researchers?

The type of questions posed by the teachers were based on the effects of attitude, achievement, participation, conflict resolution, language acquisition, culture, teacher practice, gender and social norms. Seventy percent of the theses focused on both attitude and achievement of the students.

The main purpose of action research was for teachers to change their practice in the classroom being studied (Tillotson, 2000). Teachers and teacher educators will be able to focus on reoccurring concerns of teachers by studying the analysis of themes in the questions teachers asked. Knowing what teachers examined can also be useful in observing gaps in research that might be occurring. For example, if the majority of teachers just observed attitude then there would be a need for achievement to be observed so a more complete picture of pertinent questions can be made. By the large majority of teachers focusing on achievement and attitude shows what the majority of teachers felt it was vital to research in their classroom.

Research Question #2-

What ways did teachers examine the questions they asked?

There were also trends in the sources of data collected to aid in answering the questions posed by teachers. They included audio recordings, checklists, class discussions, ethnographic review, field notes/observations, focus groups, interviews, journals, oral presentations, parent surveys, portfolios, report cards, researcher

reflections, rubrics, student artifacts, student surveys, teacher conferences, tests and video tapes. When measuring attitude most of the teacher researchers used student surveys, journals, and field notes. When measuring achievement, tests, journals, and student artifacts were mainly used.

Knowledge of effective data collection tools is helpful to teachers who will pursue future action research. It will help them align their question with previous data collection methods. Investigating these methods will also help in observing gaps in research. Knowledge of effective data collection tools is helpful to teachers who will pursue future action research. Also teacher educators can see what instruments they should be sure to teach teachers how to use by examining what was and what was not incorporated in the research methodology of this sample of teacher researchers. Analyzing the types of methods of data collection can help teachers and teacher educators to examine, learn about and teach methods of data collection that are commonly used and introduce other methods that are warranted but do not appear to be used by teacher researchers.

Research Question #3-

What were the themes and patterns in the problems posed by mathematics and science teachers and what caused these themes to be posed?

Common studied topics emerged from the teachers. They included, in order from most frequent to least frequent, writing, cooperative learning, inquiry, technology, problem solving, conceptual knowledge, alternate assessment, multiple intelligence, hands-on learning, literature, thematic units, gender, conferences, constructivist learning, culture, integration, learning centers, manipulatives, music, peer learning, real-world scenarios, special needs, spatial reasoning, storytelling, teacher collaboration, and social

norms. The most frequently researched topics for mathematics were writing, problem solving and cooperative learning. The most frequently researched topics for science were inquiry, technology, and cooperative learning. Cooperative learning was largely researched in 2001; and writing was largely researched in 2003. The leading two most frequent reasons why a topic was chosen was teachers wanted to see how his/her teaching practice would affect the students in general and teachers were dissatisfied with the normal way that the subject was being taught. No patterns emerged between years of teaching experience, gender, ethnic group or grade level taught in the types of studies done by the teachers.

By examining the topics of the theses a wide range of topics that can be research foci is illustrated. This examination also uncovered common questions teachers have about their practice and current trends in education. It also helps teacher educators by assisting them in what they can do to help teachers answer their questions by identifying the topics that lead to those question.

The dominance of two themes, cooperative learning in 2001 and writing in 2003, demonstrates that reoccurring topics can be dependent upon the focus of research during a given year. Cooperative learning was largely researched in 2001; and writing was largely researched in 2003. Trends from year to year showed what was relevant to educators during specific periods in education.

There are many different reasons as to why a topic was chosen. Some teachers might have chosen their topic based on literature of the subject, practicing technique of a master's class or dissatisfaction with the way the concept is currently being taught by most educators. As Culbert (2005) did, some teachers might have more than one reason.

She states, “During my graduate work, I have adopted a constructivist philosophy of teaching. In contrast to the traditional classroom, I believe education should be student-centered, and the teacher’s role is to establish a strong sense of community” (p. 1). Along with Culbert, other theses topics were chosen due to the LMA program. This demonstrates that the LMA program does have an effect on the students in the program. It also suggests that the topics being taught in the program could have an influence on what teachers want to research in their classrooms.

Research Question #4-

What are some patterns in the conclusions made by mathematics and science teachers who have performed action research?

Common teacher practice topics were analyzed for their results. Overall 88% of the theses reported an increase in student attitude and 72% reported an increase in student achievement. Researching why theses results occurred may help teachers to improve upon their practice. Also further research into effects of teacher practice will help explain why one practice might have a greater effect on attitude and achievement than others. As well as, help teacher educators become aware of what has worked in the classroom to increase student attitude and achievement.

Thirteen theses had inconclusive results when student achievement was analyzed. The data collected for these theses had conflicting results. One of the reasons why results were inconclusive was that there were mixed results from different data sources. For example, when the teacher took field notes and interviewed the students they noted an increase in achievement, but then students’ written assessments would illustrate otherwise. Elliot discusses the results of how inquiry affected students’ achievement

when she states, “I had conflicting results for this question. The reason for this was due to the fact that 1 of the 5 supporting data, the report card grades, showed a negative trend” (T. A. Elliott, 2002, p. 27). This conflict in data demonstrates why having more than one method to analyze results is vital. If Elliot had only looked at report card grades, her results would have been different. This finding provides support for the need for triangulation of data when performing action research (Mills, 2003). Therefore teacher educators should make sure teachers are learning about triangulation. Also by observing reoccurring topics that provide inconclusive results can help teacher educators and teachers to learn why the studies were inclusive and use the findings while conducting their own research.

Teachers do not want just philosophies, theories and points of view, they want something they can use in the classroom (Whitehurst, 2003). The results from this study will help bridge that gap between research and practice. From this analysis teacher educators can see the topics and types of questions that teachers pose and their results, which can be used when teacher educators perform traditional research.

Recommendations

I would make several recommendations in order to further this study. First, I would recommend a deeper analysis of what might have caused the findings of this study. For example, further research into effects of teacher practice will help explain why one practice might have a greater affect on attitude and achievement than others. I would also recommend interviewing the teachers that did the studies and see how their action research process has changed their practice. Next I would recommend that other action research theses and/or studies from different programs/universities be examined and

results compared to this study. Only the theses that had two or more of the same topics were analyzed in the findings. I would suggest further studies be done on the topics of the theses that were not included in the findings. It would be interesting to see if similar results would be found from these studies since they did not have any other studies to be compared to in this study. Another proposal I would recommend is more systematic reviews be completed focusing on mathematics and science because it is a technique that gives an overview of a body or research. Lastly, I would suggest that this study be continued over many years to see how trends in topics in mathematics and science education change over time.

Summary

The conceptual framework of this study looked at action research studies from the Lockheed Martin/University of Central Florida Academy for Mathematics and Science (LMA) program through a systematic review of common themes and results that can be used by teachers and teacher educators to apply to their current practice in which they will grow professionally. Themes from existing data in collections and databases are deemed as an important step in conducting research (Whitehurst, 2006). This study fulfills this step. The research conducted was a systemic review of 88 masters theses and the teachers that performed the studies. A summary sheet was completed for each thesis and teacher then entered into a spreadsheet that was later analyzed for reoccurring themes in the data. The results showed themes in topics of the action research studies, trends in attributes that were used to look at affects on students and that students attitudes' and achievements mostly improved in the studies. No trends in themes were found when comparing attributes of teachers that performed the studies.

A priority has been placed to examine issues surrounding teacher education because education has become more politicized (Marsh & Horns-Marsh, 2000). Also teachers are becoming more accountable for student progress and action research can help teachers improve their classrooms (Cochran-Smith & Lytle, 1999). To change the practices in the school the teachers will need a further understanding of it and this understanding will come from studies such as action research (Stenhouse, 1975). All of these provide support for the importance of action research.

It is often implied that teacher educators are sometimes viewed as being "out of touch" to in-service teachers (Anderson & Herr, 1999). As Szabo states, "there is a need not only to examine our own teaching practices at the university level but also to examine the process of learning to teach that takes place in the university classroom" (Szabo, Scott, & Yellin, 2002, p. 1). The sharing of action research results empowers teachers as learners and inquirers which leads to a reduction in the research practice gap (Cox & Craig, 1997). By investigating different aspects in action research such as common topics and trends in effects of results, teachers and teacher educators can improve their practice. The teachers will reflect and make necessary changes for improvement and the teacher educators will reflect upon what they are teaching teachers and relate those teachings to current topics and questions of practicing teachers. Thus, they will be developing professionally by improving upon their practice. After all, the common goal of teachers and teacher educators is to seek effective ways of educating students, and a great place to start is by examining current themes, questions and results of previous action research studies.

APPENDIX A: SUMMARY SHEET

Summary Sheet

Title:
Author:
Year:
Subject:
Topics: Math (Computation, Concepts, Problem Solving, Technology, etc.) Science (Inquiry, Concepts, Journal, etc.)
Methods
• School Setting
o Grade Level:
o School Grade:
o SES:
• Classroom Setting
o Number of Students:
o Gender:
o Ethnicity: Majority/Majority Majority/Minority
o Special Characteristics:
o Why were students selected:
Instruments (inventories, surveys, test):
Data Collected:
Results:
Recommendations:
Why the topic was selected: Courses taken Professional Development Observations Literature Dissatisfaction with the norm Other

APPENDIX B: LIST OF READ THESES

Name		Year	Title
Allanson	Patricia	2003	The Effects of using graphing calculators in the middle school classroom.
Allen	Colleen	2005	An action research study involving fifth-grade students learning fractions through a situative perspective with story problems
Apple	Sara	2003	Effects of integrating writing with mathematics on students' mathematical learning through problem solving
Arnold	Sandra	2002	Integrating conflict resolution skills in the middle school classroom to enhance cooperative learning
Arthur	Debbie	2005	The effect of inquiry-based instruction on students' participation and attitudes in a third grade science classroom
Austin	Jennifer	2001	The effects of using alternative assessment methods on students' attitudes towards mathematics and on student achievement
Avila	Maria	2003	Improving the quality of teaching and learning through dialogue math journals
Babyak	Joanne	2004	Constructivist teachers enable peer learning in the gifted science classroom
Bale	Vickie	2006	How my practice of using manipulatives in teaching multiplying and dividing fractions influences the student's conceptual understanding of these operations
Barbella	James	2001	Curriculum, instruction, assessment, alignment via inquiry-based science
Bell	Jeanine	2001	Effects of cooperative learning strategies and structures on sixth grade mathematics students attitude and achievement
Bemiller	Sarah	2002	The effects of teacher collaboration and flexible age grouping in a primary mathematics setting
Brunton	Gregory	2005	The effects of integrating technology into an 8th grade science curriculum
Bush	Eugene	2003	Effects of project-based learning on students' attitudes toward science and performance
Cain	Lisa	2003	The Effects of Kagan's approach to cooperative learning on mathematics performance and attitude of second graders
Campbell	Meghann	2006	The effects of the 5E learning cycle model on students understanding of force and motion concepts
Ciesla	Wendi	2002	Effects of hands-on instruction on students' attitudes and academic performance in science
Concepcion	Fada	2003	Storytelling in middle school science
Connaughton	Debra	2002	Kindergarten students writing about science
Cooper	Brett	2001	Problem solving : teaching strategies to solve higher level mathematics problems
Crittenden	Gwyndolyn	2003	The extent to which the teaching for understanding instruction/assessment practices in my classroom facilitate students' understanding of scientific processes and experimentation
Culbert	Kelly	2005	Effects of integrating writing activities on students' attitudes and achievement in problem solving: an action research study
DaCosta	Virginia	2001	Fostering mathematical understandings through writing
DiFabio	Nadja	2001	A study to document evidence of student learning in a constructivist kindergarten classroom
Doerr	Gloria	2004	Effects of hands-on instruction on fifth grade students' attitudes and academic performance in science
Dunn	Angela	2003	Using science journals to promote inquiry in the primary classroom
Edwards	Jodi Lynn	2003	Using mathematical learning centers to improve learning for primary level students with severe emotional disabilities
Egendoefer	Lisa	2006	Challenging a traditional social norm in a second grade mathematics classroom
Elliott	Trisha	2002	Implementation of inquiry-based instruction on an 8th grade science classroom and its effect on students

Estrada	Elsy	2006	The effects of inquiry and single-gender grouping on second grade girls' attitudes and participation
Fontana	Heather	2003	The effects of inquiry on middle school science students
Gibson	Annette	2003	The effects of implementing writing in a 6th grade Pre-IB mathematics class
Gill	Clara	2003	The effects of performance based tasks on student understanding of science concepts and science process skills
Gunn	Keri	2003	Integrating science literature and language arts to teach third grade science concepts
Hallett	Rachel	2002	Effect of integrated thematic units on sixth grade students' attitudes and performance in science
Harter	Rebecca	2003	Supplemental small group elemntary [i.e. elementary] mathematics lessons: the effects on academic performance and student's attitudes in mathematics
Helton	Julie	2002	Effects of elementary student participation in an aerospace and aviation magnet program on attitudes and achievement in science
Hess	Janice	2004	Effects of creating meaning in mathematics through real-world activities on fourth-grade students' mathematical performance
Hillsman	Melondy	2004	The effects of mathematics and science integration with low achieving fifth grade students
Hoover	Pamela	2002	Effects of cooperative learning in second grade science instruction
Horel	Patricia	2002	The effects of using technology on students' attitudes towards mathematics and on student performance
Horsack	Lindsey	2006	The effects of hands-on instructional strategies on forth grade students' attitudes and performance in mathematics
Hull	Lynette	2005	Fraction models that promote understanding for elementary students
Huntzinger	Stacy	2001	Math manipulative materials in a first grade classroom
Jenkins	Kimberley	2001	Student attitudes and perceptions toward project-based science units
Johnson	Sandra	2001	Moving toward technology one step at a time
Kells	Christine	2001	The effects of cooperative learning on language acquisition in the mathematics and science classroom
Kraft	Tamara	2002	The effects of using multiple intelligence mathematics instruction on primary students in a rural multi-ethnic school
Krutzler	Stephanie	2002	The effects of inquiry and brain-based learning on the understanding of scientific concepts and student attitudes toward science
Lien	John	2003	The effects of cooperative learning on eighth grade students' attitudes and performance in science
Lindsey	Tracey	2004	The use and effectiveness of reflective journal writing in mathematics
Lowell	Robert	2002	The effects of team-building on middle school science students
Luke	Stephanie	2006	The effects of science inquiry in a forth grade classroom
Mahony	Diane	2001	Effects of cooperative learning in the at-risk science classroom
Marzullo	Kristine	2004	The effects of technology on student achievement and attitude in a sixth grade science classroom
McCue	Lilian	2001	Effects of small group cooperative team work on high school students' attitude and achievement in algebra
McDuffie	DeAnna	2003	How problem-based learning affects students' attitudes and performance in the elementary mathematics program
Miller	Julie	2002	Effects of inquiry-based technological learning on students attitudes and performance in science
Norris	Marty	2003	Effects of technology on students' science learning and attitudes
Oglesby	Kelly	2003	Using "Bottle Math" in a first grade classroom
Parks	Melissa	2006	The effects of gender in elementary science groups
Pearson	Genene	2002	The effect of music infused into the middle-grades mathematics curriculum on student attitudes and performance

Quinones	Christine	2005	The effects of journal writing on student attitudes and performance in problem solving
Richards	Wendy	2003	A study of the effects of using the 5-E inquiry model in science instruction
Rivera	Debbie	2002	A dash of technology : a study of the integration of technology into a second grade science-based curriculum
Rose	Anna Kathryn	2005	The effects of discourse and journal writing on students' attitudes towards mathematics in a fifth grade classroom an action research study
Ross	Ronni	2002	Finding learning connections in science for culturally diverse low socio-economic status students
Roy	George	2002	Thematic teaching in an inner city school and its effects on 8th grade algebra students' attitudes and performance in mathematics
Sedely	Rose	2002	The impact special needs students have on a class of fourth grade students
Shipley	Rebecca	2001	Effects of integrating writing mathematics on students' mathematical learning
Smith	Christine	2003	Integrating writing into the sixth grade mathematics curriculum and its effects on student attitude and performance
Smolik	Joyce	2003	Pentimento: examining the conceptual change model in an elementary science classroom
Somwaru	Paramdai	2004	The effects of problems and problem-solving tasks on students' communication in and attitudes toward mathematics
Spiess	Deborah	2004	The effects of the teacher's use of guided inquiry in the fifth grade classroom
Stickle	Jennifer	2003	Using journals in science : integrating reflective journals in a fifth grade mathematics science technology curriculum
Stutin	Donna	2003	The effects of using multiple intelligences on curriculum design and improved student achievement and attitudes toward science
Swan	Bonnie	2003	The effects of a mentor-supported model of technology professional development on middle school mathematics teachers' attitudes and practice
Townsend	Jeffrey	2004	Science-based inquiry via an after school robotics program
Tumbleson	Mary	2001	The effects of cooperative grouping in the mathematics classroom
Varn	Theresa	2005	Effects of a mathematics curriculum rich in spatial reasoning activities on fifth grade students' abilities to spatially reason: an action research project
Vila	Ana	2004	A "culturally based problem-solving curriculum" : the effects on academic performance and students' attitudes in mathematics
Washington	Arnita	2005	The effects of literature on student motivation and connections in mathematics
Weaver	Karen	2004	Student-led conferences using portfolios in mathematics and science and their affects on student attitudes and parental involvement
Whidden	Chandra	2001	Effects of cooperative learning on 6th grade science students
Whisonant	Tricia	2003	Examining student assessment in middle school science
White	Michele	2002	Multiple intelligences with an attitude : the effect of multiple intelligences in mathematics
Wilkinson	Julie	2004	Effects of guided inquiry on students' attitudes and academic performance in science
Zima	William	2003	Effects of technology on student's performance and attitude in science

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