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Teacher Perceptions of Inquiry-Based Instruction vs. Teacher-Based Instruction

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Abstract

This applied research was designed to analyze the effectiveness of inquiry-based instruction as compared to teacher-directed instruction in 5th-grade mathematics and science courses at the subject school. The subject school modified mathematics and science curriculum for 3 years and became an Alabama Math, Science, and Technology (AMSTI) [2009] school. AMSTI provided extensive professional development and ongoing support for the use of inquiry-based mathematics and science instruction. AMSTI also regularly sent kits of necessary materials to the subject school to support the implementation of inquiry-based mathematics and science instruction. The research interviewed current 5th-grade teachers and drew conclusions about the teachers' perceptions of inquiry-based instruction in the broader curriculum as well as feelings of self-efficacy. Of note, many teachers discussed the importance of adequate time allowances to feelings of self-efficacy and the place of inquiry-based instruction in the broader curriculum.

Keywords: Math, Science, Teacher Perceptions, Inquiry-based instruction.

1. Introduction

Students in American schools today will enter a global society with extreme competiveness among talented youth for the best careers [Cornish, 2004]. Although ongoing research studies seek to find the best way to give American youth the most appropriate education in this era of great world change [Kirby, Berends, & Naftel, 2003], various fears have not yet allowed innovative teaching methodology to become widespread [Emery, 2007]. AMSTI [AMSTI 2009] seeks to provide schools with intensive professional development, inquiry-based learning units, and the necessary supplies to execute these learning experiences.

The study assessed the perceptions of teachers currently implementing the inquiry-based mathematics and science instruction concerning the role of inquiry-based mathematics and science instruction in the broader curriculum and teacher perceptions concerning self-efficacy with inquiry-based mathematics and science instruction. Teacher interviews to assess teacher perceptions of inquiry-based mathematics and science instruction and feelings of self-efficacy were administered to assess the perceptions.

The activities of inquiry include observations, questioning, gathering data, and creating explanations [National Research Council, 1996]. Dewey [1938: 56] said inquiry-based instruction occurs when the "educator is responsible for a knowledge of individuals and for a knowledge of subject-matter that will enable activities to be selected . . . in which all participate and are the chief carrier of control". The work of Dewey and a colleague of the theorist, Vygotsky [1962], were pivotal to understanding the framework of inquiry-based instruction. As such, writings of the two are frequently utilized in this study.

In a more recent review of the pedagogical shifts in American education during the last hundred years, Sherman [2009] held that the progressive movement in education is vital to the success of American students into the 21st century. The research outlines two facets of inquiry-based instruction evident in American classrooms in recent history: open education and differentiation. Open education allows the daily classroom instruction to be dictated by the desires of the students, while differentiation allows student preferences to guide how particular content is encountered. Sherman warned that one technique, open education, was attempted and abandoned. Further, the research posited differentiation, the most current technique associated with inquiry-based instruction, may not remain an active component of modern classrooms unless wider support for the use of inquiry-based instruction is solicited.

This progressive model of education is in contrast to traditional, teacher-directed instruction with specific, organized bodies of knowledge presented by teachers to students. When teacher-directed instruction is employed, Dewey [1938: 18] said, "books, especially textbooks, are the chief representatives of the lore and wisdom of the past, while teachers are the organs through which pupils are brought into effective connection with the material." A study by Olsen and Sexton [2009] found that a significant factor contributing to the continuation of the ideal of teachers leading students to wisdom is societal validity. Namely, the structures that provide fiscal support for public schools and then monitor the progress of the institutions expect and in many cases demand the familiar construct of teacher-directed instruction without consideration for the potential effectiveness of other pedagogical strategies.

Many teachers and school administrators hesitate to support fully the inquiry-based mathematics and science instruction facilitated through the AMSTI in fear that standardized testing data will not improve with its continued implementation. The hesitance to move beyond teacher-directed instruction has become widespread in the years following the implementation of the No Child Left Behind (NCLB) [2001] Act [Alsup, 2005]. Initial and perhaps lingering resistance to inquiry-based instruction may also be evident in the teacher perception interview responses gathered at the subject school. This resistance could be related to teacher feelings of self-efficacy, which were explored through one on one interviews conducted.

Mirriam [as cited in Pantry & Roberson, 2002] suggested that truly exploring and appreciating life by continually asking questions and seeking answers is the path to wisdom. Although educators seek to enable students to build wisdom, the fear of failing to meet the required yearly progress delineated through the NCLB Act [2001] causes many to avoid providing students with experiential learning through the structured interactions between concrete experiences and abstract thought first lauded by the designer of the progressive movement in education, Dewey. Instead, teachers will often select learning activities composed primarily of additional repetitious drill to prepare for standardized assessments of achievement [Alsup, 2005].

2. Background and Justification

The history of the formal American educational system reveals a close reliance on teachers as dispensers of knowledge to students, and this is a difficult pattern for educational agencies to end

[Hickey, Moore, & Pellegrino, 2001]. By demonstrating the effectiveness of inquiry-based mathematics and science instruction at the local school level, this study may increase student achievement outcomes by adding support for research-driven, inquiry-based instruction in mathematics and science. The study notes meaningful trends in standardized testing data as well as positive teacher perceptions of inquiry-based instruction over time, allowing school administrators to more confidently support teachers in their efforts toward inquiry-based instruction.

The work of Vygotsky [1962] on constructivist learning along with the work of Dewey [1938] is an important component of the theoretical framework for this study. The assumption of the role of facilitator of student learning experiences on the part of teachers is fundamental to both AMSTI and the constructivist learning theory. By supporting learning in relevant contexts [Dewey, 1938; Vygotsky, 1962], AMSTI [2009] offers teachers the opportunity to encourage student construction of meaningful knowledge through the providing of professional development, classroom supplies, and ongoing technical support.

Building on the constructivist learning theory and inquiry-based learning while adding to the professional literature on the subject, a longitudinal study conducted by Le, Lockwood, Stecher, Hamilton, and Martinez [2009] found that progressive educational reforms in mathematics and science consistently led to gains in achievement measures designed to assess students' problem-solving and processing abilities.

3. Literature Review

3.1 Teacher-Directed Instruction

According to Heal, Hanley, and Layer [2009: 124], "Direct instruction is characterized by relatively simple and precise materials tailored to specific learning objectives, planned (and sometimes scripted) prompting procedures, provision of high-quality reinforcers for responding, and multiple trials conducted during brief teaching periods." Examples of direct instructional strategies include teacher-led lectures, student completion of worksheets, and skill repetition computer programs [Thompson, 2006]. For many years, this instruction has composed the majority of student learning experiences in America in an attempt to maximize student achievement. The theoretical framework for teacher-directed instruction is, quite simply, that teachers have utilized this pedagogical technique throughout our history to build student learning [Alsup, 2005]. Most recently, the NCLB Act [2001] set student achievement goals closely aligned with the memorized content mastery expected outcomes of direct instruction.

Heal et al. [2009] found direct instruction was most effective and often preferred by the preschool students in a recent study. This is in opposition to common practice with children in early elementary and preschool settings, which often consist of structured play. The researchers found that contrary to pervasive theories on early childhood education, preschool children could benefit from and even enjoy prescribed, teacher-directed learning activities.

Expanding on the link between teacher-directed instruction and the NCLB Act [2001], response to intervention (RTI) has been suggested in recent legislation as a means to address gaps in student learning effectively [Codding, Hilt-Panahon, Panahon, & Benson, 2009]. School districts are to systematically analyze student-testing data and prescribe intervention strategies that vary in intensity to address the severity of student needs. RTI, then, is applicable to students performing at the grade-level standard as well as those with deficiencies in core subject areas. The learning activities selected for students are to be evidence based and offered in tiered succession.

The three tiers of RTI are distinct portions of the school day, and students participate in at least one if not all three tiers of instruction. Students performing at or above the standard of mastery set by the district receive Tier 1 instruction: whole group, largely teacher-directed lessons. Students with some deficiencies are given Tier 2 instruction, which is usually small group, teacher-directed drill-and-repetition instruction. Finally, students with the greatest needs for progress in a given subject area receive Tiers 1, 2, and 3 of RTI. Tier 3 is most often a separate, layered, teacher-directed learning opportunity specifically targeted to the strengths and weaknesses of the small student group.

For mathematics instruction, RTI addresses primarily computational concerns and strategies for tiered

interventions vary from whole class to individualized delivery including the use of scripted teacher-direct lessons, repetitive use of flash cards, and other drilling of target skills. For their analysis of the varied strategies currently employed as RTI in mathematics, Codding et al. [2009: 281] found "explicit instructional components such as drill, repetition, segmentation, strategy cues and active instruction represented the most variance associated with high effect sizes." These teacher-directed instructional strategies were found to be the most effective when addressing general education mathematics students in a whole-class setting. Increasingly prescribed, teacher-directed methodologies were employed as students were placed in more complex tiers designed to close significant gaps in achievement. The authors reported widespread success of teacher-directed instruction in providing the computational framework they perceive as necessary for building the conceptual framework of mathematics.

3.2 Inquiry-Based Instruction

In contrast to the focus of direct instruction on the teacher as a content expert, according to Hazari, North, and Moreland [2009: 189], "constructivism is inquiry-based, discovery learning in which learners construct personal interpretation of knowledge based on their previous experience and application of knowledge in a relevant context." Thompson [2006: 53-54] said constructivist-learning activities involve the use of "manipulatives or hands-on materials [and] incorporating inquiry, discovery, and problem-solving approaches . . . [and] applying math and science concepts to real-world context." Further, inquiry-based learning connects classroom activities to specific careers, involves the analysis of original data, and encourages student communication and collaboration [Thompson, 2006]. In a study of 10,000 students and 400 teachers, Thompson supported the idea that inquiry-based instruction is effective in improving student achievement and teacher satisfaction when appropriate professional development opportunities are in place.

Inquiry-based instruction has been utilized in a variety of settings in a myriad of ways for the 70 years since Dewey [1938] penned the progressive movement of education and yet there is still a great propensity to the use of teacher-directed instruction [Codding et al., 2009]. In the case of mathematics instruction previously considered, although proponents of teacher-directed instruction believe basic computational facts and operations must be memorized first [Codding et al., 2009], inquiry-based learning advocates propose the formation of authentic, real-world concepts of mathematics before basic skill sets are memorized [Thompson, 2006].

Theoretical Underpinnings of Inquiry-Based Learning Progressive movement in education. Dewey [1938: 74] outlined the following:

It is a cardinal precept of the newer school of education that the beginning of instruction shall be made with the experience learners already have; that this experience and the capacities that have been developed during its course provide the starting point for all future learning.

Dewey moved on to contextualize traditional, teacher-directed instruction. He stated that the methodology of teachers offering to students a prescribed set of facts stems from an age when it was assumed that the future would be quite similar to the past. In fact, 70 years ago as the progressive movement began in education, change was already considered inevitable. For the purposes of this review of the literature, the ideals, theories, and suggestions of Dewey and Vygotsky (1962) will be thoroughly explored because the writings are so critical to a thorough understanding of the inquiry-based instructional framework.

The primary question set forth by Dewey [1938: 22] and, subsequently, by proponents of today's inquiry-based instruction is, "What does freedom mean and what are the conditions under which it is capable of realization?." Papanikolaou and Grigoriadou [2009: 194] conducted a pilot study of an instructional technology medium capable of offering students guidance as they freely selected individual learning paths towards completion of an authentic product. Papanikolaou and Grigoriadou delineated a distinction between this new hypermedia and older existing media that focus on the definition of specific outcome objectives, design of materials and procedures that are targeted on these objectives, and assessment procedures that determine if learners have attained the desired objectives whilst the constructivist approach focuses on in-context learning organized around authentic tasks.

Through the use of expert reviews of the medium as well as a 19-student trial, these researchers found that the active participation solicited through the inquiry-based model's use of guiding questions and student choice was both highly motivating and effective.

Historically, Dewey [1938] described the teacher's role in an inquiry-based instructional setting as a quintessential planner. The teacher must constantly seek connections between students' prior experiences with mathematics or any subject area and new experiences that may be offered to the student who is then free to build further connections, skills, and factual information. Contrasting teachers in inquiry-based classrooms to teachers in teacher-directed classrooms, Dewey noted that the range of planning is far longer for teachers in inquiry-based learning situations because they must more authentically offer experiences that continue to scaffold on students' prior experience.

Marshall [2010: 48] began with the premise, "our habits of mind, innate curiosity, and ways of thinking and acting are shaped and developed through immersion in experience and repeated practice." The researcher posited how students are asked to learn is equally important to the content they are learning. The most effective teachers, then, will individualize learning experiences as Marshall suggested and prepare students to meet the changing global society outlined by Cornish [2004].

Particularly in today's climate of accountability in education, it is important to note that Dewey [1938: 40] did not intend all experiences to be seen as a means of education nor did he propose that all educative experiences are inherently equal. Dewey saw a teacher's role in inquiry-based instruction as an important guide for student experiences. Teachers in this model are responsible for helping students avoid experience that will dull their capability to respond intelligently and meaningfully to new, ever more complex situations while directing them toward experiences and inquiries that will awaken natural curiosity and concept development. Dewey charged teachers with knowing "how to utilize the surroundings, physical and social, that exist so as to extract from them all that they have to contribute to building up experiences that are worthwhile."

The initial ideas of teachers as planners and those who awaken and guide natural curiosity are still an integral part of inquiry-based instruction. Kazempour [2009] found inquiry-based professional development opportunities for teachers were an important contributing factor to the implementation of inquiry-based instruction in today's classrooms. The case study focused on a high school science teacher's changes in perceptions of the ability to and necessity of implementing inquiry-based instruction that resulted from inquiry-based professional development delivered through a summer workshop series. Through these inquiry-based professional development opportunities, the case study subject was more confident in his ability to plan for inquiry-based instruction and guide them through their personal learning.

In an interesting dialogue concerning retention of subject-matter knowledge, Dewey [1938] offered that learning of facts in isolation through teacher-directed drills and practice in its worst form can leave students less able to perform well on standardized tests of student achievement than if no education was acquired at all. The theorist found children have innate capacities to reason that are harmed through isolated drill routines. Further, Dewey stated that skills and content learned in this way will not easily be transferred from the practice situation to any other application. According to this line of logic, it follows that teachers are often mystified by students' lack of performance on the mandated tests of today. This also may demonstrate yet another support for the use of inquiry-based learning to improve student achievement scores because the very nature of inquiry-based learning is the transference of experiences along a continuum.

Dewey [1938: 51] said if "the two principles of continuity and interaction as criteria of the value of experience are so intimately connected that it is not easy to tell just what special educational problem to take up first," then it is perhaps better to understand education in a social context where the two constructs exist simultaneously. Dewey likened the premises underlying inquiry-based instruction to a democratic society and went on to ask if readers can question a preference for democracy (i.e., inquiry-based learning) over a dictatorial regime (i.e., teacher-directed instruction). Dewey did own, though, that inquiry-based instruction has a far less direct tie to courses of study and sequencing of instructional goals than teacher-directed instruction. This, of course, is an ongoing cause for concern among school administrators focused on achieving adequate yearly progress. This apparent lack of accountability to the required content and skill mastery expected may be avoided if teachers thoughtfully design conceptually based instructional units for inquiry such as those available through

AMSTI.
The importance of social collaboration to the success of learning and content knowledge retention was also supported by Schiller [2009]. The study found that students engaged in collaborative, inquiry-based learning are highly motivated to attend to the learning task and retain information at the application stage of understanding. This study dealt with higher-level mathematics students in a university setting but implications included the applicability to cooperative, inquiry-based learning to K-12 mathematics courses as well.

Response to instruction. Vygotsky [1962: 83] posited,
direct teaching of concepts is impossible and fruitless. A teacher who tries to do this usually accomplishes nothing but empty verbalism, a parrot like repetition of words by the child, simulating a knowledge of the corresponding concepts but actually covering up a vacuum.
While agreeing with the basic premises of Dewey and Piaget, Vygotsky made an important distinction. The theorist allowed that the thought processes of children originate from their personal experiences and that these processes are quantitatively different from those of adults. Vygotsky, though, drew attention to the different methods children use to form spontaneous and nonspontaneous concepts not as mutually exclusive approaches but as almost entirely codependent.
Supporting the superior effectiveness of student-centered learning experiences, Hernandez-Ramos and De La Paz [2009] conducted a study comparing teacher-directed learning and inquiry-based learning among nearly 800 students in one middle school and roughly the same number of students in a neighboring middle school with comparable student demographics and teacher credentials. The students who received inquiry-based instruction performed better compared to those in the control group in the areas of content knowledge recall and intrinsic motivation and also experienced gains in the ability to think critically in the content area.
Students may then be said to form the concepts necessary for understanding and retaining science instruction by a unique interplay between their life experiences and structured school experiences designed to enable students to build upon their existing conceptual understandings in meaningful ways to reach full realization of scientific concepts. According to Vygotsky's [1962] premise, to utilize teacher-directed science instruction simply is akin to teaching students to feign an understanding of science without ever developing an understanding of science at all. Inquiry-based instruction allows teachers a venue to provide learning activities designed to engage students in authentic learning in the areas of mathematics and science.
Three beliefs of early childhood intellect were discussed by Vygotsky [1962: 101]. The first belief Vygotsky explored was Piaget's idea that children are able to experience activities, react to and learn from these activities at an egocentric level long before rational thought is possible. This underscored Vygotsky's notion that teaching concepts to students verbally before allowing inquiry is fruitless. Next, Vygotsky utilized Stern's supposition that children have an unexplained epiphany of thought processes that leads to a seemingly unimportant experience serving as catalyst for a profound inquiry-based learning experience. Finally, Vygotsky espoused the merits and faults of the ideas of both Piaget and Stern before setting forth the conceptual framework for inquiry-based learning. Vygotsky added, "Our investigation shows that the development of the psychological foundations for instruction in basic subjects does not precede instruction but unfolds in a continuous interaction with the contributions of instruction."

4. Impact of Inquiry-Based Learning on Teacher Perceptions

In addition to increasing student motivation and, in turn, achievement, inquiry-based instruction is shown to spur greater teacher self-efficacy, which leads to more positive teacher perceptions of inquiry-based learning while increasing the likelihood that continued implementation will be maintained [Alsup, 2005]. This study will ascertain teacher perceptions of inquiry-based instruction following 3 years of implementation to explore teacher perceptions of inquiry-based learning within the broader curriculum as well as possible links between teacher perceptions of inquiry-based learning and teacher feelings of self-efficacy.

4.1 Teacher feelings of self-efficacy

McDonald and Hannafin [2003: 470] found "the teacher's openness toward student-directed inquiry is a key to success in using this medium in the classroom." Teachers who believe in their own abilities are more likely to engage students in open communication. Inquiry-based instruction in college coursework for preservice teachers was shown to affect positively the future self-efficacy of teachers, subsequently impacting later choices to utilize inquiry-based instruction [Alsup, 2005]. The use of technology to aid the implementation of inquiry-based instruction is more often employed by teachers with higher feelings of self-efficacy [Dawson et al., 2009], further demonstrating the importance of developing preservice teacher self-efficacy through inquiry-based college instruction [Alsup, 2005].
This is especially true, because recent studies have shown the positive motivational and achievement gains possible when teachers employ technologically based inquiry instruction. One teacher in So and Kong's [2007: 345] study described an initial experience with inquiry-based instruction involving technology: "By watching the animation of the earth spin under the Sun, pupils almost jumped up with the explanation of the cause of day and night." Surely, this is a more highly motivating experience for both teacher and student than a teacher-directed lecture on the same concept.
In further support for teacher feelings of self-efficacy impacting the likelihood that inquiry-based instruction will be employed, Barnett [2006] found that through creating an online collaboration for teachers and preservice teachers, including the sharing of videos demonstrating inquiry-based instruction in practice, preservice teachers' feelings of self-efficacy increased, thereby increasing the likelihood that inquiry-based instruction would be employed in their classrooms. Additionally, the inquiry-based methodology of the collaboration software utilized by the preservice teachers and classroom teachers was a powerful example of the effectiveness of inquiry-based learning to cause productive questioning and problem solving.
Preservice teachers will likely emulate in their future classrooms both the experiences of their own K-12 education as well as their educational encounters at the undergraduate level [Barnett, 2006]. It is crucial, then, that at least some of the educational experiences of preservice teachers include participating in, reviewing, and collaborating with other professionals on inquiry-based instructional techniques.

4.2 Teacher perceptions of inquiry-based instruction

Once inquiry-based instruction is undertaken, the open communication and heightened student motivation and achievement outcomes that result lead to positive perceptions of inquiry-based learning on the part of classroom teachers. According to Lipka et al. [2005: 382], the positive teacher perceptions of inquiry-based learning are due in part to "the long-term positive relationship between teacher and students that contribute to a classroom environment in which trust and mutuality were constructed." Teachers who have a positive perception of instructional programs often have greater job satisfaction and are far more likely to utilize emerging instructional technologies to further the learning gains possible through inquiry-based instruction [Dawson et al., 2009; So & Kong, 2007]. Surprisingly, inquiry-based instruction continues to be more effective than traditional teacher-directed methodologies even when employed by teachers opposing the implementation of initiatives supporting inquiry-based learning [Hickey et al., 2001].
One method employed for increasing positive perceptions of inquiry-based instruction is the reorganization of teacher education programs. By introducing preservice teachers to inquiry-based instruction before they begin teaching careers and then following the new teachers through early implementation phases of inquiry-based instruction, the number of practicing teacher with positive perceptions of inquiry-based learning will increase [Barnett, 2006].

5. Responses to the Research Supporting Inquiry-Based Instruction

Schools utilizing AMSTI inquiry-based instructional units for mathematics and science courses have shown significant improvement on standardized tests when compared to the overall scores from the

state of Alabama. Outside evaluation of AMSTI effectiveness conducted in 2007 by the University of Alabama [Ricks, 2008] supported the findings from 2003, 2004, 2005, and 2006. Each year, schools implementing AMSTI inquiry-based mathematics and science units attain higher scores on standardized tests than schools following a traditional teacher-directed program for mathematics and science instruction. Ricks [2008: 1] stated, "The fifth major study examining the effectiveness of the Alabama Math, Science, and Technology Initiative (AMSTI) confirms that AMSTI improves student achievement." AMSTI [2009] requires extensive professional development before distributing the free supplies to classrooms statewide and then follows the progress of participating schools to ensure continued application of inquiry-based instruction in mathematics and science instruction. In this way, AMSTI is able to avoid the discontinuity often present between research and practice in the field of education. By exploring 6 years of longitudinal student achievement data, this study will look into the impact of continued implementation of inquiry-based instruction on both student achievement and teacher perceptions of the role of inquiry-based mathematics and science within the broader curriculum and personal self-efficacy.

Finney [2010] outlined continued implementation and effectiveness of AMSTI inquiry-based instruction as a primary focus of the longitudinal study. The author explored inquiry-based instructional techniques such as AMSTI that demonstrate gains in student achievement and motivation along with greater feelings of teacher self-efficacy and job satisfaction often failing the test of continued implementation.

Fuchs and Fuchs [2001] found the importance of an individual dedicated to the reform at each school site, teacher control of available resources, the presence of student outcome accountability, a willingness to persevere through initial difficulties, and the time being taken to award accomplishments to be the five key components to continuous implementation of any reform initiative in the public school setting. Fuchs and Fuchs [2001: 13] found that given a particular curricular program, "personal participation in developing an innovation is not necessary for others to adopt, implement, and sustain that research-based practice." This is an important distinction because few classroom teachers have the time or desire to participate in the development of the evidence-based practices researchers are interested in putting into practice in local schools. It is encouraging that various inquiry-based instructional models, though different from the ways in which many teachers may be accustomed to instructional delivery, may be implemented and maintained with great fidelity given a few attainable criteria.

6. Research Questions

6.1 Research Question 1

What are the perceptions of current fifth-grade teachers regarding the role of AMSTI in the broader curriculum? Input was obtained from fifth-grade teachers at the subject school utilizing teacher interviews to explore teacher perceptions of the relevance, quality, and significance [Stufflebeam, 2002] of AMSTI on student classroom learning. Following the thinking of Fuchs and Fuchs [2001], it was expected to see evidence of a strong lead teacher supporting the continued implementation and acceptance of AMSTI because the inquiry-based learning initiative has remained in place for 3 years.

One-on-one interviews were conducted with each of the current fifth grade teachers to facilitate the process of grounded theory research. During the open coding process, 53 statements were made concerning teacher perceptions of the role of AMSTI in the broader curriculum. Once axial coding was completed, the research found motivation, depth of student understanding, and higher order thinking processes to be the primary positive attributes associated with AMSTI by fifth grade teachers when assessing the role of AMSTI in the broader curriculum. Ten statements were made concerning AMSTI increasing student motivation, eight statements related to deepening student understanding with AMSTI, and seven statements were made by teachers connecting the use of AMSTI inquiry based instruction with higher order thinking processes. The research further found common negative threads among teacher statements regarding the role of AMSTI in the broader curriculum: the need for additional instructional time allotment in the area of mathematics and science, additional attention to the procedural curricular component, and the need for additional summative assessment options in

AMSTI. Twenty-three teacher statements were documented expressing a need for additional instructional time to adequately implement inquiry based instruction. Twenty-one statements were documented asking for a more thorough attention to the procedural curricular components of AMSTI, but only three teacher statements were made expressing displeasure with current AMSTI summative assessment components.

6.1 Research Question 2

What impact on teacher perceptions of self-efficacy may be linked to the implementation of inquiry-based mathematics and science instructions? It was posited that teachers who believe most strongly in the effectiveness of AMSTI will in turn be those who report feelings of self-efficacy related to the utilization of inquiry-based instruction [Alsup, 2005].

42 statements were recorded concerning teacher feelings of self-efficacy with AMSTI during the open coding process. Once axial coding was undertaken, these comments were further categorized into positive, negative, and hesitant attitudes concerning self-efficacy with AMSTI. Eleven statements given by teachers indicated positive feelings of self efficacy, five statements were categorized as hesitant feelings of self-efficacy, and three statements given by teachers concerning self-efficacy described negative or low feelings of self-efficacy associated with the implementation of AMSTI.

Once open and axial coding were complete the codes derived were used to posit the following during the selective coding process: based upon evidence gathered from one-on-one interviews conducted through the research with fifth grade teachers serving the target school, inquiry based instruction as it is offered through AMSTI is motivational to students while increasing both students' depth of understanding and attainment of higher order thinking processes. Issues of adequate time allotment and curricular procedural planning should be addressed along with a more definitive summative assessment plan. Teacher feelings of self-efficacy regarding the implementation of AMSTI inquiry based instruction are largely positive in nature. By increasing peer support for those more hesitant about mathematics and science instruction, the target school could further positively skew teacher feelings of self-efficacy regarding mathematics and science instruction in general and, more specifically, AMSTI inquiry based mathematics and science instruction. It may be posited that increasing the time allotted for AMSTI instruction would decrease teachers' feelings of anxiety concerning inquiry based instruction, particularly those with less positive feelings of self-efficacy in this area.

7. Conclusions

Axial coding of the responses to one-on-one interviews of fifth grade teachers conducted through the research revealed a strong positive perception by teachers concerning the impact of AMSTI on student motivation, depth of understanding, and the use of higher order thinking processes. The resulting grounded theory reflected that AMSTI is perceived as important to student overall achievement by fifth grade teachers, particularly with regards to student motivation. According to Fuchs and Fuchs [2001] evidence of a strong lead teacher for the inquiry based science initiative should have emerged. Interestingly, the research found many teachers in strong support for increasing the role of AMSTI in the broader curriculum. It may be posited that AMSTI will continue to be utilized and innovated in the target school as a result of the emergence of several lead teachers supporting AMSTI in the grade level of interest.

Although axial coding revealed largely positive feelings of self-efficacy on the part of teachers regarding AMSTI, further analysis reveals the potential for greater positive feelings of self-efficacy in this area if teachers were to be given a greater time allotment for the inquiry based instruction. Also, the procedural issues surrounding implementation of this curricular process might, if eliminated, greatly increase already positive feelings of self-efficacy with AMSTI among teachers. Certainly, teacher interview responses indicate that in addition to strong feelings of the important place of inquiry based instruction in the broader curriculum the target school has several teachers in the grade level of interest to the study with quite strong, positive feelings of self-efficacy with AMSTI. The strong evidence of positive feelings of self-efficacy should lead the school to continue with the

implementation of AMSTI [Alsup, 2005].

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