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ABSTRACT

This action research project was designed to increase students' math competencies and reduce math anxiety in targeted high school classes in a Midwestern suburb. The study included 37 students and took place from September through December in 2002. Factors influencing students' math achievement included self-perceptions of math competence, teachers' perceptions of students' abilities, and an overemphasis on remediation which left students unchallenged and behind their peers (Fiore, 1999). Curriculum redesign is one way of improving students' confidence and competence in their math abilities (Allexsaht-Snider and Hart, 2001). Given this, a curriculum redesign was selected as an intervention for this study. To document student progress in mathematical achievement and improve self-perception, methods of assessment used included surveys, document analysis, and observations. Post-intervention data indicated an increase in students' comfort level related to math competencies. A review of solution strategies suggested within the literature, combined with an analysis of the setting, resulted in the selection of three primary solutions to be used as interventions: (1) a curriculum redesign that minimized tracking; (2) a constructivist teaching approach; and (3) the establishment of a community of learners. Data also revealed that students in the targeted groups were successful as a result of curriculum redesign. It is encouraged and suggested that discourse related to curriculum tracking provoked by this project continue within the site to further support students' math competencies. (Author/SOE)

A CURRICULUM REDESIGN IN RESPONSE TO STUDENTS' ANXIETY TO MATH COMPETENCIES AT THE SECONDARY LEVEL

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An Action Research Project Submitted to the Graduate Faculty of the School of Education in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Teaching and Leadership

Saint Xavier University & SkyLight
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ABSTRACT

This action research project was designed to increase students' math competencies and reduce math anxiety in the targeted high school classes located in a Midwestern suburb. The study includes 37 students and took place from September through December 2002.

Among factors influencing students' math achievement are self-perceptions of math competence, teachers' perceptions of students' abilities, and an overemphasis on remediation which leaves students unchallenged and behind their peers (Fiore, 1999). Curriculum redesign is one way of improving students' confidence and competence in their math abilities (Allexsaht-Snider & Hart, 2001). Given this a curriculum redesign was selected as an intervention for this study. To document students' progress in mathematical achievement and improve self-perception the following methods of assessment were used: survey, document analysis, and observations.

A review of solution strategies suggested within the literature, combined with an analysis of the setting, resulted in the selection of three primary solutions to be used as interventions: a curriculum redesign that minimized tracking, a constructivist teaching approach, and the establishment of a community of learners.

Postintervention data indicated an increase in students' comfort level related to math competencies. Data also revealed that students in the targeted groups were successful as a result of curriculum redesign. The researcher encourages and suggests that discourse related to curriculum tracking, provoked by this project; continue within the site to further support students' math competencies.

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

Students in the targeted geometry classes demonstrated difficulties performing well in math. There were consistently low scores on standardized tests (specifically the American College Testing or ACT exam), and students were observed as having high anxiety related to math competencies. The study reported in the following pages was structured to address ways curriculum redesign can facilitate students' math performance. Problem evidence includes a document analysis of students' past performance on the ACT, observations of students' classroom performance, and students' self-report of math anxiety.

Immediate Problem Context

The targeted geometry classes are nested in a Catholic, all women, college preparatory high school with a student population of approximately 1,076. There are 314 ninth graders, 254 tenth graders, 272 eleventh graders, and 236 twelfth graders. The targeted school hosts an inclusive environment as is evidenced by its diverse population. The latest school-wide survey notes a variety of ethnic backgrounds and racial groups. There are 714 White students, 231 Hispanic, 85 Black, 31 biracial, 8 Asian, and 7 Native American. Average daily attendance is 95% and of the 1,076 students present, 975 are Catholic and 101 are non-Catholic.

Economic data of students is not collected by the school; however, a list of occupations furnished by the attendees indicates that the students come from predominately blue collar families. While students enrolled pay annual tuition of $5,200, the school provides $300,000 in annual scholarships based on need.

The school has an accredited program recognized by the state. It operates on a president-principal leadership model, which was implemented in the fall of 1999. There are two additional administrators on site. One is responsible for curriculum and instruction and the other assumes the responsibility for student life. There are 45 full-time teachers on staff; 40 are women. In addition, there are 13 part-time teachers (nine also act in a supervisory capacity). There is a counselor and dean assigned to each academic grade level. Of the 66 member staff; 36.2% hold a bachelors degree, and 63.8% have attained a masters degree or higher. The average years of teaching experience is 10.3. There is a 20:1 student teacher ratio.

The suburban, two-story high school is located just outside of a major metropolitan area and has been in existence since 1962. The facility has gone through many changes over the last forty years. The site has defined and redefined space in response to the needs of the school community. In 1979 the 50-bedroom convent was converted to a ministry and retirement center. In 1991 the same space was changed to the community center which is home to the guidance and counseling department, curriculum coordinators, parent volunteer coordinator, service office, ministry office, a renovated chapel, the office of institutional advancement and a retreat center. From 1996-1999 significant enhancements occurred resulting in two new science labs, a fitness and dance center, a softball field, a computer assisted design lab (CAD), internet technology advances and a renovated gymnasium. The school utilizes 59 of its 60 available classrooms. The school's pioneer spirit propelled it through these physical changes while continuing to provide a rigorous program of study in a creative learning environment.

The introduction of interdisciplinary studies in 1977 is testimony to the school being at the forefront of educational issues. It also ranked among the first Catholic schools to require computer skills, and established a ministry program that incorporated a service requirement for graduation. The 1997-1998 school year spoke volumes about the school's commitment to peace and justice, with the advent of Catholic Schools Opposing Racism (COR) for all archdiocesan schools. The theme of peace and justice continually emerges in every facet of the school's curriculum.

The college preparatory curriculum is almost entirely non-tracked, offering many choices for all students, and ample advanced placement opportunities. The rich program of study complies with the state's minimum standards for public college and university admission requirements. College application and acceptance is attained by 100% of the school's graduates. In addition to its course offerings, the school includes 19 clubs and seven athletic teams.

The belief in every student as a learner and contributor is marked in each of the school's nine disciplines. The current math program is committed to providing experiences that enable all students to gain confidence in their mathematical ability, become problem solvers, communicate and reason mathematically and use appropriate technology so that they can appreciate the full power and beauty of mathematics and its value in their everyday lives. While the math program includes a course for everyone, it is the one tracked discipline in the school.

Incoming students are offered one of four courses. Algebra A is the first year of an algebra course spread over a two-year time period and is established to meet the needs of students for whom math is a particular challenge. The majority of students enroll in a traditional first-year algebra course. Students demonstrating a significant math background enroll in a fast-paced, in-depth study of the subject, while an honors level geometry course is reserved for those who have completed a full year of advanced algebra at the elementary level. Course placement is determined by entrance exam scores, grammar school performance, and grade school teacher recommendations. The department also offers advanced placement (AP) courses for those completing prerequisites.

The school shines among its Catholic school partners, forever in the foreground, forever the maverick, forever progressive in its programs and visions while holding firm to the Catholic social principles that define it. Four decades since its inception, the school continues to celebrate its mission, rooted in scholarship, truth, compassion, community, and a commitment to inspire a passion for peace and justice.

The Surrounding Community

The young, suburban community located just outside of a large metropolitan city was incorporated in 1970. There are 27,600 residents that call the 4.17 square mile suburb home. The latest census defines the community as being made up of 94.3% White, 4.4% Hispanic and 1.3% other minorities. The median income is $64,357. The mayor credits the people of the predominately white, middle class town as its greatest asset.

There are 13 congregations of various faiths in the town. Catholic, Presbyterian, Lutheran, Baptist, and Seventh Day Adventist are among those represented.

There are two school districts in the town comprised of eight public elementary schools, one public high school, and three special education schools. Of the three parochial schools in the community, one is elementary, one is an all girls' high school (the targeted site), and an all boys' high school.

The local chamber contributes to the area high schools by providing a scholarship fund. As a member of the local chamber, the targeted high school is a recipient of this annual donation. Given that the targeted high school is not part of the town's public school district, it has the ability to extend its boundaries beyond the constraints of the municipality. Students from 150 feeder schools attend the school which includes 1,076 students. Of this number 1,056 live more than 1.5 miles away from the campus. A majority of students come from the surrounding metropolitan area with only 2.4% of the present population coming from the local community.

National Context of the Problem

The problems of classroom performance for learners who struggle academically, students' math anxiety (as it relates to perceived competence), and a growing concern to raise achievement scores is not new to the educational arena. There is an over demand nationwide for testing and accountability (Shafer, 2001). In an effort to "leave no child behind" our nation has responded by mandating testing programs that make schools more accountable. Assessment continues to be linked to accountability. Consequently, states tend to hold teachers accountable for curriculum by measuring students' test scores. Districts are left enforcing policies that require schools to assume more responsibility by making test results public. Even pay raises of principals are connected to student gains. The belief appears to be that school systems need only respond to incentives and threats of punishment (Lee-Smith & Fey, 2000). The results of this rationale of finding the "best," or highest performing schools and providing them the most recognition and scholarships, leaves those perceived as the "worst," with a probationary status. At worst, schools perceived as having the lowest performance are assumed by the state for remedial assistance.

In an effort to insure that all students attain minimal competence the buzzwords of "accountability," "standards," and "results" continue to resonate, resulting in even more standardized testing. The 2002 reauthorization of the Elementary and Secondary Education Act requires states to test students annually from third to eighth grade (Metcalf, 2002). Proponents of the policy argue that standards, benchmarks, and testing will help diagnose the problems of underachieving schools.

A growing concern at the national level for increasing achievement has not necessarily resulted in a feasible solution. If standardized test scores are used to improve the learning environment in under performing schools, then testing has the potential of being a useful tool. If however, test results become the standard for graduation or promotion and little else is done to improve failing schools; groups already at a disadvantage may be penalized further by being denied academic opportunities (Brennan, Kim, and Siperstein 2001).

The problems of math performance in classes intended to assist learners with basic competencies do not always result in students' academic success (Schoen, Hirsch, and Coxford 1999). Ability grouping or tracking has been used for years to remediate students. Too often students never move between tracks. Students who place in a low performance group at an early age may find their educational experience limited to rote drill on basic skills. These students may also attain modest computational skills but limited problem solving ability. Schoen et al. reported further that students need to develop their ability to analyze and conceptualize problems. Yet, the lowest tier of students may never have this opportunity.

Davenport (1993) reported the effects of homogeneous groupings in mathematics. He noted that while students enter secondary school at different places, tracking only widens the gap between the lowest and highest achievers over time. Students in the lowest ability group may never earn the prerequisites required to enroll in college preparatory courses. Not surprisingly, differences in mathematics achievement result. A closer look at Davenport's study reveals that heterogeneous grouping has little effect on high achievers. However, heterogeneous grouping opened the door for their low achieving counterparts, who may have been stuck in a program that did little to respond effectively to their deficiencies.

According to Slavin (1990), students' perception of math competence is affected by placement in the lowest group. These courses are typically taught not only at a slower pace, but a lower pace, making students feel more inept. Teachers spend less time preparing for these classes and less time engaging students in questions beyond the most routine. Slavin's review of the literature parallels what was previously reported. Ability grouping does not appear to have an affect on student achievement. If ability grouping is not producing desired results of increased achievement then its practice needs a closer review.

In order to better respond to students' math competencies and national reactions to testing, standards, and accountability, an alternative curriculum is worth consideration (Stodolsky & Grossman, 2000). As teachers teach to a more diverse group of students, teaching strategies are needed to accommodate the changing population.

Traditional mathematics curricula required students to mimic what they had been shown. Students spent most of their time learning computational procedures that they could not explain (Battista, 1999). Battista also observed current trends supporting a more constructivist approach to the way that people learn math. Constructive theorists agree that as students make sense of situations, they naturally construct solutions based on their prior knowledge. To develop students with powerful mathematical thinking skills, instruction must focus on, guide, and support learners' personal construction of ideas. Paralleling the constructivist tenet, Battista maintained that more attention should be given to helping students analyze and make sense of facts rather than merely obtain them. The benefits of constructivist theory appears to be twofold; not only does it engage students in the problem solving process, it also provides a framework from which students can work, making the process more meaningful (while helping them to acquire higher order thinking skills). Students who experience a community of learners also feel a sense of belonging. When students believe their contributions are consequential, they believe that they are valued and are more willing to risk learning advanced concepts (Stodolsky, 1999).

A review of the literature revealed that students' math competence may not be remedied by exploring one avenue. Testing, standards, diverse student populations, feelings of belonging, students' self perception, and curriculum design all need to be explored. Designing the best possible curriculum might be a good place to start (Schoen et al. 1999).

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

In order to document the extent of students' math performance and their self- perceptions related to their mathematical ability, historical records, a preassessment, and a student survey were used. The data collected illustrates connections between the way that students think about their math competence and their actual math ability. Comparisons were also noted regarding students' previous math grade as it related to preassessment performance. These connections assisted the researcher in making curriculum revisions individually and across grade levels. Of the 37 students in the targeted geometry classes, 14 were juniors and 23 were sophomores. Figure 2.1 provides a comparison between these grade levels.

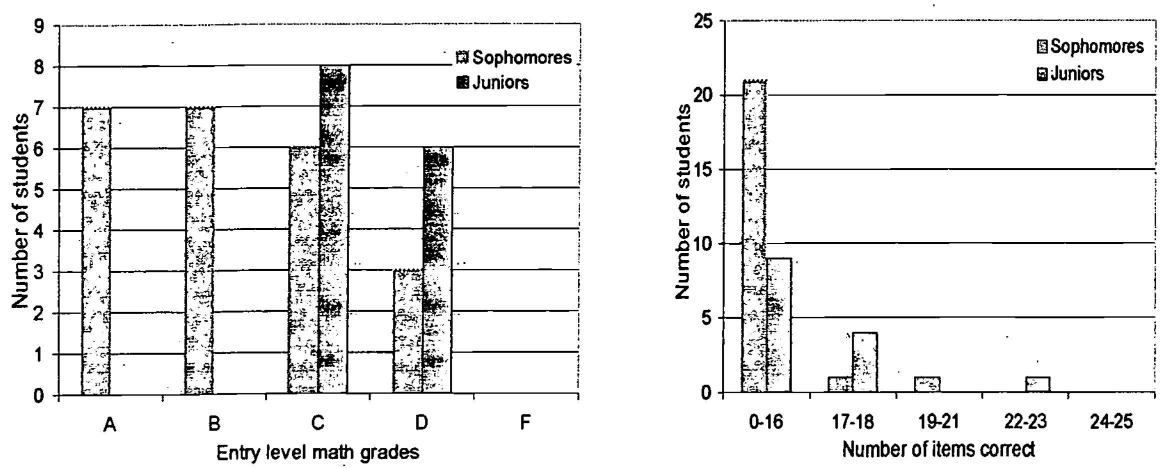

Figure 2.1 Participants' entry level math grades and number of items correct on math preassessment.

Figure 2.1 illustrates that the majority of sophomores performed well above average while the juniors maintained average to below average grades. Sophomore grades were also considerably better in the prerequisite algebra course. However, on the math preassessment (Figure 2.1), sophomores scored considerably lower than juniors. Of the 23 sophomores tested 91% scored below average. Of the 14 juniors tested 71% scored below average.

While a high number of participants, regardless of grade level, appeared to retain less than 50% of the prerequisite knowledge necessary for a geometry course, sophomores scored considerably lower than juniors. The connection between grades earned and knowledge retained was inconsistent. Students' grades appeared to suggest that they exhibited content mastery that was not evident on the preassessment. For this reason, the gap at the sophomore level between previous class grades and preassessment performance was a primary concern during intervention.

Figure 2.2 represents students' self-perceptions of their math ability. Of the 37 students responding, 40% of sophomores described themselves as being "good" in math, and 50% said that they were successful. A strong difference was not noted across grade levels, with juniors reporting 43% being "good" in math, and 50% being successful. These findings suggest that although students are aware of their competency level; they still manage to succeed.

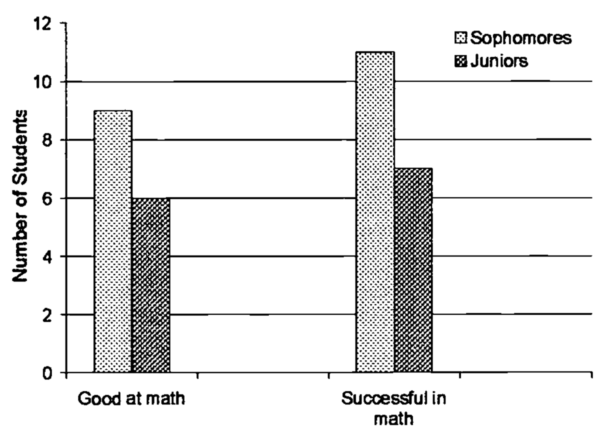

Figure 2.2 Students' self-perceptions of math success.

An analysis of data collected prior to interventions revealed that while students report success in math; their successes are inconsistent with how "good" they think they are in the subject or how well they perform on preassessments. A contradiction exists among students' previous math grades, how competent they are in the discipline (as evidenced by their preassessment report) and their successfulness as evidenced by their previous grade report. The purpose of the intervention is to narrow this gap so that perception and achievement are more authentically matched. These concerns are addressed in the literature review that follows.

Probable Causes

A review of the literature disclosed several underlying causes influencing students' math achievement. Among factors impacting achievement are students' self-perceptions of math competence, teachers' perceptions of students' abilities, and an overemphasis on remediation which leaves students unchallenged and behind their peers (Godbey, 2002).

Fiore (1999) noted that anxiety related to math competence is more prevalent than ever. A student's belief in their ability to do math impacts their achievement and effects how much effort they are willing to spend on tasks they feel unable to do. Anecdotes of past math experiences reveal countless stories of embarrassment in math class. Students often feel pressured to know an answer rather than work through the problem solving process. Fiore observed that many students shut down before the process of problem solving even begins.

While it sounds cliché to mention teachers' expectations or beliefs about students; these assumptions influence students' progress (Fiore, 1999). If teachers don't believe that students have necessary problem solving skills, they may not challenge them in the problem solving process, settling instead for algorithmic answers. Stevenson and Stigler (1992) contend that while teachers are not solely responsible for students' self-perceptions, society tends to reinforce the belief that students' abilities rather than their effort or commitment to hard work matters the most. Stevenson and Stigler also reported, "A student who is 'bright' is expected just to 'get it', whereas duller students are assumed to lack the requisite ability for ever learning certain material" (Stevenson & Stigler, 1992, p. 102).

Americans go to great lengths to prevent failure rather than have students risk failing a task that may be difficult (Stevenson & Stigler, 1992). The unfortunate result of feared failure leaves many students out of the mainstream curriculum and left in remedial programs.

Remediation is a perennial issue in the educational forum. As more students pursue college degrees, more programs must be instituted to handle the influx of under-prepared students (Moses, 1999). Remediation in this sense is necessary. At the high school level however, continued remediation will invariably turn kids off. Targeting kids early on for programs that expose them to lower levels of material may result in writing off the majority of children as being more or less mathematically uneducable (Stevenson & Stigler, 1992). While students may perform well in corrective programs, they are at the same time being deprived of rich core content and future course opportunities (Davenport, 1993). It is not enough to get a good grade; true self-esteem for children (or anyone) is realized by mastering challenging tasks not merely by making the grade in curative ones. Continually awarding good grades may give students a false sense of achievement while leaving them behind their peers (Haury & Mibourne, 1999).

The literature reveals that our past notion of what effects student achievement persists. The results of students' self-perception, teacher expectations, and ability grouping continue to surface. Researchers continually echo what does not work in math achievement. Perhaps it is time to stop talking louder or slower to students who do not understand what is being said (we know this does not work) and to start speaking differently.

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

A variety of solution strategies exist to increase students' math competencies. Among these, three interventions are addressed that include implementing a curriculum minimizing tracking, utilizing a constructivist teaching approach, and establishing a community of learners (Stevenson & Stigler, 1992). An overview of the strategies reviewed in the literature follow along with the study's action plan, objectives and processes, and methods of assessment.

Tracking

As far back as the 1920's and 1930's, educators used tracking to place students in classes with peers thought to have similar abilities (Oakes, 1985). Ability groups were defined as being "low," "average," and "high," and students were assigned to a "track" based on intelligence quotients and standardized tests. The practice of tracking came under fire in the mid 70's with the influential work of James Rosenbaum. Rosenbaum's work, Making Inequality, stirred up discourse on the equality of tracking that continues to provoke discussion today.

While most academic disciplines have de-tracked their curricula; the math curriculum continues to be the exception (Burnett, 2002). Because of much criticism, the practice of tracking and ability grouping has been abandoned by many schools. One of the solution strategies to be implemented in this project is a curriculum redesign that minimizes tracking. According to Slavin (1990), de-tracking does not impede the progress of high achieving math students as was previously thought. Low achieving math students will however, have an opportunity to excel with their peers. Slavin's literature review points out that an advantage of ability grouping was thought to be failure reduction; students grouped together would be more successful. Failure reduction in an inept, remedial curriculum is hardly progress. If we hope to increase mathematical achievement, then math educators must catch up to their colleagues and provide a rich curriculum to all students. Davenport (1993) looked closer at the effects tracking had on student achievement. She reported that achievement can't help but be affected by tracks that produce wider learning gaps as time goes by, varying learning opportunities to students in different groups. Haury and Milbourne (1999) echoed Davenport's concern about tracking inequities calling for an end to existing practices.

Achievement and compromised student opportunities are directly related to students' needs. Students need to have positive peer role models; tracking practices ignore this issue. At risk students may never share a classroom with their successful peers (Fahey, 2000). Fahey believes that high and low achievers benefit from peer assisted learning. Questions asked of high achievers force more proficient students to examine situations in different ways provoking discussion that may never come to pass in homogeneous settings. Healthy competition and discourse brings all students up. Students more readily question and challenge their peers as opposed to a teacher who is seen as already competent in the discipline. To move to an effective heterogeneous system, committed instructors will have to surrender traditional teacher directed instruction to a more student directed approach. The careful use of cooperative learning, journaling, and self-reflecting would need to be employed (Claus, 1999; Heath, 1999). The pursuit of more democratic schools begins by recognizing variability in students' educational backgrounds as opposed to trying to define children's ability levels.

> If we get kids in the right courses it can make a difference. If we can make those courses better it can make a difference. Our priorities are to help every kid to get ready and be ready for what they want to do when they walk out of high school (Schmeiser, 2002, p. 23).

Constructivist Approaches

Traditionally mathematics education included a sequence of memorized facts that made little sense to students. The best students performed algorithmic tasks without having much understanding of what tasks meant on a broader scale. Merely memorizing formulas without making connections lead to a lack of retention for most (Battista, 1999; Schoen, Fey, Hirsch, & Coxford, 1999; Stodolsky & Grossman, 2000).

Battista (1999) reported that it is not the difficult mathematical content that hinders students' progress, rather how the material is presented. A more constructivist approach to teaching math may furnish students with lessons that have more meaning. A constructivist approach moves away from the traditional algorithmic method of learning math and spends more time helping students reason conceptually (Battista, 1999). In discovering, conceptualizing, and synthesizing new experiences, Sprague and Dede (1999) asserted that students will attach new experiences to prior knowledge and form their own understandings. Constructivist teachers use several methodologies to accomplish this goal. Richetti and Sheerin (1999) emphasized a question driven approach. Critical and creative questions move beyond the most routine to stimulate thought. Through discussion, analysis, and collaboration students are encouraged to solve a wider range of problems thereby seeing themselves as problem solvers and seeing the relevance of questioning to real-life situations. Stodolsky and Grossman (2000) echoed the importance of an investigative approach to learning. They maintained that inquiry is really an approach to life and view math education as a more open and less structured discipline than most realize. The process of making connections to already learned concepts and reflecting on them hopes to provide learning experiences that will transcend the classroom.

Establishing a Community of Learners

Perhaps it is never enough to de-track or adjust pedagogical practices if we fail to establish an environment where these things can flourish. Allersaht-Snider and Hart (2001) reported that when students believe that they belong and are a necessary part of the group, they are more likely to be vested in their work. A sense of community is critical in establishing a collaborative learning spirit (Baker & Tara, 1997; Chapman, 1993; Fogarty, 1997; Jacobson, 2000; Young, 1998). It is in establishing and maintaining a caring climate, rich in activity, where students are free to make mistakes, grow, and reflect, that risks are taken and autonomy develops (Fogarty, 1997).

Barth (2000) claimed that educators must assume the role of the leading learner in a community of learners. In his view a bumper sticker which reads: "You can't lead where you won't go" sums it up best. The interaction between teacher and student is a powerful relationship. It can provoke students positively or negatively (Fiore, 1999; Young, 1998). When the exchanges between teacher and student are positive, consisting of positive talk, encouragement, and a belief in every student's ability to learn, students feel valued and are able to trust the learning environment (Young, 1998).

A trusted environment cannot exist unless educators empower each individual by valuing diversity (Cummins, 1986; Jacobson, 2000). It is in the respect for individual differences that every child will commit to the learning process. In nurturing strong relationships, sensitive to diversity, motivating and challenging every student, that life long learners and risk takers will emerge.

A summary of the literature revealed that tracking and ability grouping does not increase mathematical achievement. Achievement appears to depend more on a constructivist approach to teaching, freeing students to engage more in the problem solving process rather than simply arriving at a correct answer. Lastly, students must perceive that they are a part of a collaborative community which fosters growth, which invariably leads to achievement.

Project Objectives and Processes

The objective of this study was stated as follows: As a result of curriculum redesign during the period from September through December 2002, students in the targeted high school will improve their self- perceptions as math learners and increase math achievement as measured by a survey, document analysis, and observations of students' classroom performance.

To accomplish the project objective, the following processes were necessary:

1. Curriculum redesign.
2. A constructivist teaching and learning approach.
3. Establish a community of learners.

The project objectives was met by implementing a change in course sequence by minimizing tracking (Burnett, G. 2002; Davenport, L. R. 1993; Slavin, R. E. 1990), utilizing a constructivist approach to teaching (Battista, M. T. 1999; Mullinix, B. 2001; Rowan, & Bourne, 2001), and establishing a community of learners (Allexsaht-Snider & Hart, 2001; Cummins, J. 1986; Stodolsky and Grossman, 2002; Wood, G. H. 1998).

Project Action Plan

August

- Meet with principal
- Distribute and collect informed consent
- Build classroom rapport

  Student self-report of their math history (Appendix B)

  Peer interview and introductions

  Create base groups

- Administer Student Survey (Appendix A)

September

- Administer math pre-assessment and record results on Document Analysis Form (Appendix B)
- Model constructivist teaching approach in lesson implementation
- Observe and record students' classroom performance (Appendix C)
- Write individual and base group reflection on course progress (monthly)
- Continue building classroom rapport

  Utilize base groups in math activities

  Teacher participation in extra-curricular activities to strengthen teacher/student relationship

  Thought of the week - teacher led reflection

October

- Continue to observe and record students' classroom performance (Appendix C)
- Continue constructivist teaching approach in lesson implementation

- Administer First Quarter Exam and record results on Document Analysis Form (Appendix B)
- Write individual and base group reflection on first quarter progress
- Continue building classroom rapport

  Utilize base groups to reinforce community

  Participate in extra-curricular activities to strengthen teacher/student relationship

  Thought of the week - teacher led reflection

November

- Continue to observe and record students' classroom performance (Appendix C)
- Continue constructivist teaching approach in lesson implementation
- Write individual and base group reflection on course progress (monthly)
- Continue building classroom rapport

  Utilize base groups to reinforce community

  Participate in extra-curricular activities to strengthen teacher/student relationship

  Thought of the week - teacher led reflection

December

- Continue to observe and record students' classroom performance (Appendix C)
- Continue constructivist teaching approach in lesson implementation
- Administer and record semester exam (Appendix B)
- Administer Student Survey (Appendix A)
- Compute and record semester grade (Appendix B)
- Write individual and base group reflection on first semester progress

- Continue building classroom rapport

  Utilize base groups to reinforce community

  Participate in extra-curricular activities to strengthen teacher/student relationship

  Thought of the week - teacher led reflection

Methods of Assessment

To document students' progress in mathematical achievement and improved self-perception the following methods of assessment were used: survey, document analysis, and observations.

Survey

The Mathematics Education Survey (Appendix A) included 10 statements each with four possible responses regarding students' self-perception of math competence. The survey was designed to assist the researcher in analyzing students' self-perception as it relates to math competencies at the targeted high school. The researcher administered the survey in September and again in December to 37 participants during designated class time. To protect confidentiality, participants were instructed to return completed surveys at the end of class in a sealed envelope omitting any reference to names and note only their grade level. The researcher stored the information in a locked file cabinet located in the classroom. The survey assisted the researcher in analyzing students' entry level perceptions of math competence prior to and during interventions.

Document Analysis

The Document Analysis Form (Appendix B) was used by the researcher to record results of students' math performance throughout the study beginning in September and ending in December. The researcher used this form to document student progress in mathematics achievement when reviewing grade reports and various classroom assessments for 37 participants. To protect confidentiality, the researcher omitted any reference to names and noted only their grade level. The researcher stored the completed forms in a locked file cabinet located in the researcher's classroom. The document analysis was designed to assist the researcher in analyzing student growth in mathematical achievement as a result of the interventions. The analysis also served to aid the researcher in making curriculum connections across grade levels.

Observation Checklist

The Observation Checklist (Appendix C) included four behaviors each designed to document students' effort in math class for participation and preparedness. The researcher used the checklist to observe 37 participants in the targeted high school beginning in September and ending in December 2002. The researcher observed 37 participants at the beginning of the study using Form A and then used Form B to observe participants from extreme and typical cases for more in-depth observation. During observations, the researcher used the checklist to record a "+" for yes and a "-" for no for each of the four behaviors noted. To protect confidentiality, the researcher omitted any reference to names and referred to participants only by grade level. The researcher stored completed checklists in a locked file cabinet located in her classroom. The checklists assisted the analysis of students' participation and preparedness as a result of the interventions. The analysis also assisted the researcher in making connections across grade levels.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The object of this project was to take a critical look at curriculum redesign as it relates to math competencies at the secondary level. The project was approved by the administration with the intent that it was exploratory in nature. Curriculum redesign, a constructivist teaching approach, and establishing a community of learners were used as interventions. Data were collected using a student survey, document analysis of classroom assessments, and an observation checklist.

This study focused on two Integrated Geometry courses, one at the sophomore level and one at the junior level. Its purpose was to explore differences in achievement across grade levels. Groups were established at the beginning of the school year and were maintained throughout the intervention. Juniors had taken Algebra I over a two-year time period as Frosh and sophomores. In this case, Frosh refers to a non gender specific term used to describe first year students. Likewise, sophomores completed a semester of Algebra I at the Frosh level and were scheduled to enroll in the second semester as juniors. The researcher believed that this alteration of course sequence would ultimately find all sophomores enrolled in a geometry course and all juniors enrolled in an algebra course providing more necessary ACT preparation.

A constructivist teaching approach was also employed as an intervention beginning with a math survey and a math preassessment in an attempt to pinpoint prior math knowledge, prior math grades, and overall student perceptions related to successes and competencies. The rationale for using a constructivist approach was based on the plethora of research related to this topic.

Similarly, the researcher established a community of learners by building classroom rapport. Peer interviews and introductions, the creation of base groups, followed by weekly teacher led reflections were all instrumental in creating an optimal classroom climate. The researcher also participated in extra-curricular activities to strengthen teacher/student relations.

Throughout interventions the researcher observed and recorded notes using a checklist (Appendix C). In addition, individual and base group progress was analyzed and noted throughout interventions. Students' progress and achievement were also recorded and reviewed throughout the study.

Presentation and Analysis of Results

In order to assess the effects of curriculum redesign minimizing tracking, progress and achievement were documented throughout the intervention. As a result of the interventions imposed on the targeted geometry classes, students anxiety in math decreased, students participated and were prepared for class, and all participants demonstrated growth over time with no noticeable difference across grade levels.

A math survey was used to inform the researcher of students' perceptions about math (Appendix A). While only 49% of students surveyed boasted a "love" of math, students nevertheless reported overwhelmingly, 95% of participants that their high school math teachers believed in their mathematical ability. A majority, 73% of participants, reported that all sophomores should be enrolled in a geometry course. Students' responses indicated that sophomores have the ability to successfully complete a geometry course when bolstered by strong teacher support. Although not included as part of the student survey, reflections from individual and base groups documented are important to note. A marked response came from students when asked to describe what they valued most about math class. A high number, 81%, reported that they valued the fact that their teacher and peers worked together. Students expressed this by their accounts of being comfortable in class; that they weren't made to "feel stupid" when asking questions and they were pushed and encouraged not to give up. "I value the fact that I have a helpful teacher and that she has faith in me." "I value that she takes time to help us individually." "You don't get yelled at for getting the wrong answer and you have confidence." "I value the closeness of the class because everyone knows each other, and this class works together, and we have fun!" "That my teacher pushes me to do well in my class." The remaining 14% valued an increased understanding of the subject ("I think I'm slowly learning something") and 5% did not respond. An analysis of reflections mirror research that describes the importance of establishing a community of learners. Despite participants' self-report, students were observed by the researcher to be rather passive learners, quick to give up, and frustrated by challenges that went beyond the most routine. The researcher believed that students' self- doubt was largely responsible for their passivity. Even the highest achieving students were observed, often enough to note, as being content to assume a prosaic response to demanding course work.

An observation checklist was used to record students' preparedness for class. Across grade levels students consistently brought homework and required materials to class. Whether students were self- motivated to this end or merely complying with expectations to earn a passing course grade was not clear. It is also unclear to what extent the established classroom community was responsible for the participation and preparedness exhibited. Nevertheless, the researcher believed that being equipped with necessary materials was a vital step toward students becoming active learners and for improving achievement.

Lastly, in order to assess the effects of curriculum redesign in response to students' competencies, students' progress and achievement were recorded beginning with a preassessment, followed by a first quarter exam, and ending with a semester exam. Comparisons were noted across grade levels. The following figures illustrate these results beginning with sophomore participants.

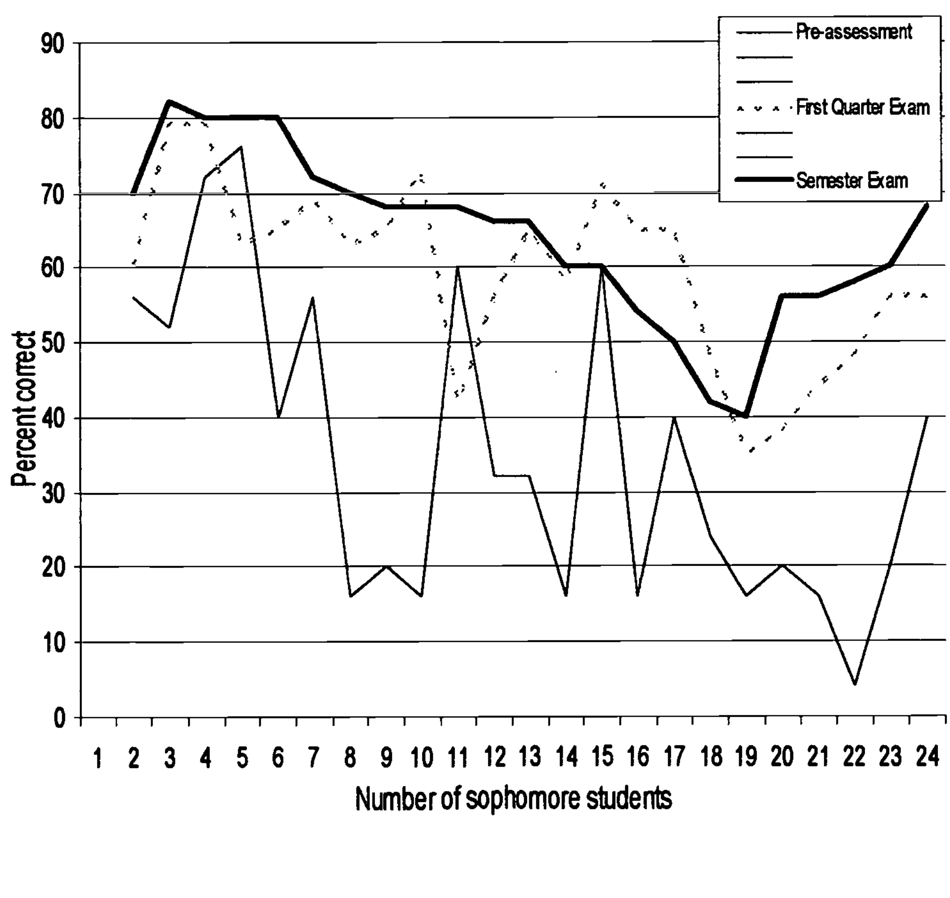

Figure 4.1 Sophomore assessment results.

The graph indicates that there was growth over the course of the intervention. The average preassessment score was 34.78%, the average first quarter exam score was 59.26%, and the average semester exam score was 61.04%. The low preassessment scores may have been a result of students being tested following a school break due to summer vacation.

Although juniors' preassessment scores were higher than sophomores, this was not true at the time of first quarter exams, when sophomores actually out performed juniors. By the end of the first semester the juniors' scores were slightly higher. The data suggests that juniors entered the geometry course with an advantage over their sophomore peers noted by the gap in preassessment scores. Juniors had an average score of 61.85% while sophomores reported average was a mere 34.78%. However, the preassessment scores appeared to have little effect on students' progress across grade levels as evidenced by quarter and semester exam results. Figure 4.2 illustrates the results of geometry assessments at the junior level.

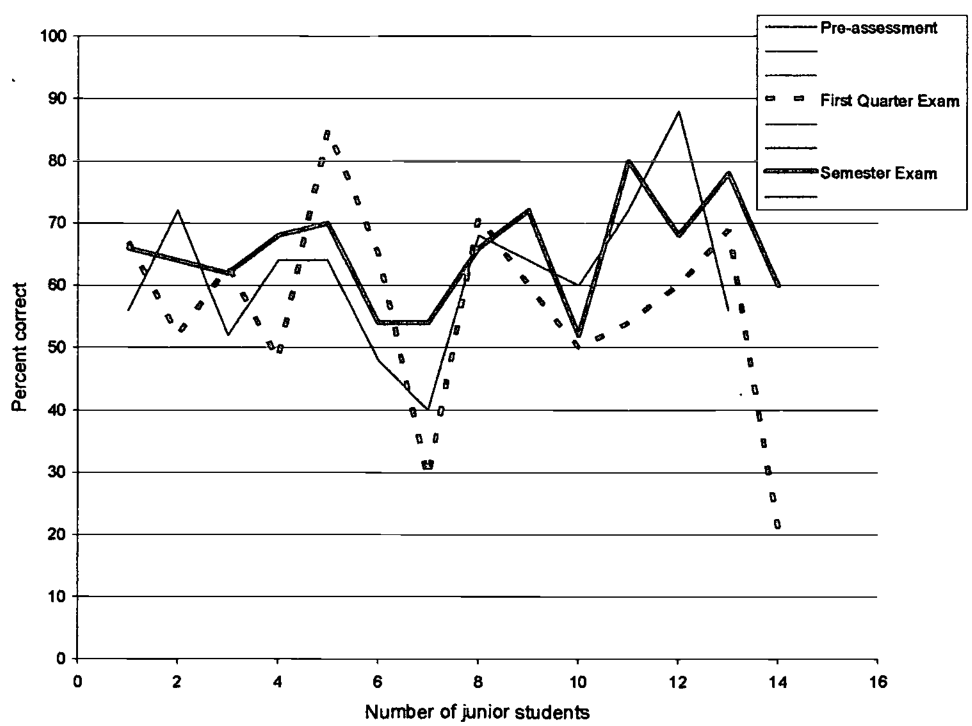

Figure 4.2 Juniors' assessment results.

At the end of the first quarter juniors averaged 56.71%, while sophomores averaged 59.26% on quarter exams. By semesters end juniors' semester exam average was 65.29% compared to sophomores' semester exam average of 61.04%. An analysis of this data suggests that regardless of initial algebraic content mastery, students at the sophomore and junior level did not differ significantly by the end of the intervention. Both groups showed growth between first quarter and semesters end, however neither group markedly out performed the other. At the conclusion of the intervention both groups faired about the same.

Conclusions and Recommendations

Based on the presentation and analysis of data, the results revealed that the interventions were successful in creating a positive community of learners as evidenced by students' self-report of reduced anxiety in math class. At the very least the curriculum redesign was not harmful given that students were able to perform at or above expectations established in previous years. In addition, students demonstrated growth in their math performance, which supports the researcher's belief that given the opportunity students could perform well outside the conventional program.

Factors contributing to the successes noted include supportive administrators who were willing to work collaboratively with the math department in exploring new possibilities. Moreover, faculty members within the math department supported the possibility for curriculum review and future redesign. In essence, faculty members were not afraid to critique the existing program. Considering the level of support provided by critical stakeholders in the targeted school, this researcher recommends further dialogue to explore whether or not additional revision is needed. Specifically, the researcher wonders what would happen if a total redesign could be envisioned. A design that dismantled tracking, might better consider students' untapped potential. For example, in this study, the researcher simply shifted the order of courses taught, but did not address systemic issues influencing students' perceptions of their abilities. Additional changes may be needed given that ten students with similar profiles as participants were able to meet with success when taken out of the existing system and placed in courses with high expectations that are viewed by faculty as more rigorous. They are testimony to hard work versus the notion of predetermined ability.

The issue of students' passivity can also be easily addressed given the relative size of the school (N = 1,100) and the number of students recycling through the existing classes. Many of these students have dropped out while continuing to occupy space. They have found their place. They fill the role, fulfilling hidden expectations. The researcher believes that surface changes (e.g., renaming courses, revising course sequence) will not resolve these issues. A more systemic change is needed and solutions reviewed in the context of collaboration within the setting. In effect, the researcher encourages and recommends that this research be ongoing to foster further dialogue and further attention to what these results imply. Possibilities for launching this dialogue include using the literature to create solutions and make research based decisions. The action research process used in this study may be helpful in continuing this discussion.

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Appendix A

Mathematics Education Survey

I am currently a (check one)
Sophomore _____
Junior _____

Circle one response for each of the following ten items.

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I love math.	1	2	3	4
2. I am good at math.	1	2	3	4
3. I will never understand math.	1	2	3	4
4. I was challenged in my previous math courses.	1	2	3	4
5. My high school math courses have moved too slow.	1	2	3	4
6. I do not ask questions in math class.	1	2	3	4
7. I am confident in math.	1	2	3	4
8. I am successful in math.	1	2	3	4
9. My high school math teachers believe in my ability to do math.	1	2	3	4
10. All sophomores should take geometry.	1	2	3	4

Appendix B

Document Analysis Form

Participant S_____ or J_____

Math grade in last years class _____

Pre-assessment score _____

First quarter exam score _____

Semester exam score _____

Semester grade _____

Comments

Appendix C

Observation Checklist

Form A

Date of observation: ______ Begin time: ______

Class: S_____ J_____ End time: _____

Codes
+ = yes – = no

Participant	On task	Book	Notebook	Homework
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Appendix C

Observation Checklist

Form B

Date of observation: _____ Begin time: _____

Class: S_____ J_____ End time: _____

Codes	
+ = yes	– = no

Participant	On task	Book	Notebook	Homework
1				
2				
3				
4				
5				
6				

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