THE IMPLEMENTATION OF PORTFOLIO ASSESSMENT INTO THE SECONDARY MATHEMATICS CURRICULUM

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ABSTRACT

The signing of the No Child Left Behind Act, NCLB, on January 8, 2002 made it clear that the government’s main concern in education was assessment. NCLB was designed to hold schools accountable for every student achieving academic proficiency. Since the signing of this important piece of legislature the mean proficiency score for the state of North Carolina in Algebra 1 has increased only 1.4 points. Traditional assessment methods such as standardized multiple choice tests are the current tool used for measurement of student proficiency. But, can you really measure whether students have mastered, or are proficient, in a subject by their score on one multiple choice test. Would a better judge of student proficiency be a semester or year long summative evaluation? This study discusses the potential advantages of implementing portfolio assessment into the mathematics classroom.

I investigated the achievement levels of two Algebra 1B classes in which all participants had failed Algebra 1 at least once. Portfolio assessment was implemented in one class while the other received traditional assessment methods. The effects of implementing portfolio assessment were examined using the North Carolina Algebra 1 End of Course Exam scores. The results showed that implementing portfolio assessment did not lead to a higher mean score than the traditional assessment group. However, the two students in the portfolio assessment group who had previously taken the North Carolina Algebra 1 EOC Exam increased their achievement level on the exam by 30 points and 7 points respectively. Also, the mean scores were only 1.2 points apart and both classes were over 80% proficient which leads to a strong implication for portfolio assessment as a useful strategy for students who struggle in and/or fail Algebra 1.
ACKNOWLEDGEMENTS

My thanks go to Dr. Edward Caropreso whom I had the privilege of spending the last few years with as my professor, mentor, and friend. He took on a great challenge by accepting to be my thesis advisor and I am sure I helped to add a couple of grey hairs. Even with the busiest of schedules, his door was always open. He exemplifies the character of an educator.

I would like to thank my colleagues for welcoming me into our school three years ago and always offering a helping hand. The family environment that has been established within our math department is a true blessing for me as a young teacher. A special thanks to my mentor, Pamela Highsmith, whose kindness and dedication to education is unmatched.

I am very thankful to have studied at the University of North Carolina Wilmington. The professors throughout my undergraduate and graduate studies always treated me with the utmost respect and continued to be a positive influence in my life. I would like to thank Dr. Karen Wetherill for her guidance and assistance throughout my graduate studies.

Finally, very special thanks to the Lord, who blessed me with the most wonderful parents I could have asked for, and who answered many prayers during my years at UNCW.
DEDICATION

I would like to dedicate this thesis to my parents who have believed in me throughout my entire life. I am eternally grateful for their support and I pray that my wife and I will be half the parents they were for me.
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Lack of Proficiency in Algebra 1

For many years math has been a dreaded subject for high school students. In fact, only 53.1% of the 82,656 students who took the North Carolina Algebra 1 End of Course Exam during the 1995-1996 school year were proficient (See Appendix A). Passing Algebra 1 is a requirement for high school graduation in North Carolina, therefore Algebra 1 proficiency is a major concern for educators in North Carolina. The county in which I currently teach follows the regular year block schedule consisting of four 90 minute periods per day with each class lasting one semester. This is my third year of teaching and I have taught at least one Algebra 1 class each semester. During my three years I have observed students failing Algebra 1 for reasons other than their given mathematical ability, such as lack of organization, motivation, and poor attendance.

For many years scholars have researched alternative assessment methods in hopes of increasing the achievement levels of our students, but such efforts have provided little empirical evidence for methods other than traditional testing. However, research on portfolio assessment does provide evidence of greater organizational skills and self assessment in students. In this study I will be implementing a teacher alternative assessment portfolio model in one of my two Algebra 1 classes. The purpose of this study is to examine the potential advantages of implementing portfolio assessment in an Algebra 1 class in an attempt to enrich learning experiences and increase achievement in ways traditional assessment may not.

I am both a math teacher and a site team member/advisor for the AVID program at my high school. AVID, which stands for Advancement Via Individual Determination, is a fifth-through twelfth-grade program founded by Mary Catherine Swanson whose purpose is to
“prepare students in the academic middle for four-year college eligibility” (AVIDonline, n.d.). Students considered in the academic middle are “B, C, and possibly D students who have the desire to go to college and the willingness to work hard, but are falling short of their potential” (AVIDonline, n.d.). Many of these students come from low-income minority families and are possibly the first in their family to attend college. All AVID students are required to keep a three-ring binder, much like a portfolio, to house the contents of their academic subjects. “Since 1990, nearly 40,000 AVID students have graduated from high school and gone on to college” (AVIDonline, n.d.). The principles of the AVID program are: attendance, work ethic, and organization.

The southeastern North Carolina county in which I currently teach in does not have an attendance policy, therefore, I cannot control that area. However, work ethic and organization are two qualities in students that I can help improve. Motivation is a key element to being a successful educator. Demanding the absolute best from your students, while keeping the material meaningful is one way to help improve work ethic. Part of our jobs as educators is to teach organization to help students succeed at the next level. I believe to help our students succeed more in school, specifically Algebra 1, higher levels of organization need to be implemented. Requiring students to complete a portfolio would put into practice a higher level of organization and assessment. The problem here is that minimal evidence exists supporting the claim that implementing portfolio assessment increases achievement levels in students. Therefore, the high school I currently teach at developed a program using instructional modules in 2001 to help increase the proficiency levels in Algebra 1.

Progressive Algebra
My high school offers Progressive Algebra in which the Algebra 1 curriculum is separated into three divisions called modules or mods. Each mod consists of four chapters:

- **Mod 1**: Chapter one through four including solving one-step equations to the slope of a line;
- **Mod 2**: Chapter five through eight which includes writing equations of lines to properties of exponents;
- **Mod 3**: Chapter nine through twelve which includes factoring to the Pythagorean Theorem.

Every student enrolled in Algebra 1 must begin in Progressive Algebra Mod 1. Mod 1 lasts six weeks; at the end of a six-week session, all students take a Mod 1 Exam that counts 20% of their six-week average. A student must have a 77 average or higher to move on to Mod 2. A grade below 77 results in students repeating Mod 1 with a different teacher. Students moving on to Mod 2 may have the same teacher or be switched to a different teacher depending on enrollment. The same process for advancement or retention holds for Mod 2; it lasts six weeks and ends with a Mod 2 Exam.

All students start the second six week session with a “clean slate.” The previous six week average does not carry over. At the end of the second six weeks, if a student has a 77 average or higher they move on to Mod 3, in which they will complete the book and take the North Carolina End of Course Exam.

The best-case scenario for a student is to pass Mod 1 the first six weeks, Mod 2 the second six weeks, and Mod 3 the third six weeks, finishing Algebra 1 in one 18-week semester. However, only a small percentage of students pass all three mods in the first semester. For example, during the fall of 2005 there were 280 students enrolled in Progressive Algebra Mod 1;
only 81 (29%) made it to Mod 3 during the first semester. The majority of students will finish in two semesters. This happens when a student has to repeat a mod. For example, if a student does not pass Mod 1 the first time, they do not have a chance to pass all three mods in the following twelve weeks since each mod is taught in six-week sessions. Therefore, they are automatically put in what is called Algebra 1A/1B. Once a student passes Mod 2, they receive an Algebra 1A credit. If a student passes Mod 2 by the end of the first semester they are put in Algebra 1B for the second semester. This is not a Mod system, but a regular Algebra 1 class in which they have the same teacher for the entire semester and will take the North Carolina End of Course Exam at semester’s end.

The Algebra 1A/1B credit system was set up so students taking longer to make it through the mods would not suffer losing credits for promotion. If a student does not pass Mod 2 by the end of the first semester, they begin the second semester in Mod 1 or Nova Net, which is computer-based instruction where the students are allowed to move at their own pace.

Progressive Algebra has its advantages and disadvantages. The system has proven to raise proficiency levels on the Algebra 1 End of Course Exam at our school (See Appendix C). However, students face the possibility of attending three different classes with three different teachers in one semester. This may interfere with the students’ learning of organizational skills. This system in fact, creates a day of chaos when it is time to switch classes. On the “switch day,” each teacher provides their students with a progress report indicating their final six-week average. Depending on whether students advance to the next mod or are retained, and also depending on what mod their current instructor will be teaching, the teacher name and room number of their new class is listed on their progress report. Some students are then moved in groups to another room while others may get to stay with the same teacher.
This process affects self esteem very negatively for students who are identified to repeat a mod. It also negatively affects students who have formed a bond with their current teacher and his/her instructional style, as well as bonds made with classmates. In my experience the most discouraging moment is when students continue to repeat a certain mod two or three times. I have taught a Mod 1 class during the last six weeks of the semester, which means each student had to be taught the first four chapters of the book for the third consecutive time. Each one of those students’ self esteem level was at an all-time low, and it was extremely difficult to motivate them to work. Therefore, even though our school has developed a program that has shown promise, there is still room for improvement. The need remains to develop an assessment strategy that allows for academic growth without the short time period of only six weeks. With the implementation of portfolio assessment in our mathematics classrooms the opportunity arises to show not only higher levels of proficiency on the state exam, but also a summative evaluation of a student’s progress over a period of time.

Algebra 1B

This study took place in the fall in which normally all students enrolled in Algebra 1 begin in Progressive Algebra Mod 1. However, the students enrolled in my two Algebra 1B classes had been through the Progressive Algebra system the previous year. These 22 students advanced to Mod 3 and failed, passed Mod 2 at the end of the spring semester, or attended summer school to receive the necessary requirements to be enrolled in Algebra 1B in the fall, rather than start all over in Mod 1. Only 6 of the 22 students had advanced to Mod 3 and taken the North Carolina Algebra 1 EOC during the previous school year, and all six failed. I felt this was the perfect time to implement an alternative assessment for these students so they would not feel as though they were repeating the mods.
What is Portfolio Assessment?

Portfolio assessment is defined as “a cumulative and ongoing collection of entries that are selected and commented on by the student, the teacher and/or peers, to assess student’s progress in the development of a competency” (Simon & Forgette-Giroux, 2000). Portfolios are nontraditional assessments that focus on the learning process, self evaluation, and progress rather than a single performance on a standardized test. An authentic portfolio assessment “should represent a collection of students’ best work or best efforts, student-selected samples of work experiences related to outcomes being assessed and documents according growth and development toward mastering outcomes” (Paulson, Paulson, & Meyer, 1991). According to Koca and Lee (1998), there are three types of portfolios for classroom use by teachers. They are:

1) Showcase: Focuses on the student’s best and most representative work. This type of portfolio is similar to an artist’s portfolio in which a variety of work is selected to reflect breadth of talent. Therefore, in this portfolio the student selects what he or she thinks is representative work. This folder is most often seen at open houses and parent visitations.

2) Teacher-Student Portfolio: Often called the “working portfolio” or a “working folder.” This is an interactive teacher-student portfolio that aids in communication between teacher and student. The teacher and student conference to add or delete with the content of the portfolio

3) Teacher Alternative Assessment Portfolio: All the items in this type of portfolio are scored, rated, ranked, or evaluated. Teachers can keep individual student portfolios that are solely for the teacher’s use as an assessment tool. This is a focused type of portfolio and is a model of the holistic approach to assessment.
Portfolio assessment has been used, or is presently being used, in many subjects, but limited research linking portfolio assessment to an increase in student achievement appears to exist. Educators may therefore wonder why they should change their current assessment methods. The fact that a portfolio may contain a large and diverse collection of data on student performances could provide a more accurate account of student learning than any standardized test. The question is how to implement portfolio assessment in a mathematics classroom when the most common form of assessment is paper and pencil testing, as is the North Carolina Algebra 1 EOC.

Math portfolios are “deliberate collections of student and teacher selected work that reflect students’ progress and success in mathematics over a period of time” (Micklo, 1997). A math portfolio is a collection of artifacts accompanied by reflective narratives that not only help the student understand and extend learning, but helps the reader of the portfolio gain insight about the learner. Within the context of a portfolio assessment, it is recommended that the following five learning dimensions be addressed: cognitive, affective, behavioral, metacognitive, and developmental (Simon, & Forgette-Giroux, 2000).

Wiggins (1990) states portfolio assessment has not been used in traditional state-testing because, “it requires students to perform what they have understood rather than to memorize; it presents the students with a full array of tasks rather than writing one line answers; it is process-oriented rather than guessing and selecting the correct answers; it probes the reliability and validity by devising a criterion varied to situation and the purpose of the assessment rather than trying to establish an objective framework.” Still, without empirical evidence to support the use of portfolios our assessment methods have not changed. Along with little empirical evidence there are some significant disadvantages to portfolio assessment.

Disadvantages
Although portfolios are an alternative to standardized testing, there are still many issues that need to be examined. The first concern is time. Portfolio assessment requires a great deal of preparation time before the implementation begins. During preparation time, decisions about what contents are expected to be in the portfolio and how those contents are going to be assessed must be made. Even though as Cramer (1993) notes, “students should have a say about the contents of their portfolios,” the teacher should provide a contents list and/or rubric of expectations. To ensure a successful portfolio experience for the teacher and the students, both need to be “on the same page” about expectations, activities, and products to be included in a portfolio. The teacher and the student need to know exactly what is going to be assessed and how it is going to be assessed.

A decision also has to be made on who will view the portfolio and, if different, who will be assessing the portfolio. There is also a concern about “portfolio storage, who is responsible for storing it, and how this will occur” (Lambdin and Walker, 1994). Cicmanec and Viechnicki (1994) indicated some unresolved issues with portfolio assessment including “legal defensibility, technical credibility, development and implementation, quality control, bias, fairness, and equal opportunities to learn.”

The issue of cost is always a factor of consideration in education. Portfolio assessments are a considerably more expensive alternative to state testing. “A recent estimate by General Accounting Office found that a national multiple-choice achievement test would cost $42 million, while a slightly longer test with short, performance-based questions would cost $209 million” (IASA, 1996). The states in which these methods were considered on a trial basis were: Arizona, California, Connecticut, Illinois, Kentucky, Vermont, and Wisconsin. IASA (1996) concluded “implementing statewide alternative assessments have expended considerable
resources not only training teachers to score assessments, but also to change their instruction to match the objectives tested.” A recent article in the Washington Post noted, “the portfolio system that has been used for 20 years in Great Britain has recently been discarded” (Matthews, 2004). The decline in portfolio use appears to be due to the belief that “portfolio activities took time away from basic skills and computation” (Matthews, 2004). The inequities in which schools administer requirements were also found to be an issue.

The question of validity is an issue in the upper grades and college levels. “Scorers may have no way to tell if the work samples came from a student or a smart uncle or from an Internet download” (Matthews, 2004). This raises further questions in the opposition of portfolio use. “Despite all these concerns, the benefits of portfolio assessment clearly outweigh the negative aspects” (Apple & Shimo, 2004).

Advantages

Although there is limited research supporting the claim that portfolios increase achievement levels, there is sufficient support for cognitive and affective gains. Cook-Benjamin (2001), who has used portfolio assessment for over a decade, states that her students “see the growth they have achieved and the areas in which they still need to improve.” This is a major advantage over EOC exams because the students never see what questions they got right or wrong. All they see is a score that determines whether the state believes the student is proficient or not. As a teacher, I would love to at least get some type of data showing questions missed that could help me as an instructor. Then I would have some data illustrating goals or concepts I may not address adequately during instruction. With a portfolio, self evaluation occurs consistently throughout the year for the student as well as the teacher. Cook-Benjamin (2001) also stated that her students “felt a sense of accomplishment” and former students were “using the portfolio as a
referral device in later classes.” There is also evidence that “portfolio assessments of mathematics learning facilitates learning and enhances communication among students, teachers, and parents” (Cicmanec and Viechnicki, 1994).

“Portfolios also help students develop skills for life-long learning” (Koca and Lee, 1998), such as organization, communication, and work ethic. In a thesis by Pinzker (2001), she concluded that “students recognize when a teacher is focused on student learning and achievement. Students appreciate and know when the teacher provides new opportunities for learning that are different from the traditional mathematics classroom.”

In a website article from Prince George’s County Public Schools, the advantages of using portfolios are listed (Prince Georges Schools, 1991):

1) Revealing a range of skills and understandings.
2) Supports instructional goals.
3) Reflects change and growth over a period of time.
4) Encourages student, teacher, and parent reflection.
5) Provides continuity in education from one year to the next.
6) Instructors can use them for a variety of purposes.

In addition to these examples, other advantages are cited as “portfolios provide more information about student progress and encourage students to be responsible for their own learning” (Koca & Lee, 1998). Portfolios are also believed to shift the responsibility of grading papers to the more valid assessment of work samples.

But, will the implementation of portfolio assessment lead to students performing at a higher level of proficiency in Algebra 1? Although research for implementing authentic assessment into the math classroom and research linking portfolio assessment to achievement is
limited, I hope to show evidence through this study that authentic assessment can lead to an increase in achievement. My focus has been on reaching higher levels of proficiency in Algebra I using an alternative method of assessment to supplement standardized testing, but I will also examine cognitive, affective, and social gains of the participants.

RELEVANT LITERATURE

Where are Portfolios Used?

Portfolio assessment has been used, or currently is being used, in a variety of educational fields. Academic domains in which portfolio assessment has been applied are: language arts (Gagliano and Swiatek, 1999), writing and math (Koretz, Stecher, Klein, McCaffrey, and Deibert, 1993 also Brosnan and Hartog, 1993), science (Berenson and Carter, 1995), physical education (Kulinna, 2001), ESL students (English and Keshavarz, 2002 also Pierce and O’Malley, 1992), students at-risk of failing (Smith, Brewer, and Heffner, 2003), paraeducators (Winans, 2003), higher education (Johnston, 2004), medicine (Driessen, van der Vleuten, Schuwirth, van Tartwijk, and Vermunt, 2005), and primary grades (Micklo, 1997). Practioners in each of the domains chose to implement alternative assessments for the following reasons: low scores on state mandated tests; discrepancies between tests and student ability; and an overall dissatisfaction with the limitations of standardized testing to accurately assess the students. Fields/disciplines not using a state exam such as physical education, medicine, and higher education, have applied an alternative assessment method that represented knowledge and allowed for more student involvement in the assessment process. No matter which field of study, the consistent argument reflects a perceived need for better forms of assessment.
AVID is an academic program designed to support students in the “academic middle” and every student enrolled is required to keep a three-ring binder, similar to a portfolio, to house the contents of their academic subjects. Involvement in the AVID elective provides time during the school day to teach organizational skills, effective studying habits, and receive academic help from tutors. The program “has a proven track record in bringing out the best in students” (AVIDonline, n.d.). The organizational skills and experiences appear to be an important part of this process.

What are the Findings?

Since 1990, “94.3% of AVID students report enrolling in college; 77.1% in four-year institutions and 17.2% in community colleges. The national average for four-year college enrollment is 35%” (AVIDonline, n.d.). Although portfolio assessment is not implemented into the AVID curriculum, its key element of success is; organization.

“Portfolios are being heralded as vehicles that provide a more equitable and sensitive portrait of what students know and are able to do” (Herman and Winters, 1994). Empirical research specifically linking portfolio assessment to increased levels of achievement is very limited. However, findings in a majority of alternative assessment implementations show students’ cognitive and affective gain. In a study done by Hackett and Wilson (1995) primarily focused on mathematics communication, they “found that there was improvement in the usage of mathematical language. As the writing improved, confidence about what was being written was also increased.” In the 2004 JALT Pan-Sig proceedings, Apple and Shimo reported that portfolio construction was more difficult for students, but learners showed improved cognitive awareness and encouraged learner autonomy. Apple & Shimo (2004) stated that students were able to enjoy their assignments while they were developing cognitive and affective abilities. In
an article by Lambdin and Walker (1994), math teachers that implemented portfolio assessment in their classrooms state that:

Portfolios has changed my communication with students and their parents in ways I had never considered before. Student-parent communication has also benefited. My students are more thoughtful about what mathematics they are studying and why. They seem to be developing a better understanding of what is meant by problem solving and mathematical reasoning. They are improving their abilities to communicate about mathematical ideas and about their own personal strengths and weaknesses.

The previous research provides evidence of cognitive and affective gains; though limited evidence of portfolios increasing achievement levels exists, some evidence has been presented. Shultz (1998), a seventh grade middle school science teacher, found the “implementation of student portfolios did improve the student’s organization and impacted positively on the student’s academic performance.” More specifically, test scores improved an average of 6% during the intervention (Shultz, 1998). English and Keshavarz (2002) conducted a study in Iran that focused on 60 female high school sophomores needing to pass the Nelson English Language Test. The 60 students were split into two groups of 30, an experimental group and a control group. The experimental group was assessed through teacher-made tests as well as a portfolio, while the control group only received teacher made tests. After administering the Nelson English Language Test, it was found that the experimental group had a higher mean score than the control group. This finding indicated that “portfolio assessment is a promising testing and teaching tool for teachers in EFL classes” (English and Keshavarz, 2002).
Hicks (1998) used portfolio assessment at a middle school with a population of only 180 students. This middle school is in the “deep south” and is a Drop Out Prevention middle school. The school proficiency level in science had dropped each of the previous two years such that during the 1995-1996 school year only 100 of the 155 (65%) students met the district requirement for successful completion of middle school science. The following school year, 1996-1997, only 93 of the 168 (55%) students, a 10% reduction, met the district requirement. The following year portfolio assessment was implemented along with workshops for teachers and multiple intelligence classes. In the 1997-1998 school year, 164 out of the 180 (91%) enrolled students met the district requirements for passing science. This was an increase over the previous two years of 65% and 55% respectively.

In another middle school study conducted by Cross, Greer, and Pearce (1998), portfolio assessment was implemented along with traditional testing. The study focused on reading comprehension at the fifth grade level and five unit tests were given “authentically and traditionally.” Even though not all students scored higher on the authentic assessment than the traditional scores, authentic assessments averaged out to be higher than the traditional tests for each unit. Given this kind of evidence in a variety of grade levels and content areas, the question is why move toward a portfolio assessment in the mathematics classroom.

Why Use Portfolios in Math?

“Students are not interested in math because there is a lack of variety in teaching strategies. Traditional methods of teaching math fail to show transfer of material to life and relevance to the student” (Panasuk and Greenleaf, 1998). Research has shown that “classrooms in which discussion of multiple solutions are allowed have higher-achieving students” (Barb and Quinn, 1997). Ellsworth and Sindt (1994) also found that “learning can be advanced when
teachers challenge students to find alternative solutions.” Pinzker (2001) conducted a study with 10-12 grade math students in which she used a portfolio to supplement teacher made tests; she stated that “students showed an increase in achievement as measured by semester grades and journal entries.”

Wolfe (1996) concluded that “through the use of large-scale portfolio assessment, students can realize educational outcomes that are not afforded in an educational system that focuses on traditional goals such as acquiring content knowledge and performing well on standardized multiple-choice tests.” In addition, “students were able to reflect on and formulate statements about their personal beliefs, values, their understandings of themselves as learners and writers, their abilities and skills as writers, and their goal aspirations” (Wolfe, 1996).

The fact remains there is a lack of empirical evidence linking portfolio assessment to achievement, especially in mathematics. The purpose of this study is to provide evidence that implementing a portfolio assessment in an Algebra 1 classroom will promote higher levels of proficiency than traditional assessment methods.

METHODS

Sample

Participants in the study included 22 Algebra 1 students ranging from ages 14 to 18. These 22 students were assigned to the course at the beginning of the fall semester and separated into two classes in which 10 were in first period and 12 in second period. No systematic procedures were used to assign these students into the Algebra 1B classes. Students were assigned based on their scheduling needs and whether they had successfully completed Mod 2. I randomly chose the students in first period to be the portfolio assessment group and second
period the traditional assessment group. Even though all 22 participants in the study are Algebra 1B students, meaning they have failed Algebra 1 at least once previously, the classes were split in a way that could not guarantee equivalence. For example, the portfolio group consisted of 4 males and 6 females, while the traditional group included 8 males and 4 females.

The table on page 17 shows the gender and ethnic breakdown for the portfolio and traditional groups in comparison to all students taking the Algebra 1 EOC in the fall of 2005 at my high school. Table 1 shows that the percentage of minority students in my classes is high, 40% in the portfolio group and 42% in the traditional group, which is inconsistent with the overall percentage of minority students advancing to Mod 3 in Algebra 1 which is approximately 21%. In fact, out of the 22 minority students taking the Algebra 1 EOC during the fall semester, 9 (40%) were in one of my two classes. A complete description of all participants including grade point average, courses failed, and attendance is presented in Appendices F and G.
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Table 1. Gender and ethnic breakdown of all students taking the North Carolina Algebra 1 EOC during the Fall 2005 semester.
Measurement

To ensure the students in both groups had equivalent prerequisite skills, the classes completed a pre-test. The McDougal Littell Algebra 1 Pre-Course test was given to both classes on the same day during the first week of school to make sure the comparison of scores would be valid. At the end of the semester each participant completed the McDougal Littell Post-Course test. Both the pre- and post-test were published by McDougal Littell and aligned with the North Carolina Competency Goals for Algebra 1. These test scores were used to compare the levels of growth between the portfolio assessment group and the traditional assessment group.

Since I did not implement the portfolio assessment until the second nine weeks, a chapter test/retest was used to explore potential growth before the implementation of the portfolio. I began the school year with a chapter in the middle of the book, Equations of Lines, which is covered heavily on the Algebra 1 EOC. Both groups were administered the same test consisting of 25 free response and multiple choice questions. The participants took the chapter test during the first week of school and then took the same test again before midterms. Finally, the North Carolina Algebra 1 EOC Exam was used to compare levels of proficiency.

Procedure

The instructional and assessment procedures for both the portfolio assessment group and the traditional assessment group were the same during the first nine weeks of school. Both classes were taught using traditional direct instruction, and grades were dependent upon tests, quizzes, and class-work. Due to schedule changes, newly enrolled students, and students withdrawing, I did not change my instruction or assessment for either group until the second nine weeks. During the second nine weeks, the second period Algebra 1 class remained under
traditional direct instruction and the first period Algebra 1 class had portfolio assessment
integrated into the curriculum.

The participants in the portfolio assessment group were required to keep a portfolio
divided into the following five sections: bell-work, notes, tests/quizzes, journals, and Algebra 1
goals. These five sections were chosen to create an organizational infrastructure that mirrored
the structure of the class. Each class consisted of bell-work that lasted 10 to 15 minutes and
included review questions from the previous day. Once bell-work was complete we moved on to
the day’s objectives and notes. Journals were only assigned after chapter tests. Towards the end
of the semester, I selected questions that aligned specifically with the North Carolina
Competency Goals for Algebra 1; the students kept them in the goals section to reference while
studying. These five sections were graded equally on a 500 point scale, 100 points per section,
for which I created a holistic rubric as a guide for evaluation.

The portfolio assessment group was still required to take the same exams as the
traditional assessment group. Specific exams were selected at the beginning of the school year to
use for comparison between the portfolio assessment group and the traditional assessment group.
Those exams selected for comparison were the McDougal Littell Algebra 1 Pre- and Post-Course
Test, the Chapter 6 Test on Equations of Lines, and the North Carolina Algebra 1 End of Course
Exam. The pre-test was used to ensure equivalence on prerequisite skills for the two classes.
The post-test scores were used to show the levels of growth for students in the portfolio
assessment group in comparison to the students in the traditional assessment group. The North
Carolina Algebra 1 EOC Exam scores, which were taken at the end of the fall semester in
January, were used to show the levels of proficiency in the portfolio class versus the traditional
class. The mean EOC score for the portfolio class was also used in comparison with the previous
school year’s mean score.

Data Collection

The focus of this study was to provide evidence that implementing portfolio assessment into an Algebra 1 class would lead to students achieving higher levels of proficiency than a class using only paper/pencil traditional assessment. The four sources of measurement used for comparison between the two groups were: Class Assessment, Equations of Lines test/retest, McDougal Littell Algebra 1 Pre- and Post-Course Test, and the North Carolina Algebra 1 EOC. Prior to the study, six of the participants, two in the portfolio group and four in the traditional group, had advanced to Mod 3 and had taken the Algebra 1 EOC. All six had previously failed the exam. The scale scores of the six participants who were taking the Algebra 1 EOC for the second time were used in comparison to their previous score. Also, the scale score increase of the two students in the portfolio group was compared to the increase of the four students in the traditional group.

RESULTS

The data presented in the table on page 21 represent the mean score for the portfolio and traditional assessment groups within each measurement used by the instructor. A list of all individual scores for each group is presented in Appendices D and E.
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<th>Group</th>
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<th>Algebra 1 EOC</th>
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^aMean adjusted for n = 10.
^bMean adjusted for n = 11.

Table 2. Mean scores for portfolio assessment group versus traditional assessment group. n = 9 for cells unless otherwise noted.
The results show the mean scores for the traditional group on the class assessment, McDougal Littell Algebra 1 Post-Course Test, and the North Carolina Algebra 1 EOC were higher than the mean scores for the portfolio assessment group. The McDougal Littell Post-Course Test and Algebra 1 EOC only differed by 2.8 and 1.2 points respectively, but the class assessment showed a difference of 5.1 points. The results for the Equations of Lines Test, which was given during the first week of school, provided evidence of equivalence between the portfolio and traditional groups with mean scores of 62 and 56.9 respectively. Prior to the midterm, when the re-test was administered, the portfolio group scored a mean of 75 which was a 13 point increase from the original test. The traditional group only increased their achievement by scoring a mean of 59.3; a 2.4 point increase.

The results for the students taking the North Carolina Algebra 1 EOC for the second time were also examined. One of the six students, who advanced to Mod 3 the preceding year, withdrew from school during the study. The data for each student who had previously taken the Algebra 1 EOC are presented in Table 3 on page 23.
<table>
<thead>
<tr>
<th>Group</th>
<th>Student</th>
<th>Prior to Fall 2005</th>
<th>Conclusion of Fall 2005</th>
<th>Amount of Increase/Decrease</th>
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*Student scores not available due to withdrawing from school during the study.

Table 3. Student scale score on Algebra 1 EOC prior to and at the conclusion of the Fall 2005 semester.
The results show four out of the five students (80%) increased their achievement level. Closer examination reveals both students in the portfolio assessment group increased their achievement level. Two of the students in the traditional group also increased their achievement level, however, one student decreased by three points. The average rate of change for the portfolio and traditional assessment group was +18.5 points and +16 points, respectively.

DISCUSSION

The data from the four sources of measurement indicate that implementing portfolio assessment did not lead to a higher mean score on the North Carolina Algebra 1 EOC compared to the traditional group. The traditional group had a mean score of 1.2 points higher than the portfolio assessment group. However, the data do show an almost equal mean proficiency score between the portfolio and traditional assessment groups and both groups had a mean score over 80. Also, when examining the scores from the students who had previously taken the North Carolina Algebra 1 EOC, each of the two students in the portfolio assessment group increased their scale score by 30 points and 7 points respectively. One of the three students in the traditional assessment group scored less than their previous score. Also, the average rate of increase for the students in the portfolio assessment group was higher than the students in the traditional assessment group.

The mean scale score on the Algebra 1 EOC for the portfolio assessment group was also compared to the mean score from the previous school year, 2004-2005. The previous year’s mean was 84.8, which is 4.3 points higher than the 80.5 scored during the study by the portfolio assessment group.

Another important note about the portfolio group’s mean scores for the McDougal
Littell Post-Course Test and the class assessment is that one of the students changed schools in December. This student had a high “B” average before leaving and would have affected the mean scores for the McDougal Littell Post-Course Test and the class assessment in a positive way.

As far as classroom management, the portfolio group was a much easier class to handle because of the required organization. I did not have any discipline problems in the portfolio group during class and the only referral I had to write was because of tardiness. The only other student issue within the portfolio group was a student who was absent 31 of the 90 classes. Since our county does not have an attendance policy, teachers must take it upon themselves to make sure absences are legitimate and hopefully minimal. After 10 absences and no returned phone calls from home, I confronted the student and he/she informed me of his/her lack of parental support and how he/she was going to get a job and drop out of school. The student ended up getting a job and working late on school nights, but also tried to come to school everyday and scored the second highest in the class on the Algebra 1 EOC.

I had four similar situations of students threatening to drop out in the traditional group that did not result in the same happy ending. Three of the four students in the traditional group withdrew from school and the fourth, who was a tremendous discipline problem, finished the semester by scoring the lowest on the EOC out of both classes.

CONCLUSIONS

The portfolio group bought into the new assessment early and could see I was trying to help them by changing their image of a math class. Throughout each class the students were constantly taking notes, giving feedback, and willing to work more difficult problems instead of
putting their notes away. The class was engaged for the entire 90-minute block each day which is tough for me to accomplish even with my honors classes. The portfolio required them to be organized and take control of their own learning and they accepted the challenge. They enjoyed doing something new, and though taking notes and paying attention should not be new, it was for these students.

If the traditional group had the required organization, I know for a fact that I could have gotten more out of those students and may have enticed the students who dropped out to stay in school and try to pass. The traditional group accepted defeat from day one, skipped class, and often caused disruptions because they were tired of the same stuff. It seemed that the majority of the students in the traditional group felt they were going to fail again. Only 5 of the 12 students within this group kept an organized notebook on their own. It took almost the entire semester for them to realize I was on their side and wanted to help them pass. The portfolio group appreciated the teaching of organizational skills and took pride in their notebooks; they even started to bring their own materials to class. I had to beg the traditional group to get class started when the tardy bell rang; some students never had paper or pencil. Even when I provided the materials, some students would only participate for a very minute portion of class.

The transition from the portfolio assessment group, which was first period, to the traditional assessment group, second period, was like “night and day.” I was often frustrated because the students within both groups were so alike at the beginning of the fall semester. Yet when the portfolio assessment was implemented, it was like a “switch was turned on” in first period. The levels of attention, respect, and interest in the class all increased. Even though the quantitative results show a fairly equal level of achievement between the two groups, the quality of the learning experience for the portfolio assessment group was far higher than the traditional.
The students in the portfolio group developed higher levels of self-assessment, self-discipline, organization, and work ethic. I truly enjoyed the learning experience of implementing portfolio assessment in an Algebra 1 class. I am excited to have found an assessment method that is conducive to both student and teacher growth.

Limitations

There are several limitations of this study. The implementation of the portfolio assessment was only 9 weeks long instead of the full 18-week semester in order to avoid scheduling conflicts. Therefore, the portfolio assessment group still received 9 weeks of traditional assessment along with portfolio assessment. Once the study was complete, I was able to see what changes needed to be made for future implementation. If I had more preparation time or collaboration, the portfolio assessment may have reached its potential. After the implementation, I realized there was still too strong an emphasis on testing and not enough on reflective practice. Given a full 18-week implementation, the student self-reflection and assessment time would have doubled possibly leading to higher achievement levels.

The results of the pre- and post-test showed that both classes increased their achievement level, however, the mean scores were still below passing. Therefore, the pre- and post-test were possibly too difficult. The tests for both classes were never all multiple choice including problem solving questions that frequently required the use of higher order thinking. I never taught either class to guess the right answers or plug-in values to see what works. Therefore, although the traditional group faced more basic instruction, the students were still often forced to use higher order thinking.

Another limitation was the small class size of both groups, 10 for the portfolio assessment group and 12 for the traditional assessment group. The number for the traditional
group decreased to 9 students with the withdrawal of three participants. This extremely small
class size may have positively affected the success of both groups.

One last limitation is much of the limited research linking portfolio assessment to
achievement has been done by graduate students.

Implications

This study brings attention to several implications for future research. Due to the success
of the portfolio assessment group, I can infer that portfolio assessment is a potentially useful
strategy for students who struggle in, or have failed Algebra 1. Also present in this study was
portfolios as a helpful tool for classroom management. Future research is also needed on
organization and its positive affect on achievement.

As far as future work in curriculum and instructional supervision, a few areas need
further investigation. There have been a couple of recent changes in the North Carolina
secondary mathematics curriculum such as eliminating trigonometry as a course and increasing
the requirements for admission to 4-year college/universities. One curriculum change to
possibly pursue is developing an alternative math course for students who fail Algebra 1. This
course would be designed for students who are on the Career-Prep track and could be used as the
student’s graduation requirement instead of Algebra 1. Another possibility could be to
investigate the implementation of portfolios into the Progressive Algebra program offered at my
school in hopes of changing our current decline in Algebra 1 proficiency.

Upon completing my graduate studies, I am confident that I can play a key role as an
instructional supervisor at my school. I would like to become an Initially Licensed Teacher
(ILT) mentor in the math department and possibly take on a role of mentor for all beginning
teachers at my school. I feel that through my graduate studies I have learned how to advocate for
younger teachers by supporting emotional and instructional concerns; especially assessment issues. I feel it is vital in education to investigate alternative approaches toward assessment. I would not require teachers to apply one particular assessment strategy, but I would make myself available for suggestions. I would also like to offer a workshop on portfolio assessment providing teachers with answers to the following questions: What is portfolio assessment, why should we use it, and how do we implement it? By answering these three questions first, maybe this will “get the ball rolling” on more implementation of portfolios, leading to more research hopefully linking portfolio assessment to increased achievement.
LITERATURE CITED


Statewide performance of students tested in Algebra 1.

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County performance of students tested in Algebra 1.

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High school performance of students tested in Algebra 1.

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Appendix D. Student performance in portfolio assessment group.

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<td>53</td>
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<td>68</td>
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<tr>
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*Scores not available due to student changing schools during the study.
Appendix E.  Student performance in traditional assessment group.

<table>
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<th>Student</th>
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<td>Post</td>
<td>Test</td>
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<td>NA*</td>
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<td>42</td>
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*Scores not available due to student withdrawing from school during the study.
## Appendix F. Cumulative High School Report for Portfolio Assessment Group.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Gender</th>
<th>Ethnicity</th>
<th>Age</th>
<th>Grade</th>
<th>GPA</th>
<th>Math Course Taken/Grade</th>
<th>Courses Failed</th>
<th>Absences / Tardies</th>
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<tbody>
<tr>
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<td>4/22</td>
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<tr>
<td>006</td>
<td>F</td>
<td>White</td>
<td>15</td>
<td>9</td>
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<td>Earth &amp; Environmental, English 1, World History, Mod 2</td>
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<td>Algebra 1B, Earth &amp; Environmental, Spanish 1</td>
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<td>23/62</td>
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Appendix G. Cumulative High School Report for Traditional Assessment Group.

<table>
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<th>Student #</th>
<th>Gender</th>
<th>Ethnicity</th>
<th>Age</th>
<th>Grade</th>
<th>GPA</th>
<th>Math Course Taken/Grade</th>
<th>Courses Failed</th>
<th>Absences/Tardies</th>
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</thead>
<tbody>
<tr>
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<td>White*</td>
<td>16*</td>
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<td>NA*</td>
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<tr>
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<td>M</td>
<td>White</td>
<td>16</td>
<td>10</td>
<td>2.5</td>
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<td>Algebra 1B</td>
<td>8/14</td>
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<tr>
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<td>White</td>
<td>18</td>
<td>12</td>
<td>1.3</td>
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<td>Algebra 1A, 1B, Physical Science, Principals of Business, Intro Math, English 3</td>
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<td>4/19</td>
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<td>9</td>
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<td>English, World History</td>
<td>3/14</td>
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<tr>
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<td>M</td>
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<td>15</td>
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<td>Fundamentals of Technology, English 1, Spanish 1, World History</td>
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<td>World History, Appar. Div., Earth and Environmental</td>
<td>4/63</td>
</tr>
</tbody>
</table>

*Student records unavailable due to being a new student at the school and withdrawing during the study.*
Appendix H. Rubric for Algebra 1 portfolio.

Algebra 1 Portfolio Rubric

Student Name ______________________________ Date ___________________

Scoring: 100 – 90 -Exemplary work
-All work dated and in order.
-All bellwork, notes, journals, and assignments complete with a maximum of 2 missing tasks.

89 – 80 -Satisfactory work
-Majority of work dated and in order.
-Bellwork, notes, journals, and assignments complete with 3 to 4 missing tasks.

79 – 70 -Minimal work
-Minimal work dated and in order.
-Incomplete bellwork, notes, journals, and assignments with 3 to 6 missing tasks.
-1 portfolio entry missing or incomplete.

69 – 60 -Inadequate work
-Incomplete bellwork, notes, journals, and assignments with more than 6 missing tasks.
-2 or more missing or incomplete portfolio entries.

<table>
<thead>
<tr>
<th>SECTION</th>
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<tbody>
<tr>
<td>Bellwork</td>
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<tr>
<td>Notes</td>
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<td>Quizzes and Tests</td>
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<td>Journals</td>
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<tr>
<td>Algebra 1 Goals/Portfolio Entries</td>
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</tbody>
</table>

Total = ________________

% = ________________

Comments:

Student Signature ______________________________

Teacher Signature ______________________________
Appendix I. Rubric for portfolio entries.

**Algebra 1 Portfolio Rubric (Problem Solving)**

Portfolio Entry _______________________________________________________

4 Rating = Exemplary Response

- Chooses appropriate strategy (Problem Solving)
- Finds all possible solutions (Problem Solving)
- Provides clear, coherent explanation (Communication)
- Includes clear diagrams, drawing, model if appropriate (Communication)
- Computes correctly (Computation)

3 Rating = Satisfactory Response

- Chooses appropriate strategy (Problem Solving)
- Finds most solutions (Problem Solving)
- Provides reasonably clear explanation (Communication)
- Includes diagrams, drawings, even though they may be unclear or incomplete (Communication)
- Generally uses appropriate mathematical terms (Communication)
- Computes correctly (Computation)

2 Rating = Minimal Response

- Chooses an inappropriate strategy (Problem Solving)
- Finds one possible solution (Problem Solving)
- Explanation is somewhat unclear (Communication)
- Diagrams, drawings are somewhat unclear (Communication)
- Misuses or confuses mathematical terms (Communication)
- Computation has minor errors (Computation)

1 Rating = Inadequate Response

- Chooses an inappropriate strategy (Problem Solving)
- Finds one or no solution (Problem Solving)
- Explanation is unclear or missing (Problem Solving)
- Diagram, drawings are unclear, missing, or inappropriate (Communication)
- Fails to use mathematical terms (Communication)
- There are serious computation errors (Computation)

0 rating = No Attempt

Student Score = ___________