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The effectiveness of using portfolio assessment to improve instructional planning and to determine attitudes toward mathematics of sixth grade students

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THE EFFECTIVENESS OF USING PORTFOLIO ASSESSMENT TO IMPROVE INSTRUCTIONAL PLANNING AND TO DETERMINE ATTITUDES TOWARD MATHEMATICS OF SIXTH GRADE STUDENTS

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ABSTRACT

Moran, Heather A. The Effectiveness of Using Portfolio Assessment To Improve Instructional Planning and To Determine Attitudes Toward Mathematics of Sixth Grade Students. 1995. Thesis Advisor: Dr. Louis Molinari, Department of Elementary Education.

It was the purpose of this study to determine the effectiveness of using information gained from portfolio assessment to improve the quality of instructional planning in order to meet the needs of a specific group of students. This study also evaluated the change in attitude toward mathematics of the control and the experimental groups. A unit on the addition and subtraction of fractions was taught by this researcher to two different sixth grade classes. The control group was instructed using lessons designed from textbook recommendations and the experimental group was taught using lessons designed from a combination of textbook recommendations and portfolio data.

In order to evaluate growth in achievement, a Pretest designed by the Addison-Wesley Publishing Company was administered to both seventeen member groups at the beginning of instruction. After the seven week unit, the Addison-Wesley Posttest was administered to both groups. Using a *t*-test at the 0.05 level of confidence, it was found that there was no significant difference in growth of achievement between the two sample groups. Based on these findings, portfolio assessment, as used in this study, does not significantly improve the effectiveness of instructional planning.

The *Children's Academic Intrinsic Motivation Inventory* was given to both groups as a pretest and posttest to measure attitude toward mathematics. Using a *t*-test analysis at the 0.05 level of confidence, it was found that there was no significant difference in attitude toward mathematics between the two groups. Based on these findings, portfolio assessment, as used in this study, did not effect attitudes toward mathematics.

MINI-ABSTRACT

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The Effectiveness of Using Portfolio Assessment To Improve Instructional Planning and To Determine Attitudes Toward Mathematics of Sixth Grade Students. 1995. Thesis Advisor: Dr. Louis Molinari, Department of Elementary Education.

It was the purpose of this study to determine the effectiveness of using portfolio assessment information to improve the quality of instructional planning. This study evaluated effectiveness in terms of achievement and attitude. Using the *t*-test for significant differences at the 0.05 level of confidence to evaluate the data from the achievement pretest and posttest designed by Addison-Wesley, portfolio assessment, as used in this study, does not improve the quality of instructional planning. Based on the results from the *Children's Academic Intrinsic Motivation Inventory*, using the *t*-test for significant difference at the 0.05 level of confidence to analyze the data, portfolio assessment, as used in this study, did not significantly alter student attitude toward mathematics.

TABLE OF CONTENTS

LIST OF TABLES

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CHAPTER ONE

INTRODUCTION

The Problem

This study will provide evidence regarding the effectiveness of portfolio assessment in the planning process for daily classroom instruction. The pivotal question is: Could it be that this specific, teacher-designed portfolio assessment method of lesson planning will improve the quality of instruction for a specific group of students in the sixth grade?

Significance of the Study

The *Curriculum and Evaluation Standards for School Mathematics*, or *The Standards*, were adopted by the National Council of Teachers of Mathematics (NCTM) in March, 1989. This document was written in response to a desire of NCTM to "create a coherent vision of what it means to be mathematically literate both in a world that relies on calculators and computers to carry out mathematical procedures and in a world where mathematics is rapidly growing and is extensively being applied in diverse fields" (NCTM, 1989). This desire for change has affected all areas of mathematics education from: materials used in classrooms, instructional methods employed, and the way in which teaching and learning is evaluated.

Bonita Gibson McMullen (1993) has stated that assessment in mathematics education has become a very significant issue. Educators are being challenged to investigate alternative means of assessing student performance and to explore the ways in which these alternative methods influence instructional practices. McMullen (1993) stated that useful methods of assessment provide teachers with enough information to determine what the student understands, which in turn allows the teacher to alter the way he/she teaches.

The NCTM (1989) also supports this position stating that educators must place an increased "emphasis on the role of evaluative measures in gathering information on which teachers can base subsequent instruction." If educators are able to create a substantial link between instructional practices and evaluation practices, both processes will be strengthened. However, when educators view instruction and evaluation as separate entities, continuity is lost and both areas suffer.

The Standards also delineate new goals for mathematics education. Society is rapidly moving into the information age and away from the more traditional industrial-based environment. The reliance on calculators, computers, and other technologies have made past goals for education insufficient. Among the new goals for mathematics education (NCTM, 1989) are included the following:

1. Learning to value mathematics
2. Becoming confident in one's ability
3. Being a problem solver
4. Learning to communicate mathematically
5. Learning to reason mathematically

In order to meet these new goals of education, methods of assessment and instruction must change.

Gerald Kulm (1993) supports this assertion. He stated that when teachers were able to utilize alternative assessment methods, their teaching methodologies changed accordingly. Kulm (1993) found that teachers "did activities that enhanced meaning and understanding, developed student autonomy and independence, and helped students learn problem solving strategies" when they used alternative assessment methods. Teachers in Kulm's study also indicated that they felt more able to accurately assess student's areas of weakness and plan instruction accordingly.

The NCTM supports this method of student evaluation. NCTM (1989) described evaluation as a method to:

1. identify areas of difficulty for individual students.
2. gather data for instructional planning.
3. assign grades.
4. evaluate a program.

Educators need to have a clear understanding of what information they are attempting to gain from a particular evaluation method. "The purpose of assessment should dictate the kind of questions asked, the methods employed, and the uses of the resulting information" (NCTM, 1989). This exemplifies the need for alternative assessment methods. Traditional methods, such as paper and pencil tests, often provide only a limited amount of information about student understanding and proficiency and feedback is not immediate (Virginia Education Association & AEL, 1992). In order to meet the stated goals of the NCTM, instruction and evaluation must become broader and include more emphasis on student involvement, which in turn comes closer to meeting the new goals for mathematics education.

In order for students to become mathematically literate and proficient problem solvers, they must be allowed to investigate mathematical issues in a wide variety of ways. Students need to develop the ability to assess themselves. This type of practice can be a valuable, life-long skill (Virginia Education Association & AEL, 1992). For this to occur, assessment must be altered to match the current changes in instructional methodology. "Alternative assessment is aimed at stimulating students to think, to react to new situations, to review and revise work, to evaluate their own and others' work, and to communicate results in verbal and visual ways" (Virginia Education Association &

AEL, 1992). The connection between alternative assessment methods and the contemporary goals of mathematics education are clear. The goals of education encompass higher level thinking skills, reasoning skills, and creative problem-solving abilities. Alternative methods of assessment are geared toward ensuring that these goals will be met.

What methods of alternative assessment allow a teacher to make the most informed decisions about instructional planning? Nancy Kober (1991) stated that "there is a strong correlation between verbal aptitude and achievement in mathematics." With this in mind, it becomes clear that communication is a major key to successful mathematics instruction. Communication can be achieved in a variety of ways including listening, reading, writing, and speaking. Traditional mathematics classrooms tend to focus only on writing numbers and symbols and talk between teacher and student. More contemporary methods of teaching and assessment focus on talk between students about mathematical ideas and writing to explain understanding, as opposed to strict computation.

When the focus of mathematics instruction becomes the development of conceptual and higher order skills, portfolio writing may become an effective method for increasing understanding and assessing student progress. "Research supports the use of writing activities to improve math skills and help lighten math anxiety. Writing problems or keeping journals helps students communicate about math and order their thoughts" (Kober, 1991).

Communication, especially in the form of writing, also helps students explore the reasons behind various mathematical ideas. Children are much more apt to remember and utilize information if they are able to understand and interpret the relationships behind it. Students who are able to internalize the "why" part of a particular topic are able to "remember facts longer, use them more readily, and apply their knowledge to new learning tasks" (Kober, 1991).

This ability to understand and communicate the "why" part of a particular topic allows students to acquire and reinforce their higher level thinking skills. Contemporary teaching methodology encourages teachers to plan activities that allow children to think for themselves and communicate with their peers. Concepts presented in this way encourage children to refine their own thinking and enhance their understanding. Assessment methods that ask children to refine their thought processes do this as well, in turn allowing the development of higher level thinking skills.

Kober (1991) stressed that active instruction combined with alternative assessment methods allow children to have the opportunity to clarify their thinking in just this way. She stated that "communication, including listening, speaking, reading, and writing, is a major part of active instruction. In this way, students organize their thinking and confront incomplete understandings; teachers can tell whether students have grasped important mathematical concepts" (1991). It becomes a cyclical pattern in which instruction effects assessment and the results of assessment effect new instruction.

The studies cited offer many important findings, yet pose many interesting questions. As McMullen stated (1993) when "the method of assessment gives the teacher the necessary information to recognize what the student understands, then the teacher has the tools to change the way he/she teaches." The question becomes, how much information is enough? Is it possible to gain the necessary data from a set of portfolio entries to alter instruction in a positive manner? Can a teacher gather enough information from the portfolio data to impact on the learning of the class or is the information specific only to the particular child from whom it comes? Is portfolio assessment a viable alternative to traditional methods of assessment or should it be utilized only in conjunction with the methods already established in a classroom? The present study has attempted to examine the effects of portfolio assessment on the instructional planning in the classroom.

Statement of the Problem

This study will investigate the following problem: Could it be that this specific, teacher-designed portfolio assessment method of lesson planning will improve the quality of instruction for a specific group of students in the sixth grade?

General Hypothesis

There will be no significant differences between the effectiveness and accuracy of a teacher's lesson plans to more closely meet the needs of a specific group of sixth grade students when the instructional planning is based on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information about student understanding gained through student portfolios as measured by gains in achievement on the Addison-Wesley Pretest and Posttest. In order to investigate the general hypothesis above, a number of specific hypotheses were developed and are listed below.

Specific Hypotheses

1. There will be no significant differences in the effectiveness and accuracy of a teacher's lesson plans to more closely meet the needs of a specific group of sixth grade students when the instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measures by gains in achievement on the Addison-Wesley Pretest and Posttest.

2. There will be no significant differences between the information gained for instructional planning for sixth grade male students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the

instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest.

3. There will be no significant differences between the information gained for instructional planning for sixth grade female students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest.

4. There will be no significant differences between the attitudes toward mathematics when instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by the Children's Academic Intrinsic Motivation Inventory.

Method of Study

The purpose of this study was to determine if a difference exists between the effectiveness and accuracy of instructional planning in terms of meeting the specific needs of a group of students when instructional decisions were based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when instructional planning was based on information about student understanding gained via portfolio entries and confined with the Addison-Wesley recommendations.

Thirty-four students in two sixth grade classes at the Wenonah Elementary School, Wenonah, New Jersey participated in this study. The classes were selected because the students were heterogenously grouped for all subject areas. The class members were randomly selected at the beginning of the 1994-95 school year by the school principal based on teacher recommendations made in June, 1994.

The instructional lesson plans written for these particular classes up to the time of this study have been based on recommendations made by the Addison-Wesley Text Series, 1994 Edition. All assessment methods used to this point have been traditional, developed either by the Addison-Wesley Publishing Company, 1994 or the teacher. All assessment tools were primarily computational in content. Prior to the use of the portfolio assessment system, all students were given a pre-test to assess their attitudes about mathematics. The Children's Academic Intrinsic Motivation Inventory was selected for use.

The study began as both classes started a new unit entitled "Addition and Subtraction: Fractions and Mixed Numbers" (Addison-Wesley, 1994). The entire study lasted approximately seven weeks. At the beginning of the unit, each class was given the Addison-Wesley designed pretest to assess achievement prior to instruction. Lessons for Class A were then developed solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition. Lessons for Class B were developed by combining the recommendations of the Addison-Wesley Text Series, 1994 Edition with information about their conceptual understanding gained from their portfolio entries. At the conclusion of the unit, the Addison-Wesley Posttest was given to both classes to assess achievement. At the end of the seven week study, the classes were tested again on the Children's Academic Intrinsic Motivation Inventory to assess attitude.

Limitations

The following limitations have been identified in this study:

1. This study is limited by the small size of the sample population.
2. This study is not longitudinal. Long term results may not be realized.

3. Results of this study can apply only to the specific portfolio items which were used in the study.

4. Results of this study can apply only to the specific text series utilized.

Assumptions

It will be assumed that any improvement in the quality of the instructional planning in terms of meeting the specific needs of students after the use of the portfolio method of assessment, can be attributed to the data gained via the portfolio assessment method. It is assumed that all of the children in the study have had similar school experiences in the area of mathematics. Also. it is assumed that the children involved in the study are most familiar with traditional methods of assessment in the area of mathematics.

Definitions

1. Assessment - any systematic basis for making inferences about a student's learning progress and understanding.

2. Alternative Assessment - any assessment form other than standardized tests, commercial tests, worksheets, and the like.

3. Traditional Assessment - any assessment form resembling standardized tests, commercial tests, worksheets, and the like.

4. Portfolio - a record of learning that focuses on a student's work and often his or her reflection on that work; designed to show conceptual understanding of the student.

5. Authentic Assessment - assessment that engages students in challenges closely related to those that they will face as an everyday citizen.

6. Problem - a task for which a person wants or needs to find a solution

7. NCTM - National Council of Teachers of Mathematics.

Summary

Chapter One has provided an overview of the study and its significance. A brief description of the literature, method of study, and selection of groups for this study were presented. General and specific hypotheses were based on the statement of the problem. Limitations and assumptions, along with definitions were outlined.

CHAPTER TWO

REVIEW OF LITERATURE AND RESEARCH

Introduction

Historically, systems of formal education have been designed to meet two specific goals. Schools were to transmit various, socially agreed upon aspects of culture to the young. Additionally, schools were to aid students in achieving a higher level of self-fulfillment (NCTM, 1989). Today, these goals of education are not broad enough to prepare our youth for productive lives in our technologically-based society. Mathematics education is not immune from this shift in goals and educators in the field must realign their thinking about what is taught and why.

New goals for mathematics education include: "(1) mathematically literate workers, (2) lifelong learning, (3) opportunity for all, and (4) an informed electorate" (NCTM, 1989). It is a reality that the world's economic market is ever-changing and workers in all areas must be prepared to adapt to a number of given situations. The days of "shopkeeper" arithmetic are fading and employers are no longer seeking persons with these skills alone (NCTM, 1989). In fact, the United States Congressional Office of Technology Assessment (1988) stated that today's employees must be able to assimilate new and unfamiliar information, ask questions, and work cooperatively in a team environment. These skills were not required of the workers in years past. These workers were only expected to be computationally accurate and able to work alone.

Today's unstable economic climate has also effected the employment patterns of the modern worker. On average, workers will change jobs four or five times during their employment careers and each position will require a unique set of communication skills (NCTM, 1989). Along these same lines, the current economic status of most families have required that most adults work. Traditionally, mathematics was a discipline dominated by white males. However, with today's socio-economic realities, more women and other minorities are studying advanced mathematics and pursuing positions which rely heavily on the use of mathematics. Educational equity in terms of mathematics has therefore become an economic necessity.

The goal of an informed electorate is not to be forgotten either. It is vital to the survival of a democratic society that its members be aware of and understand the complex issues which face them. Questions about taxation, health care, defense spending, school vouchers, and welfare require the electorate to absorb large amounts of numerical information. People are required to understand the information and assimilate it into a usable form. Schools must be able to prepare our youth to perform such tasks.

Mathematics Education in the 1990s

Mathematics education in the 1990s must include a wider range of objectives than just pure computational skill. This is not to say that computational skill is unimportant, only that in order for our children to be successful they must have a firm understanding of important mathematical ideas (Heddens and Speer, 1992). Progress has been made in this area over the past few decades. The 1986 National Assessment of Educational Progress publication entitled *The Mathematics Report Card: Are We Measuring Up?* (1988) found that average mathematical proficiency for 9-, 13-, and 17-year old children had improved during the period of 1978 - 1986. This in itself is good news. Society still needs workers that are computationally competent. The distressing aspect of this study however, was that virtually 100% of all 17-year old students were proficient with basic arithmetic facts, but only 50% were proficient with moderately complex procedures and reasoning. The percent competent in multistep problem solving dropped off even more drastically.

This is especially disturbing when one looks at the *Curriculum and Evaluation Standards for School Mathematics* published in 1989 by the National Council of Teachers of Mathematics. The focus of this publication was the "vision of mathematical literacy necessary in a world that requires understanding and application of problem-solving and decision-making techniques" (Heddens and Speer, 1992). The NCTM *Standards* (1989) centered on five specific goals for all students:

1. that students learn to value mathematics;
2. that students develop confidence in their ability to use mathematics;
3. that students become problem solvers (as opposed to simply answer finders);
4. that students learn to communicate mathematically;
5. that students learn to reason mathematically.

With these goals in mind, it is easy to see why mathematics education, as it has been known traditionally, has become obsolete. The methods of instruction and assessment used in modern classrooms must reflect the fundamental philosophies illustrated in these goals in order to ensure that students will be adequately prepared for their place in society.

In the past, mathematics instruction and assessment was passive and generally based on computational drill and rote memorization. Today's classrooms are urged to go in the direction of active instruction so that understandings of basic mathematical principles and the interrelationships among number systems are stressed. This is not to degrade the importance of basic fact and algorithm memorization, only that it should be proceeded by a deep understanding of the reasons why (Heddens and Speer, 1992). It has been found that students who think through mathematics gain more confidence in their own abilities than those who simply memorize rules (Heddens and Speer, 1992).

Changes in classroom practices and evaluation methods are also necessary due to changes in the mathematical expectations of workers. Henry Pollack, of Bell Labs, reported the following to the Mathematical Sciences Education Board in 1987. He found that employers were looking for individuals who:

- have the ability to set up problems, not just respond to previously identified ones;
- have knowledge of a variety of approaches and techniques to solve problems;
- have an ability to work with others to reach a solution to a problem;
- have an understanding of the underlying mathematical features of a problem;
- have the ability to recognize how mathematics applies to both common and complex problems;
- are prepared for open problems situations as opposed to the very few problems that are presented to us in a well-formulated state; and
- believe in the value and utility of mathematics.

These findings correlate well with the stated goals of NCTM. Mathematics educators have a responsibility to prepare students with these attributes in mind. The failure to do so could result in a generation of mathematically illiterate citizens.

Assessment and Instruction

Since the birth of the NCTM *Standards*, mathematics education has been given a new sense of direction and meaning. What this entails, however, is that practices change to meet the new goals and objectives. NCTM (1989) has placed an emphasis on the role of evaluative measures as a means of gathering information which educators can use to make subsequent instructional decisions. Traditionally, evaluative measures have been used solely for the purpose of marking student progress. While this is important, the progress that was monitored was primarily computational in nature and the measures used for evaluation did little to investigate the reasons behind a particular child's intellectual growth or the failure of the child to achieve the expected intellectual growth. Traditional tests focused almost exclusively on the use of paper and pencil and were looking for one correct answer.

Currently, evaluation procedures are changing. Paul Barton and Richard Copely found that in 1992 - 1993, 38 of the 52 states used some form of nontraditional test items as part of their state assessment program. In New Jersey, short answer open-ended questions, extended responses open-ended questions, and other techniques were utilized. These forms of evaluation focus on the ability of students to express their thought processes as they communicate the answers to various problems. To be successful on problems of this type, it is no longer sufficient to only provide a correct numerical answer. Students are required to explain their thinking and describe the problem-solving process they utilized. When students are asked to explain their thought processes in this fashion, their "math power and math literacy" (Black, 1994) improve.

Susan Black (1994) has stated that math power and math literacy refer to a student's ability to explore, conjecture, reason logically, and utilize various methods to solve problems. These abilities embody the NCTM's goals for mathematics education in the 1990s. Black goes on to state that students are unable to develop these abilities unless they are responsible for their own learning. Alternative assessment methods, and the instructional practices they support, allow students to assume this responsibility because they force them to analyze their own thought processes. Nobody else can do this for them.

Along with becoming responsible for one's own learning, students need to be active learners in order for the modern goals of education to be met. Active instruction requires the teacher to step back from his or her role as leader and become more of a facilitator. Kober (1991) found that active instruction is based on research that recognizes learning as a dynamic process in which students try to utilize information they have already acquired. Active instruction techniques include things such as cooperative learning groups, class discussions, hands-on materials, and small group problem solving. In each of these instances, students would be required to utilize some of their communication skills, as opposed to the traditional method of only listening to the teacher lecture. This use of communication skills in turn leads to the use of alternative assessment methods. Kulm (1993) stated "many of the teachers' plans for implementing alternative assessment approaches were closely tied to strategies for using problem solving or communication activities as a regular part of instruction."

Assessment it seems, can have an impact on the instructional habits of a classroom if used correctly and chosen carefully. Written tests, the most traditional form of assessment, are just one form available to the classroom teacher and should be used with their limitations in mind (Virginia Education Association & AEL, 1992). When a child answers a computational question without providing any sort of explanation, the teacher has no idea whether or not the child truly understands the concept behind the problem. Heavy reliance on such tests has been seen as a cause of mathematics' narrowing curriculum. Teachers need to move away from such reliance on paper and pencil assessment and try out new types of assessment.

To help teachers accomplish this, assessment needs to be looked at as a process of collecting information for decision making (Virginia Education Association & AEL, 1992). When assessment is viewed in this light, there are many avenues to explore. A teacher needs to look for assessment methods which will allow him or her to diagnose student learning and provide information on which to base instructional decisions (Virginia Education Association & AEL, 1992). In turn, these alternative assessment methods require students to think, review and revise work, evaluate their own and others' work, and communicate their findings in a wide variety of ways.

Portfolios in Mathematics

A popular alternative assessment technique in mathematics deals with the use of portfolios. The use of portfolios is very familiar to those in the art world. Images of an artist's best pieces presented elegantly in a leather folder come to mind. However, the use of portfolios as a assessment method is gaining popularity across many curricular areas (Hamm and Adams, 1991). Also, the form of the portfolio is changing as well. Individual teachers are making decisions about what fits their needs the best. With this in mind however, some commonalties among portfolios can be found.

In general, students portfolios contain items that come from one of three broad categories (Ferguson, 1992). They are:

1. problem-solving activities;
2. reflective writings; and
3. written descriptions of mathematical investigations or discoveries.

A fourth general area which occurs in many portfolios deals with work that is more computational in nature, but the majority of items found in most mathematics portfolios come from the above listed areas. It is interesting to note that these three areas all stress the idea of communication. The student entry is designed to provide the teacher with a deeper insight into the child's thoughts. The "right answer" is almost a secondary component to the descriptive aspect of what occurred during the activity.

Although the types of entries contained in many mathematics portfolios tend to be similar, the reasons behind the use of portfolios tend to differ. Many educators view the portfolio as a means of assessing the progress of individual students. This type of use does have many benefits because it allows teachers to focus "on what a student can do, rather than on mistakes" (Hamm and Adams, 1991). The portfolio is seen as a vehicle to convey the child's accomplishments and showcase his or her individual talent. Others however, take a more global view of portfolio assessment. Daniel Koretz and others involved in *The 1991-92 Vermont Experience* found that portfolios could be "seen both as evaluative tools and as levers to reform mathematics curriculum and instruction." They found that the use of portfolios in mathematics led to instructional changes, with more emphasis on mathematical communication, amount of time spent working with others, use of hands-on materials, and less reliance on the standard textbook-driven lessons (Kortez et. al. 1992). These ideas impact on the school and curriculum as a whole, as opposed to being beneficial only for the owner of the portfolio.

The one idea that most portfolio users agree upon is that the entries must include a great deal of writing. Kober (1991) stated that there is a "strong correlation between verbal aptitude and achievement in mathematics." This underscores the need to have children redefine their thought processes and put their ideas into words. When a child does put thought processes into words, a teacher has a much better chance of seeing where that child could benefit from extra help or more stimulating activities. If the only information available to the teacher is a numerical answer, he or she must make assumptions about the child's level of understanding. Portfolios tend to take some of this guess work away. The information needed to make informed instructional decisions has been given by the student. When portfolios are utilized in this fashion they can "provide evidence of performance beyond the factual knowledge that has been gained" (Stenmark, 1991). It becomes very evident that the uses of portfolios in mathematics differ a great deal and educators who choose to utilize them must clearly define their purposes for doing so in order to have a successful program.

Summary

Chapter Two has reviewed some of the concerns of mathematics education in the 1990s and the role of portfolio assessment within this larger framework. Research and literature discussing the goals of mathematics instruction was presented. Also, the importance of writing and communication in mathematics was reviewed.

A study to determine the effect of utilizing a portfolio assessment system to aid in the instructional decision making process has been developed. The following chapters report on the design of the study. The population, learning environment, teaching methods, test, and the procedures for the study will be described. Also, included are the analysis of the test results, the conclusions of the study, and suggestions for further research.

CHAPTER THREE

DESIGN OF THE STUDY

Introduction

Two groups of students from the sixth grade population of Wenonah Elementary School were compared in a study to determine the effect of portfolio assessment on the ability of lesson plans to more closely meet the needs of a particular group of students. Chapter Three will describe the setting, population, time period, testing instruments, scoring procedures, and methods of instruction used in this study.

Description of the Setting

The Wenonah Public School System, consisting of one elementary school grades K - 6, was used as the setting for this study. Wenonah Public School was the only school involved in this study. The students in Wenonah Public School live throughout the town of Wenonah.

Wenonah, in Gloucester County, New Jersey, is a small, suburban community of predominantly upper-middle class citizens. A family-oriented community, the citizens of Wenonah are active in sports, churches, community service, neighborhood organizations, and the school. The community promotes interaction between its members and the school children through many after-school activities run by community members.

Description of the Sample

The data on which this study was based was collected from students attending the Wenonah Elementary School during the 1994 - 1995 academic year. The students were in the fifth through seventh months of sixth grade.

There are two sections of sixth grade mathematics offered at Wenonah Elementary School. Each of these sections is heterogeneouly grouped. These groups were formed in June 1994 by the fifth and sixth grade team of teachers and the Chief School Administrator. The students were randomly placed in a class, although some consideration was given to keeping the male/female ratio between the classes as equal as possible. The two classes used in this study were both taught by this researcher. One was used as the control group and the other was used as the experimental group.

The control group of 17 sixth grade students consisted of 9 girls and 8 boys. The ages of the students in the control group ranged from 11 years 5 months to 12 years 7 months. The experimental group of 17 sixth grade students consisted 10 girls and 7 boys. The ages of the students in the experimental group ranged from 11 years 3 months to 12 years 6 months. It was evident from the data shown in Table 1 that the students in both groups were similar in age with a mean difference of only 0.04 years.

A breakdown of the California Achievement Test scores of both groups of students is shown in Table 2. The Math Total scores (National Percentile) were used. The students in the control group had scores which ranged from 50 to 99. The students in the experimental group had scores which ranged from 51 to 99. The mean difference of 4.53 is acceptable. The two groups used in this study seem to be similar with respect to prior knowledge and age as the study began.

Description of the Instruments Used

The Pretest and Posttest used for this study were developed by the Addison-Wesley Publishing Company, 1994 Edition. The problems on both tests were free

TABLE 1

DESCRIPTION OF THE TWO GROUPS OF THE SAMPLE:

AGE LEVELS

Control Group

	No.	Range	Mean
Male	8	11.42 - 12.33	11.89
Female	9	11.08 - 12.17	11.81
Total	17	11.08 - 12.33	11.84

Experimental Group

	No.	Range	Mean
Male	7	11.25 - 12.50	11.89
Female	10	11.50 - 12.92	11.88
Total	17	11.25 - 12.92	11.88

TABLE 2

DESCRIPTION OF THE TWO GROUPS OF THE SAMPLE:

CAT SCORES: MATH SCORES (NATIONAL PERCENTILES)

Control Group

	No.	Range	Mean
Male	8	50 - 97	80.00
Female	9	51 - 99	76.44
Total	17	50 - 99	78.12

Experimental Group

	No.	Range	Mean
Male	7	51 - 99	76.86
Female	10	67 - 99	86.70
Total	17	51 - 99	82.65

response questions and correlated to the objectives contained within the unit of study. The structure of each test was identical. There were 20 items on each test and space was provided for the students to put the answers directly on the test paper. The time limits and directions were identical for each test. The actual questions were not the same for each test. The tests can be found in Appendix A.

To obtain an external evaluation of content validity the tests were submitted for validation to Mr. William Graf, Chief School Administrator for Wenonah Elementary and Mrs. Patricia Haney, Curriculum Coordinator for the Gateway Group Elementary Schools. The test items were examined and evaluated for their relevancy to the objectives outlined by the Addison-Wesley unit of study on addition and subtraction of fractions and mixed numbers. Both of these individuals agreed that the items on both tests adequately represented the material covered in the Addison-Wesley Chapter 7. The tests were also submitted to Mrs. Barbara Stilwell, Wenonah Reading Teacher, and Mrs. Kathleen Hanson, Gifted and Talented Specialist for Wenonah, to obtain validity for reading level and vocabulary. All items adequarely represented the reading level and vocabulary level of sixth grade students. Performance on the pretest and posttest is not influenced by reading level or vocabulary.

To establish reliability, the pretest and posttest were administered to a group of 24 sixth grade students at a neighboring school. These students were not taught by the researcher and were not part of the control or experimental groups. Twelve students were administered the pretest and 12 students were administered the posttest. One week later the same instruments were given to the same two groups to test for test-retest reliability. The test-retest reliability coefficient assumes that the characteristics being evaluated remain constant over time and also assumes that there was no practice or memory effect. Using the pair of scores from week 1 and week 2, the scores of each individual were examined. Also, the extent to which each individual maintained his or her ordinal position within the group was examined. Table 3 shows the distribution of these scores. The mean change between week one and week two for the group of students who took the Addison-Wesley Pretest was 1.8333. The mean change between week one and week two for the group of students who took the Addison-Wesley Posttest was 1.8334. The pretest and posttest are reliable.

The Children's Academic Intrinsic Motivation Inventory (CAIMI) was developed to measure academic intrinsic motivation of students in grades 4 - 8. Academic intrinsic motivation is defined by the test authors as the enjoyment of school learning characterized by an orientation toward mastery, curiosity, and the learning of novel and difficult tasks. It was designed to measure children's academic intrinsic motivation toward school learning in general and across the specific areas of math, science, reading, and social studies. For the purposes of this study, only the math scores were used.

The CAIMI is a 44 question inventory requiring a response on the basis of a 5-point Likert scale ranging from strongly agree to strongly disagree. The CAIMI may be given in a group setting or individually. For the purposes of this study and to accommodate classroom setting restrictions, the test was administered in a group classroom setting. Administration time for this test was approximately 35 minutes.

Development of the CAIMI occurred over three major studies in a program extending over a six year period. The subjects in study one were generally white students attending public school. The second group of subjects was biracial and again came from public school. The third group of subjects was composed of private school students. This enabled the researchers to create an instrument which appeared to be free of sex and race bias.

The reliability of the CAIMI was established by internal consistency and test-retest reliability. Internal consistency reliability coefficients (Alpha) for math ranged from 0.83 to 0.93. Thus, reliability has been demonstrated, with no difference found as a function of race, sex, or IQ. Test-retest reliability was established on a random

TABLE 3

Distribution of Pretest and Posttest Scores for Test - Retest Reliability

Pretest

Student	Week One Score	Rank	Week Two Score	Rank
A1	45	1 *	45	2 *
A2	45	2 *	50	1 *
A3	40	3	45	3
A4	38	4	38	4
A5	35	5	38	5
A6	35	6	35	6
A7	33	7	35	7
A8	30	8	30	8
A9	23	9	25	9
A10	23	10	25	10
A11	20	11	25	11
A12	15	12	15	12

* Change in ranked position (not significant)

Posttest

Student	Week One Score	Rank	Week Two Score	Rank
B1	60	1	60	1
B2	60	2	57	2
B3	55	3	55	3
B4	53	4	55	4
B5	50	5	55	5
B6	45	6	50	6
B7	43	7	43	7
B8	30	8	35	8
B9	30	9 *	33	10 *
B10	25	10 *	30	9 *
B11	23	11	23	11
B12	10	12	10	12

* Change in ranked position (not significant)

sample of subjects in studies 1 and 2. The coefficients ranged from 0.66 to 0.76 (df=83, p<.01) in study 1 and 0.69 to 0.75 (df=136, p<.01) in study 2. These coefficients indicate moderately high stability over a two-month interval. The CAIMI can be found in Appendix B.

Description of the Time Period

On January 5, 1995, the control and experimental groups were given the CAIMI as a pretest of their attitude toward mathematics prior to the study. On January 9, 1995, the control and experimental groups were given the Addison-Wesley Pretest for the unit on addition and subtraction of fractions and mixed numbers. During the next seven weeks, the experimental group was instructed using lessons plans based on the recommendations of the Addison-Wesley Text Series, 1994 Edition and information about student understanding gained through their portfolio entries. During this same seven week period, the control group was instructed using lessons plans solely based on the recommendations of the Addison-Wesley Text Series, 1994 Edition. Upon completion of the instructional period, the Addison-Wesley posttest for the unit on addition and subtraction of fractions and mixed numbers was administered to the control and experimental groups on February 28, 1995. The CAIMI was administered as a posttest to the control and experimental group on March 3, 1995. The study began in early January, 1995 and concluded in March, 1995.

Scoring Procedures for Academic Tests

The pretest and posttest used for this study each consisted of 20 free response items. Students were required to read the information contained within each item and do the calculation necessary to come up the correct numerical answer. Each question was worth a total of five points creating a total point value of 100 for each test. Partial credit was given in instances where pure computational errors were apparent and concept understanding was still evident. Partial credit was equally used on both the pretest and the posttest for both the control group and the experimental group.

Methods of Instruction

The control group for this study met in this researcher's classroom for forty-five minutes, five times a week, for the entire seven weeks of this study. Classroom instruction for this group was based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition. These lessons generally began with an exploratory component or a manipulative based activity and concluded with some independent problem work. The students always had some form of traditional homework based on the day's lesson. The lessons and the homework were identical to those given to the experimental group. The control group did not receive any portfolio activities. Examples of the Addison-Wesley lessons can be found in Appendix C.

The experimental group for this study also met in this researcher's classroom for forty-five minutes, five times a week, for the entire seven weeks of the study. Three class periods a week consisted of traditional mathematics lessons designed based on the recommendations of the Addison-Wesley Text Series, 1994 Edition. These lessons were identical to the ones presented to the control group. The students always had some form of traditional homework based on the day's lesson. The other two days of the week proceeded in the same manner for the beginning of the class period. The Addison-Wesley lesson was used and traditional homework was assigned. However, on these two days, the end of the period was spent on a portfolio entry. These entries were generally a writing assignment of some sort in which the students had to solve a problem and explain their thinking or explain some other aspect about the day's lesson. The portfolio activities always began with a brief time to share thoughts and ideas with classmates and ended with independent writing time. Sample portfolio activities for the unit of study involved in this research can be found in Appendix D.

Relationship of the Procedure to the Null Hypotheses

For the purpose of this study, the CAIMI was given on January 5, 1995 and the Addison-Wesley Pretest was given on January 9, 1995 to both groups. The Addison-Wesley Posttest test for the unit of study was then given on February 28, 1995 and the CAIMI was readministered on March 3, 1995 to both groups, so that a comparison could be made in terms of achievement and attitude at the conclusion of the study.

Specific Hypothesis 1 states that there will be no significant difference between the effectiveness and accuracy of a teacher's lesson plans to more closely meet the needs of a specific group of sixth grade students when the instructional planning is based on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolio entries , combined with the Addison-Wesley Text Series, 1994 Edition recommendations as measured by the Addison-Wesley Pretest and Posttest scores of each group. At the completion of the unit, the mean scores were compared to determine if a significant difference existed between the two groups.

Specific Hypothesis 2 states that there will be no significant differences between the information gained for instructional planning for sixth grade male students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolio entries, combined with the recommendations of the Addison-Wesley Text Series as measured by the Addison-Wesley Pretest and Posttest scores of each group. The mean scores were compared for a significant difference.

Specific Hypothesis 3 states that there will be no significant differences between the information gained for instructional planning for sixth grade female students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolio entries, combined with the recommendations of the Addison-

Wesley Text Series as measured by the Addison-Wesley Pretest and Posttest scores of each group. At the completion of the unit, the mean scores were compared to determine if a significant difference existed between the two groups.

In addition, specific Hypothesis 4 states that there will be no significant difference between the attitudes toward mathematics when instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when instructional planning is based on information gained through the use of student generated portfolio entries, combined with the recommendations of the Addison-Wesley Text Series, 1994 Edition. The CAIMI was given as a pretest and a posttest to each group to determine is a significant attitude change toward mathematics did occur during this unit.

Summary

The purpose of this study was to determine if a significant difference resulted in the teacher's ability to more closely meet the needs of her individual students based on the information gained through student generated portfolio entries as opposed to relying solely on the textbook recommendations. This study also investigated the attitudes toward mathematics of sixth grade students.

This chapter described the setting, population, testing instruments, and instructional sessions used for this study. Thirty-four sixth grade students were pretested using the Addison-Wesley Pretest to evaluate prior knowledge about the addition and subtraction of fractions and, also, pretested using the CAIMI to evaluate the students' attitudes toward mathematics. The study lasted for approximately seven weeks. At the end of this time, all students were retested on the CAIMI and were given the Addison-Wesley Posttest. The results were recorded and analyzed. The data is presented in the following chapter.

CHAPTER FOUR

ANALYSIS OF DATA

Introduction

This study was conducted to determine if a significant difference resulted in the ability of a teacher to create more effective and accurate lesson plans to more closely meet the needs of a specific group of sixth grade students when the lesson plans were generated with the help of information gained from student created portfolio entries, combined with textbook recommendations or when these lesson plans were generated solely on the recommendations of a text series. The subjects for this study were 34 sixth grade students in the Wenonah Public School, Wenonah, New Jersey, during the 1994-1995 school year. These students were all taught math by this researcher. All students received forty-five minutes of mathematics instruction daily. All lessons for the experimental and control groups were based on the recommendations of the Addison-Wesley Text Series, 1994 Edition. Two lessons a week for the experimental group concluded with a portfolio entry assignment. The experimental group consisted of 17 students, 7 males and 10 females. The control group also consisted of 17 students, 8 males and 9 females.

Analysis of Mathematics Achievement Data

In this chapter, data are presented based on a statistical analysis of the scores between the Pretest and the Posttest developed by the Addison-Wesley Publishing

Company, 1994. The mean score gains of the control group and the experimental group were compared to each other using the *t*-test for paired samples. The *t*-test analysis is deemed to be an appropriate statistical tool for measuring the mean scores of two groups. This test was used to determine if there was a significant difference between the two groups at the 0.05 level of significance. The results were analyzed to determine if there was a significant difference in the effectiveness of the lessons planned for the two groups.

In addition, the scores on the Pretest and Posttest were broken down to examine the difference between male and female subjects in each group. The mean gain scores were compared to determine whether or not there was a significant difference in the achievement gain between the males and females in this study.

The Addison-Wesley Pretest and the Posttest for the unit of study had a possible total of 100 points; 20 questions worth 5 points each. The scores of the control group on the Pretest ranged from 5 to 75 with a standard deviation of 24.745 and a mean score of 28.235. The scores of the control group on the Posttest ranged from 70 to 100 with a standard deviation of 10.899 and a mean score of 83.941. The scores of the experimental group on the Pretest ranged from 5 to 100 with a standard deviation of 24.682 and a mean score of 28.235. The scores of the experimental group on the Posttest ranged from 35 to 100 with a standard deviation of 17.947 and a mean score of 85.118.

The achievement Pretest and Posttest scores for the 17 students in the control group, 8 males and 9 females, are shown in Table 4. The mean gain was calculated by first finding the difference between each student's Pretest and Posttest score. The gain of each student was then added into one sum and divided by the total number of subjects in the control group. The mean gain for the control group was 55.118. Using the *t*-test formula, the *t*-statistic was 10.2071. Based on the Table of *t*-Values at the 0.05 level of confidence with 16 degrees of freedom, the *t*-statistic would be significant at the 2.120

level or higher. Therefore, the *t*-statistic of 10.2071 found for the control group can be considered significant at this confidence level.

TABLE 4

T-Test for the Significant Difference Between Mean Gain of the Achievement Pretest and Posttest:

Control Group

Student	Sex	Pretest	Posttest	Gain
1	M	5	70	65
2	M	10	83	73
3	M	5	88	83
4	F	10	90	80
5	F	15	88	73
6	M	5	70	65
7	M	35	95	60
8	M	5	78	73
9	F	20	70	50
10	F	65	100	35
11	F	70	85	15
12	M	60	93	33
13	F	25	88	53
14	M	40	60	20
15	F	20	84	64
16	F	75	95	20
17	F	15	90	75

Mean Gain = 55.1176 T-value with df(16) at p(0.05) = 2.120

SD = 22.4301 T-test = 10.2071 significant

The achievement Pretest and Posttest scores for the 17 students in the experimental group, 7 males and 10 females, are shown in Table 5. The mean gain was calculated by first finding the difference between each student's Pretest and Posttest score. The gain of each student was then added into one sum and divided by the total number of subjects in the control group.

TABLE 5

T-Test for the Significant Difference Between Mean Gain of the Achievement Pretest and Posttest:

Experimental Group

Student	Sex	Pretest	Posttest	Gain
1	F	10	90	80
2	M	5	60	55
3	F	5	89	84
4	M	5	35	30
5	F	50	100	50
6	M	45	100	55
7	F	20	83	63
8	M	10	85	75
9	F	60	99	39
10	M	100	100	0
11	F	35	90	55
12	M	35	100	65
13	F	15	75	60
14	F	20	100	80
15	F	20	73	53
16	M	25	98	73
17	F	20	70	50

Mean Gain = 56.8824 T-value with df(16) at p(0.05) = 2.120

SD = 20.7722 T-test = 11.2907 significant

The mean gain for the experimental group was 56.8824. Using the *t*-test formula, the *t*-statistic was 11.2907. Based on the Table of *t*-Values at the 0.05 level of confidence with 16 degrees of freedom, the *t*-statistic would be significant at the 2.120 level or higher. Therefore, the *t*-statistic of 11.2907 found for the experimental group can be considered significant at this confidence level.

Table 6 shows the achievement results of the *t*-test for significant differences in the gain scores of the control group and the experimental group. Based on the *t*-test formula, the *t*-statistic was -0.2391. Based on the Table of *t*-Values at the 0.05 level of confidence with 16 degrees of freedom, a *t*-statistic of 2.120 or higher would be significant. The *t*-statistic result of -0.2391 shows that there was not a level of statistical difference noticed when the gains of the control group and the experimental group were compared.

TABLE 6

T-Test for Significant Differences in the Mean Gains of Achievement Between the Control and Experimental Groups

Group	Mean Pretest	SD	Mean Posttest	SD	Mean Gain
Control	28.2353	24.7450	83.9412	10.8999	55.1176
Experimental	28.2353	24.6818	85.1176	17.9474	56.8824

Mean Gain = 0.8824

T-value with df(16) at p(0.05) = 2.120

T-test = -0.2391 <u>not significant</u>

In Table 7, the Pretest and Posttest scores for the male subjects in the control group are shown. The mean gain in score between the Pretest and the Posttest for the male subjects was found by first calculating the difference in score between the two tests. These gains were then combined into one sum and divided by the number of males. Using the *t*-test formula, the *t*-statistic was found to be 7.7590. Based on the Table of *t*-Values at the 0.05 level of confidence with 7 degrees of freedom, a *t*-statistic of 2.365 or higher would be significant. Therefore, the *t*-statistic of 7.7590 can be considered significant at this level of confidence.

TABLE 7

T-Test for Significant Differences in the Mean Gains of the Achievement Pretest and Posttest:

Control Group : Males

Student	Pretest	Posttest	Gain
1	5	70	65
2	10	83	73
3	5	88	83
6	5	70	65
7	35	95	60
8	5	78	73
12	60	93	33
14	40	60	20

Mean Gain = 59.000 T-value with df(7) at p(0.05) = 2.365

SD = 21.5075 T-test = 7.7590 <u>significant</u>

In Table 8, the Pretest and Posttest scores for the male subjects in the experimental group are shown. The mean gain in score between the Pretest and the Posttest for the male subjects was found by first calculating the difference in score between the two tests. These gains were then combined into one sum and divided by the number of males. Using the *t*-test formula, the *t*-statistic was found to be 4.9679. Based on the Table of *t*-Values at the 0.05 level of confidence with 6 degrees of freedom, a *t*-statistic of 2.447 or higher would be significant. Therefore, the *t*-statistic of 4.9679 can be considered significant at this level of confidence.

TABLE 8

T-Test for Significant Differences in the Mean Gains of the Achievement Pretest and Posttest:

Experimental Group : Males

Student	Pretest	Posttest	Gain
2	5	60	55
4	5	35	30
6	45	100	55
8	10	85	75
10	100	100	0
12	35	100	65
16	25	98	73

Mean Gain = 50.4286	T-value with df(6) at p(0.05) = 2.447
SD = 26.8568	T-test = 4.9679 significant

Table 9 shows the achievement results of the *t*-test for significant differences in the gain scores of the control group males and the experimental group males. Based on the *t*-test formula, the *t*-statistic was -0.6984. Based on the Table of *t*-Values at the 0.05 level of confidence with 7 degrees of freedom, a *t*-statistic of 2.365 or higher would be significant. The *t*-statistic result of -0.6984 shows that there was not a level of statistical difference noticed when the gains of the control group males and the experimental group males were compared.

TABLE 9

T-Test for Significant Differences in the Mean Gains of Achievement Pretest and Posttest Between the Control Males and Experimental Males

Group	Mean Pretest	SD	Mean Posttest	SD	Mean Gain
Control	20.6250	21.4539	79.6250	12.3628	59.0000
Experimental	32.1429	33.6473	82.5714	25.5855	50.4286

Mean Gain = 4.7143

T-value with df(7) at p(0.05) = 2.365

T-test = -0.6984 not significant

In Table 10, the Pretest and Posttest scores for the female subjects in the control group are shown. The mean gain in score between the Pretest and the Posttest for the female subjects was found by first calculating the difference in score between the two tests. These gains were then combined into one sum and divided by the number of females. Using the *t*-test formula, the *t*-statistic was found to be 6.5326. Based on the Table of *t*-Values at the 0.05 level of confidence with 8 degrees of freedom, a *t*-statistic of 2.306 or higher would be significant. Therefore, the *t*-statistic of 6.5326 can be considered significant at this level of confidence.

TABLE 10

T-Test for Significant Differences in the Mean Gains of Achievement Pretest and Posttest:

Control Group : Females

Student	Pretest	Posttest	Gain
4	10	90	80
5	15	88	73
9	20	70	50
10	65	100	35
11	70	85	15
13	25	88	53
15	20	84	64
16	75	95	20
17	15	90	75

Mean Gain = 51.6667	T-value with df(8) at p(0.05) = 2.306
SD = 23.9374	T-test = 6.5326 significant

Table 11 presents the Pretest and Posttest scores for the female subjects in the experimental group. The mean gain in score between the Pretest and the Posttest for the female subjects was found by first calculating the difference in score between the two tests. These gains were then combined into one sum and divided by the number of females. Using the *t*-test formula, the *t*-statistic was found to be 12.7707. Based on the Table of *t*-Values at the 0.05 level of confidence with 9 degrees of freedom, a *t*-statistic of 2.262 or higher would be significant. Therefore, the *t*-statistic of 12.7707 can be considered significant at this level of confidence.

TABLE 11

T-Test for Significant Differences in the Mean Gains of Achievement Pretest and Posttest:

Experimental Group : Females

Student	Pretest	Posttest	Gain
1	10	90	80
3	5	89	84
5	50	100	50
7	20	83	63
9	60	99	39
11	35	90	55
13	15	75	60
14	20	100	80
15	20	73	53
17	20	70	50

Mean Gain = 61.400 T-value with df(9) at p(0.05) = 2.262

SD = 15.2038 T-test = 12.7707 significant

Table 12 illustrates the achievement results of the *t*-test for significant differences in the gain scores of the control group females and the experimental group females. Based on the *t*-test formula, the *t*-statistic was 1.3555. Based on the Table of *t*-Values at the 0.05 level of confidence with 9 degrees of freedom, a *t*-statistic of 2.262 or higher would be significant. The *t*-statistic result of 1.3555 shows that there was not a level of statistical difference noticed when the gains of the control group females and the experimental group females were compared.

TABLE 12

T-Test for Significant Differences in the Mean Gains of the Achievement Pretest and Posttest Between the Control Females and Experimental Females

Group	Mean Pretest	SD	Mean Posttest	SD	Mean Gain
Control	35.000	26.6927	87.7778	8.2882	51.6667
Experimental	25.500	17.5515	86.9000	11.2985	61.4000

Mean Gain = 9.7333

T-value with df(9) at p(0.05) = 2.262

T-test = 1.35551 not significant

Analysis of Mathematics Attitude Data

The mathematics attitude of the students in this study was measured by the Children's Academic Intrinsic Motivation Inventory. This test was given to both the control group and the experimental group. The CAIMI was administered at the beginning (January, 1995) and the end (March, 1995) of this study. The mean scores of the control group and the experimental group were compared to each other using the paired *t*-test. The results were analyzed to determine if there was a significant change in attitude between the groups at the 0.05 level of confidence.

In addition, the pre-CAIMI scores and the post-CAIMI scores were compared within each group to determine if a significant change in attitude toward mathematics occurred within either group.

Table 13 illustrates the pre-CAIMI scores and the post-CAIMI scores for the control group. The change in attitude towards mathematics of each student is noted in the gain column. A positive number suggests a positive gain in attitude, while a negative number indicates a decline in attitude. The mean gain in attitude for the control group was 4.1765 which shows a positive change in attitude for this group. The *t*-statistic for the attitude of the control group was 1.8076. Based on the Table of *t*-Value at the 0.05 confidence level with 16 degrees of freedom, the *t*-statistic would be significant at 2.120 or higher. Therefore, the *t*-statistic of 1.8076 is not considered significant.

TABLE 13

T-Test for the Significant Differences in the Mean Gains of Mathematics Attitude as Measured by the CAIMI Pretest and Posttest:

Control Group

Student	Sex	Pretest	Posttest	Gain
1	M	51	53	2
2	M	88	94	6
3	M	98	91	-7
4	F	91	99	8
5	F	83	80	-3
6	M	60	65	5
7	M	86	88	2
8	M	91	101	10
9	F	90	94	4
10	F	112	125	13
11	F	103	115	12
12	M	73	60	-13
13	F	99	111	12
14	M	107	108	1
15	F	80	80	0
16	F	107	100	7
17	F	100	112	12

Mean Gain = 4.1765 T-value with df(16) at p(0.05) = 2.120

SD = 7.2045 T-test = 1.8079 <u>not significant</u>

Table 14 illustrates the pre-CAIMI scores and the post-CAIMI scores for the experimental group. The change in attitude towards mathematics of each student is noted in the gain column. A positive number suggests a positive gain in attitude, while a negative number indicates a decline in attitude. The mean gain in attitude for the

TABLE 14

T-Test for the Significant Differences in the Mean Gains of Mathematics Attitude as Measured by the CAIMI Pretest and Posttest:

Experimental Group

Student	Sex	Pretest	Posttest	Gain
1	F	105	108	3
2	M	100	103	3
3	F	100	100	0
4	M	96	96	0
5	F	94	93	-1
6	M	95	92	-3
7	F	91	91	0
8	M	88	90	2
9	F	76	89	13
10	M	81	82	1
11	F	80	80	0
12	M	77	79	2
13	F	73	79	6
14	F	107	108	1
15	F	99	97	-2
16	M	97	95	-2
17	F	72	92	20

Mean Gain = 2.5294 T-value with df(16) at p(0.05) = 2.120

SD = 5.8215 T-test = 1.7915 not significant experimental group was 2.5294 which shows a positive change in attitude for this group. The *t*-statistic for the attitude of the control group was 1.7915. Based on the Table of *t*-Value at the 0.05 confidence level with 16 degrees of freedom, the *t*-statistic would be significant at 2.120 or higher. Therefore, the *t*-statistic of 1.7915 is not considered significant.

In Table 15, the gain in attitude of the control group is compared with the gain in attitude of the experimental group. Based on the *t*-test formula, the *t*-statistic for this data was -0.8165. Based on the Table of *t*-values at the 0.05 confidence level with 16 degrees of freedom, a *t*-statistic of 2.120 or higher would be significant. As seen in Table 15, the *t*-statistic of -0.8165 would not be considered significant at this level of confidence.

TABLE 15

T-Test for Significant Differences in the Mean Gains of Mathematics Attitude Between the Control Group and Experimental Group

Group	Mean Pretest	SD	Mean Posttest	SD	Mean Gain
Control	89.3529	16.4884	92.7059	20.0118	4.1765
Experimental	90.0588	11.4153	92.5882	9.1451	2.5294

Mean Gain = 1.6471

T-value with df(16) at p(0.05) = 2.120

T-test = -0.816547 <u>not significant</u>

Test of Hypotheses and Results

This study was designed to test the following hypothesis: There will be no significant difference in the effectiveness and accuracy of a teacher's lesson plans to more closely meet the needs of a specific group of sixth grade students when the instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when instructional planning is based on information gained through student-generated portfolios, combined with the Addison-Wesley recommendations as measures by gains in achievement on the Addison-Wesley Pretest and Posttest. The results of this analysis are shown in Tables 4 - 6. The *t*-test value with df(16) at the p(.05) level of confidence is significant at levels of 2.120 or higher. Table 6 illustrates that the *t*-test statistic of -0.2391 indicates that there was not a level of statistical difference found berween the gains in achievement of the control group and the gains in achievement of the experimental group. Therefore, Hypothesis 1 must be accepted.

The general nature of Hypothesis 1 lead to the development of three specific hypotheses which were tested. Hypothesis 2 states that there will be no significant difference between the information gained for instructional planning for sixth grade male students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by the gain in achievement on the Addison-Wesley Pretest and Posttest. The results of this analysis are shown in Tables 7 - 9. The *t*-test value with df(7) at the p(.05) level of confidence is significant at levels of 2.365 or higher. Table 9 illustrates that the *t*-test statistic of -0.6984 indicates that there was not a level of statistical difference found between the gains in achievement of the control group males and the gains in achievement of the experimental group males. Therefore, Hypothesis 2 must be accepted.

Hypothesis 3 states that there will be no significant differences between the information gained for instructional planning for sixth grade female students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest. The results of this analysis are shown in Tables 10 - 12. The *t*-test value with df(9) at the p(.05) level of confidence is significant at levels of 2.262 or higher. Table 12 illustrates that the *t*-test statistic of 1.355 indicates that there was not a level of statistical difference found between the gains in achievement of the control group females and the gains in achievement of the experimental group females. Therefore, Hypothesis 3 must be accepted.

Hypothesis 4 states that there will be no significant differences between the attitudes toward mathematics when instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by the Children's Academic Intrinsic Motivation Inventory. The results of this analysis are shown in Tables 13 - 15. The *t*-test value with df(16) at the p(.05) level of confidence is significant at levels of 2.120 or higher. The *t*-statistic of -0.8165 shown in Table 15 indicates that there was not a level of statistical difference found between the gains in attitude of the control group and the gains in attitude of the experimental group. Therefore, Hypothesis 4 must be accepted.

Summary of the Findings

The results of the data analysis for all four hypotheses are summarized as follows:

Hypothesis 1 is accepted. There was not a significant difference in the effectiveness and accuracy of a teacher's lesson plans to more closely meet the needs of a specific group of sixth grade students when the instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest. When analyzing the scores, it can be seen that the mean gain of the experimental group was slightly higher than that of the control group even though this amount was not statistically significant.

Hypothesis 2 is accepted. There was not a significant difference between the information gained for sixth grade male students when lessons are generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest. When analyzing the scores in this data set, it can be seen that the control group males tended to gain more between the Pretest and the Posttest score. However, the mean Pretest and mean Posttest score were both higher for the experimental group males.

Hypothesis 3 is accepted. There was not a significant difference between the information gained for sixth grade female students when lessons were generated solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest.

When analyzing the scores, it can be seen that the mean achievement gain of the males as a whole group (experimental group males and control group males) was 54.714. The mean gain of the females as a whole group (experimental group and control group) was 56.533. The relative improvement between this two groups tended to be the same.

Hypothesis 4 is accepted. There was no significant difference between the attitudes toward mathematics when instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations as measured by gains in achievement on the Addison-Wesley Pretest and Posttest.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Public education is under attack as never before. Children need to be prepared to enter the work force in the 21st century. The skills and knowledge necessary to be successful are much different than those required less than 25 years ago. The National Council of Teachers of Mathematics believes that mathematics educators need to "create a coherent vision of what it means to be mathematically literate both in a world that relies on calculators and computers to carry out mathematical procedures and in a world where mathematics is rapidly growing and is extensively being applied in diverse fields" (NCTM, 1989). It is vital to determine not only what kind of instructional methods will best serve our children in the upcoming century, but also what types of assessment models will provide teachers, students, and parents with the necessary information to enable each child to work up to his or her potential. Included in this chapter are the summary of findings from this study, conclusions, and recommendations.

Summary of the Problem

This study was conducted to determine if portfolio assessment could aid a teacher in designing lesson plans which would more closely meet the needs of the students in a particular sixth grade classroom. In addition to the general hypothesis under investigation, the study also looked at the growth in achievement of the males in the study and the females in the study. Did males or females benefit from the portfolio assessment differently or were the growth patterns similar? Also researched were the attitudes toward mathematics of sixth grade students who were involved in portfolio assessment in combination with regular classroom instruction and those sixth grade students who only received regular classroom instruction without portfolio assessment.

Summary of the Procedures

The pupil sample for this study came from Wenonah Public School in Gloucester County, NJ. The sample consisted of 34 sixth grade students who attended Wenonah School during the 1994-1995 academic year. The subjects were in the fifth through seventh months of sixth grade.

The control group of 17 sixth grade students consisted of 9 females and 8 males. This group of students received instruction on the addition and subtraction of fractions and mixed numbers based on the recommended lessons designed by the Addison-Wesley Publishing Company, 1994 Edition. The experimental group of 17 sixth grade students consisted of 10 females and 7 males. The experimental group lessons were based on a combination of the lessons recommended by Addison-Wesley and the information gained through the student portfolios.

Before the unit of study began, the control group and the experimental group were both administered the Addison-Wesley Pretest for the chapter which dealt with the addition and subtraction of fractions and mixed numbers. The CAIMI was also administered as a pretest to both groups to assess the students' attitudes toward mathematics prior to the study. At the conclusion of the unit of study, both groups were administered the Addison-Wesley Posttest and the CAIMI. The results from these tests were analyzed using the *t*-test for the difference between the mean gains of the two populations to determine whether there was a significant difference in the mean gain scores of the two groups.

Conclusions

The results of the analysis of the data can be combined with the observation of this researcher to form a number of conclusions and illustrate a number of trends. The statistical analysis as measured by the *t*-test at the 0.05 level of confidence revealed that there was not a significant difference in the mean gains of achievement between the control group, who received only the lessons recommended by Addison-Wesley, and the experimental group, who received lessons recommended by Addison-Wesley and supplemented by information gained through their portfolios. Therefore, Hypothesis 1, which stated that there would be no significant difference in the effectiveness and accuracy of a teacher's lesson plans to more closely meet the needs of a specific group of sixth grade students when the instructional planning was based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning was based on the Addison-Wesley recommendations combined with information gained through student generated portfolios, has been supported. However, it should be noted that the experimental group did have a higher mean score on the Posttest than the control group and the amount of growth was also slightly higher. Although this growth was not statistically significant, this researcher believes that the experimental group had a more complete understanding of the information presented.

The data analysis has also revealed that there was no significant difference noted when the *t*-test was used at the 0.05 level of confidence to explore the difference in the mean gain of the achievement Pretest and Posttest between the control group males, who had no supporting portfolio assessment, and the experimental group males, who did have supporting portfolio assessment. Therefore, Hypothesis 2, which states that there will be no significant difference between the information gained for instructional planning for sixth grade male students when lessons are generated solely on the recommendation of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations has been supported. However, it must be noted that there were some interesting trends found in this data. The control group males, who received no portfolio support, had an average gain of almost 9 points higher than that of the experimental group. However, the experimental group who did receive portfolio support had a higher mean Pretest score and a higher mean Posttest score. Therefore, even though the Hypothesis is supported, the experimental group did show considerable growth.

The data analysis has also revealed that there was no significant difference noted when the t-test was used at the 0.05 level of confidence to explore the difference in the mean gain of the achievement Pretest and Posttest between the control group females, who had no supporting portfolio assessment, and the experimental group females, who did have supporting portfolio assessment. Therefore, Hypothesis 3, which states that there will be no significant difference between the information gained for instructional planning for sixth grade female students when lessons are generated solely on the recommendation of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations, has been supported. In the case of the female subjects, the experimental group, who received portfolio support, gained almost 10 more points between the Pretest and the Posttest than the control group. However, the control group had a mean score on the Pretest which was about 10 points higher than that of the experimental group, but a mean Posttest score which was less than 1 point higher. The experimental group seemed to improve their concept understanding and computational skills a great deal over the unit of study, even though their mean Posttest score was slightly lower.

The data analysis also revealed that there was no significant difference noted when the t-test was used at the 0.05 level of confidence to explore the difference in the mean gain of the attitude, as measured by the CAIMI pretest and posttest, between the control group, who had no supporting portfolio assessment, and the experimental group, who did have supporting portfolio assessment. Therefore, Hypothesis 4 which states that there will be no significant difference between the attitudes toward mathematics when instructional planning is based solely on the recommendations of the Addison-Wesley Text Series, 1994 Edition or when the instructional planning is based on information gained through student generated portfolios, combined with the Addison-Wesley recommendations, has been supported. The data revealed that the control group had a lower attitude score on the CAIMI at the beginning of the study and also had a higher mean gain. However, the CAIMI posttest scores were virtually the same for the two groups at the end of the study.

The following conclusions may be drawn:

1. Portfolio assessment, as used in this study, did not affect the development of skills and concept understanding of the students in the sample as measured by the Addison-Wesley Pretest and Posttest.

2. Teaching methodologies, which were based on the lesson plans for each group, did not significantly affect learning. Both groups made positive gains in achievement over the course of the unit as measured by the Addison-Wesley Pretest and Posttest.

3. Portfolio assessment, as used in this study, did not affect the attitude toward mathematics of the students in the sample as measured by the CAIMI pretest and posttest.

The following observations were made during the study:

1. The use of portfolio assessment allowed the teacher to gain greater insight into the level of understanding of the students. The students and the teacher had many discussions relating to the reasons behind various concepts in the group which used

portfolio assessment. These discussions did not occur in the control group who did not participate in portfolio activities.

2. The learning in the classroom which used portfolio assessment activities was much more self-guided. The students were more interested, more involved, and relied more heavily on one another.

3. Students who utilized portfolio activities were more able to communicate their ideas and solutions to problems, as well as articulate the areas in which they were having difficulty.

4. Portfolio assessment requires more time than regular paper and pencil exercises. The 45-minute class period was often a restraint. Many activities could have yielded better results if students had more time to work.

Recommendations for Further Research

Based on the findings, analysis of the data, and conclusions of the study the following recommendations are made:

1. This study should be conducted at various grade levels, and the results compared using the same analysis as in this study.

2. Future studies could be made to determine how portfolio assessment changes the teaching methodologies utilized in a classroom.

3. Future studies could be made to determine how various teaching methodologies influence students' attitudes toward mathematics.

4. Future studies could be made to determine how long term use of portfolio assessment (throughout many grade levels) affects performance on the Early Warning Test and the High School Proficiency Test.

5. It is suggested by this researcher that students begin to have exposure to portfolio techniques at a much earlier level. Much time had to be spent learning how to respond to various types of question. If students were already familiar with this type of

assessment, they would be able to focus more clearly on the content.

APPENDIX A

ADDISON-WESLEY PRETEST AND POSTTEST

Pretest

Name______________________________

Fill in the ◯ for the correct answer.

Add. Reduce if possible.

1. $\frac{4}{8} + \frac{6}{8}$

2. $1\frac{5}{9} + 2\frac{1}{9}$

Subtract. Reduce if possible.

3. $\frac{7}{16} - \frac{5}{16}$

4. $6\frac{11}{12} - 2\frac{3}{12}$

Choose the best estimate.

5. $6\frac{1}{5} + 2\frac{7}{8}$

6. $12\frac{5}{6} - 3\frac{1}{4}$

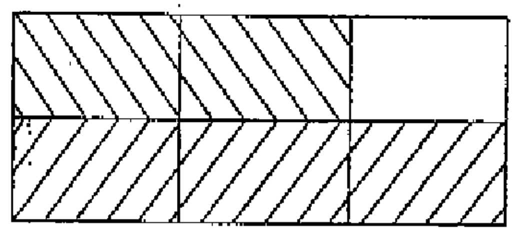
Solve mentally.

7. $5\frac{3}{8} - 2$

8. $\frac{3}{4} + 1\frac{1}{3} + \frac{1}{4}$

9. Find $\frac{1}{2} + \frac{1}{3}$.

Think:



10. Add. The LCD is 10.

$\frac{1}{2} + \frac{2}{5}$

11. Add.

$\frac{3}{5} + \frac{1}{3}$

Name________________________________

Fill in the ◯ for the correct answer.

12. Subtract. $\frac{11}{12} - \frac{1}{4}$

Find the sum.

13. $6\frac{3}{4} + 2\frac{1}{3}$

14. $12\frac{5}{8} + 7\frac{1}{2}$

Subtract.

15. $28\frac{5}{6} - 19\frac{1}{12}$

16. $14 - 5\frac{5}{9}$

17. Mike wanted to know how many library books Kim checked out during the year. The librarian told Mike that if he added 10 to the number of books she checked out and then doubled it, the number would be 90. How many books did Kim check out during the year?

18. Joanna gave half of her apples to Alex. She gave $\frac{3}{4}$ of the rest to Jennifer. Joanna has 8 apples left. How many did she start with?

19. Glenn spent $3.78 on lunch. Then he spent half of what he had left on a magazine. He still had $3.11. How much did he have to start with?

20. An elevator inspector got on an elevator and rode down 8 floors. She noted the number of the new floor and rode up to the floor 5 times that number. Then she rode down 6 floors to the 44th floor. At what floor had she gotten on the elevator?

Name

Add. Reduce if possible.

1. $\frac{7}{9}+\frac{4}{9}$

2. $2\frac{3}{8}+4\frac{3}{8}$

Subtract. Reduce if possible.

3. $\frac{11}{12}-\frac{5}{12}$

4. Subtract. Reduce if possible.

$5\frac{5}{6}-2\frac{1}{6}$

Estimate the answer.

5. $5\frac{7}{8}+4\frac{1}{5}$

6. $9\frac{1}{6}-3\frac{9}{10}$

Solve mentally.

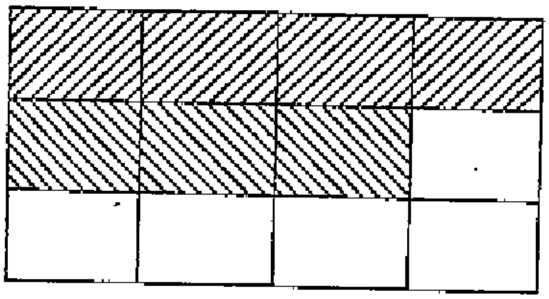
7. $\frac{1}{8}+2\frac{2}{3}+1\frac{7}{8}$

8. $6-2\frac{1}{4}$

Name ______________________

9. Find $\frac{1}{3}+\frac{1}{4}$.

Think:



______

10. Add: $\frac{2}{5}+\frac{1}{3}$. The LCD is 15.

______

11. Add. $\frac{5}{8}+\frac{3}{4}$

______

12. Subtract. $\frac{9}{10}-\frac{2}{5}$

______

13. Find the sum.

$$\begin{array}{r} 6\frac{4}{5} \\ +4\frac{2}{3} \\ \hline \end{array}$$

______

Name ______________________________

14. Find the sum. $8\frac{5}{6}+3\frac{3}{8}$

______

Subtract.

15. $13\frac{3}{4} - 12\frac{5}{12}$

______

16. $7\frac{1}{6}-3\frac{4}{9}$

______

17. Calvin had some baseball cards. He gave 25 of them to Marcia. Then he gave $\frac{4}{5}$ of the rest to Clarise. Calvin has 13 cards left. How many did he start with?

______

18. The original price of a Mark 5 calculator was reduced by $12. Then the resulting price was cut in half to its current price of $15. What was the original price?

______

Name ______________________________

19. Jim spent $1.78 on toothpaste. Then he spent half of what he had left on books. He still had $9.11. How much did he have to start with?

______

20. Sue noted the temperature at 6 a.m. During the day the temperature doubled, fell 5 degrees, rose 8 degrees, and fell 12 degrees to 27° F. What was the temperature at 6 a.m.?

______

APPENDIX B

CHILDREN'S ACADEMIC INTRINSIC MOTIVATION INVENTORY

CAIMI DIRECTIONS

All instructions should be read aloud. The CAIMI should be introduced as follows:

I am interested in finding out what you think about school. The reason I am interested is so I can discover more about what you like and what is most interesting to you. You are about to read some sentences and be asked if you agree or disagree with them. There are no right or wrong answers to any of the questions. I only want to find out what you really think and I ask you to give the best answer that you can. It is important that you answer on your own. Remember, this is not a test with right and wrong answers. Please wait until you are asked to begin.

CAIMI SCORING

The direction of scoring is indicated by the direction of the arrow to the right of the ratings. For items with the arrow pointing to the right (>), ratings are assigned as follows:

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

Reversed-scored items are indicated by an arrow pointing to the left (<), and ratings are assigned as follows:

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
5	4	3	2	1

1. I enjoy learning new things in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

2. I keep working on a problem until I understand it.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

3. I do not enjoy learning.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

4. I like to review work I already know.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

5. I like to find answers to questions in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

6. I try to learn more about something that I don't understand right away so that I will understand it.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

7. I think it is boring to do work in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

R	M	SS	Sc	G

R	M	SS	Sc	G

8. I do not enjoy doing hard assignments in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading					
math					
social studies					
science					

9. I feel good inside when I know I have learned something new in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading					
math					
social studies					
science					

10. I like to do easy assignments.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE

11. I am not curious about learning things in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading					
math					
social studies					
science					

12. When I get bored, I look for new things to do.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE

13. I enjoy practicing things I've already learned in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading					
math					
social studies					
science					

14. I give up easily when I don't understand an assignment in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading					
math					
social studies					
science					

R M SS Sc G

R M SS Sc G

15. I enjoy doing new work in school.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

16. I enjoy doing easy assignments in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

17. I don't like to work on new problems.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

18. I enjoy understanding my work in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

19. I don't like to do more school work than I have to.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

20. I like to do the same assignments over again in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

21. I like to do as much work as I can in…

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

R	M	SS	Sc	G

R M SS Sc G

22. When I don't understand a problem, I give up right away.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

23. I like to learn new things in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

24. When I don't understand something right away, I try to learn more about it so that I can understand it.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

25. I don't like to figure out problems in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

26. When I don't have new things to do in school, I get bored.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

27. New ideas are not interesting to me in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

28. I would like to learn more about...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

R	M	SS	Sc	G

R	M	SS	Sc	G

29. I don't like to find answers to questions.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

30. When I get bored, I look for new things to learn in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

31. When I know I have learned something new, I feel good inside.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

32. I like to do as little work as I can in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

33. I think it is interesting to do work in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

34. When I get bored, I do not look for new things to do.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

35. I do not enjoy practicing things I've already learned in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

R	M	SS	Sc	G

R	M	SS	Sc	G

R M SS Sc G

36. I don't give up on an assignment until I understand it in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

37. I get bored when I don't have new things to do in school.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

38. I don't like to find answers to questions in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

39. I like to learn.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

40. I enjoy doing hard assignments in...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

41. I do not feel good inside when I know I have learned something new.

STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
○	○	○	○	○

42. I would not like to learn more about...

	STRONGLY AGREE	AGREE	DON'T AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
reading	○	○	○	○	○
math	○	○	○	○	○
social studies	○	○	○	○	○
science	○	○	○	○	○

R M SS Sc G

STOP HERE

In the next sentences choose the answer that agrees with your opinion. Mark your answer by making an X in the circle under the words that match your opinion. Answer for each subject separately and mark only one answer for each subject. Remember: there are no right or wrong answers. Ask for help if you need it.

43. Is it more important to you to do a school assignment so that you will: LEARN MORE; or GET A GOOD GRADE, in...

	LEARN MORE	GET A GOOD GRADE
reading	○	○
math	○	○
social studies	○	○
science	○	○

44. Would you rather: DO SOMETHING OVER AGAIN THAT YOU'VE ALREADY DONE CORRECTLY; or DO SOMETHING DIFFERENT TO LEARN SOMETHING NEW, in...

	DO SOMETHING AGAIN	DO SOMETHING DIFFERENT
reading	○	○
math	○	○
social studies	○	○
science	○	○

R	M	SS	Sc	G
R	M	SS	Sc	G

APPENDIX C

SAMPLE ADDISON-WESLEY LESSONS

CONTROL GROUP

Control Group Sample Lesson One

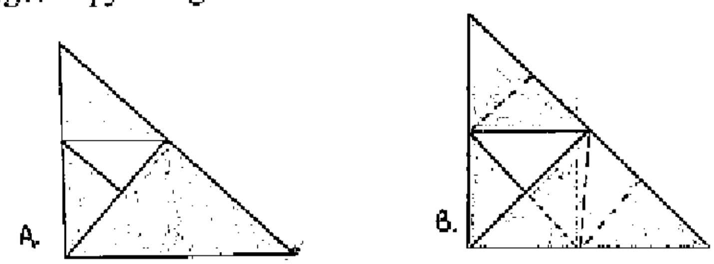
Objective:

Students will be able to add and subtract fractions and mixed numbers having common denominators.

Procedures:

1. Review terminology associated with fractions - numerator, denominator, set ,region - What does each term mean?

2. Distribute an enlarged copy of figure A below to each student. Put students into groups of three.



3. Ask students to determine what fraction of the larger triangle is shaded. Before they begin, brainstorm a class list of methods to do this. If needed, suggest dotted line method as seen in figure B above. Groups work independently.

4. After groups have decided on their response, have one student from each group give their answer and explain how they got it. If no group explains figure B method, teacher should. Explain that all 8 triangles in figure B are of equal size, so that 7/8 of the larger triangle is shaded. Discuss pros and cons of each group's method.

5. After discussion of the problem, transfer to symbols and solve problems like 5¾ + 1¼ together. Have students describe steps orally. Why do we solve in this manner?

6. Do a few more examples as a whole class - review the term "reduce."

7. Use computational problems from the text independently for practice. Correct as a whole class.

8. Assign homework. The assigned worksheet follows this lesson plan.

Evaluation:

Homework - On the Road! worksheet (Addison-Wesley Publishing Company, 1994)

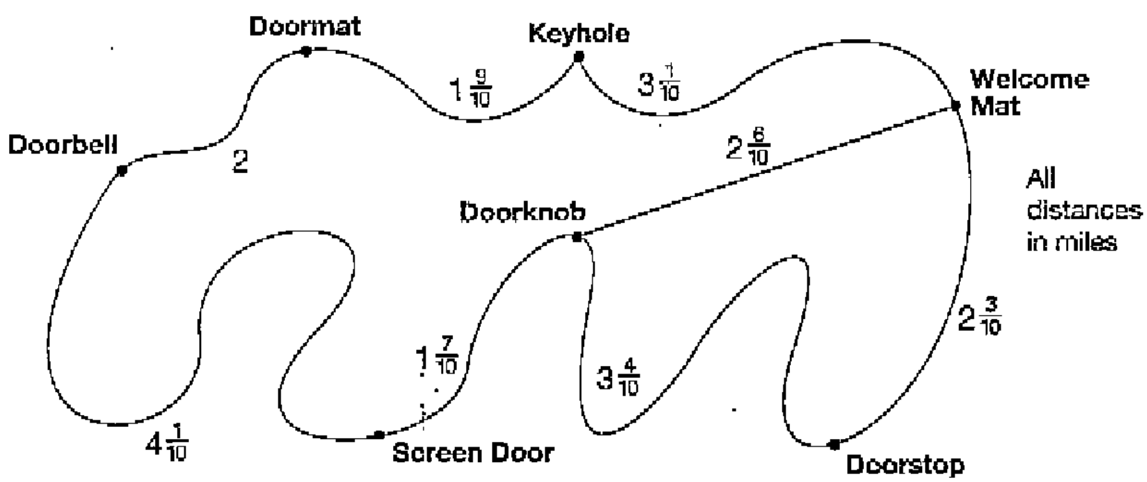
Math Reasoning 7-1

Name ______________________________

On the Road

The Helmets play in the new outdoor-under-150-pound football league. They are going on a lengthy road trip to play other teams in the league. Their first game is at home, in Doorbell.

Use the map to solve the problems. Reduce your answers if possible. Use mental math whenever you can.



1. The next game is in Keyhole. How far is the trip?

____

2. From Keyhole, the Helmets go to games in Doorstop and Doorknob. How far is the trip?

____

3. The next game is in Welcome Mat. The road that is the shortest route is under construction. How much longer is the next shortest route?

____

4. As the crow flies, the distance back home to Doorbell is $5\frac{7}{10}$ miles. How much longer is the shortest route by which the Helmets can return by bus?

____

Control Group Sample Lesson Two

Objective:

Students will be able to use pictures to develop an understanding of adding and subtracting fractions with unlike denominators.

Procedures:

1. As a warm-up, present the following to the whole class:

   "A rectangle is divided into 24 squares of equal size. If the given number of small squares is shaded, tell what fraction of the rectangle is shaded. Write the fraction in lowest terms."

1. 2	2. 3	3. 8
4. 12	5. 18	6. 20

2. Distribute graph paper to each student. Break class into pairs. Have each student outline 2 rectangles on their graph paper with sides no longer than 6 units. Shade in some of the small square units inside each rectangle.

3. Exchange papers with partner. Tell what fraction of each rectangle has been shaded. Explain to partner why that particular fraction was selected.

4. With partner, brainstorm ways to find out how much has been shaded in on both rectangles on one person's paper.

5. Discuss ideas with the whole class. List things that seem important when adding fractions.

6. Each pair now turns over one sheet of graph paper and outlines a rectangle that has an area of 20 square units.

7. Each person selects a crayon of a color separate from their partner. Each person in pair shades in some of the small squares in the rectangle.

8. Each person writes a lowest terms fraction for the part of the rectangle they shaded. Then, as a pair, write a lowest term fraction for the total amount that is shaded. Write the three fractions as an addition problem. What do you notice?

9. Use the following questions to guide whole class discussion:
   a. Name a pair of equivalent fractions you could show on the rectangle.

b. What about this activity suggests that you are adding fractions?

c. Can both you and your partner color more than half of the rectangle? Why or why not?

10. As a whole class, go through an adding fractions problem using pictures. Use the problem 3/4 + 1/6.

   a. Outline a rectangle with an area equal to the least common denominator.
   b. Color 3/4 one color and 1/6 another color.
   c. Count how many squares are colored in all.
   d. Discuss what is happening in each step.

11. Repeat with a subtraction example.

12. Assign homework.

Evaluation:

Homework - Use graph paper to illustrate each of the following problems and their solutions.

a. 1/2 + 1/3

b. 1/2 - 1/3

c. 2/3 + 1/4

Control Group Sample Lesson Three

Objective:

Students will be able to solve problems using the strategy Work Backwards.

Procedures:

1. Ask students to mentally take their age, multiply it by three, and then add six. Ask them what operations they can use to get back to their age. Describe concept as working backwards. Why does it work?

2. Discuss idea of opposite operations.

3. Put the following problem on the overhead:

> The Owls, Cardinals, Jays, and Sparrows had an earthworm catching contest. The Jays caught one fourth as many worms as the Owls and twice as many as the Cardinals. The Owls caught three times as many worms as the Sparrows. How many worms did each team catch if the Sparrows caught 8 worms?

Discuss the problem in pairs. Each pair is to have a numerical answer and be able to explain how they reached their answer.

4. After pair work, discuss methods used with the whole class. Discuss pros and cons of each method.

5. Break into groups of three and distribute three problems to each group. Each person assumes one of the following jobs for each problem. Individuals should take each job once.

   a. Reader - reads problem to the group; explains any unclear information; asks for clarification if necessary
   b. Methodologist - develops a method to use to solve the problem
   c. Computationalist - does mathematical computation as needed

6. Share results with the whole class.

7. Assign homework.

Evaluation:

Homework - Work Backwards (Addison-Wesley PS 7 - 10)

Name ______________________________

Work Backward

The sixth graders visited the used paperback bookstore.
Solve the problems by working backward.

1. Jan bought the most books. Mike bought 6 fewer books than Jan. Carolyn bought 3 more books than Mike. Dawn bought 6 books, half as many books as Carolyn. How many books did Jan buy? ______________

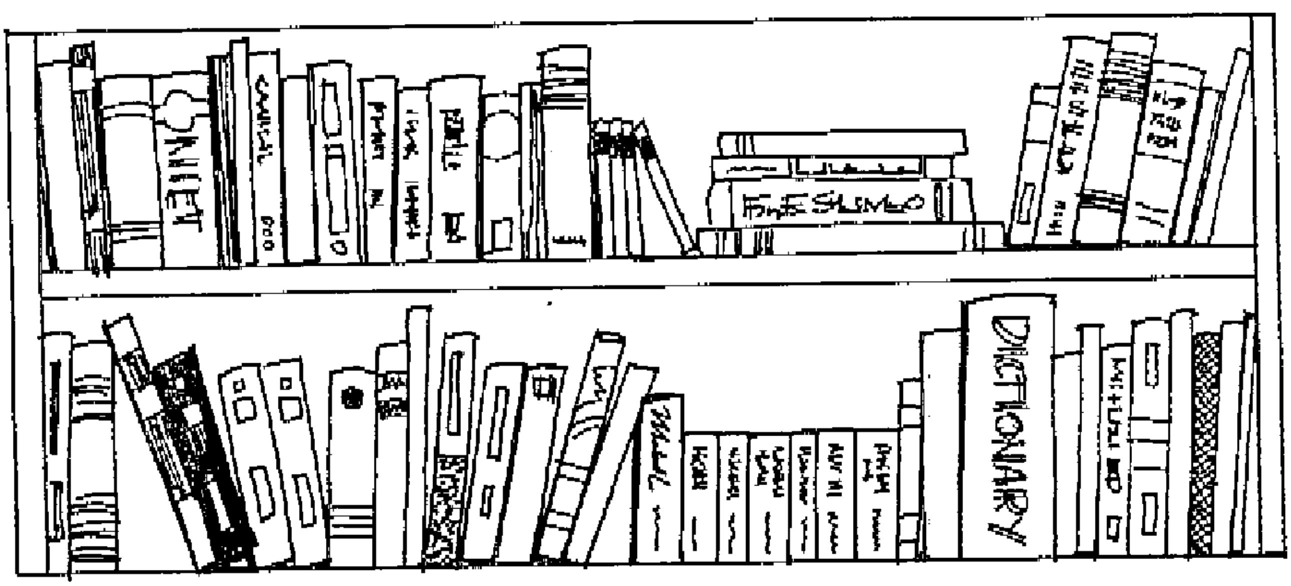
2. Leo spent \$2 more on books than Pat. Herman spent \$4 less than Leo. Tina spent \$3, 3 times as much as Herman. How much did Pat spend on books?

____

3. Mike said, "If you multiply the number of pages in my book by 2, then subtract 20 from that answer, then divide by 3 you will get exactly 50." How many pages are in Mike's book?

____

4. The school librarian visited the used paperback bookstore and bought a number of books for the school. He bought 12 books for the sixth grade. He bought twice as many as that for grades three to five combined. Each of the remaining three grades received 8 books. How many books did the librarian buy? ______________



Control Group Sample Lesson - Unit End Small Group Project

Pretend that you work for a wax museum. Make a map of the exhibits that shows visitors from one wax figure to another. Decide who your figures will be (classmates, pets, or famous people make interesting choices). Decide how far it is from one figure to the next. All distances must be given in fractions and mixed numbers. Make all your distances realistic and give reasons for all your choices.

APPENDIX D

ADDISON-WESLEY LESSONS WITH PORTFOLIO COMPONENT
EXPERIMENTAL GROUP

Experimental Group Sample Lesson One

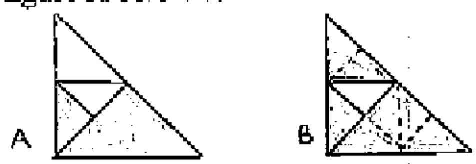
Objective:

Students will be able to add and subtract fractions and mixed numbers having common denominators.

Procedures:

1. Review terminology associated with fractions - numerator, denominator, set ,region What does each term mean?

2. Distribute an enlarged copy of figure A below to each student. Put students into groups of three.



3. Ask students to determine what fraction of the larger triangle is shaded. Before they begin, brainstorm a class list of methods to do this. If needed, suggest dotted line method as seen in figure B above. Groups work independently.

4. After groups have decided on their response, have one student from each group give their answer and explain how they got it. If no group explains figure B method, teacher should. Explain that all 8 triangles in figure B are of equal size, so that 7/8 of the larger triangle is shaded. Discuss pros and cons of each group's method.

5. After discussion of the problem, transfer to symbols and solve problems like 5¾ + 1¼ together. Have students describe steps orally. Why do we solve in this manner?

6. Do a few more examples as a whole class - review the term "reduce."

7. Do a few computational problems from the text independently for practice. Correct as a whole class.

8. Portfolio Activity - Use the following question. "How could you double the following fractions mentally?" a. 2/3 b. 1½ c. 4¼
Discuss ideas with a partner. Then, write a paragraph explaining what you would do. Give an answer for each.

9. Assign homework. The assigned worksheet follows this lesson plan.

Evaluation:

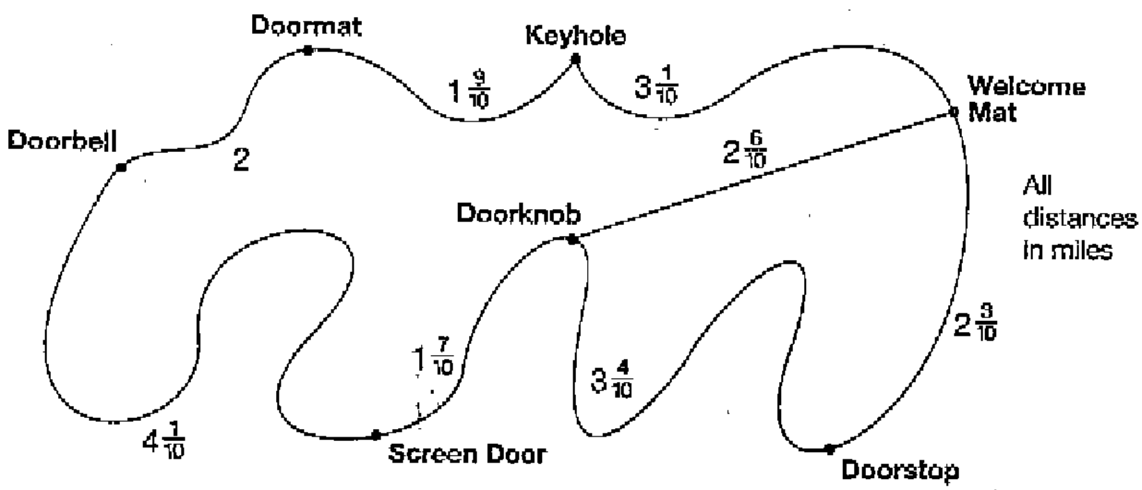
Homework - On the Road! worksheet (Addison-Wesley Publishing Company, 1994)

Name ___________________________________

On the Road

The Helmets play in the new outdoor-under-150-pound football league. They are going on a lengthy road trip to play other teams in the league. Their first game is at home, in Doorbell.

Use the map to solve the problems. Reduce your answers if possible. Use mental math whenever you can.



1. The next game is in Keyhole. How far is the trip?

____

2. From Keyhole, the Helmets go to games in Doorstop and Doorknob. How far is the trip?

____

3. The next game is in Welcome Mat. The road that is the shortest route is under construction. How much longer is the next shortest route?

____

4. As the crow flies, the distance back home to Doorbell is $5\frac{7}{10}$ miles. How much longer is the shortest route by which the Helmets can return by bus?

____

Experimental Group Sample Lesson Two

Objective:

Students will be able to use pictures to develop an understanding of adding and subtracting fractions with unlike denominators.

Procedures:

1. As a warm-up, present the following to the whole class:

   "A rectangle is divided into 24 squares of equal size. If the given number of small squares is shaded, tell what fraction of the rectangle is shaded. Write the fraction in lowest terms."

1. 2	2. 3	3. 8
4. 12	5. 18	6. 20

2. Distribute graph paper to each student. Break class into pairs. Have each student outline 2 rectangles on their graph paper with sides no longer than 6 units. Shade in some of the small square units inside each rectangle.

3. Exchange papers with partner. Tell what fraction of each rectangle has been shaded. Explain to partner why that particular fraction was selected.

4. With partner, brainstorm ways to find out how much has been shaded in on both rectangles on one person's paper.

5. Discuss ideas with the whole class. List things that seem important when adding fractions.

6. Each pair now turns over one sheet of graph paper and outlines a rectangle that has an area of 20 square units.

7. Each person selects a crayon of a color separate from their partner. Each person in pair shades in some of the small squares in the rectangle.

8. Each person writes a lowest terms fraction for the part of the rectangle they shaded. Then, as a pair, write a lowest term fraction for the total amount that is shaded. Write the three fractions as an addition problem. What do you notice?

9. Use the following questions to guide whole class discussion:
   a. Name a pair of equivalent fractions you could show on the rectangle.

b. What about this activity suggests that you are adding fractions?

c. Can both you and your partner color more than half of the rectangle? Why or why not?

10. As a whole class, go through an adding fractions problem using pictures. Use the problem 3/4 + 1/6.

   a. Outline a rectangle with an area equal to the least common denominator.
   b. Color 3/4 one color and 1/6 another color.
   c. Count how many squares are colored in all.
   d. Discuss what is happening in each step.

11. Repeat with a subtraction example.

12. Assign homework.

13. The following day when students return with their homework, have them write a paragraph about what the pictorial representation of 2/3 + 1/4 tells them about the addition of fractions with unlike denominators. They should also include an outline of the steps that they followed to solve the problem.

<u>Evaluation:</u>

Homework - Use graph paper to illustrate each of the following problems and their solutions.

a. 1/2 + 1/3

b. 1/2 - 1/3

c. 2/3 + 1/4

Experimental Group Sample Lesson Three

Objective:

Students will be able to solve problems using the strategy Work Backwards.

Procedures:

1. Ask students to mentally take their age, multiply it by three, and then add six. Ask them what operations they can use to get back to their age. Describe concept as working backwards. Why does it work?

2. Discuss idea of opposite operations.

3. Put the following problem on the overhead:

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Discuss the problem in pairs. Each pair is to have a numerical answer and be able to explain how they reached their answer.

4. After pair work, discuss methods used with the whole class. Discuss pros and cons of each method.

5. Break into groups of three and distribute three problems to each group. Each person assumes one of the following jobs for each problem. Individuals should take each job once.

   a. Reader - reads problem to the group; explains any unclear information; asks for clarification if necessary
   b. Methodologist - develops a method to use to solve the problem
   c. Computationalist - does mathematical computation as needed

6. Share results with the whole class.

7. Assign homework.

Evaluation:

Homework - Work Backwards (Addison-Wesley PS 7 - 10)

Students are to complete the assigned problems and choose one of them and write a step by step explanation of how their solution method.

Name ______________________________

Work Backward

The sixth graders visited the used paperback bookstore.
Solve the problems by working backward.

1. Jan bought the most books. Mike bought 6 fewer books than Jan. Carolyn bought 3 more books than Mike. Dawn bought 6 books, half as many books as Carolyn. How many books did Jan buy? ______________

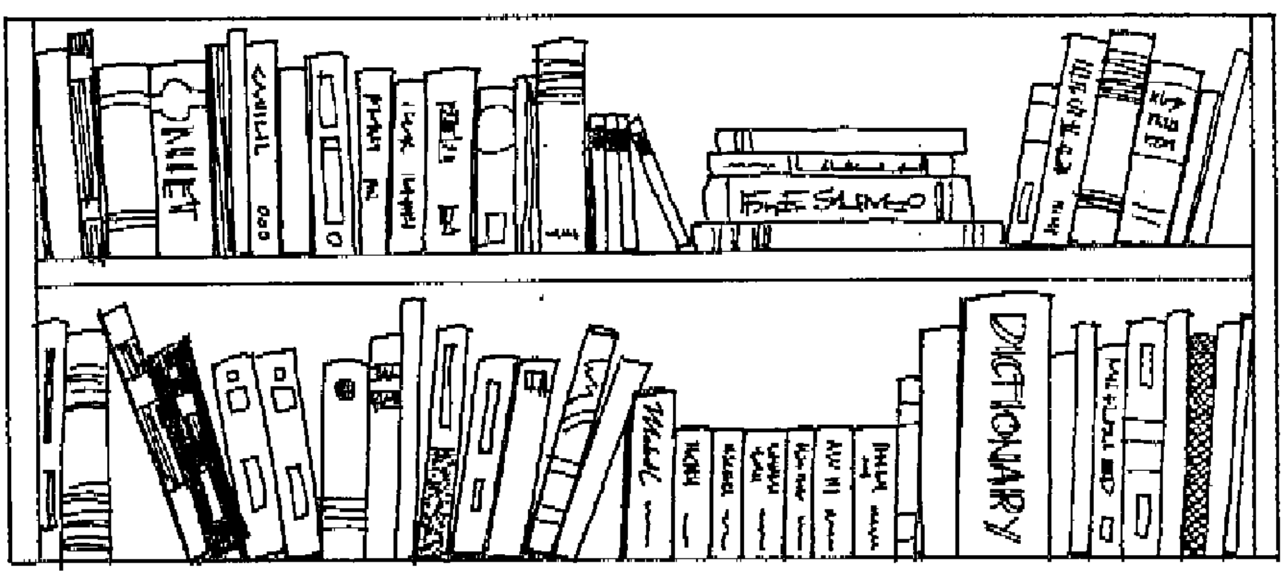
2. Leo spent $2 more on books than Pat. Herman spent $4 less than Leo. Tina spent $3, 3 times as much as Herman. How much did Pat spend on books?

____

3. Mike said, "If you multiply the number of pages in my book by 2, then subtract 20 from that answer, then divide by 3 you will get exactly 50." How many pages are in Mike's book?

____

4. The school librarian visited the used paperback bookstore and bought a number of books for the school. He bought 12 books for the sixth grade. He bought twice as many as that for grades three to five combined. Each of the remaining three grades received 8 books. How many books did the librarian buy? ______________



Experimental Group Sample Lesson - Unit End Small Group Project

Pretend that you work for a wax museum. Make a map of the exhibits that shows visitors from one wax figure to another. Decide who your figures will be (classmates, pets, or famous people make interesting choices). Decide how far it is from one figure to the next. All distances must be given in fractions and mixed numbers. Make all your distances realistic and give reasons for all your choices.

Make up 6 - 8 word problems based on your museum diagram. Be sure that all problems can be solved using addition or subtraction.

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