INCORPORATING WRITING INTO THE FIFTH GRADE MATHEMATICS CURRICULUM

MASTER'S PROJECT

Submitted to the School of Education
University of Dayton, in Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

by

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April, 1994

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Dedicated to Geoffrey, Daniel, Kelly, and Diane

CHAPTER I
INTRODUCTION TO THE PROBLEM

Purpose of the Study

"Students in the United States will be first in the world in science and mathematics achievement by the year 2000" (National Education Goals, 1990).

"Students will demonstrate competency in challenging subject matter, and every school will ensure that students learn to use their minds well" (National Education goals , 1990).

"Recent assessment of mathematics achievement show a gain in basic skills but a lack of demonstration of higher-level application" (National Assessment of Educational Progress, 1990).

"Mathematics instruction should focus on problem solving as an integral part of the curriculum " (National Council of Teachers of Mathematics, 1989).

Faced with such high national expectations and the outpouring of criticism of mathematics instruction and achievement, various educational changes have been instated or recommended in recent years. In order to address the concerns, the State of Ohio instituted mandatory proficiency testing at the ninth grade level. Students must pass four tests in the areas of reading, writing, citizenship, and mathematics in order to receive a diploma of graduation from an Ohio public high school. The Ohio Department of Education developed a state Model, or course of study, for all districts to follow.

This then left the classroom teacher to sift through new directives and recommendations to find alternate strategies with which to meet demand and also meet the needs of the children.

One alternative to rote learning and drill is the incorporation of writing in the mathematics classroom. Writing promotes higher level skills in that it requires the student to process prior and new knowledge in order to organize thought.

The author has developed this study in order to use mathematics journals, or learning logs, in the classroom as a way of tapping and further developing the cognitive skills of the students. The author contends that the use of such logs by the students will have a significant effect on the retention and understanding of the skills taught. In directing learners to respond in writing, the lessons will necessarily be revisited in order to formulate answers and/or use problem solving skills. The use of learning logs, or journals, allows for the integration of basic skills and higher level application on a regular basis.

Viewing written responses may prove to serve as a window to the cognitive levels of various students, therefore providing information that will be important in the planning of further lessons. Insights that can be gained may empower the teacher to design strategic techniques valuable in aiding learners to reach proficiency levels while internalizing various strategies for problem solving.

This study, then, is one educator's attempt to incorporate writing into the mathematics classroom on a daily basis and to examine its effect on mathematics achievement.

Statement of the Problem

The purpose of this study is to analyze the acquisition of selected geometry skills after students have been exposed to a journal writing approach.

Hypothesis

There is no significant difference in pretest and posttest achievement scores after students have been exposed to a journal writing approach.

Assumptions

The author assumes that the pretest and posttest are reliable and measure the skills and concepts that are taught. The author also assumes that the students will participate in directed journal writing activities. It is assumed that students will perform to the best of their abilities on both written assignments and on the tests administered.

Limitations

Several limitations will affect this study. The design $T_1 \times T_2$ is limiting in that no control group is available. Internal validity can be affected by the factors of history and pretesting procedures. External validity can be influenced by the confounding effects of pretesting and the interaction of selection and treatment. Other factors that limit the study include the small sample size and the short duration of treatment.

Definition of Terms

Cognitive skills consist of the integration of facts and the procedures for utilizing those facts. Such skills can be developed through training and experience.

Journal writing refers to the use of special notebooks by the students in which directed and free response writing are organized and kept.

Mathematics learning log is used interchangeably with the term journal in reference to the notebook the students use for writing in mathematics class.

CHAPTER II
REVIEW OF RELATED LITERATURE

Recommendations for the Improvement of Mathematics Instruction

Recent publications have addressed the issue that students are not able to confidently deal with the mathematical requirements of society. In 1990 the National Assessment of Educational Progress (NAEP) completed a mathematical assessment of fourth, eighth, and twelfth graders. Information was collected from students, their teachers, and administrators in order to assemble a picture of mathematical education in the United States today. Results were reported in the publication entitled, *The State of Mathematics Achievement.*

Teachers were asked to assess four skill areas in relation to teaching emphasis: learning facts and concepts, learning procedures for problem solving, developing reasoning ability in unfamiliar situations, and learning how to communicate ideas in mathematics effectively.

At the fourth grade level, over eighty-five per cent of the students received heavy emphasis in the areas of facts and concepts and learning procedures while less than forty-two per cent were exposed to heavy emphasis on the other two areas.

At the eighth grade level, the heaviest emphasis still appeared in the first two content areas. Among Ohio eighth graders forty-two per cent reported to having emphasis placed on developing reasoning ability to solve unique problems with only thirty-six per cent having received emphasis on learning how to communicate mathematical ideas.

At both the fourth and eighth grade levels one third received emphasis on mathematical communication while one fifth received little or no emphasis.

In the publication, *Accelerating Academic Achievement*, NAEP summarizes twenty years of findings. It is reiterated that recent assessments show some gain of basic skills but the lack of demonstration of higher-level application. Students do not demonstrate use of the mind and have difficulty in articulating evidence for the understandings they have reached. Students have trouble communicating effectively in writing informative or persuasive tasks.

Across the last twenty years, there has been little change in mathematics teaching methods despite research that suggests better alternatives than texts and worksheets. Most students were never asked to write reports or do mathematics projects. Reliance on textbooks and worksheets limited the use of innovative strategies. Various reasons were given for not being able to address the problem more fully. These reasons included crowded curriculum, lack of materials, and the focus on standardized testing.

Recent efforts of educators and researchers recommend that the teaching and learning of mathematics be relevant to everyday situations that serve to foster thinking skills. It is advised that students be exposed to unfamiliar avenues that require the discovery of alternative solutions and/or strategies. NAEP recommends changes in curricular and instructional emphasis in order to aid students in "learning to reason, think productively, and to communicate in mathematical situations."

Teachers, curriculum directors, and researchers advise taking a cognitively-based approach i.e.,focus should be on problem solving not as a topic but as a thread that runs throughout the course of study (Jones, 1987). Because learning mathematics is recursive, learners move from level to level. They experience the same concepts but construct new meaning in other situations. Children impose structure on mathematics. Teachers need to help students organize this structure in order for them to see the "big picture" and to reflect on their own thinking.

The National Council of Teachers of Mathematics (NCTM) recommends that students be taught to communicate in mathematics in order to foster cognitive skill improvement (Cooney, 1992; Ford, 1990; Wadlington, Bitner, Partridge, & Austin, 1992; Coffield, 1992; Hatfield & Price, 1992). The NCTM states,"As students communicate their ideas, they learn to clarify, refine, and consolidate their thinking" (Coffield, 1992). Mathematical communities need to be developed in classrooms so that students are encouraged to share ideas (Cooney, 1992). The understanding of mathematics is enhanced by using it in various contexts.

Researchers and educators recommend that communication in the mathematics classroom include verbalization through cooperative learning, peer discussion, and writing (Burton,1985; Evans, 1984;

Ford,1990; Geeslin, 1977; Nahrgang & Peterson, 1986; Davison & Pearce, 1988; Gordon & Macinnis, 1993; Coffield, 1992; Wadlington, Bitner, Partridge, & Austin, 1992; Johnson, 1983; Burns, 1993). Burns (1993) writes:

> "What is missing is attention to children's deciding on the reasonableness of their solution, justifying their procedures, verbalizing their processes, reflecting on their thinking - all those behaviors that contribute to the development of mathematical thinking."

Burns (1993) contends that children are forced to organize their ideas when they are asked to explain their thinking. Opportunity is given to "develop, cement, and extend" understanding. Interaction is essential in that it provides feedback and allows the child to experience other points of view. Burns suggests preceding written assignments with small group or whole class discussion so that students have a chance to formulate ideas and responses. Writing is then a natural extension of talking.

Writing To Foster Cognitive Skills In Mathematics

Burns (1993) quotes William Zinssel in *Writing to Learn:* "Writing is how we think into a subject and make it our own." Writing in mathematics class requires children to revisit their thinking and reflect on their ideas. It also gives teachers a way to assess how students think.

Applebee (1984) writes that the role of writing in thinking is attributed to some combination of the following four factors: the permanence of the written word which allows the writer to rethink and revise, the explicitness required in writing, resources demanded to organize and think through new ideas or experiences, and the active nature of writing itself.

Applebee (1984) reports that various process-oriented studies state that writing involves recursively operating subprocesses, and the processes vary depending on the type of written task. Planning processes involve generating ideas and making new connections among old ones. Reviewing processes involve attention to the consistency of argument. A writer's plan incorporates available information and a pre-processing of information from long-term memory.

In noting the implications of these studies, Applebee (1984) summarizes that given a body of content, it would be expected that the more the writer manipulates new material in the process of writing about it, the more understanding the writer will gain. He goes on to state that this would be especially true " if understanding is measured by the ability to apply new concepts in new situations." This statement then ties writing to the cognitive goals recommended by both NAEP and NCTM. Applebee states that further studies are needed to explore interactions among writing activities and the instructional aims of the classroom teacher.

Royer, Cisero, and Carlo (1993) write that cognitive skills consist of a mixture of specific facts and procedures for utilizing those facts. They also conclude that such skills, unlike intellectual abilities, can be acquired through training and experience. Thus writing in the mathematics classroom serves to aid students in obtaining thinking skills through the active experiences of relating facts and procedures.

Implementing Writing in the Mathematics Classroom

Hatfield and Price (1992) advise teachers to make the change in focus in small steps. They encourage the use of mathematical journals in which students communicate through drawing as well as writing. The teacher needs to create opportunities for children to discuss mathematics and to create situations in which students need to analyze, evaluate, and make decisions. They suggest that problem solving situations be based on newspaper articles, advertisements or graphs.

In a study by Geeslin (1977) students in grades four through twelve were asked to write sentences and paragraphs concerning probability. In this study and subsequent studies, students of various ages and ability levels performed poorly on written tasks. Geeslin attributes this partly to a lack of experience and largely to the inability to express a complete mathematical idea.

Geeslin (1977) concludes that student misconceptions are not always revealed by achievement tests. Writing about mathematics can be useful to the teacher as a diagnostic tool as well as to the student as a learning device. Although Geeslin advocates mathematical discussions, he states that written explanations have several advantages. Writing encourages the student to be more precise than verbal explanation. In order to discuss specific problems, both teacher and student can review the work together. Teachers are advised to be patient and allow for sufficient practice as students slowly develop skills.

Johnson (1983) agrees that teachers need to recognize writing as a valuable learning and evaluative tool in the mathematics classroom. Students should rewrite problems they do not understand and should construct story problems of their own. The necessary thinking in completing such tasks facilitates the retention of the concept in the mind of the student. To extend writing even further, it is suggested that students be required to research and report on the development of particular mathematical areas, biographical information on mathematicians, and to review books or articles relating to the field of mathematics.

Davison and Pearce (1988) characterize writing as a mode to acquire new knowledge. They classify mathematical writing activities into five categories: direct use of language, linguistic translation, summarizing, applied use of language, and creative use of language. Direct use of language involves copying and recording information such as practiced in notetaking. Notetaking is more effective if students are given a structure with which to work.

Linguistic translation includes the translation of mathematical equations, the expression of the solution to a word problem in a complete sentence, and the listing of procedural steps in solving mathematical operations. Summarizing includes paraphrasing material from textbooks or from a lesson while the applied use of language incorporates skills in developing and writing story problems based on real life situations including possible quiz and/or test questions. Lastly, Davison and Pearce (1988) refer to the creative use of language as an incorporation of research, organization , and presentation on some topic in the field of mathematics.

In the article "The Writing Process: A Strategy for Problem Solvers," Ford (1990) parallels the writing process and problem solving. Using the five stages of the writing process, she engages her third graders in mathematical communities where they compose, discuss, and solve problem situations. In the prewriting stage, the teacher provokes thought by providing a stimulus such as a restaurant menu. The student then writes down ideas to be shared with the teacher or a peer during the conferencing stage at which time questions are asked about the writer's meaning or purpose. In the fourth, or revising, stage, the author clarifies the writing through the addition or deletion of information. Finally, publication involves creating a clean copy for others to read. Student work is then kept in a file box to which all have access.

Ford (1990) found that her students developed a greater confidence in mathematics and felt an ownership of the subject. If one child could not solve another's problem, he/she merely needed to visit the author for further explanation. Using the writing process helped students focus on essential information and become familiar with the structure of the written problem.

Wadlington, Bitner, Partridge, and Austin (1992) outline three phases in the development of writing communities in the mathematics classroom. Having children discover the importance of writing to communicate mathematics and keeping a mathematics journal are the goals of the first phase. The initial task is one in which the student is asked to complete a practical or creative use of mathematical writing. Examples include making a bulletin board for mathematics, writing a note justifying a purchase, planning a party, or creating a poem. The second phase involves exposure to cooperative learning techniques in which peers work together for first-hand experiences in mathematics.

The goals of the third phase are to apply diverse problem solving strategies. The goals are carried out by combining the writing learned in the first phase with the cooperative learning techniques stressed in the second phase. In the third, problem solving phase, each student is required to write the given problem, possible strategy choices, resolution (answer), and his/her reflections on how the cooperative group arrived at the resolution. In this manner Wadlington, Bitner, Partridge, and Austin (1992) feel teachers can present an effective way to engage students in positive mathematics communications.

Journals in the Mathematics Classroom

Student mathematical writing can be effectively presented, organized, and monitored through the use of journals (Gordon & Macinnis, 1993; Davison & Pearce, 1988; Nahrgang & Petersen, 1986; Burton, 1985; Evans, 1984; Wadlington, Bitner, Partridge, & Austin, 1992; Hatfield & Price, 1992). A journal, or log, is defined as a notebook in which daily writing is entered. Researchers differ as to the type of entries to require but concur that the journal entries should not be graded on content.

Writing in journals is a technique that yields benefits in the quality of class time (Burton,1985). Journal writing can help teachers to discover patterns of thought. Burton describes journal writing as "brainstorming with oneself." With quantity as a goal, students are directed to write everything down without evaluation and are encouraged to build upon expressed ideas. Burton grades the journals for length but not for content. She instructs her students to place a red check mark next to any entry that they do not want her to read. Thus she affords first hand experience in journal writing to her college classes of perspective mathematics educators.

Gordon and Macinnis (1993) conducted a study in intermediate grade classrooms involving the use of dialogue journals. A dialogue journal is one in which the student and teacher take turns writing responses to one another. Two types of writing were encouraged in these logs: prompted writing and free writing. Teacher responses consisted of comments, questions, or assurances without being judgemental or evaluative. No attempt was made to teach the concepts through the dialogue, but it would be noted if a student was off-track.

Gordon and Macinnis (1993) found that students could assess teaching methods in relation to learning the material. They had awareness of themselves as learners as to what worked for them and what didn't work. Discoveries, insights, and difficulties were shared as students empowered themselves by taking control, or responsibility, for their learning. Gordon and Macinnis adjusted instructional methods accordingly and view the journal as "a window on student's thinking."

Nahrgang and Petersen (1986) report that the use of journals is the most effective method of using writing to help students learn mathematics. The student is forced beyond rote learning and is challenged to use intellectual skills. Nahrgang and Peterson used journals with university students over a ten week period. All responses were to be written in prose rather than in numbers and equations. The journal writing sessions lasted approximately seven minutes each and were used as substitutes for the unannounced quizzes usually given in the class. Each entry was a short written response to the teacher's question, or set of instructions.

At first, Nahrgang and Peterson (1986) assigned grades to the journal with the intention of counting it as a part of the final grade. They found that this restricted thinking and did not encourage individualized learning and discovery. In order to assign credit to the journal entries, then, they decided to add points toward the next major examination. In this way they attempted to reward the quantity and quality of the entry without being judgemental.

Nahrgang and Peterson (1986) conclude that continued use of journals requiring the utilization of a variety of intellectual skills, allow the student to grow in mathematical understanding and in the expression of that understanding.

Evans (1984) conducted a study to determine what effect journal writing could have in an intermediate grade classroom. Using a colleague's fifth grade as a control group with no writing assignments, Evans began the study by profiling standardized test scores of both classes. Both teachers taught units on multiplication, which entailed computation, and geometry, which carried a heavy vocabulary load. Teaching approaches were conducted in the same manner except that Evans incorporated writing during mathematics time.

Three types of writing were included in Evans' (1984) mathematics class. Students wrote explanations or described "how to do" something. Secondly, they were instructed to write their own definitions for the mathematical terms used in the textbook. "Troubleshooting" was the third type of writing. Students were directed to specifically explain errors they had made on tests or quizzes.

In analyzing the results of her study, Evans (1984) found that although her class had averaged lower pretest scores than her colleague's class, it surpassed the control by one percentage point on the multiplication posttest and surpassed the control by ten percentage points on the geometry posttest. In reviewing individual performances, students in the test group with the lowest pretest scores made the most gains. Writing affords the teacher one more tool to help the less capable students grow and learn.

In summary, researchers have found that a need exists for students to communicate mathematical ideas in order to develop cognitive skills. Cognitive research suggests new approaches in instruction and training. It is recommended that teachers build mathematical communities in the classroom where children are encouraged to participate in discussions, cooperative learning, and writing activities.

Writing requires the development, use, and practice of cognitive skills. Writing activities in the mathematics classroom include explanations, definitions, learning responses, lesson summaries, paraphrasing word problems, creating word problems, book or article reviews, real-life application in letters, notes, or displays, and creative poems, stories, or cartoons developed around a mathematical topic.

Journals are recognized as an effective way of organizing student writing. The student becomes an active learner by analyzing and looking for connections. Math terminology is used in context while procedural writing is practiced. The student develops strategies for unlocking the meaning of the text and begins to take responsibility for self-evaluation and the process of learning.

Journals are also effective as diagnostic tools. The teacher is able to spot misconceptions or misunderstandings and make lesson adjustments accordingly. A view of the level of reasoning or thinking can be gained, and explanations can be framed in the language of the students for better understanding.

CHAPTER III

PROCEDURE

Subjects

This study was conducted with seventeen fifth grade students in a self-contained classroom. The population consisted of five boys and twelve girls. Fifteen of the students were ten years old at the time of the study while two were eleven years old. The age range was nineteen months.

Individual Iowa mathematics averages based on national percentages from the previous fourth grade term ranged from a low of twenty-nine per cent to a high of fifty-seven per cent . The median score was forty-three per cent with a group mean of forty-one per cent. One female student attended Chapter I reading class daily. Two female students attended a gifted and talented mathematics and science class once a week. No other students received special services.

The seventeen students had come to this classroom from three different district fourth grade teachers. Their experiences in geometry were similar in that they had had only a minimal knowledge of the very basic shapes and concepts. The majority of the material presented was new to the students.

Setting

School. This study was conducted in a rural three-story red brick elementary school housing kindergarten through sixth grade. The building contained one classroom per grade level up to and including the fourth grade. Two fifth and sixth grade classes and one intermediate Developmentally Handicapped class occupied the top floor. Lessons were conducted in self-contained rooms by the classroom teachers. Physical Education, Music, and Band were taught by traveling teachers who serve the district. Available service personnel for the district included a nurse, counselor, learning disablilities tutor, gifted teacher, and a speech therapist. The total number of students attending the school was two hundred twenty-five consisting of one hundred seventeen males and one hundred eight females. Two hundred nineteen students were of Caucasian descent while six were representative of other races. The faculty was made up of eleven full time female teachers.

Community. The school district was made up of three villages and their surrounding townships. About four hundred twenty people live in each village. The area was thirty-eight percent agricultural with a median family income of $24,710. One thousand two hundred eighty-seven students were enrolled in the district and were served by eighty-four certified staff and fifty-five classified personnel. Minority population was less than one percent.

Data Collection

Construction of the Data Collecting Information. The same test was used to determine both pretest and posttest scores. The test was developed by Harcourt Brace & Company as a component of the *Mathematics Plus* program adopted by the school district to use with the mathematics course of study through and including eighth grade. The test consisted of thirty multiple choice questions. Twenty-eight were based on geometrical concepts while two dealt with the use of problem solving strategies. Students were required to identify geometric figures and to associate the terminology particular to each. Visual thinking was required in order to determine the characteristics of various figures and to determine how the figures had been acted upon.

Administration of the Data Collecting Instrument. The tests were administered by the author of the study who was also the regular classroom teacher. Students sat at individual desks and were instructed to read each question carefully, study any drawings, and to circle the correct choice. Test items were not read to the class, and students were directed to complete the assessment without teacher or peer assistance. In both instances of the test administration, students were given no prior knowledge that they would be assessed. This was done so that the posttest scores would reflect the acquisition of knowledge gained throughout the course of the treatment rather than the efforts of extra preparation for an announced chapter test.

Design

The one group pretest-posttest design (T_1 x T_2) was used for the study. This included a pretest, a treatment, and a posttest. The duration of the treatment was four weeks.

Treatment

The independent variable in this study was the use of learning logs, or journals, as an integrated part of the mathematics textbook unit.

Students were directed to respond to teacher selected questions within the context of the unit. Students engaged in writing extensions of the lessons and the geometric concepts presented therein.

Pocket folders with brads were used as mathematics journals. Each journal was divided into three sections through the use of differently colored pages.

The pages in the first section of lined green copy paper were titled *Math Vocabulary.* In this section students were directed to record and define new terms as the unit progressed.

The second section of lined orange copy paper consisted of pages headed *Problem Solving Strategies.* Here students were to include notes and comments on the various methods of tackling problem situations as they were presented and studied.

The third section of the journal was composed simply of notebook paper supplied by the student. This section contained the daily writing assignments.

The journal was designed so that it could be used throughout the course of a school year and was color-coded so that the student could easily access needed terminology and problem-solving information.

This particular study was based on a *Mathematics Plus* textbook chapter as developed by Harcourt Brace & Company (1994) and as adopted by the school district to implement the course of study. Specific pupil performance objectives for the unit being taught were: 1. to identify and classify lines, angles, rays, polygons, triangles, quadrilaterals, and circles; 2. to identify congruent, similar, and symmetric figures; 3. to identify slides, flips, and turns; 4. to identify solid figures and their attributes; and, 5. to use the strategy of guess and check in problem solving.

Throughout the duration of the study, lessons were presented in the usual teaching style of the classroom teacher with the use of the textbook. The treatment, or change, was the daily written requirements.

Seven to ten minutes were reserved at the end of each mathematics session for writing. The daily prompt was written on the board. Students dated and copied the prompt and proceeded to follow the directions. Prompts varied from the general structure of "Today I learned _____" to specific questions based on the lesson, and to thought-provoking questions meant to extend the pupils' thinking about various geometric concepts (see appendix).

Journal entries were not graded individually but did count as a completion or participation grade. Upon reading each entry, the teacher used a "seal of approval" ink stamp to indicate that the student's writing had been read. No other written comments were included on the part of the teacher.

In reviewing the written statements of the students, the teacher noted any misconceptions. These, then, were addressed in subsequent lessons. It should be noted that the teacher, in attempting to isolate the treatment, did not grade or study the pretest for general problem areas before planning the lessons. Daily assessments and subsequent planning were dependent on the use of regular daily practices and the use of the journals.

Upon completion of the unit students were administered the posttest. In order for the posttest to reflect knowledge acquired through the use of daily journals with regular mathematics lessons, students were not informed of the upcoming posttest. Students, therefore, did not practice or study the concepts in preparation for the test.

CHAPTER IV

RESULTS

Presentation of Results

The mean test score for the pretest was 12.24 points while the mean test score for the posttest was 20.47 points. Fifteen students showed gains, one student experienced a loss of points, and one student showed no gain or loss. The mean gain was 8.24 points. The value of t when computed using the t-test for dependent variables was 6.75 which was greater than the .001 significance level for two-tailed tests.

TABLE 1 TEST SCORES AND DIFFERENCES

STUDENT	POSTTES	PRETEST	DIFFERENCE	
A	26	12	+ 14	
B	23	14	+ 9	
C	7	10	-3	
D	23	15	+ 8	
E	22	10	+ 12	
F	18	11	+ 7	
G	26	20	+ 6	
H	27	15	+ 12	
I	22	7	+ 15	
J	22	17	+ 5	
K	24	11	+ 13	
L	21	10	+ 11	
M	17	11	+ 6	
N	18	11	+ 7	
O	14	14	0	
P	20	6	+ 14	
Q	18	14	+ 4	

TABLE 2 PRETEST SCORES

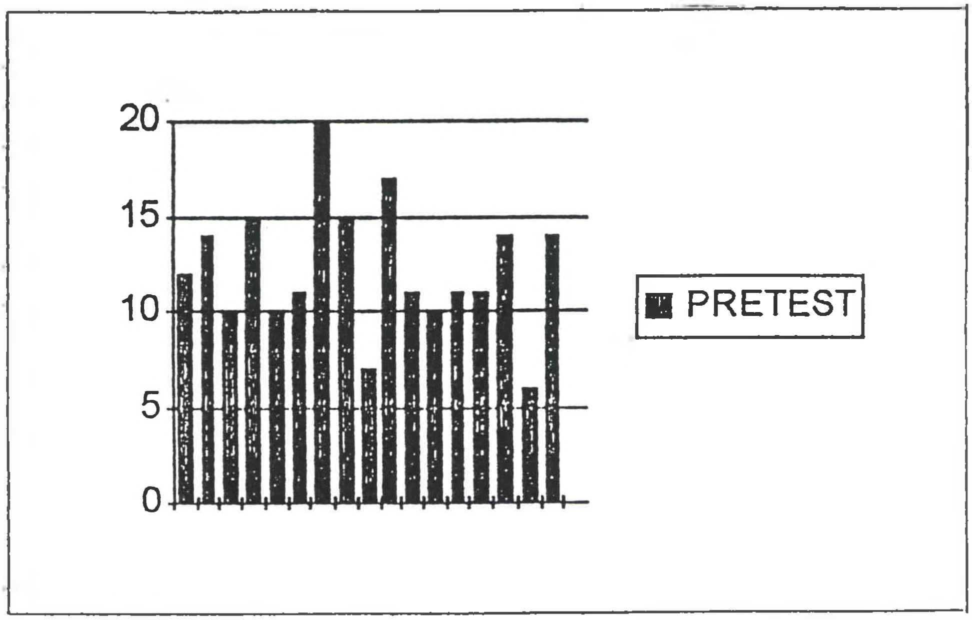


TABLE 3 POSTTEST SCORES

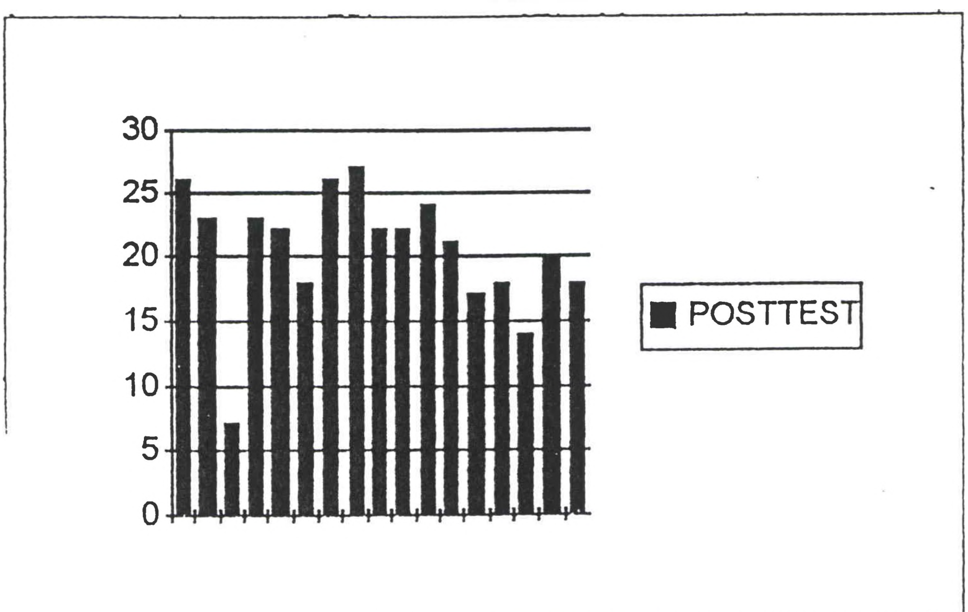
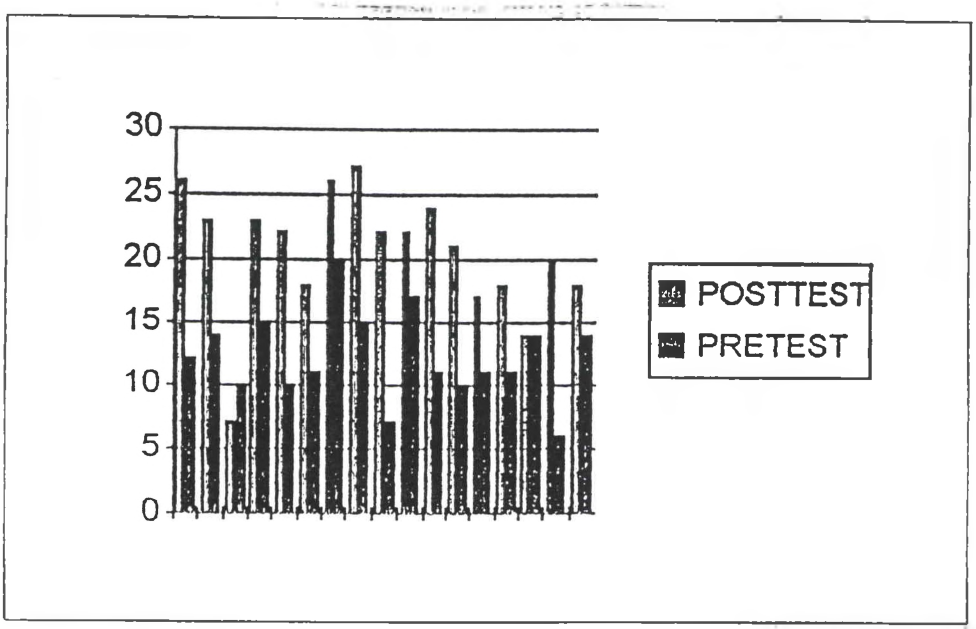


TABLE 4 COMPARISON OF TEST SCORES



Discussion of Results

Because the value of t proved to be of significant difference, the null hypothesis was rejected. Therefore, something other than chance or error must have produced the change. In this study, the use of daily writing journals in the mathematics classroom served as the treatment and is assumed to have affected the acquisition of knowledge retained by the individuals taking part in the study.

Most of the students earned a higher achievement score after being exposed to the treatment. Of the fifteen students who recorded a gain, nine scored at or above the mean gain of 8.24. The two lowest scores on the pretest resulted in the two highest gains. This put these scores within five to seven points of the top score on the posttest where they had been thirteen to fourteen points from the top score on the pretest.

The resulting gains served to narrow the gap for the lower scoring students.

In analyzing the scores, the lowest score on the posttest was one in which the student had shown a loss from the pretest score. The low score on the posttest was seven points from the next highest score. After the pretest the lowest scores ranged within four points of each other. Because this posttest low score was so different from the rest , the researcher questioned the validity of the posttest for that particular student at that particular time. The analysis of such data alerted the researcher to a student who needed intervention.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to analyze the acquisition of selected geometry skills after students had been exposed to a journal writing approach. The hypothesis stated that there would be no significant difference in pretest and posttest achievement scores after students had been exposed to the journal writing approach.

The study was conducted with seventeen fifth grade students in a self-contained classroom. The independent variable was the use of learning logs, or journals, as an integrated part of the mathematics textbook unit. Students were directed to respond to teacher selected prompts within the context of the unit on a daily basis. Students engaged in writing extensions of the lessons and the geometric concepts presented therein.

The mean gain in scores from the pretest to the posttest was 8.24 points. This proved to be of significant difference ($t=6.75$; $p<.001$).

Conclusions

The null hypothesis was rejected. Something other than chance or sampling error was responsible for the change. Therefore, the author concluded that the use of journals in the mathematics classroom was significant in affecting achievement scores.

Recommendations

The use of mathematics logs in the classroom can serve as a valuable tool for both the student and for the teacher. For the student, the log provides the space for daily thinking and writing. In reviewing what has been written, it serves the student as a study aid and gives the individual the opportunity to revisit lessons. The use of a log requires active learning on the part of the pupil and is a step in guiding that child towards the responsibility for one's own educational progress and self-reliance. It provides the student with a strategy for learning.

Likewise, the mathematics log provides the educator a strategy for teaching. Questions and/or prompts can be generated that allow the teacher to assess the understanding of the concepts that have been presented. In reviewing the entries, the teacher can revise plans to incorporate or reteach ideas that may have not been fully understood. On the other hand, entries may show that students have an excellent grasp of the concepts at hand and may be able to progress at a faster pace. On an individual basis, journal writing may reflect the need for tutoring or other intervention before assessment testing.

This study of journals was conducted in such a manner that the teacher could easily integrate the use of logs in the mathematics classroom without a major change in teaching strategies. A primary concern of the author was that the study not involve extra planning and/or paperwork on the part of the teacher. Lesson plans were developed as usual except for the additional determination of the daily question or prompt. Many days the prompt was merely "Today I learned..". Students were allowed seven to ten minutes to write before moving on to the next subject. In this way, a great deal of time was not spent on the journal, but the writing became routine, and students often reminded the teacher when it was time to write.

Students do not need to be evaluated on everything they do in the classroom, and teachers should not feel obligated to grade every paper or assignment completed by the child. In the case of the mathematics journals, the teacher acknowledged efforts by stamping the entries. Stickers could be used for the same purpose. To insure participation, each entry was considered part of a participation grade, but no one entry was evaluated on its correctness or writing skills. In this way, the teacher was free to read the entries without passing judgement and without feeling obligated to write comments on each one. In this way , the journals could be easily managed, and extra paperwork was avoided.

This author recommends that intermediate and middle school teachers try mathematics logs as a teaching/learning strategy. When starting the next chapter in the mathematics textbook, provide the students with small journals made simply of plain paper folded in half with construction paper covers. After each daily lesson, before assigning practice problems, instruct the children to write three sentences about the lesson using any new terminology. Read over the journals periodically, collect them at the end of the chapter, and evaluate them as to the value they provided for the students.

If the use of even a short term mathematics log seems cumbersome, or if there is no time to assemble separate logs, try instructing the students to write one to three sentences at the end of each page of practice problems. Although this does not provide one special place to collect comments, it still would be valuable in that students are writing, and that writing has shown to be an effective way to improve learning and achievement scores.

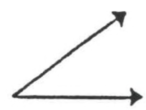
It is essential that teachers of intermediate and middle school grades guide students in how to learn. The use of logs can be a strategic tool in a learner's repertoire.

Choose the letter of the correct answer.

1. Which of these has exactly two endpoints?

   A. ray B. plane
   C. line D. line segment

2. Which is the best estimate of the measure of this angle?



   A. 10° B. 45° C. 65° D. 80°

3. Which polygon has eight sides of equal length and eight angles of the same measure?

   A. irregular octagon
   B. irregular hexagon
   C. regular octagon
   D. regular hexagon

4. A triangle has exactly two sides of equal length. What type of triangle must it be?

   A. isosceles
   B. scalene
   C. equilateral

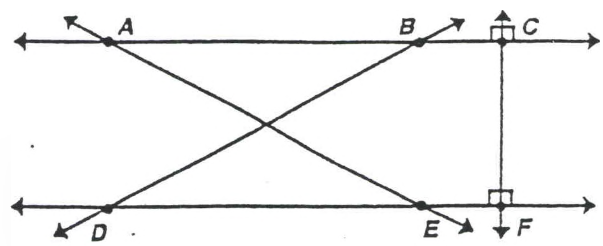
5. Which quadrilateral must have four right angles with opposite sides parallel and of equal length?

   A. trapezoid
   B. rectangle
   C. parallelogram
   D. rhombus

6. Which of these is a line segment that has the center of a circle and a point on the circle as endpoints?

   A. radius B. chord
   C. diameter D. not here

Use the figure below to answer questions 7–9.



7. Which line is perpendicular to $\overleftrightarrow{AC}$?

   A. $\overleftrightarrow{AE}$ B. $\overleftrightarrow{BD}$ C. $\overleftrightarrow{CF}$ D. $\overleftrightarrow{DF}$

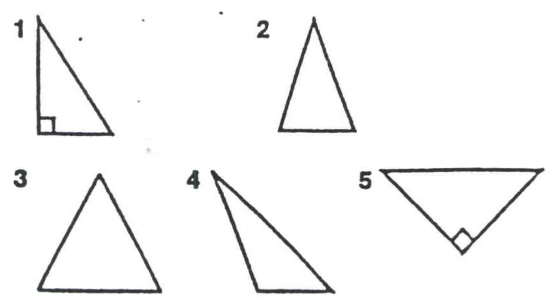
8. Which names a ray?

   A. $\overleftrightarrow{DB}$ B. $\angle DBC$
   C. $\overline{DB}$ D. $\overrightarrow{DB}$

9. Which is an obtuse angle?

   A. $\angle AEF$ B. $\angle DFC$
   C. $\angle CAE$ D. $\angle AED$

Use the triangles below to answer questions 10–12.



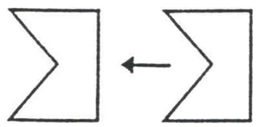
10. Which triangle is equilateral?

   A. 1 B. 2 C. 3 D. 4

Go on to the next page.

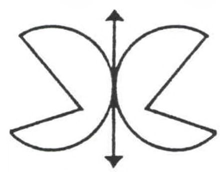
Name ______________________________

21. How was the figure moved?



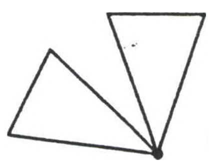
A. slide B. turn
C. flip D. flip and turn

22. How was the figure moved?



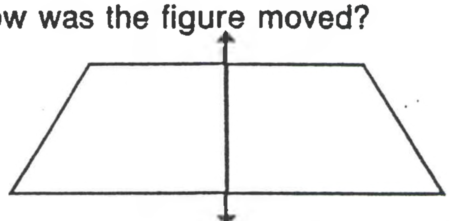
A. slide B. turn
C. flip D. slide and turn

23. How was the figure moved?



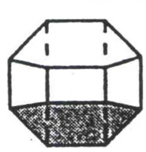
A. slide B. turn
C. flip D. slide and turn

24. How was the figure moved?



A. slide B. turn
C. flip D. flip and slide

25. What is this solid figure?

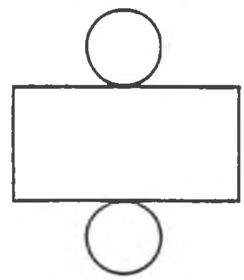


A. octagonal prism
B. octagonal pyramid
C. hexagonal prism
D. hexagonal pyramid

26. What solid figure has a square base and triangular faces?

A. triangular pyramid
B. square pyramid
C. triangular prism
D. square prism

27. What solid figure is formed from this pattern?



A. cone B. sphere
C. prism D. cylinder

28. How many vertices does a triangular prism have?

A. 3 vertices B. 4 vertices
C. 5 vertices D. 6 vertices

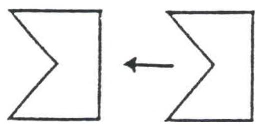
29. Tim's sister is 3 years older than Tim. Tim's brother is 4 years older than his sister. The sum of their three ages is their father's age. He is 37 years old. How old is Tim?

A. 6 years old B. 7 years old
C. 8 years old D. 9 years old

30. Sandra has 5 days left to practice running for a race. Each day she wants to run 1 kilometer farther than the day before. In all she wants to run 25 kilometers. How many kilometers should she run the first day?

A. 2km B. 3km C. 4km D. 5km

21. How was the figure moved?



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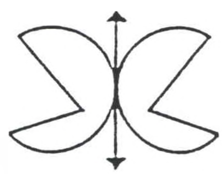

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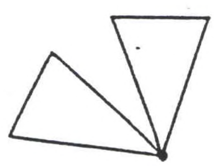
23. How was the figure moved?



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C. flip D. slide and turn

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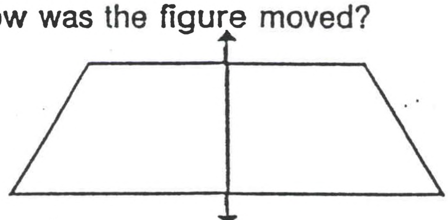

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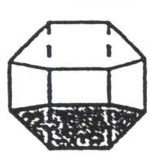
25. What is this solid figure?



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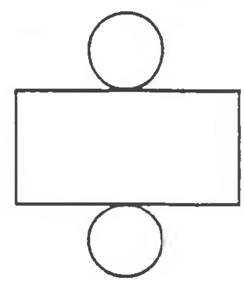

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APPENDIX B
JOURNAL PROMPTS

Draw and label the three types of angles. Give the definition of each in your own words.

Today I learned...

How is a regular polygon different from an irregular polygon?

Can a polygon that has more than four sides have parallel sides? Can a triangle? Explain.

Draw an isosceles triangle. List everything you can about an isosceles triangle.

Why do you think architects need to know about geometry?

How are pyramids and prisms alike? How are they different?

Give the definition of and illustrate ____________

What letters of the alphabet have a line of symmetry? What is a line of symmetry?

Explain how a protractor is used to measure angles.

APPENDIX C
STUDENT JOURNAL ENTRIES (UNEDITED)

Today I learned how to make open and closed figures. They are really cool shapes.

Today we learned about practors in math and how to use them. We made angles with the practers. 3 of each kind. We already know about right, obtuse, and acute angles.

Today I learned that colinear is when points are on the same line. That was all that was newly learned today.

Today I learned about open figures and closed figures. I also learned what a polygon is. There are regular and irregular poligons. Regular poligons have the same size of sides and irregular is the opposite.

Today I learned how to measure angles. To measure angles you have to use a prototractore.

Yes, a polygon with more sides than 4 can. A red cross simble for instance. A triangle can't because it has 3 sides more like this. All the sides are the same but the lines are intersecting not parallel.

An isosceles triangle has 3 sides, only 2 are equal length. It has 3 acute angles and not right angles or obtuse. It is a polygon.

Today in math class we learned about the degree of angles. We made three angles of the angles (acute, right, obtuse.) Then we did a worksheet on measuring the degrees of angles.

No a triangle cannot have parallel sides because a triangle has crooked sides.

They need to know the names of the different shapes so they can label them in the blue prints for the building.

They need to know about geometry because they need to measure the building pieces and if they don't the building could fall apart.

I think so because if they did not know about geometry they could not figure out what size and shape the place would need to be.

They need to know shapes and sizes, measurements, to be able to design.

A pyramid has 4 triangles and one square. A triangular prism has two triangles and 3 rectangles.

Today I learned how to meser angles. It is kind of easy and fun. That was the first time I have used a protractor. I also thought it would be boring. But I was wrong.

No, a triangle can't have parallel sides. The two lines that come up are not parallel and the bottom has no one to be parallel to.

1. A pyramid has 1 base and a prism has 2 bases.
2. They can have the same name except prism or pyramid.

I think a polygon can have parallel sides. No, a triangle can't because the sides are slanted.

You use a protractor to measure an angle. A right angle is always 90. An acute angle is always a smaller measure. An obtuse angle is always a larger measure than a right angle.

You use a protractor by putting the line or point on the vertex of an angle. Then you put the base on the bottom line on an angle, and finally use the tip line to see what degrees it extends to.

Today I learned what a polygon was. We learned how to make different shapes. We also learned what a closed and open figure was and what a irregular and regular figure was.

No, because if you extend all the lines at one time they all intersect.

Pyramids have 1 base, prisms 2 bases. Both pyramids and prisms are 3-D figures.

Today I learned how to measure an angle. To do that I used a protractor. Put the hole in the protractor on the vertex. Then line the dotted line up with one ray. Next look at where the other ray meets two numbers. The higher one is for an obtuse angle. The other is for the acute. One is your answer.

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