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ABSTRACT

This practicum was designed to incorporate critical thinking skills instruction and practice into a fourth-grade curriculum to increase fourth-grade students' ability to recognize and apply critical thinking strategies to appropriate situations. This program concentrated on the increasing of six critical thinking skills: classification, sequence identification, inference, analogies, deductive reasoning, and math problem solving. A series of multi-objective worksheets were developed to provide practice in each skill on a daily basis. The problem solving workbook, a supplement to the basal mathematics text, provided daily problem solving activities. Pre- and post-tests for both critical thinking skills and mathematics problem solving and pre- and post-checklists were administered. Analysis of the data revealed that the students improved in both critical thinking skills and mathematics problem solving. The students achieved the objective for critical thinking skills, but did not achieve the mathematics problem solving skill. (Author/DB)

Increasing Critical Thinking Skills Of The Fourth-Grade Student Through Problem Solving Activities

by

Beth Rice

Cluster 45

A Practicum I Report presented to the
Ed. D. Program in Child and Youth Studies
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

NOVA UNIVERSITY

1992

PRACTICUM APPROVAL SHEET

This practicum took place as described.

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This practicum report was submitted by Beth Rice under the direction of the advisor listed below. It was submitted to the Ed. D. Program in Child and Youth Studies and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova University.

Approved:

9-22-92 Georgianna Lowen

Date of Final Approval of Report Georgianna Lowen, Ed. D., Advisor

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Beth Rice (signature)

CHAPTER 1

INTRODUCTION

Description of Community

The elementary school, where this practicum took place is located in a rural community, whose population is diverse. A varied socio-economic level includes laboring and clerical professions, with a small percentage of management and a few migrant farm workers. The total school population was approximately 950 students. The school just recently was decreased by approximately 350 students and 11 classroom teachers due to the opening of a new school nearby and budget cuts. The percentage of students qualifying for free lunch was approximately 17%; the ethnic balance of the school being comprised of 87% White, 3% Black, 9% Hispanic, and 1% Asian. The gender balance was 52% male and 48% female. The school has grades that range from Pre-Kindergarten to Fifth Grade with 33 regular classrooms and 56 full time teachers and 1 part-time art teacher. A teacher in the fourth grade was reassigned at the end of September because of a further decrease in population; even with the reduction, the school was filled to 147% capacity. There were 10 portable classrooms on site to house the overflow of students.

Writer's Work Setting and Role

The student population of thirty students involved in the practicum was a fourth-grade self contained classroom. There were 11 males and 19 females in the classroom The ages of the students were nine and ten years old, which indicates that 16 of the students have repeated a grade at some point in their school career.

The writer has 17 years teaching experience, and was a regular classroom teacher. At the present school site, the writer was teaching fourth grade in a portable self-contained classroom for the third year. The past teaching experience

of the writer includes: one year of seventh and eighth grade math and algebra in a junior high school, six years of teaching in a fifth grade self-contained classroom in a rural town; two years experience substituting in elementary schools involving all grade levels, Fine Arts, and ESE classes; and six years teaching in a fourth-grade self-contained classroom in a remote migrant school before transferring to the present school.

The committee responsibilities of the writer outside the classroom include: Grade Chairperson, Math/Science Chairperson, member of the School Advisory Counsel, and Secretary of the PTO Executive Board. The educational degrees held by the writer are a Bachelor of Science in Elementary Education, a Master of Science in Elementary Education, and an Education Specialist Degree in Secondary Social Studies with a major in middle childhood. There are two areas of certification held by the writer: Elementary Education for grades 1 through 6 and Mathematics Education for grades 7 through 9.

A presentation has been given by the writer at the State Science Convention, and in an Instructional Arts Fair, the writer's entry earned a second place ribbon as part of the continuing effort by the writer to improve and affect education in a positive manner. A school-wide curriculum plan to change from a six week grading system to a quarter system, which included writing eighteen separate course curriculums for mathematics was co-authored by the writer and implemented by the school district at the middle school level. The writer has been a member of a curriculum writing team for redesigning mathematics curriculum at the elementary level and worked to field test the curriculum before district-wide implementation of the program took place. Since teacher training is a priority of the writer, the writer has been involved with two intern teachers and been a peer teacher in the beginning teacher program. The writer works toward the goal of self-realization and attainment for all students.

CHAPTER 2

STUDY OF THE PROBLEM

Problem Description

There are thirty students in the class of which fifteen students were identified as having specific learning disabilities; one student was identified as having an attention deficit disorder; and one student received counseling for emotional problems. Ten students were identified as English Speakers of Other Languages (ESOL). The functioning of the students in the different subject areas was identified as follows: All students were functioning on grade level in mathematics, science, and social studies; In reading, 18 students were functioning on fourth-grade reading level, 11 students were below fourth-grade reading level and receive services from the Exceptional Education teachers, one student read at a fifth grade level; In language and spelling, 16 students functioned in fourth-grade materials and 14 students received services from the Exceptional Education department staff.

The students were unable to independently solve problems or correlate information that is not a direct verbatim quote from a textbook. When given problem solving exercises in mathematics, the students selected all the numbers in a problem and applied any operation without regard to the question being asked. In classroom discussion, the students were able to answer questions only at a basic recall level. When placed in a situation requiring critical thinking or problem solving strategies, the students experienced great difficulty. The students did not possess the necessary skills and strategies to be effective critical thinkers.

Problem Documentation

The evidence that a problem existed with students and their critical thinking strategies was documented from several different sources: teacher observations and the students themselves through questionnaires and surveys.

During the first month of the 1991-1992 school year, the writer observed the class and recorded occasions when critical thinking skills were not properly applied to the work situation. The daily mathematics assignment of word problems would be completed by only five children; even when instructed that the word problems were part of the assignment. Of the five students that worked the problems, only three consistently solve the problems correctly.

Students constantly state confusion when presented with any assignment that requires thinking skills beyond immediate recall of details. The teacher was approached by the students to provide assistance while making no attempt to solve it for themselves first.

On October 14, 1991, the OLSAT practice test was given. There were three main types of questions asked on the test: patterns, analogies, and word selection. Only five students did not experience confusion with the questions. A detailed explanation was required and some students were still confused.

A teacher made student questionnaire was given to the class on October 23, 1991. A copy of the questionnaire is located in Appendix A. The questionnaire had four questions related to problem solving strategies and feelings concerning problem solving. The majority of the students indicated that when faced with a word problem in mathematics; they read the problem and then do it. When asked how they feel about doing a page of mathematics word problems, the students responded in the following ways: Angry, sad or upset, frustrated, and confused. The students indicated that when answering questions in other subject areas, they just "figure it out or look it up in the book." When faced with an unfamiliar word, the students stated that they ask a fellow student first, and then go ask the teacher. Tables 1, 2, 3, 4, and 5 illustrate the range of answers provided by the students.

Table 1

Critical Thinking Survey

Question 1: When you are given word problems to solve in math, what steps do you take to solve the problem?

Response Given	Number of Students
Read, Write, and Solve	7
Read and Look	4
Ask and Write	1
Look, Read, and Write	1
Read and Write	3
Read Only	2
Look and Do In Head	2
Do it, Solve it, and Find Answer	2
Write Problem	3
Think, Work it, and Do it right	2
No Answer given	1

Table 2

Critical Thinking Survey

Question 2: When you are answering questions in Reading, Science, and Social Studies and the answer are not one sentence from the book, what do you do to find the answer?

Response Given	Number of Students
Figure it out	2
Read the pages	15
Go to the Index	2
Ask another student	1
Look in the Glossary	1
Look in the Dictionary	1
Write the best answer	1
Make up an answer	1
I don't know	4

Table 3

Critical Thinking Survey

Question 3: When you find a word that you do not know how to pronounce or what it means, what do you do?

Response Given	Number of Students
Look as it and sound it out	6
Look in the Glossary	1
Go ask the teacher	8
Sound it out, then ask ancther student	10
Sound it out, then ask the teacher	2
I don't know	1

Table 4

Critical Thinking Survey

Question 4: How do you feel when the assignment is to do word problems or read and answer questions by yourself?

Responses Given	Number of Students
Unhappy, Terrible, or Sad	7
Panic, Paranoid, Confused, Frustrated or Worried	6
Angry or Mad	11
Excited or Fine, it's fun	2
Wouldn't do it	3
"I feel like being the teacher to give out work."	1

TABLE 5

Critical Thinking Survey

Question 5: When the teacher says that the answer is not in exact words, that you must read and figure it out for yourself, How does that make you feel?

Response Given	Number of Students
Angry or Mad	6
Bothers me, Scared, Gross, Bad, Paranoid, Sad, or Upset	13
I feel stupid	1
I complain	2
I don't want to do it	1
I will try it	1
I want to learn	1
I feel fine or normal	2
Happy	1
No answer given	1

A Constructive Critical Thinking post test created for college aged students was modified by the writer (Varlett, 1986). The modified critical thinking frequency checklist was administered to twenty-eight students on October 25, 1991; two students were absent. The checklist was a very difficult task for the students to perform and required much time-consuming explanation to complete. Appendix B contains a copy of the ten item checklist, and the results of the checklist are recorded in Table 6. On six of the statements, the majority of the students indicated that they sometimes use the strategy listed. Seldom do a majority of the students try to think of all the things that could happen for each way a problem can be solved. The critical thinking strategy that students use most was to ask themselves questions as they work. Noteworthy, the students who gave themselves the highest scores are students that ask for the most help, experience the greatest difficulty, and turn in the least amount of work.

Table 6

Critical Thinking Frequency Checklist

No.	Question	Seldom	Occasion	Sometime	Frequent	Always
1	I make a list of all steps I need to take before starting a project.	9	6	10	0	3
2	I know where and how to obtain the information I need.	5	4	11	5	3
3	I can identify what my major problems are.	4	6	14	4	0
4	I ask myself questions while I am working.	2	3	8	3	12
5	I carefully study the information in order to answer the questions myself.	3	3	11	5	5
6	I try to think of all the things that could happen for each way I try to solve a problem.	11	6	4	2	5
7	I make a plan for solving my problems.	10	5	9	0	4
8	I practice my solutions (answers) to my problems.	3	7	11	3	4
9	I think about how I solve a problem and decide what I could do better next time.	6	0	13	4	5
10	I correct my own mistakes by myself and reward myself when I do something well.	9	1	10	4	4

Causative Analysis

There were several causes for the problem with critical thinking and problem solving strategies. The required curriculum for the fourth-grade classroom was enormous. The district produced mastery test for mathematics was written using only lower level questions. The only mandated curriculum for teaching thinking was the mathematics Problem Solving Workbook, and that was required to be taught as a teacher-directed activity with the students as passive learners. Providing the students with real problem solving activities would mean allowing them to talk and move about the classroom. Most teachers and administrators value and judge classroom discipline on quiet straight rows. The high number of students identified with specific learning disabilities means that they may not have been previously challenged by teachers. Due to interruptions, a crowded curriculum, and students leaving to receive other services, there is not enough instruction time left for time consuming lessons that allow student-active thinking. Finally, teachers are told to teach thinking and problem solving skills, but most of them have never been properly trained themselves.

Relationship of the Problem to the Literature

The evidence of the problem with critical thinking and problem solving skills was abundant in professional literature. Krapp (1988) and Beyer (1984a, 1984b) discuss the inability of students to perform well on critical thinking assessments and the problems connected to critical thinking instruction. Bjorkman (1991) states, "Math comprehension...looks like a disaster area at the middle school level. Fourth-graders scored 2% lower than second graders on the county CTBS test last year." Kantowitz and Wingert (1991) state that most eighth-grade students have a minimum computation ability equal to that of a basic fifth grader. When solving word problems, most eighth graders were unable to apply correct critical thinking skills to the simplest situations.

The literature revealed several causes for the problem of weak critical thinking skills in students. Beyer (1984a) lists five major causes. First, there is no consensus upon skills to be taught. Second, the skills se' cted to be taught are not clearly and concisely defined. Third, the kinds of instruction that provide students with critical thinking skills development are never offered. Fourth, there are too many skills in the curriculum, therefore there is not enough time left to provide an adequate number of practices. Finally, the evaluation instruments that are used to measure critical thinking skills may not be an adequate reflection of the skills learned by the students (Beyer, 1984b). Chance (1986) states that the world has changed. Society at large is no longer agrarian, but technological, and the technical society demands a worker with greater critical thinking skills and abilities than were necessary in an agrarian society (Chance, 1986).

"Thinking is different from learning," states Doll (1981). Therefore a structured curriculum must be present that considers this difference, because presently most curriculums do not identify the subtle difference between thinking and learning when devising curriculums (Doll, 1981). De Bono (1984) states that schools often describe critical thinking as the process by which one finds errors in a passage. While De Bono (1984) agrees that finding the errors in a passage is an important skill, it is not a skill that is applicable in most critical thinking situations in real life. De Bono invented the word operacy to describe the skill of critical thinking in real life situations, it is this skill that he considers more relevant (De Bono, 1984).

A discrepancy exists between the strategies that students are familiar with and say that they use when surveyed, and the actual strategies observed during word problem solving activities. Even though students know different methods to solve word problems such as graph making and picture drawing; few students apply these skills in actual observed situations (Fortunato, Hecht, Tittle, and Alvarez, 1991).

While most students are capable of thinking at a cognitive level, less than half of the students surveyed do so. The difference between these two facts illustrates the need for cognitive thinking instruction. The educational system has a responsibility to decrease the disparity between the level of cognitive thinking

possible and the actual level of performance (Fusco, 1991). When students do not have the strategies needed to think through the information presented to them in a classroom, then the students will not understand the lesson postulates Lipman (Brandt, 1988). There presently exists a lack of time to adequately teach all the information educators are required to, thereby leaving no time available to teach the time-consuming skill of critical thinking (De Bono, 1983). But Lipman insists that educators have a responsibility to teach more than facts, because in this world of rapidly changing information and technology, a student that can think critically will be able to function (Brandt, 1988).

Most teachers indicate that a student's ability to think critically is a vital skill and consider critical thinking important. Most often the types of answers that are rewarded in the classroom under the guise of critical thinking questions are the answers that match the perception of the teacher; to match the perception of the teacher may not require the use of valid critical thinking skills (Raths, Wassermann, Honas, and Rothstein, 1986).

People who are successful problem solvers may not know what strategy they utilize. A good problem solver may not be able to verbalize the steps taken to come to a solution. A problem solver may have confidence in the ability to provide a correct solution, but be unable to translate the ability into a successful instruction of the technique used (Lester, 1977).

Joyce (1985) states two causes for a weakness in critical thinking skills. The first is "the habit of setting different approaches against each other and persuading ourselves that they are incompatible." The second cause is "trying to reform the school without the emotional and material investment needed to really change it" (Joyce, 1985).

Wittrock (1981) states that "learning is a generative process...that students learn and remember what they actively construct mentally," and that "repetition and reinforcement may not lead to sustained interest and attention." The academic failure of some students, states Lipman (1984), defines the need for a moral, cognitive thinking curriculum, because "not everyone can be sure of teaching it (cognitive thinking) successfully," and it requires "the ability to listen scrupulously to what children actually say". (p 53).

The interpretation placed upon the results from standardized tests should not be considered a definitive indicator a a student's critical thinking ability, but the test results should be utilized as a supplemental indicator in conjunction with other sources of information states Sternberg (1991).

Everyone seems to be stating that critical thinking is important and the students do not have the ability to utilize the correct strategies needed, but that is the only consensus on critical thinking. A consensus is missing at all stages of critical thinking instruction. A consensus is missing on a definition for critical thinking, the exact skills one needs to think critically, a proper instructional sequence to guarantee the acquisition of critical thinking skills, and finally an adequate and appropriate evaluation instrument.

Various topic and domain areas were researched to obtain information and resources. The topics were critical thinking, problem solving, cognitive development, specific lea ning disabilities, and math.

CHAPTER 3

ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS

Goals and Expectations

The following goals and outcomes were projected for this practicum. The goal of the writer was to have the fourth-grade student to be able to think critically and to be able to analyze a situation, select an appropriate strategy, to successfully utilize the selected strategy, and to evaluate the performance for future improvement.

Expected Outcomes

There were two outcomes that were the anticipated results of the solution suggested: 1. Twenty out of thirty fourth-grade students will be able to successfully complete with 80% accuracy; analogies, identifying sequences, classifying items, making inferences and applying deductive reasoning skills. 2. Twenty out of thirty fourth-grade students will be able to successfully complete with 80% accuracy word problems in mathematics.

Measurement of Outcomes

The evaluation methods to be used were writer made pre and post tests for critical thinking skills and mathematics problem solving, surveys, and the writer's personal log of daily observations. See Appendices A, B, C, and D for copies of the insturments used. The pretests to be used were administered during the first week of implementation. The post tests to be used were administered after implementation ended. The two student surveys that were given in October were to be re administered at the end of the implementation time during the evaluation week. The questions were open-ended on the writer made survey of student planning. The questions on the writer modified frequency checklist were multiple choice. The mathematics evaluation was in the open-ended question format. The reasoning skills evaluation were multiple choice. All evaluations were to be untimed and be read aloud.

CHAPTER 4

SOLUTION STRATEGY

Discussion and Evaluation of Solutions

The fourth-grade students experienced great difficulty in critical thinking and problem solving situations. The fourth-grade students did not possess the necessary skills and strategies to be effective critical thinkers.

A review of the literature offered many different solutions to the problem of critical thinking skills. Beyer (1984b) offers a five step process to follow. First, one needs to identify the skills to teach. Second, the skills need to be defined precisely. Third, direct classroom instruction with plenty of classroom practice must be provided. Fourth, a curriculum needs to be devised and implemented that integrates thinking skills into the subject areas. Fifth, a competent measurement tool must be devised.

A problem solving strategy titled "A Prescription for Problem Solving" suggests reading the problem, stating the goals. listing important information, and even trying something else for a while when the student is unsuccessful (Nickerson, 1981).

Lipman (1988) defines critical thinking as "skillful, responsible thinking that facilitates good judgment (p 39). He thinks that all classrooms should be changed into a "community of inquiry" that promotes self-correcting thought, as well as correcting others. The curriculum in a classroom must change from one of learning information that is out of date and useless to one of thinking and problem solving. The curriculum should focus on basic communication and inquiry skills utilizing elements from all subject areas (Lipman, 1988).

A ten step teaching strategy that can be used with any subject area assignment is designed by Charles, Lester and Putt (1986). First, read the problem aloud. Second, ask students questions to help their understanding of the problem. Third, have students suggest possible strategies for finding a solution. Fourth, the instructor will observe and question what students are doing. Fifth, the instructor will give hints as needed. Sixth, the students will check their own work for mistakes. Seventh, the instructor will provide an extension for students who finish work early. Eighth, a discussion of other possible solutions will take place. Ninth, a discussion of other related problems will be held. Tenth, a discussion will be held to evaluate the possible pitfalls that may occur for each solution considered (Charles, Lester, and Putt, 1986).

Joyce (1985) states that students need to be instructed in the correct model to use. Joyce believes that each situation has a model that can provide a framework from which a solution will be derived. Raths, Wassermann, Jonas, and Rothstein (1986) state that there are eight behaviors that interfere with critical thinking. They offer fifteen teaching strategies that will improve thinking skills in all subject areas. Problem solving skills can be improved by providing guided practice with problems that have multiple methods of solution, open-ended problems, and problems that are situational state Silver and Smith (1990).

The Cognitive Research Trust (CoRT) was developed by De Bono (1984) specifically to teach cognitive thinking to students. It is a 60-lesson set of books and materials, and it is intended for students in college. The emphasis of the program is on strengthening two areas of perception: breadth and change. De Bono provides the student with structured ways in which to deal with information, like the Plus-Minus-Interesting Chart (PMI) for making decisions (1984).

For the specific area of mathematics, LeBlanc (1977) states that the basic four steps of problem solving listed in most school text books are adequate. Plenty of practice must be provided in order for inculcation of the method to take place.

School Districts have a responsibility to match the curriculum design for each age to the students' cognitive ability levels. The carefully constructed and implemented curriculum that matches the level of the student's cognitive ability would insure success for the students (Fusco, 1981). To accomplish the critical

thinking curriculum inclusion, De Bono (1983) proposes that schools reduce the time spent on information instruction to provide the time needed. M. Lipman and T. Lipman (1980) enunciated their position that the type of citizen a child becomes depends upon the type of education the child receives. A child that participates in an active classroom that encourages reflective thinking processes will be more likely to participate as a citizen (M. Lipman and T. Lipman, 1980). "An education that has been structured for thoughtfulness promises to be ar academically superior education, in behaviorally measurable terms, and even more valuable as an instrument for beyond-school experience" (Lipman, Sharp, and Oscanyan, 1980, p 11). Lipman (1991) sees philosophy as a structure from which students can be taught to think, and then transfer the use of the structures to other subject areas. Lipman (1984) has created a series of philosophy courses entitled Philosophy For Children, which have an instructional curriculum for each year a child is in school.

Costa (1981) asks ten questions to foster teaching intelligent behavior. The questions are to promote the evaluation by teachers of how the instructional material is introduced and explained. The language used by teachers during instruction, activities used, the materials, the time allotments, and the teacher's behavior are critical elements in teaching intelligent thinking. With consideration given to those areas resulting in a reorganization of the instructional process; teaching for intelligent thinking will commence (Costa, 1981). "If children's cognitive performance is a function of the teacher's pedagogical performance, the we must find ways of greatly expanding the teacher's capacity for challenging the child to respond" (Lipman, 1991, p 73). Lipman states that if we want children to think when they are adults, then we have the responsibility to teach them how to think when they are in the classroom (Brandt, 1988).

The writer offered two other possible solutions to the problem of critical thinking skills. One was to provide direct instruction in the thinking process by various strategies. The other was to provide defined times in the daily schedule to practice critical thinking skills.

The multi-stepped programs recommended in the literature review were time consuming; too much of a school day would be taken up by any of these programs if fully implemented. In several references, extra training would be required in

order to use the processes or materials recommended. Some materials would have to be modified for use with a fourth-grade population, which would necessitate an expense not compensated for in the present budget. The curriculum in the school setting is state and district mandated and cannot be rewritten by just one person as was recommended by several people. The writer was required to work within the confines of the curriculum and materials presently in place. The state mandated curriculum must be completed according to schedule, and the programs reviewed would be too intrusive. For these reasons, the multi-step programs were unworkable in the present setting.

Description of Selected Solution

The solution chosen by the writer incorporated the ideas of LeBlanc and Beyer. The writer integrated a period of critical thinking skills instruction into the morning enrichment activities and the mathematics instruction time. A relaxed game time to practice occurred occasionally due to time constraints.

An exclusive work period lasting approximately fifteen minutes each morning was devoted to the specific instruction of five over all critical thinking skills, and were implemented as part of the regularly scheduled morning enrichment activities. The specific skills were classification, sequencing, inference, deductive reasoning, and analogies. Beyer (1984b) states that these five skills are the most important of the critical thinking skills. Worksheets were writer created transparencies for use with an overhead projector. A sample copy of the first worksheet is located in Appendix E.

During mathematics instruction, a page from the Problem Solving Workbook was done in conjunction with daily computational lessons. The Problem Solving Workbook, a required part of the curriculum, provided daily application of the problem solving steps suggested by LeBlanc (1977).

The Frog Pondering Kit 1 was used on an intermittent basis. The Frog Pondering Kit 1 consists of a series of 24 packs of question cards. Each pack of

cards works on one specific skill. The questions in each pack draw information from different subject areas, but concentrate on only one type of critical thinking skill. The packs of cards can be used interchangabley with ten different playing boards, or used as questions on a worksheet.. The Frog Pondering Kit 1 provided a relaxed atmosphere in which to practice skills that were being formally taught throughout the day.

Report of Action Taken

The three month implementation phase of the solution strategies began in February 1992, after final approval was received from the practicum advisor. Notification and approval were received from the setting administrators. Permission slips were copied, sent home, and returned. No parent refused permission for participation. Pre and post tests and worksheets were constructed and photocopied. Lesson plans reflected the inclusion of the critical thinking worksheets and problem solving workbook pages into the curriculum.

The first step of the solution strategy was the introduction of the fourth-grade students to the project. An explanation was given detailing the three elements of the program. It was explained that the critical thinking skills worksheet would replace the language arts multi-objective worksheet presently being done each morning, the problem solving workbook page would replace the morning math problems on the chalkboard, and that after lunch each day, they would play a game. The purpose of the critical thinking skills emphasis was explained. Questions and concerns from the students were answered.

The second step of the solution strategy was the pre testing. The pre test for both critical thinking skills and math problem solving was administered.

The third step of the solution strategy was the implementation of the critical thinking skills worksheet on a daily basis. The students completed sixty worksheets on critical thinking skills through guided practice provided by the writer.

The fourth step of the solution strategy was the implementation of the math problem solving workbook on a daily basis. The students completed sixty pages of

the math problem solving workbook through guided practice provided by the writer.

The fifth solution step was the introduction and playing of the critical thinking games in the Frog Pondering Kit I. The students played the games approximately two days a week during the implementation time.

Finally, the post tests and surveys were administered. The results were then analyzed to evaluate the success of the solutions implemented.

Month 1 - Week 1

Student actions during the pre testing stage reflected their avoidance to thinking work. Two students tapped pencils. Three students asked either the teacher or other students for help. Two students shot rubber bands at each other. One student put pencil down and ignored the paper completely.

The critical thinking worksheets 1 through 5 were done on a daily basis. The worksheets were done as teacher-directed activities. When students could give a correct answer to a sequence or an analogy, they were unable to explain why the answer was correct. The students had difficulty transferring information from the transparency to their paper. Drawing the chart for the deductive reasoning was extremely time consuming for the students with learning disabilities. By Day 5 most students were able to understand the directions to the worksheets even if they could not answer the questions directly.

Problem Solving Workbook pages 1 through 5 were worked. The students with the strongest skills were the ones raising their hands to read and answer questions. The teacher used a round robin method to make sure that each student was required to provide some input. The teacher would also make sure that each student had completed each section before moving on to the next question. The students with difficulties experienced frustration with being forced to participate. The students with stronger skills make noises and comments about how long it took or to hurry up. Some students went a head and worked the problems by themselves and then would do something else. It was an arduous task to keep the all members of the class on task. It was taking approximately forty-five minutes a morning to accomplish the worksheet and the workbook page.

Due to interruptions in the schedule, the Frog Pondering Games were not introduced until the third day. The students were placed into 8 groups and the first eight packs of cards were used. The students spent most of the time arguing over the order of play and accusations of infractions of the rules. Only two of the teams were able to finish their pack of cards in the twenty minutes. On the fourth day when the games were played, a different pack of cards was given to each group. On the fifth day, there was not time to play the games. Some of the children reacted with comments of joy at not having to do the games, "because all my group does is argue". Some students were disappointed, "because it's fun and better than work."

Month 1 - Week 2

The Critical Thinking Skills Worksheets 6 through 10, and Problem Solving Workbook pages 6 through 10 were completed in teacher-directed instruction. The copying of the charts and using the transparencies still made the process slow, but there were less negative comments and less reluctance on the part of the students with learning difficulties. The Frog Pondering games were played each day. The teacher made sure that the card packs of 1 through 8 were being rotated through the groups.

Month 1 - Week 3

Critical Thinking Skills Worksheets 11 through 15 and problem solving workbook pages 11 through 15 were completed with teacher-directed instruction. Each student was still required to participate in answering or reading questions with assistance. The students were demonstrating less reluctance to being forced to attempt solutions and give explanations for thinking, but the reluctance is still there.

For the first two days of the week, the students stayed in the same groups to finish out the card pack rotation for the first eight packs of cards. On the third day, the students were allowed to form new groups with the understanding that the

new group would last through the next rotation. A number was assigned to each member of the new group thus rotation of who-goes-first was established. The game playing went more smoothly with these two modifications. On the fifth day, the class had a field trip and did not play a game.

Month 1 - Week 4

Critical Thinking Worksheets 16 through 20 and problem solving workbook pages 16 through 20 were accomplished with teacher- directed instruction. The students were able to answer the questions and explain their answers unless the information was a fact that was not in their memory previously. It was still taking thirty minutes to complete each day because of the time it takes some students to write answers. The Frog Pondering games using card packs 9 through 16 were played for fifteen or twenty minutes each day. Rotation of the card packs was maintained. Four observations by the teacher were noted during the games. The students seemed to argue less, but also socialized off task more. Some groups modified the rules of the games to fit the needs of the members. Some students expressed boredom and requested to skip the games in order to finish other work. The request to finish other work came mostly from students who were to leave and go to the special education teachers. The students stated that they were tired of playing the games.

Month 2 - Week 1

Critical Thinking Skill Sheets 21 through 25 and problem solving workbook pages 21 through 25 were completed. Copies of the Critical Thinking Worksheets were made for each student. The transparency was used as a teaching device. The students were able to complete both the Critical Thinking Skills Worksheet and the problem solving workbook page in twenty minutes. Now that writing was at a minimum, the students were able to concentrate on the skills. Participation among the students with learning difficulties increased. Comments of "I like it better this way," and "This is easy," were now being made. For the first

two days of the week, the Frog Pondering Games were played to finish the card rotation of packs 9 through 16. On day four, the teacher handed out Scantron answer sheets to the students, then read the questions aloud using the animal attribute pack of cards. The answers were read aloud and each student scored their own paper. It took ten minutes to do the pack of cards. The students expressed a liking for the change. On the fifth day, the implied attribute card pack was used to read questions aloud.

Month 2 - Week 2

Critical Thinking Skill Sheets 26 through 30 and problem solving workbook pages 26 through 30 were completed. Copies of the Critical Thinking Skills Worksheets were made for each student. On four days of this week the class had a substitute teacher. The substitute had the children do both the Critical Thinking Skills Worksheets and problem solving workbook pages as silent seat work. No use was made of the Frog Pondering Kit. The teacher went over the worksheets and workbook pages with students upon returning the next week.

Month 2 - Week 3

Critical Thinking Skills Worksheets 31 through 35 and problem solving workbook pages 31 through 35 were completed with teacher-directed activity. With each child having a copy of the worksheet and with the gaining of experience and confidence, it is now taking an average of fifteen minutes each morning to complete both exercises. Each day a pack of the Frog Pondering Kit cards was read aloud for the students to answer on Scantron sheets, and check together. The five skills studied during this week were story attributes, another viewpoint, categories, recognition of irrelevant sentences, and analogies.

Month 2 - Week 4

Critical Thinking Skills Worksheets 36 through 40 and problem solving workbook pages 36 through 40 were completed through teacher directed activity. The Frog Pondering Kit packs were used with Scantron sheets. The questions were read aloud by the teacher, and students bubbled in the answers. The five skills practiced were naming the next item in a sequence, choosing the best possible solution, identifying the necessary conditions for a solution to take place, identifying the observation to match a conclusion, and identifying how things were alike and different. The three components of the program have become an integrated part of the curriculum that the students now did them as naturally as other subjects.

Month 3 - Week 1

Critical Thinking Skills worksheets 41 through 45 and problem solving workbook pages 41 through 45 were completed with the assistance of the teacher. Students have begun to come into the room, pick up the worksheet, and have it complete by the time the teacher is ready to teach it. The students have been working with each other to discuss possible solutions. Only about five of the weakest or most frequently absent students have difficulty completing it before the teacher goes over the material. The students have taken responsibility for their own learning.

The students requested a return to playing the games. Therefore they formed their own groups with the understanding that they would have to stay together for the next eight days. Frog Pondering Kit card packs 17 through 24 were used each day. Each day a group received a different pack of cards.

Month 3 - Week 2

Critical Thinking Skills worksheets 46 through 50 and problem solving workbook pages 46 through 50 were completed as seat work and then reviewed

with the teacher. Frog Pondering games were played daily. The rotation of card packs 17 through 24 ended on the third day. No games were played on the fourth and fifth day.

Month 3 - Week 3

Critical Thinking Skills Worksheets 51 through 55 and problem solving workbook pages 51 through 55 were completed as seat work. The students experienced no difficulty in completing the worksheets, but still have difficulty with certain problem solving workbook pages. The students have questioned how much longer they have to do this every day.

Since each student has been exposed to all 24 card packs of the Frog Pondering Kit, the students were allowed to form a new group everyday and pick which pack of cards they want to play with. The teacher observes that the children with the most severe learning disabilities have chosen the cards with pictures, graphs, diagrams, and the fewest words. Students helped each other and little disagreement was heard.

Month 3 - Week 4

Critical Thinking Skills Worksheets 56 through 60 and problem solving workbook pages 56 through 60 were completed. The students were happy to be finished with the program. A few of the students expressed regret at not getting to do the deductive reasoning puzzles anymore. Some students stated that their favorite part was the number sequences. The students were allowed to choose groups and card packs each day to play the Frog Pondering Kit games.

Month 4 - Week 1: Evaluation

Day 1: The students took the Critical Thinking Skills Post Test. The only assistance required by the teacher was to read it aloud. No explanations were needed. Requests were made to reread sections. All students were completed in fifteen minutes.

Day 2: The students took the Problem Solving Post Test. The questions were read aloud to the students as many times as was needed. All students attempted to answer the questions. Some students worked diligently for over one hour on the five questions.

Day 3: The students retook the Frequency Checklist Survey and The Survey of Feelings. There were no great discussions on how to do the checklists or explanations needed for what the questions meant. The Frequency Checklist took about fifteen minutes to complete with the teacher reading it aloud. The Survey of Feelings took about thirty to forty-five minutes to complete, because the students had to write answers. The students were informed that spelling would not count.

Over the next two days, the students that were absent any of the first three days were given the sections missed. Therefore all thirty students were given post tests.

CHAPTER 5

RESULTS, DISCUSSION, AND RECOMMENDATIONS

Results

The problem that existed in the writer's work setting was that the fourth-grade student experienced difficulty in critical thinking and problem solving situations. The fourth-grade student did not posses the necessary skills and strategies to be effective critical thinkers.

Two main strategies were implemented as possible solutions to the problem. Both strategies emphasized constructing a course of action, implementing a course of action, and arriving at a solution that could be explained.

The goal of the writer was to increase the critical thinking and problem solving skills of the fourth-grade student. Two objectives were established to accomplish this goal. Each objective will be considered separately, with the results presented for analysis.

The first objective projected that twenty out of thirty students would successfully complete with 80% accuracy : analogies, identifying sequences, classifying items, making inferences and applying deductive reasoning skills. Evaluation was made by a writer made pre and post test. The pretest was administered during the first week of implementation, and the post test was administered during the evaluation period. Table 1 gives the results of the critical thinking skills pretest and post test instruments.

Table 7
Comparison of Pre and Post Test Results for Critical Thinking Skills

	Pretest	Post Test	Differences Noted
Analogies	2	25	+23
Identifying Sequences	8	20	+12
Classification	0	30	+30
Inferences	2	30	+28
Deductive Reasoning	0	25	+25

Note. Number of students = 30

The final results show that the objective was met. It was anticipated that 20 out of 30 students would answer questions correctly on five critical thinking skills. On the post test for each skill, at least 20 students passed the test items for that skill. On the critical thinking skill of analogies, two students gave correct responses on the pretest, and twenty-five students gave correct responses on the post test. That is an improvement by 23 students. On the critical thinking skill of identifying sequences, eight students gave correct responses on the pretest, and 20 students gave correct responses on the post test. That is an improvement by 12 students. On the critical thinking skill of classification, none of the students gave a correct response on the pretest, and all thirty of the students gave a correct response on the post test. That was an improvement by the whole class. On the critical thinking skill of inferences, two students gave the correct response on the pretest, and all thirty gave the correct response on the post test. That was an improvement by twenty-eight students. On the skill of deductive reasoning, none

of the students gave the correct response on the pretest, and twenty-five gave the correct response on the post test. An improvement was made by 25 of the students.

The second objective anticipated that 20 out of 29 students would be able to successfully complete with 80% accuracy word problems in mathematics. Evaluation would be determined by a writer-made post test. The students completed a pretest during the first week of implementation and a post test during the evaluation time. The test consisted of five math word problems, each problem focused on a different math basic computation operation. Table 2 presents pretest and post test results.

Table 8

Comparison of Pre and Post Test Results - Mathematics Problem Solving Test

	Pretest	Post Test	Difference Noted
Number of students with 0% correct responses	14	8	-6
Number of students with 20% correct responses	10	9	-1
Number of students with 40% correct responses	5	8	+3
Number of students with 60% correct responses	1	4	+3
Number of students with 80% correct responses	0	1	+1
Number of students with 100% correct responses	0	0	±0

Note. Number of Students = 30

Final results suggest that the objective was not met. It was anticipated that 20 out of 30 students would improve in math problem solving. Although improvement was made by most of the students, final results indicate that only one student was able to achieve the 80% accuracy level expected.

The Critical Thinking Survey Critical and Thinking Frequency Checklist were re administered during the evaluation period. The responses recorded on the following tables. A discussion and analysis of the results will be stated.

Table 9

Post Critical Thinking Survey

Question 1: When you are given word problems to solve in math, what steps do you take to solve the problem?

Response Given	Number of Students
Read problem. Read Question. Skim. Find Clues. Solve	1
Read problem. Read question. Find clues. Solve	17
Read problem. Find clues. Solve	6
Read problem. Solve	3
Take the easiest steps	2

Table 10

Post Critical Thinking Survey

Question 2: When you are answering questions in Reading, Science, and Social Studies and the answer are not one sentence from the book, what do you do to find the answer?

Response Given	Number of Students
Read question. Find key words. Skim pages. Write answer.	6
Read the question and the pages.	2
Think of own answer	10
Skim pages	4
Find key words	2
Ask Teacher	8

Table 11

Post Critical Thinking Survey

Question 3: When you find a word that you do not know how to pronounce or what it means, what do you do?

Response Given	Number of Students
Look in the glossary or dictionary	18
Sound it out, then ask the teacher	5
Sound it out, then ask another student	3
Look as it and sound it out	1
Go ask the teacher	1
I don't know	2

Table 12

Post Critical Thinking Survey

Question 4: How do you feel when the assignment is to do word problems or read and answer questions by yourself?

Responses Given	Number of Students
I do the work. Don't mind. Feel fine.	18
Unhappy, Terrible, or Sad	6
Angry, or Hate	3
Wouldn't do it or don't care.	1
No Answer	2

TABLE 13

Post Critical Thinking Survey

Question 5: When the teacher says that the answer is not in exact words, that you must read and figure it out for yourself, How does that make you feel?

Response Given	Number of Students
Bothers me, Angry Scared, Bad, Embarrassed, Sad, or Upset	11
I feel fine. Doesn't bother me.	9
I don't want to do it, but do it anyway.	2
I give up.	1
It depends on the subject.	1
It makes me feel responsible.	1
It's hard by myself.	1
No answer given	4

Table 14

Post Critical Thinking Frequency Checklist

No.	Question	Seldom	Occasion	Sometime	Frequent	Always
1	I make a list of all steps I need to take before starting a project.	7	3	9	6	5
2	I know where and how to obtain the information I need.	4	4	10	7	5
3	I can identify what my major problems are.	5	2	10	6	7
4	I ask myself questions while I am working.	6	2	6	6	10
5	I carefully study the information in order to answer the questions myself.	6	7	6	6	5
6	I try to think of all the things that could happen for each way I try to solve a problem.	5	6	8	8	3
7	I make a plan for solving my problems.	11	4	9	3	3
8	I practice my solutions (answers) to my problems.	9	6	5	3	7
9	I think about how I solve a problem and decide what I could do better next time.	5	5	7	5	8
10	I correct my own mistakes by myself and reward myself when I do something well.	10	5	5	5	5

Discussion

Upon examination of the practicum results, the writer finds that although improvement was made throughout both the objectives, only one objective was successfully obtained. The objective of math problem solving that was not obtained bears further investigation. This objective focused on the student's ability to correctly solve word problems dealing with math. After further analyzation, it becomes apparent that improvement did take place. The improvement may not have been enough to accomplish the stated objective, but that does not discount the improvement that was accomplished. The greatest difference is not reflected by the information on the table. The types of answers and incorrect responses made by the students bears close scrutiny. Most of the incorrect responses were a result of errors in basic facts, not in operational procedures. Most students were now able to select the correct strategy for the specific post test question. When 14 students had 0% correct responses on the pretest, that included students that turned in a blank paper. When 8 students had 0% responses on the post test, all of these eight students attempted the problems; no student turned in a blank paper. LeBlanc (1977) states that the instructional goal in the teaching of problem solving should be to help students learn the necessary procedures. By applying LeBlanc's criteria for success in problem solving, the students were successful.

Lester (1977) states that the degree of stress the student experiences during problem solving activities will effect a student's performance. The stress on the students involved in the practicum can be evaluated in three ways: Observed student behaviors, the Critical Thinking Survey responses, and the types incorrect responses given. Observable differences were in students' attitudes towards the work. Before implementation, students exhibited procrastinating behaviors, complained loudly, wrote "I don't know" or even refused to do the assignment given. On the pre-Critical Thinking Survey the predominate emotions expressed were negative, some very strongly negative. During implementation, student participation increased with time. Some of the weaker students became the first ones to participate. Emotions expressed on the post Critical Thinking Survey show that only a few students still had negative feelings, but not as strong. Most

students did not mind doing the problems, and stated a preference to problem solving activities instead of computational activities. The types of incorrect responses decreased from no attempt made to the ability to select an appropriate strategy and apply the correct operation, but use an incorrect basic fact. The basic fact weakness relates to the identified short term-long term memory problems typical of students with learning disabilities. Curiously the most striking evidence came from the results of the Comprehensive Test Of Basic Skills (CTBS) testing done in April, about two-thirds of the way through implementation. The results of the CTBS showed that for 10 of the 19 students tested, the total scores for math concepts and application exceeded the total scores in math computation. It has been the writer's experience that usually a student has a higher score in computation than in concepts and analysis. While the writer is not claiming that the CTBS scores were the direct result of the practicum implementation, it does provide an interesting note.

The objective of teaching five specific skills in critical thinking bears discussing. Even though the objective was met and therefore considered a success, weaknesses in the students' abilities were still notice. Two main areas of weakness emerged from the compilation of the results. Some students were still weak in sequence of events and analogies, which indicates that more practice needs to be offered. De Bono (1983) states that thinking skills should be a formally recognized subject on the same level with reading and math, and should be taught with the same directness as the other recognized subjects. Beyer (1984) states that the instruction of critical thinking skills should be based upon a limited amount of skills. The success of this objective is due to the direct teaching and daily practice of the five specific skills.

Throughout the three month implementation there were many instances of carry over of critical thinking skills into other areas. Students were heard to make such comments as, "I can think for myself. I'm not stupid, you know." The call for teacher assistance changed from a do it for me attitude to an attitude of show me how to do it. The questions ask to the teacher became more specific, instead of "How do you do this junk?" the question would be, "What do I do next?". Students were overheard to use questioning techniques to guide fellow students in

the learning process instead of doing it for them. The more the students had practice with the critical thinking worksheets, the more confident and independent they became in all other areas.

The Critical Thinking Checklist provides documentation of attitude changes. When the Critical Thinking Checklist was first given, it was an exercise in frustration. The students did not understand how to do the checklist and did not understand what the items meant. It took one hour of class time to administer. When the Critical Thinking Checklist was re administered during the evaluation period, the children understood it and completed it in fifteen minutes. It was considered easy and no problem to do. The main difference between Table 6 and Table 14 is that the results recorded on Table 6 are suspect due to the lack of understanding of the process and the questions. Whereas the results reported on Table 14 show a wide distribution on each question that relates to the wide distribution of ability levels within the classroom, therefore making these results more valid, in the writer's opinion.

When the Specific Learning Disabilities teachers were asked if they had observed any changes in the students during implementation, the teachers stated, "We have noticed an improvement in critical thing with oral comprehensive questions during reading group. The students seem to work more cooperatively at problem solving and they are able to analyze situations presented more thoroughly and independently."

On the basis of the results of the practicum, the writer arrived at three conclusions. The first conclusion is that critical thinking skills can be directly taught. The second conclusion is that when critical thinking skills are directly taught, it indirectly influences all other areas of learning and self concept in a positive way. The third conclusion is that problem solving activities may benefit from a more controlled instruction. The problem solving workbook tended to leap around in the types of problems offered. Each page offered a different type of problem without the sufficient practice needed. The problem solving workbook has too many specific skills for the short implementation time. Math problem solving would be worthy of a longer practicum in isolation, where the focus would be specific and would allow for more practice on both basic facts and strategies.

Recommendations

1. It is recommended that students receive direct instruction into critical thinking skills, with the number of the skills to be taught kept to a maximum of five skills.
2. It is recommended that math problem solving activities be implemented over a longer period of time, with the number of the types of math problem solving kept to a minimum.
3. It is recommended that teachers receive in service training to help them implement direct critical thinking and problem solving instruction in their classrooms.

Dissemination

This practicum will be shared with members of the faculty in a workshop setting. Plans for implementation of the critical thinking skills worksheets for the ent. fourth grade into the curriculum exist for the 1992-1993 school year.

The writer has submitted an application to present the results of this practicum to fellow educators at a county Math Convention next fall.

The writer plans to copyright, publish, and offer for sale copies of the critical thinking skills workbook created during the course of this practicum.

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APPENDIX A

CRITICAL THINKING SURVEY

1. When you are given word problems to solve in math, what steps do you take to solve the problem?

2. When you are answering questions in Reading, Science, and Social Studies and the answer is not one sentence from the book, what do you do to find the answer?

3. When you find a word that you do not know how to pronounce or what it means , what do you do?

4. How do you feel when the assignment is to do word problems or read and answer questions by yourself?

5. When the teacher says that the answer is not in exact words, that you must read and figure it out for yourself, how does that make you feel?

APPENDIX B

CRITICAL THINKING FREQUENCY CHECKLIST

DIRECTIONS: Mark the number beside each item that best reflects how often you do the item being stated.

1 - seldom 2 - occasionally 3 - sometimes 4 - frequently 5 - always

_____1. I make a list of all the steps I need to take before starting a project.

_____2. I know where and how to obtain the information I need.

_____3. I can identify what my major problems are.

_____4. I ask myself questions while I am working to help me.

_____5. I carefully study the information in order to answer the questions by myself.

_____6. I try to think of all the things that could happen for each way I try to solve a problem before I begin.

_____7. I make a written plan for solving my problems.

_____8. I practice my solutions (answers) to my problems.

_____9. I think about how I solved a problem and decide what I could do better next time.

_____10. I correct my own mistakes by myself and reward myself when I do something well.

APPENDIX C

REASONING SKILLS PRETEST

DIRECTIONS: Give the best answer for each question.

1. Puppy is to dog as kitten is to _____.
   a. tiger b. cat c. kitty d. poodle
2. Mountains are to land as rivers are to_____.
   a. jungle b. desert c. ocean d. water
3. Needles are to pine trees as migration is to_____.
   a. whale b. bear c. owl d. maple
4. What number would come next in the sequence? 7, 11, 9, 13, 11, __
   a. 7 b. 9 c. 13 d. 15
5. What would come next in the pattern A, M, D, N, G, O, J, _____?
   a. E b. P c. Q d. F
6. What is the "magic" word that will fit in both sentences?
   The phone rang and interrupted my "magic" of thought.
   The runners "magic" hard for the Olympics.
   a. train b. practice c. line d. work
7. What is the "magic" word that will fit in both sentences?
   The jet flew "magic"the city of Miami.
   I like to put syrup "magic" my pancakes.
   a. passed b. near c. around d. over
8. Put the following items in correct order from 1 to 8.

_____a. While the chicken is cooking, cut the vegetables for the salad.
_____b. After the potatoes are baked, melt butter over them.
_____c. Clean and stuff the chicken.
____d. After the salad vegetables are cut, put the potatoes in the oven to bake.
_____e. Buy the chicken and the other groceries.
_____f. Put the stuffed chicken into the oven.
_____g. Just before serving dinner, put the dressing on the salad.
_____h. On the way home from the grocery store, get a pumpkin pie from the bakery.

9. Classify the following into two groups.

State	Country

a. Minnesota b. France c. Wyoming

d. Vermont e. Mexico f. Canada

10. Fill in the following chart based upon the clues given.

Brian, Susan, Jeff, and Candy decided to have a contest with four different events. Each child won one of the events. Read the clues below. Then put X's on the grid to mark each child with the contest he or she won.

Clues

1. Jeff, who planned three of the events, won the event he did not plan.
2. Brian and the winner of the Cookie Eating contest both lost the Sack Race.
3. Candy who planned the Ball Throwing Contest , did not win the 100 yard dash.
4. Susan almost won the Sack Race.

	SACK RACE	COOKIE EATING	BALL THROWING	100 YDS. DASH
Brian				
Susan				
Jeff				
Candy				

REASONING SKILLS POST TEST

DIRECTIONS: Give the best answer for each question.

1. Tadpole is to frog as caterpillar is to _____.
   a. insect b. butterfly c. cocoon d. flight
2. States are to countries as counties are to_____.
   a. continents b. states c. hemispheres d. countries
3. Football is to sports as ballet is to _____.
   a. dance b. gymnastics c. tap d. opera
4. What number would come next in the sequence: 6, 10, 8, 12, 10?
   a. 6 b. 8 c. 12 d. 14
5. What letter would come next in the pattern: B, N, E, O, G, P, K?
   a. F b. Q c. R d. G
6. What is the "magic" word that will fit into both sentences?
   I can skip a "magic" on the water.
   I can listen to "magic" and roll.
   a. jazz b. boat c. rock d. radio
7. What is the "magic" word that will fit into both sentences?
   A "magic" a day keeps the doctor away.
   There was a worm in Jack's "magic".
   a. aspirin b. salad c. orange d. apple
8. Put the following steps in order from 1 to 8 on how to build a bird house.

_____a. Cut out the door.
_____b. Nail the roof onto the walls.
_____c. Buy the wood, nails, and paint.
_____d. Draw the plans for the bird house.
_____e. Put the tools away and clean up
_____f. Cut out the wood for the sides and the roof.
_____g. Paint the bird house.
_____h. Put up the walls.

9. Classify the following into two groups.

LIVING	NON-LIVING

a. cow b. desk c. tulip d. tractor e. pen
f. TV g. mosquito h. grass

10. Fill in the following chart based upon the clues given.

Jose, Ruth, Moses, and Rosa rode their skateboards in the park. Each one had a different color skateboard. Read the clues below. Then put X's on the grid to match each skateboard with its owner.

Clues:

1. Jose and the girl with the black skateboard live ac. oss the street from eachother.
2. Moses lives seven houses north of Jose's home.
3. Jose's house, skateboard, notebook, and favorite shirt are all yellow.
4. Rosa bought a backpack with purple flowers to match her skateboard.

	YELLOW	PURPLE	BLACK	WHITE
Jose				
Ruth				
Moses				
Rosa				

APPENDIX D

MATHEMATICS PROBLEM SOLVING PRETEST

DIRECTIONS: Solve each problem and write the solution on the paper.

1. Mr. Smith was standing in line at the ticket window. There were 5 people in front of him and 8 people behind him. How many people were standing in line?

2. Maria bought 7 packages of cups for the club picnic. Each package had 50 cups. After the picnic there were 47 cups left over. How many cups were used at the picnic?

3. Orange juice in a machine costs $.50. Rufus put 7 coins in the machine. Which seven coins did he use?

4. Put one nickel into a parking meter and you can park for 12 minutes. Put one dime into a parking meter and you can park for 24 minutes. How long can you park if you put 3 dimes and 4 nickels into a parking meter?

5. Kathy and Tasha planted some bean plants in their garden. If they plant 3 more bean plants each day for the next 5 days, they will have a total of 21 plants. How many did they plant the first day?

MATHEMATICS PROBLEM SOLVING POST TEST

Directions: Solve each problem and write the solution on this paper.

1. About 760 people visit the museum each day. The museum is open 6 hours each day. How many hours is it open in 7 days?

2. There are 24 boxes of crayons in a carton. Each carton costs $15.00. How much do 7 cartons cost?

3. Saturn has 23 moons. Mars and Neptune have 2 moons. What is the average number of moons for these 3 planets?

4. A paint store sold 381 liters of paint in one week. If customers bought an average of 3 liters each, how many customers were there?

5. The distance around a sandbox is 16 meters. The length of the sandbox is 5 meters. What is the area of the sandbox?

APPENDIX E

CRITICAL THINKING WORKSHEET 1

CLASSIFICATION: Place each item under the correct title.

PARTS TO WHOLE	ANIMALS TO HOMES

a. bear to cave b. branch to tree c. finger to hand
d. wheel to car d. fish to pond e. robin to nest

SEQUENCING: Write the item that comes next in the sequence.

a. 1, 3, 2, 4, 3, 5, 4, ____

b. Get materials together to bake a cake. Grease a pan. Preheat oven. Mix up materials in a bowl. Pour mix in a pan. What do you do next?

INFERENCE. Figure out the "magic" word that will fit into both sentences.

a. The boat will travel "magic" the bridge.

b. The recipe for brownies is in the cookbook "magic" desserts.

"magic" means_____.

ANALOGIES: Fill in the blank with the correct word.

a. Quiet is to noisy as dark is to _____.

b. Dresser is to bedroom as refrigerator is to _____.

DEDUCTIVE REASONING: Use the clues to fill in the chart.

CLUES:

1. Neither Alice nor Debbie likes the Fun House.
2. John loves the Ferris Wheel.
3. David's idea of fun is to get wet.
4. Lucie does not like the Bumper Cars

	JOHN	ALICE	DAVID	DEBBIE	LUCIE
SUPERSLIDE					
BUMPER CARS					
FUN HOUSE					
FERRIS WHEEL					
WATER SLIDE					

APPENDIX F

Dear Parent:

Critical thinking is an important part of every student's education. Without the necessary skills, a person experiences great difficulty in making the decisions needed in daily living.

Your child is being given the opportunity to take part in a project designed to emphasize the critical thinking and problem solving activities involved in the fourth grade curriculum. The regular text books that your child is presently using will be used for the project. The addition of a daily worksheet and games that use thinking skills will be added to the present instructional material. This project will in no way impede the progress your child will make in fourth grade. The test and evaluation instruments are made by me, and all instruction will be given by me. The items to be used in the program are available for your viewing.

Please sign the following permission slip allowing your child to take part in the project. If you have any questions, please feel free to contact me.

Thank you for your cooperation and support in the continuing education of you child.

Sincerely yours,

Beth Rice

Name_____

has my permission to participate in a critical thinking skills program that will be a part of the basic program of study for fourth grade. I understand that my child will be given a pre and post test to evaluate the progress made.

Parent Signature_____

Date_____