THE EFFECT OF GRADE LEVEL, ACHIEVEMENT, AND TYPE OF TASK ON METACOGNITIVE AWARENESS IN ELEMENTARY MATHEMATICS

by

Maryanne Bozarth Bongiovani

Dissertation submitted to the Faculty of the Graduate School
of the University of Maryland in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
1985

APPROVAL SHEET

Title of Dissertation: The Effect of Grade Level, Achievement, and Type of Task on Metacognitive Awareness in Elementary Mathematics

Name of Candidate: Maryanne Bozarth Bongiovani
Doctor of Philosophy, 1985

Dissertation and Abstract Approved: Judith Torney-Purta
Dr. Judith Torney-Purta
Professor
Department of Human Development

Date Approved: November 27, 1985

ABSTRACT

Title of Dissertation: The Effect of Grade Level, Achievement, and Type of Task on Metacognitive Awareness in Elementary Mathematics

Maryanne Bozarth Bongiovani, Doctor of Philosophy, 1985

Dissertation directed by: Dr. Judith Torney-Purta
Professor
Department of Human Development

Metacognition is an awareness of how one thinks and learns. It includes an awareness of the strategies used to learn as well as an awareness of oneself as a learner. The purpose of this study was to describe children's metacognitive awareness during a classroom type task. A further purpose was to determine how grade level, achievement, and type of task influence this awareness.

One hundred sixty-eight fourth, sixth, and eighth grade boys and girls were classified as high or low math achievers based on their performance on the Comprehensive Test of Basic Skills, a group achievement test. These children were then randomly selected to receive

either known or unknown math problems. The known math task was operationally defined as one that was easy; it was a problem that the children would be able to solve. The unknown task was operationally defined as one that was difficult, it was a math problem that these children would find unsolvable. Immediately following the task, the children were given feedback about their performance and were then asked to identify types of thoughts they may have had as they were working on the problems. The types of thoughts included general and specific strategies as well as ability and effort self-evaluations.

A 3 x 2 x 2 factorial analysis of variance design was used with Grade Level (four, six, and eight), Achievement (high and low), and Type of Task (known and unknown) as the between subjects factors. Findings showed that a known task elicited positive ability and effort self-evaluations for success. An unknown task evoked the use of more specific strategies than a known task. A grade level difference in metacognitive awareness showed that young children reported more metacognitive thoughts than older children.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

Recent research on learning and instruction in both educational and psychological literature has focused on the study of how children actually learn in the classroom. One method utilized to examine learning is to find out what children are thinking as they do classroom tasks and how aware they are of these thoughts.

Learning is defined as the process by which knowledge is acquired. Cognitive strategies are the procedures that facilitate this learning. Strategies help in the acquisition, retention, or retrieval of knowledge (Rigney, 1978). For example, in learning tasks that involve remembering, young children who use a rehearsal strategy do better than children who use no strategies (Keeney, Cannizzo & Flavell, 1967). Similarly, Carnine, Kameenui and Maggs (1982) taught young children a science rule about the food ladder. Other children were taught the rule as well as concepts associated with the rule. Neither instruction was as effective as specific strategy training which involved practice in determining how and when to apply the rule to specific examples.

These studies suggest that when children are taught specific strategies, they become more effective learners. Are children aware of the strategies they use in the classroom? Are children aware of the strategies they are using only in a general way or in a specific manner? Are children aware of how they are performing during classroom tasks?

Are children aware of the effort they put forth? Do they engage in evaluating their abilities? Does this awareness have self-evaluative change with age and with the type of material presented?

The purpose of the present study was to determine children's awareness of cognitive strategies and self-evaluations during classroom type tasks. The purpose was to discover the thoughts children are alert to or have knowledge of as they do classroom type tasks. A further purpose was to determine how grade level and achievement level influence these strategies and self-evaluations.

The awareness children have of strategies or of themselves as learners is known as metacognition. Flavell (1976) described metacognition as an awareness, regulation, monitoring, and management of cognitive strategies in order to learn effectively. Metacognition involves both general and specific knowledge about learning. A child using metacognition has a general realization of when something is not understood and knows specifically whether re-reading the problem, asking for assistance, or some other strategy would be most helpful. A child using metacognition will also be more aware of whether a task is difficult or easy, and the child will know when information has been learned and when more practice is needed.

Metacognition is believed to be developmental in nature (Brown, 1978). The conscious awareness and control of what we know, what we need to know, and how to go about learning is said to increase with age. First-graders and college-age students, for example, have been found to

differ in their ability to estimate their performance on a memory recall task (Levin, Yussen, DeRose & Pressley, 1977). Worden and Sladewski-Awig (1982) also found that older children were better able to describe and give ideas about strategies and their use. Kindergarten children were unable to explain why they would remember certain items, but fourth and sixth graders were more aware of the importance of task variables in helping memorization. Myers and Paris (1978) reported an age-related difference in the metacognitive awareness of reading. In their study, sixth graders were more aware of how various strategies could affect learning than were second graders. The sixth graders were able to give some indications about what makes one a good reader, were more aware of the structure of prose, and, were able to recount how different strategies could be effective depending on the type of reading being done. The effective learner not only must be aware of many strategies that can be used to learn, but must also know which ones to use in various situations. Brown and Smiley (1978) found that the ability to use extra study time to improve recall of a story was not present at all ages. Children below seventh grade did not benefit at all from extra study time; after seventh grade, a qualitative difference in strategy use was found.

It appears that fourth graders have at least a basic awareness of metacognition (Worden & Sladewski-Awig, 1982); this awareness is even more developed by sixth graders (Myers & Paris, 1978), and the ability to use this awareness begins to be seen by eighth grade (Brown & Smiley,

1978). One aspect of the present study was to replicate these age-related changes in metacognition among fourth, sixth, and eighth grade children. In particular, fourth graders were expected to have the least awareness of metacognition, and the eighth graders to have the most awareness of metacognition.

In addition to the age-related changes, Chi (1981) believes that the development of metacognitive strategies is related to the growth of content knowledge. Chi describes three types of knowledge. Procedural knowledge is a knowledge of rules such as knowing how to divide two digit numbers. Declarative knowledge is a knowledge of facts (e.g., In chess, the Queen can move in any direction). Procedural and declarative knowledge are together referred to as content knowledge. Strategic knowledge is a knowledge of rules that are applicable in several domains. An example of strategic knowledge would be knowing how to rehearse because it can be used with all subject areas and with many types of data. Other examples of strategic knowledge include identifying the main idea and checking or monitoring one's work. Strategic knowledge begins as domain specific procedural knowledge and eventually becomes more generalized. In Chi's view, content knowledge and strategic knowledge interact in a way that allows a child to learn to apply a strategy most easily when the content knowledge is stable and overlearned.

Chi (1981) believes that when age differences are found in

metacognitive studies, the results may be attributed to the older children's greater knowledge. In one study, a chessboard with the figures arranged was shown to adults and children. The children in this study, had some knowledge of chess but the adults had only limited knowledge. The children, presumably because of their greater knowledge, were able to memorize more about the placement of the pieces and did so in fewer trials.

Chi and Koeske (1983) also demonstrated the influence of prior knowledge on learning with a young boy who was very interested in dinosaurs. Through various games and questions, forty dinosaurs were chosen and then divided into two groups. Twenty dinosaurs were well known to the boy, and the other twenty were less well known. In recall, clustering and retention tasks, the child did better with the well known group of dinosaurs. The organization of knowledge for the better known dinosaurs was superior. There was a greater number of knowledge links, and the links were stronger. Knowledge of the well known dinosaurs was easily remembered by the child one year later.

Glaser (1984) also suggests that problem-solving difficulty may be due to an inadequate knowledge base. He postulates that high aptitude individuals may appear to be better at reasoning because their level of content knowledge and procedural knowledge is greater. Specific prior knowledge was found to be a significant predictor of comprehension in a sixth grade reading task when both intelligence and reading achievement were controlled (Langer, 1984). Both the quality and quantity of prior knowledge was related to comprehension, but it was the qualitative

measure that was found to have the stronger relationship.

Howe and Ceci (1979) have suggested that the ability to use effective strategies improves as a combined result of both development and increased content knowledge. Although fourth graders are aware of metacognitive skills, they do not use them effectively until eighth grade (Myers & Paris, 1978; Brown & Smiley, 1978). Within the present study, it was predicted that metacognitive awareness would increase with age, but it was also predicted that metacognitive awareness would be greater when the information presented was well known to the student. When the student is very familiar with the information, it should be easier to attend to the strategies one is using.

In addition to age and familiarity with content, research also suggests that metacognitive skills may be more apparent in high achieving than low achieving students (Sanacore, 1984). Peterson and Swing (1982) have studied metacognitive strategy use during actual classroom instruction. The authors differentiated two types of strategies: general ones such as thinking, listening, or working and specific ones such as repeating, reviewing information, relating information to prior knowledge, checking an answer, and re-reading the problem to name a few. They found that high achieving students were able to name the specific strategies they used when learning whereas, low achieving students only identified general strategies.

Hare and Smith (1982) reported on sixth and seventh graders who

were asked what they were thinking in order to remember the material they were reading. The only general strategy mentioned often was concentrating. Specific strategies such as imaging and re-reading were more commonly named. A moderately significant positive correlation was found between the number of strategies used and reading achievement. The students in this study were responding to open ended questions rather than a questionnaire or check list.

Corno, Collins and Capper (1982) had teachers rate students on their academic orientation. The more academically oriented student was described as a student who took part and became involved in classroom learning. Students who were rated low on this scale reported using fewer strategies and reported having less cognitive control over their learning in classroom situations. They seemed unable to regulate their own thinking.

In the present study it was predicted that students high in math achievement would be more aware of specific strategies than students low in math achievement. For example, high achieving math students are probably more aware of specific ways to try and solve math problems than low achieving math students.

When learning is studied in a classroom situation, another dimension of metacognition emerges which involves self-knowledge of why one has succeeded or failed at a task (Weiner, 1979; Guthrie, 1983). The awareness that a person can affect learning by attitude, motivation,

ability and other variables is present in some degree by kindergarten (Miller & Weiss, 1982). However, the accuracy of this awareness seems to increase with age (Nicholls, 1978). This self-knowledge is influenced in a classroom by other variables such as the task being performed and past performance. How one integrates classroom information and then uses this to understand why there has been success or failure has become known as attribution (Weiner, 1979). Attribution theory postulates that individuals strive to explain outcomes of achievement related events using factors such as ability, effort, task difficulty or luck (Weiner, 1979).

Weiner (1979) has suggested that ability and effort attributions are prevalent explanations for achievement outcomes and events and have contrasting consequences for subsequent achievement behaviors. For example, failure attributed to low ability will decrease the expectation of future success more than failure attributed to lack of effort. Diener and Dweck (1978, 1980) describe children who tend to attribute their failure in achievement situations to a lack of ability as learned helpless children. These children feel that they have no influence on a situation and no matter how hard they try, what they do will not really affect the outcome since they lack the basic ability to do well. By contrast, children who see failure as a lack of effort are referred to as mastery oriented children. They tend to focus on motivational factors and believe these factors influence outcome; thus they feel they can succeed if they really want to do well.

There is some evidence to suggest that achievement level affects the type of attributions consistent with an interpretation of learned helplessness (Butkowsky & Willows, 1980). Poor readers attributed failure to ability while they often considered success due to some external factor other than their own ability or effort. Other studies, however, (e.g., Ames, 1984), have found that achievement differences may not affect attributional statements as much as the situation in which the child is tested. When children performed a task with other children present, they tended to focus on ability self-evaluations such as "Am I smart?" without regard to their achievement levels. When children were tested individually they reacted more like mastery oriented children and focused on effort evaluations.

Within the present study, it was predicted that the higher achieving students would make more self-evaluative statements especially when the task was a known one. It was also predicted that the unknown task would produce a focus on effort because the high achievers were expected to be more mastery oriented than the low achievers.

Developmental factors may play a part in children's causal attributions for success and failure. Children as young as age three could use past performance information and make judgments about future performance based on this. This age group did not differentiate on the attributions which had caused the success or failure (Stipek & Hoffman, 1980). A later study (Stipek & Tannatt, 1984), found that children

evaluated their abilities according to different rationales depending on the child's age. The preschool child was only able to say he was smart because he was smart, but as children reached grade three, they were able to explain their smartness by saying it was due to effort, work habits, or ability. There was, however, no clear distinction between these causes. This finding was also reported by Nicholls (1978). Effort, ability, and outcome are not differentiated as separate in young children. If a child tries hard he is smart even if he fails. Effort is seen as separate from outcome by age eight or nine, but the distinction between effort and ability is not fully understood until age twelve or thirteen. This implies that negative feedback on work habits could be interpreted as negative feedback on a young child's ability.

Stipek and Tannatt (1984) found that as children got older, ratings of their own ability declined. By age eight, children rated themselves significantly lower in ability than preschoolers. This decrease in feelings of ableness was also found in a study by Rholes, Blackwell, Jordan and Walters (1980). Children at age five and six did not appear to be influenced by failure. Neither kindergarten children nor first graders showed significant correlations between their attributions and their behaviors. Significant correlations between these two factors were more prevalent in the third and fifth graders. For example, the fifth graders who rated themselves high in ability showed greater persistence and better performance on a task involving hidden pictures. The children who felt that the task was too difficult for them, showed

less persistence and had a poorer performance on the task. Rohrkemper and Bershon (1984) also found that older children were more likely to attribute the outcome of a task to their ability or effort than younger children.

Predictions for the present study were that self-evaluative statements such as "I am smart", and "I try hard" would increase with age as the children become more aware of the concepts of ability and effort and their relationship to success and failure outcomes.

Learning and self-evaluative statements about that learning cannot be considered separately. They interact to influence each other (Covington, 1979). Covington describes the ideal as using cognitive strategies to manage our ability while recognizing the amount of effort necessary to complete classroom tasks successfully. Thus in any given task, a student must be aware of useful cognitive strategies, and must know his/her ability, so that an accurate prediction of the effort needed for the task can also be made. The question is: do children consider all these aspects of metacognition when they are learning?

While there is an increasing body of knowledge about metacognitive strategies and attribution, when they are considered together in the classroom, there is a significant gap in the literature. One of the few studies was done by Peterson, Swing, Braverman and Buss (1982). They asked students what they were thinking as they were learning a new math task and they found that the higher achieving students mentioned more

specific cognitive strategies. Self-evaluative or motivating statements (e.g., "I think I can do it" and "I tried my best"), however, correlated with the children's attitudes towards math, but not with their achievement. In this study, however, there were many more strategy questions than self-evaluative ones on the questionnaire given to students. In addition, in the stimulated-recall interview, most questions focused on strategies, and the wording of the questions gave little opportunity for self-evaluative statements. Thus the low number of self-evaluative statements may have been a function of the instruments used.

Rohrkemper and Bershon (1984) also investigated what children think as they learn. They found that children faced with a difficult problem claimed to use strategic self-speech such as talking to themselves and repeating strategies to themselves. Self-evaluative statements were made less often and these involved more effort statements than statements of ability. However, when faced with an easy problem, statements of self-evaluation were more frequent than strategy statements. A limiting factor in this study was the type of questioning utilized in the study. For example, several questions asked what the subject says to himself when the work is hard or easy. This seems to encourage a response of some kind even if the subject doesn't remember saying anything to himself. It was also a retrospective study that dealt with situations that may or may not have occurred recently.

In the present study, it was predicted that high achieving math

students would make more strategy statements than low achievers. It was also expected that the strategy statements would be specific rather than general. It was also predicted that a known task would evoke more self-evaluative statements than an unknown task.

For the most part, researchers studying both metacognition and attribution have not investigated these areas with children doing schoolwork in a classroom setting. Therefore, the issue of how best to study this topic has not been resolved. The present study focused on children's thoughts immediately after a school type math task. This immediacy guarded against the inaccuracies of retrospective subject reports discussed by Taylor and Fiske (1981). The questionnaire format also avoids some of the problems of experimenter subject interaction as well as the problems connected with interpretations of thought processes from what children might verbalize. The children are only asked what they thought rather than how or why (Taylor & Fiske, 1981). The statements used to develop the questionnaire include general and specific cognitive strategies derived from questionnaires used in the work of Peterson and Swing (1982) and attributions to ability or effort derived from questionnaires used in the attributional work of Ames (1984). Research also indicates that when students are performing a task their thoughts are naturally focused on strategies needed to solve the task. After a task is finished, students react with attribution-type thoughts. To deal with this bias, Ames (1984) tapped

children's thoughts as they had completed two tasks and were anticipating a third. This methodology was also employed in the present study.

In summary, the present research focused on children's awareness of metacognitive thoughts during school type tasks. This study examined the effects of age, ability, and information on children's awareness of strategies and self-evaluative statements. The operational definition of this awareness was whether or not the children recognized the questionnaire statments as being important. This awareness was measured by the number of statements checked. It was predicted that the older students would show more metacognitive awareness by choosing a greater number of statements both in the strategy and self-evaluative or attributional areas. The higher achieving children were expected to choose more statements than the lower achieving students. It was also predicted that the familiarity of a known task would elicit more strategy and self-evaluative statements than a more difficult unknown task.

In a comparison of the two types of strategy statements, it was predicted that specific strategy statements would be chosen more than general strategy statements by the older high achievers, especially when the task was a known one. A comparison of ability and effort self-evaluative statements was expected to elicit a greater number of ability statements for low achievers given an unknown task. It was predicted that high achievers given an unknown task would have a greater number of effort statements.

METHOD

SUBJECTS

The participants of the study were 168 children with 84 boys and 84 girls. The children were selected from a total enrollment of about 360 children in grades 4, 6 and 8 enrolled in two predominately white middle class parochial elementary schools in an urban section of Baltimore County. Familes from the one school were made up of mostly blue collar workers with some white collar workers and a few professionals among them. The other school had mostly white collar workers and professionals with only a few parents having blue collar jobs.

Children in each grade who obtained parental permission were divided into those from the high or low half of their grade based on their total math achievement score on the Comprehensive Test of Basic Skills (CTBS) (McGraw-Hill, 1974). Children were then randomly dropped until there was an even number of high and low achievers of each sex at each grade level. These children were then randomly assigned to "known" and "unknown" test conditions controlling for grade level, class achievement and sex. The "known" task was operationally defined as a task consisting of easy math problems while the "unknown" task was operationally defined as one made up of very difficult math problems. Of the 168 children in the study, there were 56 at each grade level. Of

the 56, 28 were high achievers and 28 were low achievers. Of each group of 28, 14 were assigned to the "known" task and 14 were assigned to the "unknown" task.

PROCEDURES

Five months prior to the study, the entire 4th, 6th, and 8th grade classes were given two math tests, one easy and one hard. This provided normative data concerning the difficulty of specific math problems and was the basis for determining easy versus hard math word problems at each grade level. At each grade level, four problems which all children answered correctly were selected for the future easy word problems and four word problems that all children answered incorrectly were chosen for the hard math problems.

After the Comprehensive Test of Basic Skills was given in October of the school year, the children in each grade were grouped as to high or low math achievement by a median split. The median score for the 4th graders was a 4.7 grade level. Scores ranged from a 2.9 - 8.5. The median score for grade 6 was 7.1. Scores at this grade ranged from 3.4 to 11.9. The median grade level score for grade 8 was 9.5. The range of scores was from 5.6 to 12.9. After being grouped, the children were then randomly assigned so that there were the same number of boys and girls at each achievement level for each grade.

On the day of testing, the children in each grade were taken in groups of approximately 10 to a separate room with one of two female

examiners. The examiner explained to the group that they would be helping in a study to find out how children learn and that this would not count as part of their grade.

Each child was handed either an easy or difficult test with the four problems selected according to results on the pilot rest. Four problems were selected so that the students with the difficult test would not be frustrated to the point where they would stop working. The children were told to do the best that they could and they were told that they had five minutes. After five minutes, the answers were given, the children were told they did well or poorly, and then the tests were collected. The children were told that they would be given more problems in a minute, but first they were to answer some questions. While the children were anticipating a second task, they were asked to respond to a questionnaire which contained a checklist of twenty-five items. There was one general question about their thoughts followed by twelve self-evaluative statements, six on ability and six on effort. There were also six general and six specific cognitive strategy statements presented. All were presented in random order. The categories of statements are described below:

1. General cognitive strategies. These statements referred to things one does when trying to take in information. They included such statements as "I thought about what I was doing," "I paid attention to what I was doing," "I

kept my mind on my work," "I concentrated on these problems," "I read the problems carefully," and "I thought about the problems."

2. Specific cognitive strategies. These statements also referred to things one does when trying to take in new information but they were more detailed. This would include such statements a "I figured out little parts of the problem, then I did the work," "I thought about how the problems were like ones I did before," "I thought about the problems by using a blackboard in my head," "I first thought about what the answer should be, then I did the problem," "I pictured the numbers in my head and then did the work in my head," and "I asked myself questions like 'Did I add the right numbers?'"

3. Self-evaluative ability statements. These statements referred to one's ability to do the work. The statements given to the children with the "known" task included, "I am good at this kind of work," "I am good in math," "I knew what I was doing," "I can do this work," "I thought I was doing well," and "This was easy for me." For children with the "unknown" task, statements included, "I

am not good at this kind of work," "I am not good in math," "I didn't know what I was doing," "I can't do this kind of work," "I didn't think I was doing well," and "This was hard for me." The statements given to the "known" and "unknown" group were parallel but were related to their performance on the task.

4. Self-evaluative effort statements. These statements referred to how much one tried in the situation. The statement given to the children with the "known" task included "I try hard on things like this," and "The harder the problems got, the harder I worked," "I worked hard on this," "I tried my best to get these right," "I am a hard worker," and "I tried my best." The statements for the "unknown" task group included, "I usually don't try hard on things like this," "The harder the problems got, the less I tried," "I didn't work hard enough," "I didn't try hard enough to get these right," "I didn't work hard enough," and "I didn't try to do well." The statements given to the "known" and "unknown" group were parallel but were related to their performance on the task.

The statements in each of the four categories were derived from the

instruments used by Ames (1984) and Peterson and Swing (1982). When independently classified by three expert judges an average .94 agreement was achieved across each of the four categories.

The children were given the following instructions:

> There are some things students think to themselves when they are doing classwork like the problems you just did. Some children think a lot of things, other children don't think any of these things. Read the statements on this paper and check the statements that tell what you were thinking as you did the test.

When the children were finished they were told that there was no more testing. They were thanked for their help and returned to their classroom.

There were four scores obtained for each student, one on each of the four scales, general, specific, ability and effort. Each category had a potential seven point range from 0 to 6 according to the number of statements a child checked in each category.

ANALYSES

To examine the data on self-evaluative and cognitive strategy awareness, ratings on measures of the known and unknown math problems

were analyzed using a factorial analysis of variance design with three crossed factors (Grade Level and Type of Task). The third effect (Achievement) was nested within Grade Level. The factors included three grade levels, 4th, 6th, and 8th, two levels of math achievement, above and below the median, and two levels of content, known and unknown.

Several main effects were the focus of the study. It was expected that a main effect of grade level on strategy and self-evaluative statements would be found with older children choosing more metacognitive statements than younger children in each of the four areas. A main effect of achievement on the dependent variable was also expected with the higher achieving children choosing more strategy and self-evaluative statements. A main effect of the type of task on the dependent variable was examined. It was expected that a main effect of the type of task would be evidenced by the known task eliciting more strategy and self-evaluative statements than the unknown task.

This study also examined the interaction of grade level and type of task on strategy and self-evaluative statements. Because of their greater amount of content or prior knowledge, it was expected that an interaction would be found with the older children giving more strategy and self-evaluative statements on the known type of task. The interaction of achievement level and type of task was also considered. Based on the literature findings, it was expected that an interaction would be found as evidenced by the higher achieving children giving more strategy and self-evaluative statements on the known type of task.

To test the relative use of general vs. specific strategies a 3 x 2 x 2 x 2 (strategy) ANOVA with repeated measures on the last factor was used. It was expected that the specific strategy statements would occur more with older children, higher achieving children and with known information. To test the relative use of ability vs. effort type of self-evaluation a 3 x 2 x 2 x 2 (self-evaluative) ANOVA with repeated measures on the last factor was used. It was predicted that the lower achievers would use more self-evaluative ability statements for the unknown task, whereas, the higher achievers would use more self-evaluative effort statements on the unknown task.

RESULTS

A factorial analyses of variance design was used to examine children's responses on the metacognitive awareness questionnaire. There were three crossed factors. Grade Level (four, six and eight) X Type of Task (known and unknown) X Achievement (high and low) Achievement was nested within Grade Level. Tables 1 and 2 present the means and standard deviations for the general and specific and for the ability and effort type of metacognitive statements, respectively.

General strategy statements

The ANOVA for general strategy statements is shown in Table 3. A significant main effect for Grade, F (2,156) = 10.36, p <.001, revealed a difference in the number of general strategy statements selected according to grade level. An examination of the means as indicated in Table 1 showed a decreasing linear trend with children in grade four making a greater number of general strategy statements (M = 5.38) than either sixth (M = 4.29) or eighth graders (M = 3.89). Post hoc tests comparing the means were computed using the Tukey honestly significant difference (hsd) procedure. These analyses showed that differences between fourth and sixth (p <.05) and fourth and eighth graders (p <.01) were significant, but the difference between sixth and eighth graders

Table 1

Means and Standard Deviations
for number of
Metacognitive Strategy Statements

N per cell = 14

Problem Condition	Metacognitive General		Metacognitive Specific	
	Known	Unknown	Known	Unknown
4th Grade				
High Achievers				
M	5.21	5.35	2.50	2.42
SD	1.31	1.08	1.09	1.69
Low Achievers				
M	5.71	5.21	3.50	3.78
SD	.61	1.36	1.74	1.31
6th Grade				
High Achievers				
M	4.78	4.42	2.35	3.28
SD	2.08	2.02	1.39	1.77
Low Achievers				
M	3.78	4.14	1.71	3.00
SD	2.04	2.24	1.97	1.61
8th Grade				
High Achievers				
M	4.35	3.85	1.92	2.35
SD	1.44	2.10	1.43	1.39
Low Achievers				
M	2.85	4.50	2.00	2.57
SD	2.31	1.87	1.96	1.28

Table 2

Means and Standard Deviations
for number of
Self-evaluative Metacognitive Statements

N per cell = 14

Problem Condition	Self-Evaluative Ability		Self-Evaluative Effort	
	Known	Unknown	Known	Unknown
4th Grade				
High Achievers				
M	5.21	1.35	4.14	.57
SD	1.05	1.33	1.65	1.08
Low Achievers				
M	5.50	2.57	4.71	1.42
SD	.75	1.65	1.85	1.65
6th Grade				
High Achievers				
M	5.28	2.85	3.78	.78
SD	1.43	1.83	2.19	.97
Low Achievers				
M	4.50	3.07	2.07	1.57
SD	1.74	1.43	2.09	1.55
8th Grade				
High Achievers				
M	4.78	1.71	2.64	1.42
SD	1.57	1.43	1.73	1.34
Low Achievers				
M	3.28	2.14	.92	1.07
SD	1.93	1.61	.73	1.26

Table 3

Analysis of Variance for
General Strategy Statements

Source of Variance	df	MS	F
Grade (A)	2	33.01	10.368***
Achievement (B:A)	3	2.93	.922
Task (C)	1	.72	.226
A X C	2	2.14	.675
B:A X C	3	6.43	2.024
Error	156	3.18	

*** p <.001.

was not significant. In contrast to predictions, younger children appeared more likely to endorse general strategy statements than older children.

Specific strategy statements

The ANOVA for specific statements is shown in Table 4. A significant main effect for Grade level, F (2,156) = 3.96, p <.05, was found for specific strategy statements. The effect was a decreasing linear trend indicating that fourth graders chose more specific strategy statements (M = 3.05) than the sixth (M = 2.59) or eight graders (M = 2.22). Tukey hsd post hoc tests, however, showed that only the difference between fourth and eighth graders was statistically significant (p <.05).

A significant main effect of Achievement which is nested in Grade Level was found, F (3, 156) = 3.04, p <.05. Post hoc comparisons made by using the Tukey hsd procedure resulted in significant differences between high and low achievers only at Grade 4 F(3,156) = 3.95 p <.01. The low achievers (M = 3.64) made a significantly greater number of specific strategy statements than the high achievers (M = 2.46). This finding was contrary to predictions.

A significant main effect for Task, F (1.156) = 5.49, p <.05, showed that when given an unknown task, children gave more specific strategy statements than those given a known task. This finding did not

Table 4

Analysis of Variance for
Specific Strategy Statements

Source of Variance	df	MS	F
Grade (A)	2	9.89	3.967*
Achievement (B:A)	3	7.58	3.044*
Task (C)	1	13.71	5.496*
A X C	2	3.55	1.424
B:A X C	1	.31	.127
Error	156	2.49	

* $p < .05$.

support the hypothesis that children would engage in more strategy-related thoughts when the task was more familiar.

Ability statements

As shown on Table 5, the ANOVA for ability statements showed significant main effects for both Grade Level and Task. The main effect of Grade, F (2,156) = 5.78, p <.01, showed that sixth graders chose more ability statements (M = 3.92) than either fourth (M = 3.66) or eighth graders (M = 2.98). Post hoc testing with the Tukey showed the difference in ability statements chosen between grades four and eight (p <.05) as well as between grades six and eight (p <.05) was statistically significant. The main effect for Task, F (1,156) = 111.81, p <.001, indicated that the known task elicited a significantly greater number of ability statements (M = 4.76) than did the unknown task (M = 2.28). This finding was expected and supported the hypothesis that the known task would elicit a greater number of self-evaluative statements.

Both of these main effect findings were qualified by a Grade X Task interaction, F (2,156) = 3.87, p <.05. An analysis of simple effects showed that the grade level effect was present whether the task was known, F (2,156) = 5.46, p <.01, or unknown, F (2,156) = 4.02, p <.05. Further testing using the Tukey procedure indicated that when the task was a known one only the fourth (M = 5.35) and eighth graders (M = 4.03) differed significantly in the amount of ability statements given

Table 5

Analysis of Variance for
Ability Statements

Source of Variance	df	MS	F
Grade (A)	2	13.32	5.787 **
Achievement (B:A)	3	4.38	1.904
Task (C)	1	257.52	111.816***
A X C	2	8.93	3.879 *
B:A X C	3	6.50	2.827 *
Error	156	2.30	

* $p < .05$.

** $p < .01$.

*** $p < .001$.

($p < .05$). When the task was unknown, it was the sixth graders (M = 2.96) who differed significantly from the fourth graders (M = 1.96) ($p < .05$) as well as the eighth graders (M = 1.92) ($p < .05$). Neither of these findings were consistent with the hypothesis that the older students given a known task would have the most self-evaluative statements.

An Achievement nested in Grade Level X Task interaction, F (3,156) = 2.82, $p < .05$, showed that the difference between the known and unknown task for high and low achievers differed at the three grade levels. Post hoc testing results using the Scheffe procedure were less than conclusive in describing the nature of the interaction.

Effort statements

The ANOVA for effort statements is shown in Table 6. A main effect for Grade on effort statements was significant, F (2,156) = 8.15, $p < .001$, indicating a difference in the number of effort statements made according to grade level. Consistent with the previous findings but contrary to prediction, Tukey tests showed a decreasing linear trend with the fourth graders selecting a significantly greater number of effort statements than either the sixth graders ($p < .05$) or the eighth graders ($p < .01$).

A significant main effect of Achievement which is nested in Grade Level was found, F (3,156) = 3.40, $p < .05$. Post hoc comparisons made by

Table 6

Analysis of Variance for
Effort Statements

Source of Variance	df	MS	F
Grade (A)	2	20.11	8.150***
Achievement B:A	3	8.38	3.406 *
Task (C)	1	152.38	61.744***
A X C	2	29.54	11.970***
B:A X C	3	9.53	3.875 *
Error	156	2.46	

* $p < .05$.

*** $p < .001$.

using the Tukey hsd procedure resulted in a finding of significant differences between high and low achievers only at Grade 8, F (3,156) = 3.51, p <.05. The high achievers (M = 2.03) made a significantly greater number of effort statements than the low achievers (M = .99). This finding was consistent with predictions that the high achieving older children would make the greatest number of self-evaluative statements.

Task was also a significant predictor of children's use of effort statements, F (1,156) = 61.74, p <.001. As expected, children given a known task made a greater number of effort statements (M = 3.05) than those given an unknown task (M = 1.15). The findings in both the ability and effort categories indicated children's willingness to give themselves credit for success when the task was a comfortable one and they had met with success.

An interaction which qualified the previous main effects was a Grade X Task interaction, F (2,156) = 11.97, p <.001. Simple effects testing showed that the grade level effect was present only when the task was a known one, F (2,156) = 19.93, p <.01. Further testing with the Tukey, showed a statistically significant difference between all grades, the fourth and sixth (p <.01), the fourth and eighth (p <.01), and the sixth and eighth (p <.05).

Another interaction of significance was one of Achievement nested in Grade Level X Task, F (3,156) = 3.87, p <.05. The difference in the number of effort statements for the known and unknown task differed for

high and low achievers. Post hoc testing results using the Scheffe procedure showed this was true only at the sixth grade level, $F = 8.90$, $p < .05$. It was the sixth grade high achievers who differed significantly in the number of effort statements made for the known ($M = 3.78$) and unknown task ($M = .78$).

Repeated measures

To determine the effects of grade level, task, and achievement on the relative use of general vs. specific strategy statements, a 3 (Grade) X 2 (Task) X 2 (Achievement) X 2 (Strategy) ANOVA with repeated measures on the Strategy factor was used (See Table 7). This finding showed essentially no significant interaction effects involving the repeated factor, general versus specific strategy.

To determine the effects of grade, task, and achievement on the relative use of ability vs. effort self-evaluative statements, a 3 (Grade) x 2 (Task) X 2 (Achievement) X 2 (Self-evaluation) ANOVA with repeated measures on the Self-evaluation factor was used (See Table 8). A Grade X Self-evaluation interaction of significance was found, $F(2,156) = 3.52$, $p < .05$. Simple effects tests showed that the grade level effect was present whether ability statements, $F(2,156) = 7.74$, $p < .01$, or effort statements were considered, $F(2,156) = 11.68$, $p < .01$. Further testing using the Tukey procedure indicated that when ability statements were considered, the eighth graders made significantly fewer statements ($M = 2.98$) than either the fourth graders ($M = 3.66$) $p < .05$),

Table 7

Between Subjects Analysis of Variance
for Strategy Repeated Measure

Source of Variance	df	MS	F
Grade (A)	2	39.16	10.21 ***
Achievement (B:A)	3	7.35	1.92
Task (C)	1	10.36	2.70
A X C	2	3.14	.82
B:A X C	3	3.76	.98
Error	156	3.83	
Strategy (S)	1	302.86	164.35 ***
S X Grade (A)	2	3.75	2.04
S X Achievement (S X B:A)	3	3.16	1.72
S X Task (C)	1	4.07	2.21
S X A X C	2	2.55	1.39
S X (B:A) X C	3	2.98	1.62
Error	156	1.84	

*** $p < .001$.

Table 8

Between Subjects Analysis of Variance
for Self-evaluative Repeated Measure

Source of Variance	df	MS	F
Grade (A)	2	27.37	8.98 ***
Achievement (B:A)	3	12.07	3.97 **
Task (C)	1	403.04	132.21 ***
A X C	2	33.14	10.87 ***
B:A X C	3	14.29	4.70 **
Error	156	3.04	
Self-evaluative (E)	1	172.42	99.52 ***
E X Grade (A)	2	6.06	3.52 *
E X Achievement (E X B:A)	3	.65	.38
E X Task (C)	1	6.85	3.98 *
E X A X C	2	5.33	3.09 *
E X (B:A) X C	3	1.74	1.01
Error	156	1.72	

* $p < .05$.
** $p < .01$.
*** $p < .001$.

or the sixth graders (M = 3.92) (p <.01). There were no significant difference in the number of ability statements made between the fourth (M = 3.66) and sixth graders (M = 3.92).

Another significant interaction found was that of Task X Self-evaluation, F (1,156) = 3.98, p <.05. Simple effects tests, however, showed that ability statements were more frequent that effort statements under both conditions of the known task F (1,156) = 35.83, p <.01, or the unknown task, F (1,156) = 15.92, p <.01. The tendency to choose positive ability statements was quite high when the task was a known one (M = 4.76). At the same time when the task was unknown, there was a tendency not to choose negative effort statements (M = 1.14).

A Grade X Task X Self-evaluation interaction of significance was also found, F (2,156) = 3.09, p <.05. Post hoc comparisons made using the Scheffe procedure were less than conclusive in showing the nature of this interaction.

DISCUSSION

The present study addressed several important questions. The first concerned differences between metacognitive awareness at various grade levels. The results indicated that younger children differ from older children in their metacognitive awareness. A second question addressed differences between high and low achieving students' metacognitive awareness. Differences in achievement level were found at different grade levels and when achievement level was combined with task there was a tendency for high and low achievers to differ in their metacognitions. A third question addressed differences in metacognitive awareness between two types of task. Specific strategy statements occurred more frequently with an unknown tsk, and ability and effort self-evaluative statements occurred more often with a known task.

Type of task

The present study lends support to prior research findings (Covington, 1979) which show that students are much more willing to identify positive ability and positive effort statements than negative ones. It also lends strong support to the research that indicates children wish to appear effortful and capable (Covington & Omelich, 1979). Children, in this study, given a known or easy task engaged in positive self-evaluation. They responded to success with statments such

as "I am good in math," "I knew what I was doing," "I am good at this kind of work," "I tried my best," and "I try hard on things like this."

Children in this study given an unknown or difficult task did not openly evaluate their ability or effort. They did not choose statements such as "I am not good in math," or "I didn't work hard enough." Children given the hard or unknown task responded to specific strategy statements such as "I figured out little parts of the problem, then I did the work," and "I thought about how the problems were like ones I did before." They thought about specific things they could do to help solve the problem.

It had been expected that the known task would elicit more specific strategy statements. The literature on memory suggests that material must be familiar before one can focus on the strategies needed to learn or memorize it. Chi (1981) found that when children who knew the game of chess were shown a chess board that was set up in a game pattern, they were able to memorize the placement of the chess pieces much faster than adults who had no background in chess. Other literature suggests that prior knowledge plays an important part in learning new material. A story or lesson is much easier to understand or learn when information about the subject matter is familiar to the learner. It was therefore expected that if the task was known or familiar, the children could use strategies to help them solve the problem. In this study, however, the children indicated they were aware of using specific strategies when the problems were difficult. A reason for this may have been that the

difficult math problems were hard, but their form was familiar. The problems consisted of vocabulary and mathematical procedures which the children often used. The difficulty of the problems varied, but the nature and requirement of both the known and unknown task were similar. Although the children could not correctly solve the difficult problems, their knowledge of basic math computation and their ability to understand what the problem was asking may have given them prior knowledge or familiarity. This familiarity allowed them to think about appropriate strategies for solving the problem. This would indicate that strategies can be used in solving difficult problems when there is background knowledge or familiarity with the subject already present.

A recent study by Rohrkemper and Bershon (1984), has shown that when children were asked to talk to themselves when doing difficult math problems, their self-speech involved cognitive strategies dealing especially with problem solving. The results of the present study and the Rohrkemper and Bershon findings suggest that at least in the area of math, with a known vocabulary and known mathematical procedures, individuals are aware of using specific strategies in helping them solve difficult problems. These findings also indicated that when the math problems were relatively easy, the students were less aware of using cognitive strategies. When performance became automatic, their awareness was directed to the ability or effort they had put forth rather than to strategies.

From an attributional perspective, a known task that brings success

elicits an awareness of causal factors of both ability and effort (Weiner, 1979). Additionally, from a learning perspective, an unknown or difficult task elicits specific strategy awareness, an awareness of methods or specific ways that may help in solving the problem (Rohrkemper & Bershon, 1984). Therefore, if a task is easy, one thinks about the ability or effort which has been responsible for success. If a task is more difficult, one must concentrate on the cognitive strategies needed to solve the problem. A known or easy task does not elicit an awareness of the strategies used to solve the problem because it is not necessary. Solving an easy problem is almost automatic, it just happens.

It is not clear how difficult a problem must be before children begin to consider making strategies explicit. Are children aware of using strategies whenever a problem presents some challenge or do they only think of them when a problem is so difficult as to be unsolvable? If strategy use is an important skill to be learned, and if it is to be taught to children, we must consider how to teach it. Teaching the use of strategies with simple problems may not be effective. In summary, the role of problem difficulty in the teaching and learning of cognitive strategies needs further consideration.

Grade level

Another purpose of the present study was to investigate the effects

of grade level differences on metacognitive awareness. Contrary to expectations, it was found that the younger children made a greater number of metacognitive awareness statements than the oldest children. This may have been because the known task was not an automatic one for the fourth graders. They needed strategies to help them solve the unknown task. They may also have found the known task more difficult than the older children and thus may have needed strategies to help them solve the known problems as well.

Another explanation for these findings was that the younger children responded to the familiarity of the metacognitive statements. They have heard admonitions such as "Pay attention", "Read it carefully", "Try your hardest", and "You can do it", in the classroom and probably during tasks similar to the ones in this study. It is possible that the younger children were aware of the metacognitive thoughts one should have and responded with what they believed they should be thinking. In other words, they responded to statements connected to classwork that they have often heard, rather than to their actual thoughts while dong the task.

This viewpoint is substantiated by Bjorklund and Zeman (1982). They found that first, third, and fifth graders were able to perform the memory task of naming everyone in their class. While the children were naming their classmates, they were scored on how their answers clustered together, whether they were naming children according to sex, seating arrangements, etc. After recall, strategies of recall were explained to

the students and they were asked which of these or other strategies they had used. About half of the first grade, and almost all of the third and fifth graders claimed to use strategies, but additional analysis showed that fifty percent or more of the children at each grade level named strategies that they had not in fact employed. Knowledge or awareness of strategies was present, but the use of these verbalized strategies was not yet consistently applied. Miller and Weiss (1982) also reported similar findings with second and fifth graders. Students at both grade levels were able to name variables that affect a learning task, but when given a learning task, they were not able to apply this knowledge to their own learning.

Following this line of reasoning, the results of the present study may be indicative of younger children's awareness of metacognition in general. But when a specific task is considered, we cannot conclude that the fourth graders (and perhaps even the sixth graders) actually used or thought about all the strategies they mentioned on their questionnaires. A questionnaire that includes strategies that children hear in a classroom as well as strategy-type statements that are less likely to be mentioned might help clarify the issue as to whether or not the younger children are reacting to familiarity of these phrases rather than actual thoughts about strategies. Studies on children's awareness of the strategies they actually employ on a task could include instruments other than or in addition to a questionnaire. A questionnaire followed by an actual learning situation in which the

questionnaire strategies could be monitored might also be a way to distinguish between knowledge of strategies and actual strategy use.

From a learning perspective, implications are that educators cannot assume that a knowledge of cognitive strategies means a usage of these same strategies. It also implies that when young children are asked how they studied or learned something their answer may show an awareness of what strategies they should use, but this may not be indicative of actual strategy use.

The effect of a known or unknown task influenced all grade levels. As indicated in the literature, children feel more comfortable crediting their ability or effort when the task is easy and they meet with success. This was found to be true especially with the younger children who gave the greatest number of positive ability and effort statements. All children in the study seemed equally unwilling to cite a lack of effort following failure on the unknown task. This may have been because the situation was an experimental one and children usually do try hard in a situation such as this. Therefore, lack of effort cannot become a possible reason for failure. The sixth graders, however, responded to failure with the greatest number of statements indicating a lack of ability. The reason for this finding is unclear, but may in part be due to the educational atmosphere. These children have spent several years in a classroom situation where comparison with others is inevitable, and it may be that at this point in time they are feeling vulnerable. The findings may also be explained by Nicholls' research on

casual attribution. Nicholls (1978) described four levels of reasoning about ability and effort. The levels were found to be age related. At level 1, effort and ability are used interchangeably and at level 2, effort is perceived as the causal factor for most outcomes. By level 3, children begin to use ability more often as a cause of outcomes and they begin to see the interaction of ability and effort that is found in Level 4. Sixth graders, who are often between levels 2 and 4, begin to see that if effort was used and failure still occurred then lack of ability must be the cause. Further investigation is necessary to see if Nicholls' finding is a consistent one at this age or if external variables may have been responsible for the outcome of this study.

Self-evaluative statements

Another interesting finding was the interaction of self-evaluative statements and the type of task. Children were much more willing to take credit for success than they were to give a personal reason for their failure. This might have been a function of the statements used on the questionnaire. The statements that would have been checked for failure on the unknown task may have been too negative. Although the children did not succeed, they did not seem willing to say such things as "The harder the problems got, the less I tried," or "I usually don't try hard on things like this." A Likert-type questionnaire which allows for gradations of feelings might lessen this effect. It also must

be remembered that these children were tested in a school and these statements are not ones that are usually expressed in a school or classroom situation.

It was expected that the findings on the achivement variable would replicate the attributional literature on learned helpless and mastery oriented children. Low achievers were expected to make a smaller number of self-evaluative statements when they succeeded and a greater number of self-evaluative statements when they failed. This, however, was not the case. The only significant difference was found between the eighth grade high and low achievers. The eighth grade high achievers made a greater number of effort statements than the low achievers. The findings may not have been as predicted partly due to the population of this study. The students were labeled as high and low achievers based on whether their math achievement scores were above or below the median for their grade level. As a result, some children labeled low achievers were actually performing at grade level or above. These children were low achievers in their grades, but would not parallel low achievers in the general population and thus may not have responded as a child having difficulty with schoolwork.

When achievement was combined with task, the results became more predictable. Both high and low achievers were more willing to be self-enhancing when the task was easy and were much less willing to be negative about their ability and effort when the task was difficult. However, even when the task was easy, there was a tendency for the low

achievers to be less confident than the high achievers of their ability and effort. The tendency was for children who usually did well in math to be the most self-enhancing. When the task was unknown or difficult, there was a tendency for the low achievers to make a greater number of negative statements about their ability choosing such remarks as "I am not good in math," and "I can't do this kind of work." This tendency was also present when effort statements were examined; however, the findings did not reach a level or significance for either the ability or effort statements.

It was the fourth grade low achievers who made the largest number of negative effort statement. This could partly be explained by Nicholls' levels of reasoning about ability and effort. Nicholls (1978) found that third graders are often at a level 2. At this level, effort is seen as the main cause of an outcome. Whether the outcome is success or failure, it is seen as due to effort or a lack of it. Nothing else is considered. The older children could see their failure in some cases as due to a lack of effort but they could also see their failure as due to other causes at other times. However, the fourth graders at a level 2 stage of reasoning had only a lack of effort to blame for their failure. The largest number of negative effort statements made by the fourth grade low achievers could also have been due to their willingness to make socially acceptable responses. They have often heard comments concerning effort in the classroom such as "Did you really try on this?", and "Perhaps you need to try harder." The fourth graders,

wanting to please and feeling that effort is responsible for outcomes, chose a larger number of negative effort statements than the older children. The lack of negative ability statements can also be explained by a self-worth theory of achievement behavior (Kun & Weiner, 1973). Individuals try to maintain a positive self-image of ability particularly when risking failure. A self-concept of high ability must be maintained whenever possible. Thus it is better to blame a lack of effort rather than a lack of ability for failure. The children also knew that on the unknown task everyone did poorly thus they did not have reason to feel that they were not as smart as the other fourth graders.

From both an attributional and learning perspective, it would seem that as children progress through school, they become more aware of their ability or lack of it. Many low achievers seem to have given up and decided they have no control over their failure. It happend because they lack ability and nothing they can do can change things. The youngest children have not yet reached this conclusion. The high achieving fourth graders credited their ability for their success, and the low achievers felt that lack of effort was the reason for their failure. More effort on their part and they too could succeed. It is this attitude which needs to be fostered so that later learning is not undermined by an attitude of helplessness. It is also important to further investigate the relationship between metacognitive awareness and the use of metacognitive strategies. Children are aware of metacognition, but it is not known how much of this awareness is

actually implemented in learning situations. There is a need to clarify this relationship so that educators can become more effective teachers and children can become more effective learners.

CONCLUSION

Metacognition has recently been singled out as a very important factor in learning. An awareness of cognitive strategies as well as an awareness of oneself as a learner is necessary to be a successful learner. Although there has been a lot written on the subject, most of the writing has been of a descriptive and theoretical nature. There is a significant lack of research in this area especially in the area of classroom performance.

In the current study, the difficulty of the task children were given had a greater influence on metacognitive process than other factors. In both metacognitive and attributional studies, students have actively considered specific ways in which they could respond to difficult problems. Easy tasks have engendered self-enhancing comments about both ability and effort. These findings were replicated in the present study. Younger children responded with the greatest number of metacognitive awareness statements for both learning strategies and self-evaluative statements; however, there are serious concerns that this awareness may not necessarily be put to use. It seems that social desirability may have been a factor in this finding.

High achievers felt good about their effort when they were successful; however, the low achievers tended to feel defeated when they

failed. The older children felt successful if they were high achievers, but the low achievers appeared helpless to change their failure. These conclusions have important implications for educators. It is one of the goals of education to have students who take responsibility for their learning. More investigation is needed into how we can help low achievers to feel more in control of their learning.

There is also much being done to teach children cognitive strategies in the schools. A re-evaluation of what we are teaching is necessary. The literature as well as the findings of this study suggest that children are aware of metacognitive strategies. The fourth graders reported using the greatest number of strategies. This could have been because the task was relatively more difficult for them. There is, however, research that suggests young children know which strategies to use but cannot apply the knowledge. Further investigation of this question by task monitoring would help to ascertain whether or not strategy knowledge and use occur together in young children.

Finally there is a need to examine how learning strategies or study skills are being taught. Strategies may be thought about but not necessarily used by young children. If the strategies are used, this study found the use is with difficult material. The usual curriculum is to teach study or learning skills with familiar material. Perhaps there is a need to re-evaluate the manner in which we teach metacognitive strategies and motivate children to actually use them.

Future research might focus on studies that would evaluate

students' knowledge of metacognition and then test for use of that knowledge in a specific situation. Another area of future research might consider the self-evaluations of the low achiever. It is important to find out at what point in their schooling children begin to see their achievement as out of their control. It is also important to see if this happens to all low achieving students at about the same grade level. By identifying this period and the children affected, we could then try to help the low achiever stay in control of his learning.

Appendix A

Test Given to Those in the "Known" Category

John had 10 goldfish. His mother gave him 3 more and Aunt Mary gave him 5 more. How many goldfish did John have in all? _____

If a girl had 24 stickers and she gave away 4, how many did she have left? _____

In the 6th grade, there are 15 girls and 12 boys. How many children are there altogether? _____

There were 20 problems on a math test. Sue did 5 problems wrong. How many problems did she get right? _____

Appendix B

Test Given to Those in the "Unknown" category

Rulers cost 20 cents more than pencils. If 15 pencils cost as much as 10 rulers, how much does one ruler cost? _____

Peggy had 4 tests. Her average mark was 78. What mark does Peggy need to get on the next test to bring her average mark up to 82? _____

A boy was paid $50 for 5 days of work. He worked 4 hours each day. How much a minute did he earn? _____

Bill has 25 coins. He wants to sell 4. How many different sets of 4 coins could he choose from the 25? _____

Appendix C

Questionnaire For Those Given the "Known" Test

___YES ___NO Were you thinking about anything as you did the problems?

____ 1. I kept my mind on my work.

____ 2. I knew what I was doing.

____ 3. I concentrated on these problems.

____ 4. I paid attention to what I was doing.

____ 5. I worked hard on this.

____ 6. I asked myself questions like "Did I add the right numbers?"

____ 7. I try hard on things like this.

____ 8. I am a hard worker.

____ 9. I am good at this kind of work.

____ 10. I pictured the numbers in my head and then did the work in my head.

____ 11. I can do this work.

____ 12. I first thought about what the answer should be, then I did the problem.

____ 13. This was easy for me.

____ 14. I read the problems carefully.

____ 15. I thought about what I was doing.

____ 16. I am good in math.

____ 17. The harder the problems got, the harder I tried.

____ 18. I thought I was doing well.

____ 19. I tried my best to get these right.

____ 20. I thought about the problem by using a blackboard in my head.

____ 21. I tried my best.

Appendix C (Continued)

_____ 22. I figured out little parts of the problem, then I did the work.

_____ 23. I thought about how the problems were like ones I did before.

_____ 24. I thought about the problems.

Appendix D

Questionnaire For Those Given the "Unknown" Test

___YES ___NO Were you thinking about anything as you did the problems?

_____ 1. I kept my mind on my work.

_____ 2. I didn't know what I was doing.

_____ 3. I concentrated on these problems.

_____ 4. I paid attention to what I was doing.

_____ 5. I didn't work hard enough.

_____ 6. I asked myself questions like "Did I add the right numbers?"

_____ 7. I usually don't try hard on things like this.

_____ 8. I didn't work hard enough.

_____ 9. I am not good at this kind of work.

_____ 10. I pictured the numbers in my head and then did the work in my head.

_____ 11. I can't do this work.

_____ 12. I first thought about what the answer should be, then I did the problem.

_____ 13. This was hard for me.

_____ 14. I read the problems carefully.

_____ 15. I thought about what I was doing.

_____ 16. I am not good in math.

_____ 17. The harder the problems got, the less I tried.

_____ 18. I didn't think I was doing well.

_____ 19. I didn't try hard enough to get these right.

_____ 20. I thought about the problem by using a blackboard in my head.

_____ 21. I didn't try to do well.

Appendix D (Continued)

_____ 22. I figured out little parts of the problem, then I did the work.

_____ 23. I thought about how the problems were like ones I did before.

_____ 24. I thought about the problems.

BIBLIOGRAPHY

Ames, C. (1984). Achievement, attributions and self-instructions under competitive and individualistic goal structures. Journal of Educational Psychology, 76, 478-487.

Bjorklund, D.F., & Zeman, B. (1982). Children's organization and metamemory awareness in their recall of familiar information. Child Development, 53, 799-810.

Brown, A.L. (1978). Knowing when, where, and how to remember: a problem of metacognition. In R. Glaser (ed.), Advances in Instructional Psychology (Vol. I, pp. 77-165). New Jersey: Lawrence Erlbaum Assoc.

Brown, A.L., & Smiley, S.S. (1978). The development of strategies for studying texts. Child Development, 49, 1076-1088.

Butkowsky, I.S., & Willows, D.M. (1980). Cognitive motivational characteristics of children varying in reading ability: evidence for learned helplessness in poor readers. Journal of Educational Psychology, 72, 408-422.

Carnine, D., Kameenui, E., & Maggs, A. Components of analytic assistance: statement saying, concept training, and strategy training. Journal of Educational Research, 1982, 75, 374-377.

Chi, M.T.H. (1981). Knowledge development and memory performance. In M. Friedman (Ed.), Intelligence and Learning (pp. 221-229). New York: Plenum Press.

Chi, M.T.H., & Koeske, R.D. (1983). Network representation of a child's dinosaur knowledge. Developmental Psychology, 19, 29-39.

Comprehensive Test of Basic Skills (1974). Monterey, California: McGraw-Hill.

Corno, L., Collins, K., & Capper, J. (1982, March). Where there's a will: self regulating the low achieving student. Paper presented at the annual meeting of the American Educational Research Association, New York, N.Y.

Covington, M.V. & Omelich, C.L. (1979). Effort: the double-edged sword in school achievement. Journal of Educational Psychology, 71, 169-182.

Diener, C.I., & Dweck, C.S. (1978). An analysis of learned helplessness: continuous changes in performance, strategy, and achievement cognitions following failure. Journal of Personality and Social Psychology, 36, 451-461.

Diener, C.I., & Dweck, C.S. (1980). An analysis of learned helplessness: II. the processing of success. Journal of Personality and Social Psychology, 39, 940-952.

Flavell, J.H. (1976). Metacognitive aspects of problem solving. In L. Resnick (Ed.), The Nature of Intelligence (pp. 231-235). New Jersey: Lawrence Erlbaum Assoc.

Glaser, R. (1984). The role of knowledge. American Psychologist, 39, 93-104.

Guthrie, J.T. (1983). Children's reasons for success and failure. The Reading Teacher, 36, 478-480.

Hare V.C., & Smith, D.C. (1982). Reading to remember: studies of metacognitive reading skills in elementary school aged children. Journal of Educational Research, 75, 157-164.

Howe, M.J.A., & Ceci, S.J. (1978). Why older children remember more: contributions of strategies and existing knowledge to developmental changes in memory. In M.M. Gruneberg, P. Morris, & Sykes, R.N. (Eds.), Practical Aspects of Memory (pp. 393-400). New York: Academic Press.

Keeney, T.J., Cannizzo, S.R., & Flavell, J.H. (1967). Spontaneous and induced verbal rehearsal in a recall task. Child Development, 38 (4), 953-966.

Kun, A., & Weiner, B. (1973). Necessary versus sufficient causal schemata for success and failure. Journal of Research in Personality, 7, 197-207.

Langer, J.A. (1984). Examining background knowledge and text comprehension. Reading Research Quarterly, 19, 461-468.

Levin, J.R., Yussen, S.R., DeRose, T.M., & Pressley, M. (1977). Developmental changes in assessing recall and recognition memory capacity. Developmental Psychology, 13 (6), 608-615.

Miller, P.H. & Weiss, M.G. (1982). Children's and adults' knowledge about what variables affect selective attention. Child Development, 53, 543-549.

Myers, M., II & Paris, S. (1978). Children's metacognitive knowledge about reading. Journal of Educational Psychology, 70 (5), 680-690.

Nicholls, J.G. (1978). The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. Child Development, 49, 800-814.

Peterson, P.L. & Swing, S.R. (1982). Beyond time on task: student's reports of their thought processes during classroom instruction. The Elementary School Journal, 82 (5), 481-491.

Peterson, P.L., Swing, S.R., Braverman, M.T., & Buss, R. (1982). Students' aptitudes and their reports of cognitive processes during direct instruction. Journal of Educational Psychology, 74 (4), 535-547.

Rholes, W.S., Blackwell, J., Jorden, C., & Walters, C. (1980). A developmental study of learned helplessness. Developmental Psychology, 16, 616-624.

Rigney, J.W. (1978). Learning strategies: a theoretical perspective. In H. O'Neill (Ed.), Learning Strategies (pp. 165-170). New York Academic Press.

Rohrkemper, M.M., & Bershon, B. (1984). The quality of student task engagement: elementary school students's reports of the causes and effects of problem difficulty in mathematics. Elementary School Journal, 85, 128-147.

Sanacore, J. (1984). Metacognition and the improvement of reading: some important links. Journal of Reading, 27, 706-712.

Stipek, D.J. & Hoffman, J.M. (1980). Development of children's performance-related judgments. Child Development, 51, 912-914.

Stipek, D.J. & Tannatt, L.M. (1984). Children's judgments of their own and their peers' academic competence. Journal of Educational Psychology, 76, 75-84.

Taylor, S.E., & Fiske, S.T. (1981). Getting inside the head: methodologies for process analysis in attribution and social cognition. In J. Harvey, W. Ickes, & R. Kidd (Eds.) New Directions in Attribution Research (Vol. 3, pp. 459-524). New Jersey: Lawrence Erlbaum Assoc.

Wiener, B. (1979). A theory of motivation for some classroom experiences. Journal of Educational Psychology, 71 (1), 3-25.

Worden, P. & Sladewski-Awig, L.J. (1982). Children's awareness of memorability. Journal of Educational Psychology, 74 (3), 341-350.