The purpose of this study was to analyze the effectiveness of using children's literature to promote mathematics learning. Fifty-seven kindergarteners were randomly assigned to either a control group or an experimental group. The experimental group received mathematics related storybook reading and discussion time and played with mathematics materials that were related to the storybook content during free play. The control group had ordinary storybook reading time and played with mathematics materials unrelated to the storybook content. The Learning Readiness Test and the Early Mathematics Achievement Test were administered. Four mathematics tasks were also given to compare the mathematics achievement of the two groups. The children's choice of favorite corners, the time spent, and the number of children who played in the mathematics corner were investigated also to measure children's disposition toward doing mathematics. The results showed that more children in the experimental group liked the mathematics corner, chose mathematics tasks, and spent more time in the mathematics corner. Furthermore, the experimental group did significantly better than the control group in the classification, number combination, and shape tasks, and there were qualitative differences in the content analysis.

Many early childhood educators in Korea have severely criticized traditional ways of teaching mathematics to young children. Furthermore, the Korean national curriculum guidelines for kindergarten education recommended that mathematics teaching should be based on children's active participation with concrete materials and should not rely on the use of computation.
drills, workbooks, or worksheets. However, more than one half of the preschoolers in Korea have had private mathematics lessons or been given worksheets at home that require only paper-and-pencil methods (Woo, Hyun, & Lee, 1993). In addition, two thirds of the mathematics materials used in kindergartens emphasize counting, writing numbers, and adding or subtracting (Hong, 1992). These traditional methods do not help children acquire conceptual understandings of mathematics, nor do they help children connect conceptual knowledge to procedural knowledge (Hiebert & Lindquist, 1990). It also seems that these methods fail to encourage children to solve problems creatively, think logically, or to pursue mathematics learning voluntarily and with enthusiasm.

According to current views, early childhood mathematics instruction should be developmentally appropriate as well as child-centered. Young children must have opportunities to (a) engage in physical and mental activity in their environment, (b) use prior knowledge to acquire new knowledge, (c) use methods of learning that are meaningful to them, and (d) become aware of and solve their own problems in learning mathematics (Althouse, 1994; Dutton & Dutton, 1991; Greenberg, 1993; Hiebert & Lindquist, 1990; NAEYC, 1991; NCTM, 1991). The goals expressed by the National Council of Teachers of Mathematics (1989) are to teach children to value mathematics, to have confidence in their own ability, to become mathematical problem solvers, and to communicate and reason mathematically. Mathematics education for young children should help them develop a disposition to do mathematics as well as acquire essential mathematics skills (Dutton & Dutton, 1991; Katz, 1991).

Even though many kindergarten teachers know that computation skill based teaching methods are inappropriate for young children, they still use them. One of the reasons for this may be the lack of an easily adaptable alternative approach that would not require them to completely change their current teaching methods. Recently, mathematics instruction through the use of children's literature has been suggested as a viable alternative (Brandon, Hall, & Taylor, 1993; Burns, 1992; Doig, 1989; Griffiths & Cylne, 1988; 1990; Hong, 1995; Lee, 1995b; Satariano, 1994; Slaughter, 1993; Thiessen & Matthias, 1992; Welchman-Tischer, 1992; Whitin, 1994).

Children's literature has long been used as a source to support the social and emotional development of young children. It is contended that children's storybooks provide a variety of situations that teach children how to cope with conflict, take responsibility, cooperate with others for mutual benefits, and help others (Barclay & Whittington, 1992; Howarth, 1989; Lamme & Mckinley, 1992; Schickedanz et al., 1990). Children's storybooks have also been used to develop the linguistic and aesthetic abilities of young children (Barclay & Walter, 1992; Cullinan, 1989; Danielson, 1990; Raines & Canady, 1990; Sawyer & Comer, 1991). Regrettably, however, until
recently there have been few corresponding efforts to incorporate storybooks in teaching mathematics to young children. But this trend is changing, as new ways of using children's literature to teach mathematics are proposed. Some supporters are suggesting that children's literature can be used in the following ways: to provide a context for an activity with mathematical content, to introduce manipulatives that can be used in various ways, to inspire a creative mathematics experience for children, to pose an interesting problem, to develop and review a mathematical concept or skill, to demonstrate the use of mathematics, and to introduce vocabulary associated with mathematical concepts (Doig, 1989; Griffiths & Clyne, 1988; Satariano, 1994; Welchman-Tischler, 1992). In addition, incorporating children's storybooks into mathematics instruction also helps children experience the potential wonder of mathematical problem solving, leads them to see the connections between mathematics and the imaginative ideas in storybooks, and helps them make sense of their world (Burns, 1992; Karp, 1994; Welchman-Tischler, 1992).

Despite all of this professional support for the concept of teaching mathematics using children's literature, there has been little actual empirical investigation into the effectiveness of using children's literature to teach mathematics. One such study on the use of children's literature for teaching mathematics did not provide as much evidence about changes in attitude toward mathematics as anticipated (Jennings, Jennings, Richey, & Dixon-Krauss, 1992). This was probably because attitudinal measures were based solely on the amount of mathematics vocabulary used during free play. More research is clearly warranted.

This study into the effectiveness of using children's literature to teach mathematics proceeds on the basis of the following theoretical constructs. First, research on memory and knowledge representation suggests that young children appear to find it easier to organize their experiences according to scripts rather than hierarchical taxonomic categories, also that narrative forms of knowing develop much earlier than analytic forms of knowing (Bruner, 1990; Flavell et al., 1993; Lucariello & Nelson, 1985; Nelson, 1986). In a review article, Seifert (1993) suggested that this research on memory implies that young children may learn more easily if a task is presented in a story format rather than as expository instructions. The use of storybooks can thus be a relevant way to expose mathematical concepts to children because stories provide children with problem situations and solutions in a narrative context. Evidence from research consistently points out that young children learn more effectively in a familiar setting and in a context that is meaningful for them (Althouse, 1994; Burns, 1992; Good & Brophy, 1987).

Research on motivation, defined as the dynamic psychological factors that influence the choice, initiation, persistence, and quality of goal-directed activity (Dweck & Elliot, 1983), also suggests that positive attitudes toward
tasks with intrinsic value create a willingness to work hard (Ames & Archer, 1988; Pintrich & DeGroot, 1990; Renga & Dalla, 1993). The implication from research is that if a meaningful setting related to children's own experiences and background knowledge is given, their motivation to pursue a related learning activity may increase. The storybook can act as a catalyst to motivate children because storybooks mostly deal with situations that can touch on their interests and experiences, and provide contexts that engage them. If children are given activities that allow them to use mathematical concepts in the storybook context, they may do their mathematical work more often and for longer periods of time, and in consequences they may become more deeply involved in the learning activities. Children may even start to pursue mathematical activities independently if they can choose what to do and set their own standards for solving problems.

A study on the effects of adding explicit mathematical annotations to children's trade books showed that children's storybooks with mathematical annotations were preferred by children and adults over the same books with no mathematical annotations, and that they facilitated the communication of mathematical concepts in the story (Halpern, 1996). This shows that children's storybooks containing mathematical concepts can be used for making connections between mathematics and the real-life situations from which mathematics naturally springs, without detracting from children's enjoyment of the story. It is therefore a reasonable conjecture that children's literature can be used as an effective classroom vehicle for motivating children to persist at mathematical tasks and to reason mathematically and to make sense of their real world.

The purpose of this study is to investigate the effects of using storybooks in mathematics teaching in Korea on dispositional outcomes such as children's interest in mathematics and their pursuit of mathematical activities, as well as their mathematics achievement. The following research questions are addressed:

1. What effects does using children's literature in mathematics instruction have on dispositions toward mathematics, specifically with regard to sustained interest and involvement in mathematical learning?
2. What effects does using children's literature in mathematics instruction have on children's mathematical achievement?

**METHOD**

**Participants**

Kindergarten education for 3- to 5-year-old children is not compulsory in Korea. About three fourths of all kindergarteners attend private kindergartens (KFTA, 1995). The participants included in this study attended a
private kindergarten located in a residential area of a large city. Fifty-seven kindergarteners participated, ranging in age from 4 years, 2 months to 6 years, 4 months (32 boys and 25 girls). About 82% of the participants' fathers and 50% of their mothers had graduated from 4-year colleges. These children were randomly assigned to two classrooms; an experimental group ($n_1 = 29$) and a control group ($n_2 = 28$). The teachers of both groups had graduated from 2-year colleges in which they had studied early childhood education.

**Instruments**

The Learning Readiness Test (LRT) (KEDI, 1989) for kindergarteners was used as a pretest to establish the comparability of the two groups. This test was individually administered by two research assistants in a quiet area near the classrooms on March 31. The Early Mathematics Achievement Test (EMAT) revised by Lee (1995a), the most frequently administered standardized test for mathematics achievement, was used as a posttest to assess mathematical achievement on June 2.

The research literature contains very few definitions of those variables that can be used for measuring changes in attitude or disposition. Katz (1991) and Katz and Chard (1989) are among the few who have attempted a definition, describing "disposition" as habits of mind including the pursuit of an activity or goal in the absence of expected rewards, that is, persistence at a task, or curiosity. In the study presented here, the term *disposition* is thus taken to mean such an attitude of active pursuit toward doing mathematics. It was measured by comparing two observers' records regarding the number of children who played in the mathematics corner and how much time they spent there. Two research assistants were trained to record this data. The play with mathematical materials, lasting over 1 min, was defined as mathematical activity. The number of children who were involved in mathematics activities and the time spent at them were recorded during 40-min free-play periods twice a week for 6 weeks. Finally, the children's favorite corners were also surveyed to measure their interest in mathematics. A bar graph detailing the results of this survey was made by the children of both groups during group activity periods. Reliability was calculated by the percentage of agreement between the two observers (Irwin & Bushnell, 1980). Reliability for time spent in the mathematics corner was 82.1%, and the reliability for number of children was 100%.

Qualitative measures of mathematical achievement included classification, combinations of numbers, spatial sense, and shapes (see Appendix). These mathematical tasks were modified from those developed by Bird (1991). In the classification task, the participants were asked to sort teddy bears by their own criteria, a task that allows many possible solutions and decisions on the criteria for classification. In the combination of numbers task, the participants were required to make a specified number using three number
components (e.g., ♦♦♦ + ⬤⬤ + ★★★ = 8, ▴⬜⬜ + ○○○ + △ = 8, . . .). In the shape task, the participants were asked to make as many squares or triangles as possible by connecting dots in a 5 × 5 dot paper. In the spatial sense (pattern) task, the participants were given 9 small circles arranged in a 3 × 3 square and asked to fill a specified number of small circles in as many different arrangements as they could without repeating a pattern. These tasks were presented as optional choices for children during free play. Hence, results were not obtained from all children because the aim was to see how many children would voluntarily choose the mathematics tasks.

Procedures
This study was conducted from the 1st week of April to the 5th week of May. Both classrooms were child-centered, play-oriented programs. The lesson planning procedures for both classes are shown in Figures 1 and 2. The main difference introduced between the two classes involved the selection of storybooks and the materials for free play activities. In the experimental group, special consideration was given to select storybooks that related to the weekly theme but that also contained elements that could be developed into mathematics activities or games. In the control group, the storybooks related only to the weekly theme. Although both groups did not read the same storybooks, each read 28 of them. To illustrate the differences, the storybooks used for the experimental group on the weekly theme of "Family" were Goldilocks and the Three Bears (size, seriation), Ten Brave Brothers (measure), A Wolf and Seven Little Goats (spatial position), and Good Brothers (number combination), and those used for the control group were Mommy's Hands, Cheolee's Birthday, I wish I were a Father, and Sleep Well, Dolee.

After the storybook reading, the experimental group had follow-up activities related to the story, such as acting out the story situation or extending the story situation to their real situation via its mathematical content. The control group had only general story discussion or singing related to the theme. Both groups then had free play for about 40 to 50 min. During free play, the children of both groups could choose from several different learning corners, including a mathematics corner.

To control the number of new play materials in the materials in the mathematics corner for both groups, one new mathematics item a day (four a week) was made by the teachers and placed in the corner. The experimental group had access to mathematics materials and activities that reflected the storybook content. The control group of children had access only to ordinary

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1 About 70% of mathematics materials in kindergartens are made by teachers (Hong, 1992); in a recent study, 58% of kindergarten teachers in Korea spent over 2 hr per day making learning and play materials (Park, 1995).
1. Selecting a weekly theme (e.g., family)

2. Making a concept map or listing intended learning outcomes (e.g., family members; family members' roles)

3. Selecting storybooks for group time

   Control G.: Selecting storybooks related a theme
   The storybook about the birth of younger brother, "Mommy's Hands", was selected

   Experimental G.: Selecting storybooks related a theme and were able to be developed for possible mathematics learning
   The storybook which contains the concepts of large-small and 1:1 relationships as well as family's personal things, "Goldilocks and the Three Bears," was selected.

4. Organizing theme ideas into curriculum areas (e.g., making making photo album in art corner; family role play in housekeeping corner)

5. Developing possible math activities

   Control G.: Developing possible math activities in the math corner (e.g., activity for matching objects to the corresponding number)

   Experimental G.: Developing possible math activities related to story context in the math corner (e.g., activity for seriating story family member's personal things like shorts, hats, and shoes by size)

* Only the 3rd and 5th steps of lesson planning differ between the two groups.

Figure 1. Lesson Planning Process.

Mathematics materials and activities. For example, the experimental group of children had the option to arrange objects belonging to the bear family in Goldilocks and the Three Bears—personal objects such as shoes, shirts, and hats—in order from large to small, as an activity that reflected the story situation in the storybook. The control group children drew objects to correspond to a number on empty puzzle pieces, to make a match. Both teachers during free play were asked not to initiate children's play or activities in the mathematics corner so that the choice could be left completely to the children.
<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
<td>1. storybook reading: &quot;Goldilocks and the Three Bears&quot;</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>2. discussion about family items</td>
</tr>
<tr>
<td></td>
<td>3. acting out story situation with family and their bed cut out of tagboard (comparing size of chairs, beds, &amp; bowls and ordering them)</td>
</tr>
</tbody>
</table>

| Material & Activity in Math Corner | material: story family members and their house items (e.g. shoes, shirts, and hats, etc) cut out of cardboard activity: - deal cards and collect items -. ask someone for a card and attempt to make a set of items (The person asked has to give it. If they don't have it, it becomes their turn to ask for one after the player has one more chance.) -. The winner is the person who collects a set of items and arranges them in order of size. | material: empty tagboard cutout puzzles (five or more sets of puzzles per child) activity: -. making number puzzles with favorite numbers -. comparing number puzzles which other children have made -. matching objects to the corresponding number |

Figure 2. A Sample Lesson of Day 1 on the Weekly Theme "Family".

RESULTS

Observational data collected during free play periods were analyzed using a chi-square test to determine group differences in the use of mathematics materials. The bar graphs indicating the children’s favorite corner for both the experimental and control groups were compared. The content of the mathematics tasks completed by the children was also analyzed. Finally, statistical analyses using t tests and paired t tests were performed to determine group differences in LRT scores for learning readiness and in EMAT scores and mathematics tasks for mathematics achievement.

Children’s Disposition Toward Mathematics Learning

The child-created bar graphs showing which activity corners the children chose to spend their time in are presented; Figure 3 shows the results for the experimental group and Figure 4 for the control group. As you can see, the experimental group preferred the mathematics corner above all others,
Figure 3. Graph of children's favorite corner in the experimental group.

Figure 4. Graph of children's favorite corner in the control group.
Table 1. Percentages of Children Who Chose Mathematics Tasks as Choice Activities

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Classification Task</td>
<td>26 (89.7)</td>
<td>19 (67.9)</td>
</tr>
<tr>
<td>Number Task</td>
<td>21 (72.4)</td>
<td>17 (60.7)</td>
</tr>
<tr>
<td>Shape Task</td>
<td>21 (72.4)</td>
<td>13 (46.4)</td>
</tr>
<tr>
<td>Spatial Sense Task</td>
<td>19 (65.5)</td>
<td>18 (64.3)</td>
</tr>
</tbody>
</table>

whereas the control group most preferred the art corner and also highly preferred the book and mathematics corners. The selection of the mathematics corner above other corners was remarkable in the experimental group, as shown in Figure 3. The numbers of children who selected favorite learning corners were significantly different in the experimental group, \( \chi^2 = 27.87, p = .0001 \), whereas in the control group, children did not seem to select a single favorite (ns).

Children's voluntary participation in the four mathematics tasks is shown in Table 1. The percentages of mathematics tasks participated in by the experimental group of children were higher than those of the control group of children in all mathematics tasks. The greatest differences in children's voluntary task selection between the two groups occurred in the shape and classification tasks (see Table 1).

There was a tendency for more children in the experimental group to play in the mathematics corner, \( \chi^2 = 3.25, p < .10 \), and to spend more time in the mathematics corner than the control group, \( t = 1.32, p < .10 \). The amount of time children in the experimental group spent in the mathematics corner increased during the first half of study and decreased thereafter; the number of children playing there increased. The relationship between play time and number of children playing in the mathematics corner was not linear in the experimental group. Perhaps the increased number of children in the mathematics corner led to conflict situations because children had to play together in a small space and share the learning materials with their peers, which may had led them to play there for shorter periods of time.

**Achievement in Mathematics**

The LRT results taken at the beginning of this study showed no significant preexisting differences between the two groups, \( t = 1.47, p = .15 \). After the experiment, the results of the Early Mathematic Achievement Test (EMAT) (Lee, 1995a) also showed no significant differences between the two groups, \( t = .37, p > .71 \).

Children's performance on the mathematics tasks used for qualitative measures of achievement, however, showed significant differences between
Table 2. Mean Play Time and Number of Children in Math Corner in Experimental Group (EG) and Control Group (CG)

<table>
<thead>
<tr>
<th>Week</th>
<th>Play Time (min)</th>
<th>In Math Corner (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EG</td>
<td>CG</td>
</tr>
<tr>
<td>2</td>
<td>9.1</td>
<td>10.9</td>
</tr>
<tr>
<td>3</td>
<td>8.7</td>
<td>8.5</td>
</tr>
<tr>
<td>4</td>
<td>16.7</td>
<td>9.4</td>
</tr>
<tr>
<td>5</td>
<td>13.4</td>
<td>11.3</td>
</tr>
<tr>
<td>6</td>
<td>13.4</td>
<td>11.1</td>
</tr>
<tr>
<td>7</td>
<td>8.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Total</td>
<td>937</td>
<td>722</td>
</tr>
</tbody>
</table>

Table 3. Assessments of Mathematics Achievement in Experimental Group and Control Group

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Pretest LRT</td>
<td>30.03</td>
<td>7.97</td>
</tr>
<tr>
<td>Posttest EMAT</td>
<td>31.68</td>
<td>6.55</td>
</tr>
<tr>
<td>Classification</td>
<td>25.47</td>
<td>13.86</td>
</tr>
<tr>
<td>Number</td>
<td>2.83</td>
<td>0.37</td>
</tr>
<tr>
<td>Shape</td>
<td>11.91</td>
<td>3.86</td>
</tr>
<tr>
<td>Spatial Sense</td>
<td>9.70</td>
<td>2.36</td>
</tr>
</tbody>
</table>

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

the two groups, although it should be noted that not all children selected these free-choice tasks, and so the data are not strictly comparable. The mean number of correct responses made by the children differed in three of the four mathematics tasks given (see Table 3). The mean number of classifications made by the children in the experimental group was significantly higher than that of the control group, \( t = 2.16, p = .04 \), the mean number of number combinations made by the experimental group was significantly more than that of the control group, \( t = 4.34, p = .001 \), and the mean number of shapes made by the experimental group were significantly more than those of the control group as well, \( t = 3.15, p = .004 \). There were no significant group differences in the spatial sense task.

A content analysis of the mathematical tasks completed showed that the percentage of the number combination tasks done successfully by the experimental group of children (85.7) was higher than that of the control group of children (29.4). Unlike the control group of children (0%), more of the experimental group of children used numbers greater than 10 in their number
combination tasks (14.3%). The number most often chosen by the experimental group of children in the number combination task (mode = 8, range = 2-12) was higher than that chosen by control group children (mode = 4, range = 3-8). The kinds of classifications made by the experimental group of children (10 kinds) were more varied than those of the control group of children (4 kinds). The percentage of multiple classifications made by the experimental group of children (82.9) was also higher than that of the control group of children (50.0). The percentage of children from the experimental group who successfully made over 10 shapes (76.2) was more than from the control group (23.1). But there were only minor differences in the percentages of numbers chosen for the spatial sense task.

**DISCUSSION**

This study tested the effectiveness of using children's literature to enhance mathematics learning. Effects on dispositions toward mathematics learning and on mathematics achievement were measured. The main purpose of this study was to confirm that teaching mathematics through children's literature can improve young children's dispositions toward mathematics. To measure disposition toward mathematical learning in this study, identifications of children's favorite corners, the time spent there, the number of children playing in the mathematics corner, and voluntary participation in mathematical tasks were made. The experimental group of children liked the mathematics corner more than any other learning corners. They chose more mathematics tasks than the control group of children, and they spent somewhat more time than the control group in the mathematics corner. Studies have shown that children's literature can act as a catalyst to motivate children to pursue mathematics activities related to the story (Halpern, 1996; Karp, 1994) and that motivation is positively related to cognitive engagement (Pintrich & DeGroot, 1990; Renga & Dalla, 1993). This study provides a clear indication that the disposition to voluntarily pursue mathematics learning can be increased using children's literature.

Another purpose of this study was to investigate the effects on mathematics achievement. Results of the standardized mathematics achievement test (EMAT) indicated that there were no differences in achievement between the experimental group and the control group at the end of the study. This result was not expected because an American study reported a reliable increase on a similar type of mathematics achievement test (Jennings et al., 1992). This discrepancy might be because the children's mathematical learning experiences at home may differ in the two cultures (Stevenson et al., 1985; 1990). Therefore, an investigation was made of the number of children who were regularly doing worksheets at home. In our Korean sample, about 89.7% of the experimental group children and 78.6% of the control group
children completed assigned mathematics worksheets with their parents at home on a daily basis. Because the exercises on the worksheets closely matched items on the test (e.g., counting, computation, identification of shapes), significant differences between the two groups on standardized test items might have been eliminated. A standardized test that does not contain the same kinds of problems found on these worksheets may be required to measure effects on mathematical achievement for Korean children. It is also possible that the mathematics learning produced by using children's literature does not affect the type of mathematics achievement measured by standardized tests.

However, the results of qualitative measures of achievement, using mathematical tasks designed to allow multiple solutions rather than only one right answer, and letting the children decide the criteria for the tasks by themselves, showed that the experimental group of children did better than the control group of children in tasks involving classification, number combination, and shapes. Furthermore, there were notable differences in the results of the content analysis; the experimental group of children tried larger numbers as well as a broader range of numbers in the number combination task, and more multiple classifications in the classification task. Tasks done with larger numbers as well as a broader range of numbers and multiple classification may indicate more advanced thinking on the part of the children in the experimental group. For example, if some children choose "number 3" for the number combination task, these children have to understand the concept of zero in order to make "3" with three number components (see Appendix for a sample of the task), and if they choose a larger number, they have to be able to deal with combinations for larger numbers. The results provide evidence that children achieve higher levels of performance when dealing with problem-solving situations to which they can relate (Davis-Dorsey, Ross, & Morrison, 1991; Good & Brophy, 1987). The results also support the claim that if children voluntarily persist in a learning task with cognitive engagement, we can expect children to learn more effectively. Therefore, the findings from the qualitative analysis support the use of children's literature in mathematics instruction to induce qualitative differences in children's mathematical thinking, although as noted earlier not all children chose to undertake these tasks in either group.

An interview with the teacher involved in this study suggests that this approach could be easily adapted to her ongoing program and that mathematics can be taught with joy to young children. (Detailed interview data are not included in this article.) This study thus suggests that using children's literature to teach mathematics can be very suitable for existing kindergarten programs that are based on play and activity. Furthermore, bringing mathematics and literature together is practical in that it can assist the teacher in integrating the curriculum (Griffiths & Clyne, 1988; Karp,
Teaching mathematics through children's literature can integrate learning experiences because it provides opportunities for children to express mathematical thoughts and to practice using mathematical language related to the situations in the story, helping them bridge the gap between informal oral language and the formal symbolic code of mathematics (Griffiths & Clyne, 1988; Satariano, 1994; Raines & Canady, 1990). There is therefore good reason to develop a variety of mathematics teaching approaches that utilize storybooks in kindergarten classrooms.

Although any conclusions drawn from this study must be tentative because of the small sample size, these findings support the effectiveness of teaching mathematics through children's literature on improving both the disposition to pursue mathematical learning and mathematical thinking. Once such approaches are adapted in kindergarten classes, their long-term effects may be confirmed in future studies.

REFERENCES


APPENDIX

Tasks Used in Qualitative Analysis

1. Classification Task
   Direction: (1) Decorate teddy bears (16) on the tree.
   (2) But, the bears on each side of tree should have common attributes.
   Sample:

   ![Classification Task Example](image)

2. Combination of Numbers Task
   Direction: (1) Choose one number which you want to work.
   (2) Make a specified number using three number components.
   (3) But, each combination of numbers should be different.
   Sample:

   ![Combination of Numbers Task Example](image)
3. Spatial sense (pattern) Task
   Direction: (1) Choose one number which you want to work with.
              (2) Fill in the specified number of small circles with crayon.
              (3) But, make as many different arrangements as you can
                   without repetition.
   Sample:

   4. Shape Task
   Direction: (1) Choose the shape which you want to work with.
              (2) Connect the dots into shapes, either triangles or squares
              (3) Make as many as you can.
   Sample: