THE EFFECTS OF A SPATIAL CONCEPT INSTRUCTIONAL PROGRAM UPON KINDERGARTEN PUPILS' PERFORMANCE ON PAPER-AND-PENCIL, MANIPULATIVE AND ORAL EXPRESSIVE LANGUAGE TASKS

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Chapter 1

RATIONALE OF THE STUDY

Purpose of the Study

The major purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks.

There has been an ever-increasing awareness on the part of some researchers that concept learning should be an integral component of all instructional programs at every educational level. Russell (1956:12) emphasized the importance of concept learning with regard to school experiences when he stated that "the clarity and completeness of a child's concepts are the best measure of his probable success in school learning because meaning is fundamental to such learning". Again, in Directing Reading Maturity as a Cognitive Process, Stauffer (1969:293) stressed the significance of concept development as a component of the reading program:

> Concept development is of primary importance in the teaching of reading as a thinking process because concepts are cognitive structures acquired

> through a complex and genuine act of thought.

Ribovich (1979:288), after examining the research related to concept development and reading instruction, concluded that "clear concepts help individuals think, and it's the thinking student who will get the most from reading". Ribovich emphasized the need for concept teaching in all reading programs if the act of reading was to be meaningful and successful. Therefore it would appear that before a pupil can learn to read with understanding, certain prerequisites should be acquired. However, Boehm (1971:3) cautioned:

> The assumption that children have mastered the basic concepts necessary for understanding and following directions by the time of school entry needs to be questioned.

Therefore, it seemed essential to ascertain whether kindergarten pupils did possess those identified concepts which have been determined to be basic to instruction (Boehm, 1971:3). The implications of this statement were considerable in terms of assessment procedures, which have been designed to determine the pupil's level of concept development, and alternative programs, which have been developed to promote and strengthen concept learning.

When pupils enter grade one they may be expected to perform tasks and follow directions which require spatial concept knowledge. For this reason it was decided to limit the investigation to only certain selected spatial concepts

that kindergarten pupils possess rather than to the quantitative and temporal concepts which had been previously identified by Boehm (1971).

In addition to being able to verify the conceptual level at which the pupil is functioning, the teacher should be able to determine the pupils' efficiency and accuracy in using various response modes, such as paper-and-pencil, manipulative, and oral expressive language. Programming should be based upon realistic results derived from accurate, meaningful, and varied assessment procedures. It would seem that for assessment instruments to be effective they should measure more than a single aspect of a child's concept development.

Theoretical Framework of the Study

The theoretical framework of the study was examined under two separate topics: assessment procedures and programming.

Assessment Procedures

Many researchers have investigated the question, "What is the most effective and efficient method of evaluating the knowledge a pupil possesses?". Wendt (1978:57) stressed the need for consideration to be given to the 'match' between the purposes and the programming for a child, resulting from or related to the assessment. Barrett (1970:84) noted that not all the important readiness factors were measurable with paper-and-pencil tests. Jenkins (1978:452)

reported on the basis of the data that he had accumulated, there was a strong suggestion that a basic assumption underlying standard achievement measures - that they representatively sample different curricula - is largely without support. It would appear that student achievement in a particular curriculum may in no way be reflected by achievement scores. Ideally, it would seem that pre- and post-measures of assessment should be reflective of the curricula which is to be followed throughout the school year. Both materials and teaching methodology should be considered in the examination of assessment instruments.

Boehm (1966) designed a study to describe the development of comparative concepts in primary school children as this development related to variables such as: grade/age, socioeconomic status, intelligence, etc. The Test of Comparative Concepts, measuring eighteen concepts, was constructed to measure the development and knowledge of selected comparative concepts used frequently in primary school curricula. After she had used this testing instrument, Boehm (1966:92) observed:

> With other items, such as those measuring 'in front - behind', a problem was involved in representing a three-dimensional concept with a two-dimensional medium. One may also ask if pupils could respond to the kind of representational drawings used in the test and if failure with this type of item indicated a lack of knowledge of the concept.

This raises concerns about paper-and-pencil testing

as the sole method of evaluating a pupil's conceptual performance level, especially at the kindergarten level. It is true that the educational world is deluged with paper-and-pencil tasks on a daily basis and pupils are expected to perform accurately. Yet, on the other hand, it might be necessary - especially if various features of concept development are to be assessed - to determine whether a pupil does possess and can demonstrate an understanding of a particular concept through a variety of response modes other than paper-and-pencil. Pupils might demonstrate an understanding of a concept by means of the manipulative response mode and/or the oral expressive language response mode. The manipulative response mode is in evidence when the pupil manipulates an object or objects at the oral direction of the teacher. The oral expressive language response mode is in operation when the pupil describes orally to the teacher what occurs when the teacher manipulates the object or objects (See Definitions, Page 13).

Carroll (1964:184) supported this idea of the assessment of concept development through various response modes when he remarked:

> A child who has learned a certain concept - who has learned to recognize certain experiences as being similar - may not necessarily be able to verbalize what attributes make them similar, he may not even be aware of the fact that he has attained a certain concept, since it may be the case that only his behavior - the fact that he makes a certain response to a certain class of

stimuli - indicates that he has formed a concept.

Tversky (1973) investigated whether children, like adults, could encode pictures and names either pictorially or verbally according to task demands. She discovered that preschool children could remember simple pictures, as well as the names for these pictures, but they were much slower than adults to recode previously encoded stimuli when their prior encoding modality turned out to be inappropriate. Beagles-Roos and Greenfield (1979) also noted that the complexity of the instructional task predicted and affected the development of children's performance with two-dimensional pictures. They observed that the younger children had more success with the visual reproduction of the pictures when those pictures were kept relatively simplistic. Newcombe et al (1977), using six-year-olds, nine-year-olds, and young adults as their sample, collected data which indicated there was a correlation between picture recognition improvement and the age of the pupil - at least before the age of nine. Single-object pictures were more easily recognized than multi-object ones, at least by the younger pupils. The authors summarized that single objects might be easier simply because they contained less information for the pupil to process. A paper-and-pencil test might be ineffective, i.e., not supply accurate nor sufficient information, unless the pictorial items in the test are relatively simplistic. Pictorial simplicity should

be one of the criterion used for test evaluation especially for those assessment instruments designed to determine the pre-reading abilities of the young child. These studies lend support to the premise that another mode of testing, other than paper-and-pencil, might be advisable, especially for young children. It would seem inconsistent to measure a pupil's performance on conceptual tasks solely on the basis of a paper-and-pencil test when a large percentage of the activities in many instructional programs, especially at the preschool and kindergarten level, is verbal and/or manipulative in nature.

Blank (1974) in a review of the evidence pertaining to the manner in which language may begin to function in the young child stressed the theme that often experimental tasks did not assess a situation accurately. Indeed, the tasks were either ones in which the child could function effectively with a nonverbal repertoire, or ones that required cognitive demands so complex as to preclude adequate performance by the child. Blank also appeared to advocate a 'match' between the level of development of the child and the tasks incorporated into the assessment instrument.

Similarly Borke (1975) concluded, on the basis of her study with preschool children, that the nature of the task requirement appeared to have a significant effect on the role-taking ability of the children. She stressed (1975:243) that "while young children can recognize pictures

of objects from a fairly early age, they seem to experience considerable difficulty when asked to make the transition from a three-dimensional display to a two-dimensional picture." This study also lends support to the notion that there are various levels of concept development and if an accurate assessment is to be obtained paper-and-pencil testing might need to be augmented with other forms of testing such as manipulative and oral expressive language. The pupil may have difficulty identifying a concept in the two-dimensional pictorial representation but that same pupil might successfully identify the same concept through manipulation of objects and/or through a verbal interpretation.

Meyer's findings (1978) supported the hypothesis that preschool children were more likely than older children to base their memory of a picture upon a verbal label associated with that picture rather than upon the picture itself. However, Fitzgerald (1977:610) cautioned against the assumption that a child who used verbal labels in one area of cognitive functioning would necessarily use them in another area. Again, these writers illustrate the advisability of developing assessment instruments that consist of a variety of concept tasks which draw upon a pupil's multi-cognitive abilities.

Meissner (1978:22) discovered that the five-year-olds and six-year-olds in her sample were able to verbalize an understanding of half of the concepts presented from a set

of spatial-relational concepts. Many of the spatial concepts presented, according to Boehm's norms, were not universally known by kindergarteners, but were known by virtually all second graders. This study demonstrates the significance of verbal testing when assessing a pupil's level of concept development. In today's society there are numerous variables such as: television, nursery school, day-care, parental involvement, etc., which may affect the child's performance on tests.

To conclude, the previously mentioned studies significantly illustrate the need for further exploration into the field of assessment procedures. Current research appears to support the hypothesis that verbal and manipulative test items supply the teacher with meaningful information other than that derived from paper-and-pencil tests.

Programming

At present there has been limited research into instructional programs designed to teach basic spatial concepts.

Meissner (1975) designed a study to determine the effects of age and previous exposure to the identified concepts used in her experiment on the pupils' ability to communicate these concepts. Meissner incorporated ten of Boehm's concepts into the design of her study. Her findings indicated that the comprehension of the identified concepts

was easier for inner-city children than the communication of these same concepts. Meissner stressed the need for more opportunities and practice in oral communication in terms of programs geared for these children. Although Meissner's study was limited to Black inner-city children, there did appear to be definite implications for teachers of all children in terms of oral communication as a component of a concept instructional program and as a measure of concept development level in assessment instruments.

The purpose of Priddle and Rubin's study (1977) was to investigate whether or not spatial relational concepts could be taught to preschool children. Specifically the authors sought to compare the relative effectiveness of movement-oriented versus verbal-visual-oriented spatial relational training programs for preschoolers. The results clearly indicated that, within limits, preschoolers can be taught to improve their understanding of left-right relational concepts (1977:63).

Moers & Harris (1978) examined Boehm's claim that remediation of conceptual deficiencies might improve subsequent school achievement. The authors gathered data for fifty-four pupils who were randomly assigned to one of three treatment conditions (experimental, placebo, control). The results of this study suggested that the instructional program employed might have facilitated school achievement, but the mechanism by which this facilitation occurred was unclear (1978:86). The authors suggested it would be

necessary to isolate various elements in order to determine more accurately why, and if, the instructional program made a significant difference.

The studies described above demonstrate the fact that the worth and the ingredients of an effective concept instructional program require still more examination.

Statement of the Problem

The main purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks. The instructional program consisted of seven concepts identified by means of a teacher survey. Ten nursery, ten kindergarten and ten grade one teachers identified and rated from one-to-fifteen those spatial concepts that they considered most necessary for success in learning. Through a weighted point count and a frequency count the following eight concepts were acknowledged as being important for success in learning: after, beginning, behind, below, forward, nearest, next to, top. The investigator found by means of pre-instruction paper-and-pencil assessment that the majority of children had mastered the concept 'nearest'. Consequently, the instructional program consisted of seven identified spatial concepts: after, beginning, behind, below, forward, next to,

and top.

Four main areas in the field of spatial concepts were examined in this study. They were: 1) assessment procedures for determining the degree to which kindergarten pupils possess certain selected spatial concepts, 2) the effects of a spatial concept instructional program, designed to improve kindergarten pupils' performance on spatial concept tasks, as measured by the Boehm Test of Basic Concepts and an experimental testing instrument, 3) a comparison of kindergarten pupils' performance on spatial concept tasks, as measured by paper-and-pencil, manipulative and oral expressive language tasks, 4) the degree to which paper-and-pencil, manipulative and oral expressive language tasks are related as measures of kindergarten pupils' performance on spatial concept tasks. Each of the aforementioned areas had a main hypothesis stated in the form of a question. They were as follows:

1. What is the relationship between the Boehm Test of Basic Concepts, Forms A and B, and an experimental testing instrument designed to measure kindergarten pupils' performance on spatial concept tasks?

2. What are the effects of a spatial concept instructional program designed to improve kindergarten pupils' performance on spatial concept tasks, as measured by the Boehm Test of Basic Concepts and an experimental testing instrument?

3. What percentage of subjects perform to criteria

on the paper-and-pencil, manipulative, and oral expressive language components of the experimental testing instrument?

4. To what degree do paper-and-pencil, manipulative, and oral expressive language tasks relate as measures of the kindergarten pupils' performance on spatial concept tasks?

Definition of Terms

For the purpose of this study the following definitions were used:

Manipulative Spatial Concept Task

A manipulative spatial concept task was one in which the pupil manipulated the object or objects at the direction of the teacher in order to demonstrate an understanding of the spatial concept. (eg: The teacher says, "Put the marble INSIDE the box." The pupil puts the marble INSIDE the box.)

Oral Expressive Language Spatial Concept Task

An oral expressive language spatial concept task was one in which the pupil orally described what the teacher did, in order to demonstrate an understanding of the spatial concept. (eg: The teacher says, "Do you know what the word INSIDE means? Try and use the word INSIDE in a story about something I will show you." The teacher puts the marble INSIDE the box and the pupil orally describes what was done.)

Concept Mastery

The Boehm Test of Basic Concepts is an assessment

instrument designed to screen a beginning pupil's knowledge of fifty frequently used basic concepts by means of the paper-and-pencil response mode. Mastery of a concept on the Boehm Test of Basic Concepts was measured on the basis of accuracy on the one item designed for each concept. Eight of the fifty Boehm concepts were assessed on the Experimental Testing Instrument. On the Experimental Testing Instrument mastery of a concept was measured on the basis of three response modes: paper-and-pencil tasks (four of five items correct), manipulative tasks (two of three items correct), and oral expressive language tasks (two of three items correct). The eight identified spatial concepts assessed for mastery were as follows: after, beginning, behind, below, forward, nearest, next to, and top.

Design of the Study

The design of the study is illustrated in Figure 1.1.

Limitations of the Study

There were some limitations to this study.

1. The size of the sample completing each individual test was small. There were initially a total of one hundred and thirty-one pupils, twenty-six in each of the conditions with the exception of Condition One. Consequently there were limitations as to how many students could be procurred.

2. All the kindergarten pupils in this study had attended two schools of close proximity within the same school

Condition 1	Pre-test Boehm Test of Basic Concepts Form A (paper-and-pencil)	Spatial Concept Instructional Program	Post-test Boehm Test of Basic Concepts Form B (paper-and-pencil)
Condition 2	Experimental Testing Instrument (paper-and-pencil, manipulative, and oral expressive language)	_____	_____
Condition 3	_____	Spatial Concept Instructional Program	Experimental Testing Instrument (paper-and-pencil, manipulative, and oral expressive language)
Condition 4	_____	_____	Experimental Testing Instrument (paper-and-pencil, manipulative, and oral expressive language
Condition 5	Pre-test Boehm Test of Basic Concepts Form A (paper-and-pencil)	_____	Post-test Boehm Test of Basic Concepts Form B (paper-and-pencil)

Figure 1.1
Design of the Study

division. If some of the pupils had attended an urban school while others had attended a rural school, the findings might have been generalized to a larger population.

3. The Experimental Testing Instrument assessed only eight identified concepts. This was a limitation in that the findings pertained to only one aspect of the kindergarten pupils' concept development.

4. The length of treatment (seven teaching sessions) was a limitation in that it was confined to a short period of time and no provisions were made for assessing long-term retention of the identified spatial concepts.

5. All the pupils in the study were of kindergarten age. Consequently, this study did not provide the opportunity for cross-age comparisons.

However, this study was designed to control for the following:

1. The design of the study ensured that no one group might benefit from the practice effect of testing sessions.

2. The time of day when the teaching sessions occurred was controlled through the randomization of the instructional groups when possible.

3. The effect of the normal maturation of the kindergarten pupil was taken into account by the presence of Condition Two and Condition Four in the design of this study (See Design of the Study, Page 15).

4. The pupils in the study had the opportunity to

meet the investigator before the testing sessions began.

5. The testing and instructional sessions were conducted by the investigator and were structured carefully to be similar.

6. In the Experimental Testing Instrument the order of presentation for the three components: paper-and-pencil tasks, manipulative tasks, and oral expressive language tasks was randomized.

Overview of the Study

This study was designed to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks. Chapter 1 has outlined the purpose and rationale of the study, presented some operational definitions and limitations of the study. A review of the research pertaining to the problem is found in Chapter 2. Chapter 3 presents the experimental design, description of the procedures and the statistical analyses used. In Chapter 4 data are summarized, results of the statistical tests are reported and the findings are discussed. Chapter 5 includes a summary of the procedures used, conclusions drawn from the findings and implications for research and instruction.

Chapter 2

REVIEW OF THE RELATED LITERATURE

Introduction

The major purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks.

Throughout the years there has been extensive research conducted in the area of concept development. However, the interpretation of the results of many research studies in concept development has led seldom to definitive conclusions which would benefit the classroom teacher. Vinacke (1951:1) attempted to rationalize this problem of lack of practical application in research findings pertaining to concept development.

> Despite the fact that concept formation has been the subject of numerous investigations, it is still poorly understood. The reasons for this lie apparently in two directions. First, the evolution of psychology has not gone far enough to free the treatment of concept formation from its past associations with epistemology and formal logic. Thus terms like 'abstraction' and 'generalization' are still utilized - and still influence the nature of experiments - without sufficient analysis of the behavioral

> and genetic processes involved. Second, the data utilized in discussion of the subject are much too narrow since they are usually drawn from limited experimental situations and usually emphasize simple readily quantifiable overt responses ...

Vinacke (1951:1) further explained the difficulty in formulating definite premises pertaining to concept development when he stated that "the methods of investigation have usually been restrained in scope and have lent themselves better to showing the results of concept formation than revealing its nature." While these statements were printed nearly thirty years ago, there still remains an element of truth in these comments when applied to subsequent research. Still, concept development is viewed most often from a psychological viewpoint and many research studies have limited the conclusions to the concepts the child possesses, rather than to the methodology which enabled the child to acquire the concept being taught.

The literature reviewed in this chapter pertains to the relationship of concept development and the following variables: age/grade, socioeconomic/sociocultural factors, intelligence/academic achievement of the pupil, sex of the pupil, language acquisition, beginning reading, and learning conditions.

Throughout the study the terms "concept development" and "concept formation" will be used synonymously.

Concept Development and Age/Grade

Considerable research has been implemented to determine

the correlation, if any, between concept development and the age of the pupil. Flavell (1963:20) reported that "Piaget readily admits that all manner of variables may affect the chronological age at which a given stage of functioning is dominant in a given child: intelligence, previous experience, the cultural milieu in which the child operates." Piaget cautioned against an over-literal identification of stage with age and asserted that his own findings provided only rough estimates at best of the mean ages at which various stages are achieved in the cultural environment from which the subjects were drawn. Although Piaget did recognize a positive correlation between the age of the child and conceptual learning, he warned against too rigid an adherence to the stages of conceptual development with regards to age.

Larsen (1977:1160) noted that "Piaget's theory has been extremely influential, at the same time his methods have been strongly criticized as not being well enough defined and standardized to provide data." However, the purpose of Dodwell's study (1963) was to assess the generality of the sorts of spatial concepts in operation and their development, as reported by Piaget and his co-workers, and to examine age trends. His study, with a sample of nearly two hundred pupils between the ages of five and eleven, demonstrated that the types of thinking and problem-solving described by Piaget for children between these ages occurred quite generally. The over-all ability to deal correctly with spatial concepts improved with age,

but no clear-cut progression from one type of thinking about space to another could be identified. Yet, Dodwell's research (1963), which consisted of a substantial sample, did support Piaget's claims with regards to age and concept development.

Again, Boehm (1966), Bruner & Olver (1965), Denny & Moulton (1976), Faw & Wingard (1977), Friedenberg & Olson (1977), and Meissner (1975, 1978) concluded that the age of the pupil may have a bearing upon the child's concept development.

Boehm (1966) examined children's concept development in relation to age/grade. She selected grade rather than age as her major frame of reference because grade was representative of the divisions found within the school structure. She designed a testing instrument for the purpose of measuring the development of eighteen concepts which she believed played a prominent role in the curricula of the primary school child. Boehm's findings, based on data collected from 1286 pupils in grades kindergarten to three, indicated that the total concept scores increased with grade, with the greatest gains occurring between the end of kindergarten and the end of grade one. This research lent support to Piaget's claim (Flavell, 1963:20) that age is related positively to concept development.

Bruner & Olver (1965) undertook an experiment which was designed to measure the manner in which their subjects of various grade groupings, one, four, and six, imposed a

similarity transformation on a set of verbally presented materials and the manner in which this transformation was conserved or altered in the face of difficulties. The authors discovered that there was a correlation between the pupil's age and the level of concept development. Bruner & Olver observed that there was a definite difference between the functioning on the prescribed tasks by the younger children and by the older children. They elaborated upon this difference by stressing that "in a word then, what distinguishes the young child from the older child is the fact that the young one is more complicated than the older one, not the reverse" (1965:426). A younger child is unable to utilize grouping strategies, such as chunking information into a simplified form, to the same extent as an older child. The younger child cannot encode information, in a manner that might reduce cognitive complexity, as well as the older child. Bruner and Olver noted that between the ages of six and twelve, as the child is emerging from the final stages of pre-operational thought and advancing to well-structured and formal operations, there was a steady change in behavior. There appeared to be a continual increase in the use of general superordinate concepts, i.e., those concepts occurring when items were grouped on the basis of one or more attributes common to them all with age. Conversely, the complex groupings, i.e., those concepts occurring when the subject used selective attributes of the array without subordinating the entire array to any one attribute or set of

attributes, decreased with age (1966:420).

Meissner's study (1975) was designed to determine the effects of age and previous exposure to the identified concepts used in the experiment on the pupils' ability to communicate these same concepts. She incorporated into her study, ten of the Boehm concepts: at the top, through, next to, second, most, half, behind, in a row, medium-size, and the center of. Results indicated that there was a correlation between the age of the pupil and the pupils' ability to demonstrate, through oral communication, an understanding of the identified concepts. Meissner noted that on the comprehension task, that was the paper-and-pencil task, pupils of all ages did well. Meissner indicated that perhaps the reason for this was the fact that the concepts examined in this study were already easily comprehended by the majority of the subjects (1975:11). The main implication of Meissner's study appeared to be the need for more opportunities and practise in oral communication on topics of interest for children of all ages. Emphasis was placed upon the fact that pupils should spend more class-time verbalizing their understanding of concepts to both teachers and peers. On the other hand, Lewis (1970:273) cautioned:

> Yet, while verbalization plays an integral part in concept attainment, it must not be the sole criterion for determining whether a student has learned a concept. Understanding should not be equated with a verbal response - particularly a response such as a definition of a term.

While Meissner limited her study to black inner-city children

there appear to be definite implications for all inner-city children and perhaps for other children as well.

Meissner (1978) attempted to bridge the gap between more formal communication tasks, on which developmental differences had been found (Meissner, 1975), and simpler tasks, on which young children performed very well. The tasks consisted of the same relational concepts and similar arrangements of toy objects that were used in her previous study (Meissner, 1975). Of fourteen items presented to the subjects, the kindergarten group verbalized a mean of half the items correctly and the second graders just over three quarters. Both the kindergarteners and the second graders performed well on the standard clues tasks. Standard clue tasks were defined as those tasks designed by the experimenter and presented to the subjects. Half of the standard clue tasks contained an adequate description of the object to be selected and half did not. The second graders were significantly more accurate in adequately verbalizing an understanding of the concepts identified for this study (1978:21). Subjects of both age groups performed almost perfectly in evaluating their own pupil-initiated good clues. Pupil clues were evaluated on the basis of the amount of necessary information they contained. If a pupil-clue contained sufficient information to enable the pupil to select the accurate object, that clue was considered 'good'. On the other hand, if the pupil-clue contained insufficient information, it was judged as 'poor'. Kindergarteners

responded correctly to 96 percent of their good clues; whereas, second graders responded correctly to 97 percent. This was not a significant difference. Meissner concluded that there was improvement with age on referential communication tasks. The study also supported the hypothesis that younger children can perform quite well on some communication tasks. Meissner (1978:22) observed:

> The five- and six-year-olds in the present study were able to verbalize correctly an understanding of half of the concepts presented from a set of spatial-relational concepts. Many of these, according to Boehm's norms, were not universally known by kindergarteners but were known by virtually all second graders.

Consequently, Meissner's (1978) study supported the premise that age and conceptual development are related to some degree. However, the author cautioned that no arbitrary linkage between a specific concept being developed and mastered by a specific age, could be established. Thus, it would appear that concept development had to be assessed continually with pupils of all ages.

Denny & Moulton (1976) investigated the classification behaviours of pre-school children using a picture-pairing instrument. They also examined whether a complementary-similarity shift preceded the concrete-abstract shift in conceptual preferences already observed in children beyond the age of five years. The subjects in this study ranged in age from three to nine. The pattern of significant differences between age groups indicated a distinct developmental sequence

in which complementary, perceptible, functional and then nominal conceptual preferences each increased in turn. Functional concepts, i.e., - 'Birds and airplanes can fly', increased significantly between the ages of four and five. Nominal concepts, i.e., 'Dogs and cats are both animals', showed a significant increase only between the ages of five and nine. Denny & Moulton's (1976) research has value for the classroom teacher and researcher alike in that it related age to certain levels of conceptual development. After examining this research, a teacher may have a more realistic expectation with regards to a 'match' between the age of the pupil and conceptual preference.

The results of an experiment by Friedenberg and Olson (1977), in which children's comprehension of descriptions of two vertically arranged objects were examined, demonstrated that there was a significant main effect for age. The older children made fewer errors than the younger children. In this study the following terms were investigated: above, below, higher than, lower than, rising away from, and falling away from. There were sixty-six pre-school and grade-school children, ranging in age from two-and-a-half-years to six-and-a-half-years in this study. There was a significant interaction of the age of the pupils with the direction in which the objects were arranged. For all the pairs of terms the youngest children appeared to understand the upward terms better than they did the downward terms. The difference in the understanding of upward and downward terms was less

pronounced as the pupils increased in age.

Faw and Wingard (1977), in a study designed to examine the relationship of cognitive development, incongruity and patterns of visual selection, observed that "three-year-olds failed to use spontaneously the animation dimension in performing a sorting task whereas the four-and eight-year-olds did use that dimension" (1977:140). Although both the four-year-olds and the seven-to nine-year-olds exhibited differentiating patterns of visual selection to the two levels of incongruity, the relation between the selection pattern and the level of incongruity were significantly different for the two groups. The authors hypothesized that the four-year-olds, who may have only recently begun using the conceptual distinction between animate and inanimate objects in non-linguistic tasks, avoided the more extreme incongruous stimuli. The more experienced older children sought out all levels of incongruity to clarify them (1977:141). This study has implications for the classroom teacher in terms of analyzing the pupil's choice in sorting objects that belong together. On the basis of the conclusions presented in this study, one might surmise that older pupils have had the time and perhaps the opportunity, to recognize similarities even in contradictory stimuli.

Clark, E. (1971), Coker (1978), and Cox (1979) explored the relationship between the acquisition order of particular verbal concepts and the age of the child. Coker (1978) investigated the manner in which the syntactic

variables and the task requirement variables interact with and affect the child's interpretation of 'before' and 'after'. Coker put forth the premise that sentences which preserve the actual order of events are easier than those which reverse the order of events. Another hypothesis was that performance was better on the 'before' sentences than on the 'after' sentences. Wilcoxon matched-pairs test was administered on the correct answers for three tasks, two prepositional and one subordinate. The first grade pupils performed better than the kindergarteners on all three tasks. There did not appear to be a fixed acquisition order for 'before' and 'after'. In addition, sentences which preserved the actual order of events were easier for all pupils, regardless of age, than sentences which reversed the order of events.

Clark, E. (1971) explored the acquisition of the meaning of a pair of relational terms by determining exactly how the child's interpretations differed from the adults at different stages (1971:266). Forty children, ranging in age from three-years to five-years, were tested individually on two tasks, a production task and a comprehension task. The results first demonstrated the fact that children understood 'before' and 'after' better as they became older (1971:268). The four age groups differed significantly from each other on the comprehension task, i.e., the examiner asked the children to carry out instructions pertaining to 'before' and 'after'. There was a high negative correlation

(-.78) between the ages of the subjects and the number of errors made (1971:272). Finally, the results indicated that there does not seem to be a fixed acquisition order for 'before' and 'after'.

Cox (1979) was concerned with the order of acquisition of the two expressions 'in front of' and 'behind'. She determined that "whereas the youngest children made a variety of placements with the ball; older children mostly made a 'correct' or 'opposite' placement and the other placements declined" (1979:373). However, by the age of four, children appeared to understand that 'in front of' and 'behind' refer to the horizontal-frontal dimension. Although their placements might not have been accurate, they were at least restricted to the horizontal-frontal dimension. The results appeared to demonstrate that "although four-year-olds may have understood the specific meaning of one of the terms and they were uncertain about the other, they did realize that the two terms referred to the same dimension in space" (1979:374). In this study, the concept 'behind' was acquired earlier than 'in front of'.

Two of the three aforementioned studies (Clark, E., 1971, and Coker, 1978) demonstrated that although there was a relationship between the acquisition of certain antonymic pairs of concepts and the age of the pupil, there was little evidence to suggest that one specific member of the antonymic pair was acquired first.

Eliot (1966) and Turgeon & Hill (1977) determined on

the basis of their studies that the age of the pupil had little bearing upon the pupil's conceptual development.

Eliot (1966) undertook a study to determine if children's performance on spatial tasks would show sequential development. On the basis of his research, Eliot noted that the kindergarten pupils mastered the spatial concept task requirements as well as the third grade pupils. Eliot conjectured that the inconsistency between his findings and previously mentioned research might be attributed to the complexity of the measurement device, a landscape instrument, used in this particular study. The test required children to indicate where around the four sides of a raised landscape a series of twelve pictures were taken. The test may have been too complex for all the subjects regardless of age, and consequently, there was no differentiation of scores at the various age levels.

Turgeon and Hill (1977) observed that "the ability to use concepts to mediate solution of problems does not automatically change with age, although the content and articulation of conceptual categories does" (1977:114). The aurhors (1977:115) further noted:

> When the level of concept availability was ascertained at each age level, both very young children and adults exhibited a high level of conceptual organization for easily available category sets and a low level of conceptual organization when category sets were unavailable.

These findings suggested that young children follow a pattern similar to adults in organizing stimulus input and that the types of and quality of the category sets have a direct bearing upon concept attainment for both the young and the old.

To conclude, Klausmeier et al (1974:187) summarized the results of studies pertaining to concept development and concluded that performance on concept-attainment tasks improved as a function of age. However, it is most difficult to delineate specific, meaningful conclusions with regards to the relationship of conceptual development to age, on the basis of the aforementioned studies. It does appear that there is a relationship between age and concept development (Boehm, 1966), and that there is a sequential hierarchy of conceptual awareness through which children progress (Bruner & Olver, 1965, and Denny & Moulton, 1976). Still, it is impossible to state decisively that by a particular age, a child will be able to demonstrate a clear understanding of concepts through the manipulation of objects, the performance on paper-and-pencil tasks, and/or the accurate verbalization of oral language tasks. Children appeared to understand particular verbal concepts at various ages (Clark, E., 1971, Cox, 1979, and Friedenberg & Olson, 1977). Perhaps if variables such as: socioeconomic factors, emotional stability, motivation, learning style, teaching methodology, testing instrument, etc., could be isolated then a more definite link between age and concept development might be

established.

Concept Development and Socioeconomic/ Sociocultural Factors

Recently researchers have attempted to investigate the effects of socioeconomic/sociocultural factors upon the child's level of concept development. Boehm (1971) stressed the necessity of assessing the child's functioning level of concept development at the time of school entry. She cautioned against the assumption that pupils possess certain concepts and can manipulate effectively these same concepts in a manner which would enable success in early learning. Consequently, the studies detailed below are of significance when one considers whether socioeconomic/sociocultural factors influence the child's concept development.

The studies of Boehm (1966), Dixon & Saltz (1977), Downing et al (1977), Houck et al (1973), and Nazarro & Nazarro (1973) indicated that the socioeconomic/sociocultural status of the pupil had a direct bearing upon the pupil's conceptual development.

In Boehm's study (1966), exploring the development of comparative concepts in primary school children, the socioeconomic status of the child, as estimated by father's occupation and race, was related to performance on the Test of Comparative Concepts. The mean total scores at the end of grade three for pupils with fathers from the lowest occupational levels were similar to the mean total scores at the end of kindergarten for the pupils from the highest

occupational levels. Boehm also discovered that the pupils from the lowest occupational levels also appeared to reach a plateau in mean scores at the end of grade two, with little further improvement by the end of grade three (1966:85). Boehm cautioned that the variable of socioeconomic or sociocultural status may be affected by other variables such as intelligence, absenteeism, etc.

Downing et al (1977) conducted a study to determine if children from schools in higher socioeconomic neighborhoods would have significantly better developed concepts of language than children in schools where the socioeconomic status was lower. At initial testing, kindergarten children in the high socioeconomic schools had significantly superior scores to those obtained by children in either middle or low socioeconomic schools, on three cognitive tests: "Orientation to Literacy", "Understanding Literacy Behavior", and "Technical Language of Literacy". After half a year's kindergarten experience these differences disappeared on two of the above-mentioned cognitive tests but not on the third, though the degree of difference was much reduced. The authors concluded (1970:279):

> For each cognitive test, main effects due to socioeconomic level and test/retest factors were obtained which were beyond the .001 level of significance. Significant interactions between socioeconomic level and test/retest factors were also found for each cognitive test ($p < .001$).

Nazarro & Nazarro (1973) discovered in their research, made up of a sample of forty-eight second grade pupils, that

there were learning differences between low- and high-socioeconomic populations. These differences were observed even though all the pupils had Kuhlmann-Anderson I.Q. scores between ninety and one hundred ten. The authors noted that there was a closer relationship between performance on associative tasks and performance on conceptual tasks for the high socioeconomic children than for the low socioeconomic populations. Nazarro & Nazarro (1973) determined that in spite of the homogeneity of the subjects, as measured by group test scores, significant differences in learning occurred. The authors emphasized that, "the implications of these findings suggest a need for closer examination of the ways in which concepts are presented to children in the primary grades" (1973:344).

In the Houck et al (1973) study, a comparison was made between the urban derived reliabilities of the Boehm Test of Basic Concepts (1971), with the results obtained from rural subjects. The kindergarten and grade one pupils were categorized into sociocultural groupings according to the father's occupation and his level of educational attainment. Houck et al (1973) identified that the Boehm Test of Basic Concepts appeared to be a potentially useful instrument for the diagnosis of basic conceptual knowledge. The authors warned (1973:26): "However, because of the large discrepancies in reliability estimates caution must be exercised when this test is used to assess rural children." This study has implications for teachers and test

administrators in that there is some indication that one should examine the effectiveness of any testing instrument in terms of the population to whom it is to be administered.

Dixon & Saltz (1977) were concerned with the issue that the lower socioeconomic status children had a representational deficit which would indicate that they would have difficulty learning concepts unless the stimulus materials were very concrete. The subjects, first and third grade children, were randomly selected from homes in which the occupation of the main wage-owner (almost always the father) was judged as involving object manipulation (as opposed to symbol manipulation). Children from both grades were randomly assigned to either the high-imagery or low-imagery conditions. The high-imagery condition consisted of instances and non-instances of a concept using two-dimensional line drawings. The low-imagery condition consisted of verbal labels of the objects depicted in the high-imagery condition. The functional concepts to be learned were toys and containers, the perceptual concepts were round things. There was no evidence of a representational deficit for children in grades one or three. On the set of functional concepts, the group of lower-socioeconomic children in this study performed better on the low-imagery verbal labels than on the high-imagery pictorial stimuli. The authors suggested that perhaps to have significance, the sample would have to include pupils of even a lower socioeconomic status than those represented in their study.

The results of this research supported Boehm's (1971) premise that one should never make assumptions concerning the 'match' between a pupil's concept development and socioeconomic/ sociocultural status.

Pishkin and Willis (1974) further emphasized that socioeconomic class did not appear to be a significant factor related to the pupil's concept development. Male and female children between the ages of six and eight, from middle and lower socioeconomic classes, performed on a concept identification task-classification according to form (1974:89). The authors hypothesized that the inconsistency between their findings and some of those previously described might be attributed to the nature of the task requirement outlined in their experiment.

In conclusion, the research described in this section of the chapter appears to indicate that the concept development of the pupil is to some degree related to socioeconomic/ sociocultural background. The implication of the previously noted studies for the classroom teacher is the necessity for, at the very least, awareness of the pupil's socioeconomic/ sociocultural status when assessing the level of concept development. Educators should realize that children from a lower socioeconomic status may not possess the necessary pre-requisites for success in early school learning. On the other hand, teachers should never assume that because a pupil comes from a lower socioeconomic/sociocultural environment, the necessary concepts are not present in the pupil's

background of knowledge. Today's child may acquire some of the necessary concepts for successful learning through television viewing, interacting with peers, etc. It would appear essential that the teacher ascertain every child's level of conceptual development upon school entry and at various later stages of learning.

Concept Development and Intelligence/Academic Achievement

The relationship between concept development and the intelligence and/or academic achievement of the pupil should be explored when one investigates the various facets of concept learning. The importance of intellectual ability in the field of concept acquisition was emphasized by Vinacke (1951:14) when he stressed that intelligence was as important a factor as chronological age in concept development. Researchers such as Boehm (1966), Klausmeier et al (1974), Piland and Lemke (1971), and Steinbauer & Heller (1978), investigated the importance of intelligence and/or academic achievement as they pertain to concept development.

On the basis of the data she collected, Boehm (1966) inferred that the I.Q., race, and socioeconomic status variables were all related to test performance (the Test of Comparative Concepts). However, the nature of these relationships were complicated by the relationship of each of these variables to each other. In the Boehm study, a positive relationship between intelligence and the test scores was

suggested, with pupils at the highest ranges of intelligence obtaining higher mean total scores on the Test of Comparative Concepts than pupils at the lowest ranges of intelligence (1966:87). However, Boehm was very guarded in her interpretation of the data in terms of intellectual development and concept attainment because of the measurement instrument she used in her study.

Piland and Lemke (1971) undertook an experiment to determine whether heterogeneous or homogeneous groupings, studied under laboratory conditions in which internal validity was rigorously controlled, would provide a condition for more efficient concept learning. The subjects were classified by intelligence scores attained on the Kuhlmann-Anderson Test, as either high (109 or above), medium (96-103), or low (90 or below) and then were randomly assigned to homogeneous training conditions within each school, based on I.Q. scores. Piland and Lemke (1971) observed that no statistical significance could be found among the main or interaction effects with the exception of the stratifying variable (intelligence). On the basis of Piland and Lemke's research, one might conclude that intelligence was a significant factor when examining concept development. The teaching situation, be it homogeneous or heterogeneous, appeared to have had very little effect on the pupils' concept development. The implication of this statement for educators might be the need to examine all aspects of a child's learning styles, not merely the intellectual development, before

implementing programs.

The purpose of a study designed by Steinbauer and Heller (1978) was to investigate further whether a positive correlation existed between performance on the Boehm Test of Basic Concepts and later academic success. Their subjects were second and third graders who had taken the Boehm Test of Basic Concepts when they were kindergarten pupils. Steinbauer and Heller (1978) identified that the Boehm Test of Basic Concepts predicted academic achievement in such subjects as: Paragraph Meaning, Spelling, Word Study Skills, Language, Arithmetic Concepts and Arithmetic Computation in grades two and three respectively. However, because this study was limited to pupils who came from upper-middle to upper class, a generalization could not be made to all pupils. The study did confirm, within the previously stated limits, that there was a positive correlation between the Boehm Test of Basic Concepts and academic achievement. Indeed, if the pupil possessed the basic concepts identified on the Boehm Test of Basic Concepts (1971), there seemed to be a good indication that he or she would succeed in the aforementioned academic skills. This study demonstrated the value, and indeed the necessity, of identifying the concepts that kindergarten children do not possess and of teaching those concepts through various instructional procedures. The findings did support the premise that early identification of those children lacking concept mastery and early intervention in this area might give each child a better

opportunity to succeed in later school years.

Keating and Bobbitt (1978:155) noted that one of the recurrent findings permeating the literature of developmental and differential psychology was that individual performance on a variety of cognitive tasks is likely to be positively correlated. The authors explained that some individuals simply may process basic information, such as conceptual understanding, more rapidly and efficiently than other individuals. The authors found that individuals may exhibit different learning strategies which they use in problem-solving situations. These individual differences may contribute some variance in performance on cognitive tasks, such as concept acquisition.

It is difficult to draw any definite conclusions with regards to the relationship between intelligence and/or academic achievement and concept development on the basis of the research previously quoted. There appeared to be a positive relationship between intelligence and concept development. Klausmeier et al (1974:187) concluded, after summarizing the existing research, that "almost invariably a strong, positive relationship is noted between achievement level and concept development". The authors hypothesized that this positive relationship, i.e., the superior concept mastery shown by high-achieving pupils, might be attributed in part to the fact that they were more likely to have discriminated and named the attributes. Literature pertaining to the relationship between concept development and the

intelligence and/or academic functioning of the child, illustrates the advisability on the part of the educator of being aware of intervening variables, such as motivation, emotional stability, sociocultural background, testing instruments, etc., which might affect the pupils' intellectual performance and/or academic functioning. Further studies, for the purpose of assessing the relationship between concept development and intellectual and/or academic achievement, might be conducted with every attempt being made to isolate those intervening variables.

Concept Development and the Sex of the Pupil

A limited number of research studies pertaining to the investigation of the relationship between the sex of the pupil and the level of concept development could be located. Archer (1965), Boehm (1966), Bruner and Olver (1966), Friedman & Seely (1976), Meissner (1975), and Pishkin & Willis (1974), all examined the connection between the sex of the pupil and concept development.

Boehm (1966) concluded that there was no difference in the performance of pupils of either sex on the mean scores on the Test of Comparative Concepts (1966). Friedman and Seely (1976:1105) stated that sex was never a significant main effect in their study. Indeed, the data related to the sex of the pupils reached convention levels of significance in only four out of a possible forty-nine interactions. There

were occasional differences noted between the sexes on specific spatial or temporal tasks. Meissner (1975), in her study, observed that there were no significant sex differences, either overall or by grade, in the comprehension of the ten relational concepts, - at the top, through, next to, second, most, half, behind, in a row, medium-size, the centre of.

However, Bruner & Olver (1965), in an experiment designed to measure the manner in which subjects of different ages imposed a similarity transformation on a set of verbally presented materials and the way in which this transformation was conserved or altered, noted that the results for males were striking. First grade girls were at about the same level as fourth grade boys, in their use of superordinate concepts, i.e., those concepts occurring when items were grouped on the basis of one or more attributes common to them all. However, by the sixth grade both boys and girls appeared to be functioning at the same level. Teachers who acknowledge this facet of boys' conceptual development might ensure that boys have an ample opportunity to verbalize and explain the rationale behind their conceptualizations.

Pishkin & Willis (1974) compared the male and female kindergarten, first and second grade children in a concept identification task. The authors discovered that middle-class males were superior to middle-class females in terms of their ability to recognize concepts. Indeed, kindergarten females demonstrated a deficit in concept identification when compared to their male counterparts. Again, the perceptive

teacher who is cognizant of this deficit in kindergarten females might augment existing programs.

Archer (1965) reported that males found tasks, in which shape was a relevant attribute, easier than tasks in which form was irrelevant. The two shapes used in the study were square and parallelogram. The opposite effect was obtained for females, i.e., the task was easier when shape was irrelevant and some other attribute was dominant.

To conclude, it would appear, on the basis of the limited number of research studies dealing with the relationship between the sex of the pupil and the level of concept development and the inconsistency of the findings outlined within those studies, that further investigation needs to be conducted before any definitive statement might be made.

Concept Development and Language Acquisition

Researchers, such as Clark, E. (1971), Coker (1978), Cox (1979), Friedenberg & Olson (1977), and Kuczaj and Maratsos (1975), for many years have been aware of and have explored the relationship between concept development and the acquisition of language. Carroll (1964:186) emphasized the importance of the role that language plays in the pupil's level of concept development when he stated that "the connection between a word and the concept or experience with which it stands in relation must work in either direction: the word must evoke the concept and the concept must evoke

the word." Clark, E. (1973:110) further stressed the function of language in the child's communication of the understanding of concepts when she declared that "language, after all, is what provides the child with a means of encoding and communicating his percepts about the world around him."

Nelson (1974) pondered the question, "What is the relation between the young child's acquisition of conceptual knowledge, learning of words, and production of first sentences?" After some deliberation, she arrived at the following answer (1974:267):

> The answer to this question is obscured both by inappropriate psychological models of concept learning and by an inadequate understanding of the young child's cognitive structure and processes.

Indeed, Palermo & Malfise (1972) investigated the acquisition of a child's language after four years of age with the purpose of discovering any important developmental changes that might occur. The authors concluded, on the basis of their examination of the existing literature, that after four-years-of-age, significant advances in language still occurred. Palermo & Malfise (1972:409) noted: "A review of the literature indicates that the five-year-old is far from having the equivalent of an adult native speaker's facility with the language". They further cautioned (1972:427): "First there are rather clear indications that language development is far from complete when the child reaches his fifth birthday". The authors interpreted this evidence as an indication that phonological structure and semantic levels

of analysis are intimately interrelated and that language advances appear to be correlated with developmental periods of cognitive advance. Teachers should recognize that when a pupil enters kindergarten very often the oral expressive language production will not be of adult standards. Programming should be geared to provide ample language opportunities through the use of a variety of stimuli.

E. Clark (1973) asked the question, "What does the child learn about the meanings of words as he goes through the process of acquiring his or her first language?". Clark examined the language patterns of numerous young children and observed that when the child does begin to use identifiable words, he does not know their full (adult) meaning. The young child has only a partial meaning for some words in his or her vocabulary. This partial meaning will correspond only in some limited manner to some aspect of the word found in the adult's vocabulary. Thus, a child would begin by identifying the meaning of a word with only one or two features rather than the whole combination of meaning components or features that are used criterially by the adult. Therefore, Clark concluded (1973:72) that the child's use and interpretation of words may differ considerably from the adults' use of the same words, especially in the early stages of language acquisition but over time, the child's language will come to correspond to the adult model. Teachers should realize that a pupil's language, especially in the area of concept development, may not be a 'match' with

the language of the teacher. The teacher's use of a verbal concept might be inconsistent with the image conjured up in the mind of the child. However, if the child is provided with ample opportunity to use language and listen to models of language, there will gradually come a 'match' between the language of the pupil and the language of the teacher.

Wallace (1965) reported on a study carried out by Ervin and Foster (1960), which was conducted for the purpose of determining children's ability to make appropriate semantic differentiations among dissimilar but related concepts. The findings of this study indicated that children's ability to make appropriate semantic differentiations apparently depended upon the extent of the relationship between the concepts in the child's experiences. Dimensions such as size, weight and strength, and social attributes such as those described by the words, good, pretty, etc., which are learned as variables long before the child can clearly differentiate them, remain very difficult for him to keep semantically distinct. Ervin & Foster (as reported in Wallace, 1965), suggested that conceptual structures growing out of early empirical experiences influence the entire course of subsequent language development. The data collected in the Ervin and Foster study emphasized the need for teachers to evaluate the concepts that the child possesses and on the basis of the information gained to implement appropriate programming.

Hollenberg (1970:1004) explored the role of visual imagery in the learning of language. She defined the visual image as "a picture in the mind's eye," which preserves perceptual experience for utilization at a later time. The task, used in this study, required both the learning of the names of objects and the attainment of concepts underlying the application of a given name to a series of perceptually dissimilar objects. The results of this investigation pointed clearly to a contrast of learning styles between children with a strong tendency to think in visual images and children who were weak in images. Hollenberg noted the implication of this difference for teachers with regards to programming (1970:1014):

> "The differences in the high- and low-imagery children, with their two modes of thought, appeared to be most marked in the earliest grades of school, with each imagery group apparently developing ways to compensate for its deficiencies at successive grade levels. The fact that there are such divergencies in modes of learning at the beginning of formal schooling may have important practical implications for teaching."

Hollenberg's findings lend support to the hypothesis that teachers should ascertain the learning style which the pupil finds most effective for acquiring concepts. Hollenberg's study demonstrated the necessity of continually assessing to determine if there is an adequate 'match' between the instructional procedures of the teacher and the learning style of the pupil.

Cox (1979), as a result of an experiment to determine

the order of the acquisition of two expressions 'in front of' and 'behind', concluded that there was no evidence to support the hypothesis that children interpret one antonym in the same way as the other. "The present study identified that although four-year-olds had understood the specific meaning of one of the terms and they were uncertain about the other, they do realize that the two terms refer to the same dimension in space" (1979:374). The author noted that whereas the youngest children made a variety of placements older children mostly made a correct or opposite placement and the other placements declined. In this study consensus about the meaning of 'behind' was achieved earlier than agreement on the meaning of 'in front of'.

Kuczaj and Maratsos (1975) posed several questions with regards to the lexical items 'front', 'back', and 'side'. In their study each subject was given the following tasks: self-referent (where the pupil places the object in front of, in back of, or at the side of himself), and touch tasks (where the pupil is asked to touch the front of, back of, or side of an object). The investigators discovered that there was no difference between 'the front of' and 'back of' responses. The data consistently demonstrated that children knew their own fronts and backs before they knew the fronts and backs of other kinds of objects. Two factors seemed important in the acquisition of antonymic terms: the complexity of the meanings of each term and the complexity of the dimension along which they lie as opposites. Kuczaj

and Maratsos (1975) noted in their experiment that 'the front' tended to be the most prominent side of objects.

However, both studies, Cox (1979) and Kuczaj & Maratsos (1975), pointed to the fact that one specific term was not acquired before the other on a regular basis.

Coker (1978), in an attempt to demonstrate how the syntactic variables and task requirement variables interact with and affect the child's interpretation of the terms 'before' and 'after' gave kindergarten and first grade pupils three tasks, two prepositional tasks and one subordinate task. Coker found that 'before' was easier than 'after' for both kindergarten pupils and first graders. However, it was observed that there did not appear to be a fixed acquisition order for 'before' and 'after'.

French and Brown (1977) proposed a developmental model whereby children learn the meaning of 'before' and 'after' first in logical contexts and subsequently apply this knowledge to the comprehension of arbitrary sentences. Comprehension of the terms 'before' and 'after' was measured by having subjects act out the sentences. The hypothesis that the terms 'before' and 'after' (temporal) will be better comprehended if they are constrained by the child's knowledge about the world was confirmed. The proportion correct was significantly greater for the logical sentences than it was for the arbitrary sentences. There did not appear to be an obvious effect for the 'before/after' variable in the analysis of the proportion of sentences correct. French & Brown

(1977:256) summarized:

> ... we have found that a logical meaningful sequence facilitiates performance in a task where subjects act out two events joined by either before or after. Furthermore, the ability to act out meaningful sequences precedes the ability to act out arbitrary sequences.

In the Friedenberg and Olson study (1977) children's comprehension of descriptions of two vertically arranged objects using the terms: above, below, higher than, lower than, rising away from, and falling away from were examined. Overall, children made fewer errors on upward terms than downward terms. Friedenberg and Olson observed that, "as expected, children made the fewest errors on higher than/lower than and the most errors on rising away from/falling away from, yielding a significant type of description effect, $F(2,124) = 16.99$, $p < .001$" (1977:267). This study demonstrated the fact that the acquisition of language affects the accurate manipulation of the identified conceptual terms.

Indeed, H. Clark (1973) proposed the thesis that the child knows much about space and time before he learns the English terms for space and time, and his acquisition of these terms is built onto prior knowledge. He stressed that "the perceptual features in the child's early cognition are reflected directly in the semantics of the language" (1973:30). Clark's writing illustrated the importance of establishing a link between the verbal concept and the non-verbal. He also

demonstrated the need for assessing the knowledge that the pupil possesses, both verbally and non-verbally if we are to build upon prior knowledge.

Friedman & Seely (1976) tested the prediction that children learning words that have both spatial and temporal meanings would learn the spatial meaning first. In addition, they examined the hypothesis that the positive term in antonymic pairs was learned before the negative term. Subjects, ranging in age from three years to five years, participated in two spatial tasks and two temporal tasks. The seven test words, used in each task, were: before, after, first, last, ahead of, behind, and together with. Older subjects understood the stimulus words better than their younger counterparts. With the exception of 'ahead of' in temporal tasks, comprehension scores improved with age and performance levels for all words except 'behind' in temporal tasks. Younger children received higher comprehension scores with the words 'before, after, first and last' when presented with temporal tasks, but they performed better with the word 'behind' in spatial tasks. Friedman and Seely (1976:1106) noted: "Between-word comparisons failed to support the prediction that positive members of antonymic pairs are learned before the negative member". The results of this study indicate that some of the words were understood in their spatial sense first, others in their temporal sense. The authors (1976:1107) concluded: "In the present study the youngest children understood the terms in either temporal

contexts or spatial contexts but not both, perhaps reflecting the dominant usage of the terms in the adult population". Older children had more flexibility in applying terms, whereas the younger children were locked into their own frame of reference primarily based upon experential background.

Clark, E. (1973:77) defined the term "extension" as the child's use of a word once it has entered his vocabulary. However, some of the child's uses for the word appear to be appropriate and others do not. Clerk referred to the inappropriate uses of a word as an overextension. One type of overextension was described as occurring when the child's comprehension of certain word pairs, such as 'more-less', 'tall-short', 'before-after', is such that the meaning of one of the pair is extended to cover both words. This type of overextension appears frequently when the pupil first enters school. Another kind of overextension occurs when the child has incomplete lexical entries. The child might treat some words synonymously (tell-ask, boy-brother) until he learns some of the features that will help him differentiate. Clark's study on children's language and the uses of overextensions might have implications for the classroom teacher. If the teacher is aware when the child utilizes an overextension, appropriate instructional strategies might be implemented in order that the pupil be given sufficient opportunity to use the language pertaining to the concepts being taught.

One might conclude, from the examination of the literature pertaining to the acquisition of language in relation to the pupil's concept development, that the language of the child should be given consideration when teaching concepts. A pupil's language even after five-years-of-age should be taken into account when concept development is measured (Palermo & Malfise, 1972; Clark, E. 1973). The pupil is constrained in his understanding of concepts by his experiential background (French & Brown, 1977; Friedman & Seely, 1976). The understanding of some terms is related to the age of the pupil (Friedenberg & Olson, 1977). The child has knowledge of spatial and temporal concepts even though he does not have the equivalent verbal labels (Clark, H., 1973). The child will exhibit overextensions of words (Clark, E., 1973). Nelson (1977:237) stated:

> It would seem that the school's best strategy is to take advantage of the child's own knowledge system at the outset and to do that, it is necessary to recognize that the child's system is functional, predictive, and based in prior episodic experiences.

Concept Development and Beginning Reading

It has been noted that there is a limited amount of research relating concept development to reading. Indeed, Singer (1976:304) reported that he had found only one investigation that was quite germane to a theoretical formaulation of the role of conceptualization in the process

of learning to read. Yet this research (Kress, 1955, as reported in Singer, 1976) clearly indicated that there was a relationship between concepts and beginning reading. Kress found that the non-readers tended to lack: versatility and flexibility, originality in establishing suitable hypothesis for testing, initiative, persistence in problem-solving, ability to draw inferences from relevant clues, ability to analyze the factors present, adequate labels for common concepts and adequate concepts for dealing with language. Non-readers also exhibited a tendency to be more concrete and less abstract in concept functioning.

However, Waller (1977:11) reported that studies had been completed but one of the difficulties in relating concept development and reading was that some of the research was "one-shot" correlational studies with no proper follow-up and no real effort at interpretation.

Downing et al (1977) hypothesized that conceptual development as measured by three cognitive tests, "Orientation to Literacy", "Understanding Literacy Behavior", and "Technical Language of Literacy" would be positively correlated with performance on the more conventional perceptual measures of reading readiness. In order to test these relationships, simple correlation coefficients between each of the cognitive tests and each of the perceptual tests were computed. Each of the obtained correlation coefficients was positive, as predicted, and all were significant at the .001 level. The "Technical Language of Literacy Test" tended

to correlate much higher with the three perceptual tests.

MacGinitie (1976) and his students examined the teacher's manuals for the following purposes: (1) translating into an abstract notation the logical steps that are required of the child in each reading lesson, assuming that the child performs the task in the way that the instruction seems to imply; (2) gaining an impression of just how complex the logical steps are that children are typically asked to perform; to see if certain logical operations predominated in the instruction. MacGinitie's conclusions were incomplete and tentative. He found that the complexity of the required logical operations varied enormously. Although a few logical models represented much of the instruction that is given in today's classrooms, different models were used in different manuals for teaching the same basic processes. Some of these teaching procedures seemed inherently more difficult than others. MacGinitie (1976:375) suggested that further studies be carried out to ascertain whether this is true. If so, teachers might make more use of those instructions that are easier for children to understand. MacGinitie further emphasized that future research should focus upon the most effective ways of presenting concepts and processes of beginning reading in order that the findings be of benefit to classroom teachers.

Hardy et al (1974) compiled an inventory of auditory and visual language concepts used in pre-reading and beginning reading programs and of instructional terms used by

kindergarten and primary teachers. Seven concepts were isolated and a test or test item was designed for each concept. The tests were administered individually to sixty kindergarten children three times during the year. On the basis of their findings, the writers cautioned (1974:531): "In the beginning reading and language areas, it is obviously unwise to make assumptions about the concepts and terminology which children can understand upon entering school". This conclusion was in total agreement with Boehm,(1966). She also observed that many kindergarten children did not possess those concepts which are a requisite for understanding and achieving upon school entrance.

For effective teaching, Hardy et al suggested (1974:531):

> Careful attention to and control of the instructional language used with young children should create a less confusing and more meaningful atmosphere for the orderly and sequential acquisition of beginning reading skills.

The authors further advocated the need for reading programs to provide assessment instruments designed to determine the degree of mastery of the language concepts of kindergarten children entering school. With the information obtained from the assessment instruments, teachers might capitalize instructionally upon concepts already mastered.

Hoffman & Fillmer (1979:294) proposed a program of concrete problem-solving experiences and functional language development for pre-reading children. They proposed that young children be provided with the opportunity to investigate

and explore, to inquire and discover specific concrete concepts, and that teachers should insure that the concepts suggested are understood by the child prior to the formal instruction of reading strategies. The authors suggested that learning experiences should be planned so that the children work with concrete, manipulative materials rather than artificial and abstract drawings or pictures. Hoffman & Fillmer (1979:294) stated that "the process should be one of children learning rather than teachers teaching".

In conclusion, researchers have begun to investigate the connection between knowledge of concepts and beginning reading. At first glance there does appear to be a positive relationship but much more research is required.

Concept Development and Learning Conditions

Researchers have investigated the area of concept development in the hopes of determining the most effective methods of teaching concepts. Hoffman and Fillmer (1979:294) believed that "children's concrete problem-solving ability and their ability to express the what, how and why of their problem-solving experiences can provide the classroom teacher the rationale for building an enabling curriculum for young learners". Concept development should be taken into account when curricula is being determined for the young child.

Some of the earliest research on concept development was carried out by Hull in 1920. He determined through a

series of experiments, with high school and college students, that in the evolution of functional concepts, simple experiments are more efficient than complex ones. In addition, he discovered that a combination of abstract presentation and concrete examples yielded a distinctly greater functional efficiency than either method alone. He also noted that during the evolution of concepts mildly attracting attention to the common element increased the efficiency of the process and that individual concepts usually came into consciousness very gradually. Trial-and-error played, if not a dominating, at least a very great role in the process of concept learning. While this experimentation took place sixty years ago many of the instructional techniques suggested by Hull, such as a combination of abstract presentation with concrete examples, and discovery through trial-and-error, still hold true today.

Archer (1965) designed a study to determine whether the obviousness of information was a manipulative variable and that such a characteristic of the information affects the concept identification of the pupil. The findings, based on results accumulated for one hundred and twenty-eight students, indicated that optimum conditions for enabling the student to identify a concept occurred when the obviousness of the relevant information was maximized and the obviousness of the irrelevant information was minimized.

Englemann (1969:13) stressed the need for the teacher to utilize clues concerning the implementation of tasks so that children were "motivated", made fewer errors and were

able to work more independently. In order to demonstrate to a child that different instances of a concept share a set of characteristics and that these characteristics can be referred to with a word, the teacher often has to present many instances of the concept. He then presents 'not instances' to show the child instances that do not share the essential characteristic. Woodson (1974:184) supported this teaching procedure.

Wallace (1972:141) in examining the most effective method of teaching, concluded:

> In view of the shortcomings of both the non-verbal and verbal methods and the practical necessity of establishing a methodological modus vivendi, a search for a compromise solution appears to be the appropriate course of action.

On the one hand the teacher avoids the dangers of the non-verbal approach by ensuring that the pupils examine the relevant events and remembers the relevant information, while on the other, the weakness of the verbal approach is combated by requiring them to operationally demonstrate their comprehension of the verbal terms used in the presentation of the lesson.

The findings from an experiment conducted by Imai and Garner (1965), in which they compared factors affecting the performance of two different types of classification tasks, might have implications for program development when applied to concepts. On the basis of their experiment they found in constrained classification, only the discriminability of the criterion attribute is important in speed of sorting. In free classification, discriminability of the chosen attributes,

discriminability of interfering attributes, and a preference for the attribute over and above these factors all affect performance. The classroom teacher might be able to control the interfering variables and performance might improve.

Furth and Wachs (1974:46) advocated that classroom activities should involve thinking because the act of thinking is worthwhile in itself. Classroom activities should be structured in order to challenge the child's developing intelligence. Classroom activities should be developmentally appropriate so as to challenge the child's thinking but not too difficult as to invite failure. The activity should be such that the child focuses his attention on the activity and not the teacher. Activities should be such that each individual child can perform within a group of peers with whom he relates socially and cooperates.

There were two purposes for the Katz and Denny (1977) study. First to establish the stability of the order of dominance effect for verbal concept attainment and second to propose and test a new theoretical interpretation of the effect. Results indicated that concept attainment became more difficult when memory load was increased. In a second experiment, with the same subjects, it was discovered that memory load concreteness level and the critical interaction of memory-load x concreteness were all significant (1977:18). Increasing the memory-load had a greater detrimental effect on abstract than concrete concepts. Katz and Denny observed

that "the dominance effect was that abstract concepts were more difficult to attain than concrete concepts. This effect was confirmed for both high and low memory-load conditions and when subjects' levels of instance recall is equated" (1977:19). The results also indicated that memory for previously presented instances is an important contribution to the order of dominance effect for verbal materials. Abstract concepts became especially difficult to attain under conditions requiring the retrieval from memory of information presented in previous instances. This finding has great implication for the classroom teacher in terms of realistic pupil expectations.

Reed and Dick (1968) conducted a study to determine first, if abstract concepts were more difficult to learn than concrete ones; second, if abstract concepts led to more errors of generalization than concrete ones; and third, if the correctness of a concept influenced the rate of learning it or the amount of generalization from it. The subjects, seventy volunteers from introductory psychology classes, were assigned at random to the abstract or concrete groups. The prediction that abstract concepts were more difficult to learn than concrete ones was confirmed by the fact that only one of thirteen subjects who failed to reach the criteria in training had been assigned to the concrete group, the other twelve had been assigned to the abstract group. It was also confirmed that abstract concepts had more generalization errors or less

transfer value than concrete ones and that correct concepts were easier to learn than incorrect ones. But there was no significant difference between the transfer value of correct and incorrect concepts. Correct concepts were those defined as covering all instances presented in the experiment and incorrect concepts were those concepts that covered one or several instances but not all. Reed and Dick hypothesized that perhaps the abstract concepts were more difficult to learn and had less transfer value than concrete ones because pupils had more actual associations with the concrete concepts that were used in this study. Also they hypothesized that there was more similarity among abstract concepts and instances than there was among concrete concepts.

Priddle and Rubin (1977) investigated whether or not spatial relational concepts could be taught to pre-school-aged children. Specifically, they attempted to compare the effectiveness of movement-oriented versus verbal-visual-oriented spatial relational training programs for preschoolers. The results on the basis of Pre-, Post-, and Delayed Post-tests indicated that there were no significant differences between the comparison groups. One-way analysis of variance for pre-test versus post-test and pre-test versus delayed post-test gains indicated significant differences between groups. The authors concluded (1977:63): "The results of this study clearly indicated that within limits, pre-schoolers can be taught to improve their understanding of left-right

relational concepts". It would appear that both methods, motor and verbal training, were effective. The motor training was significantly more effective than the verbal method in teaching left-right relations. These findings would indicate that pre-school children learn better through a movement method than through a rote-learning method. However, both groups were equally able to generalize from their left-right training experiences to the more general spatial knowledge tasks. In conclusion, the authors noted (1977:64):

> Since the movement 'curriculum' was no more time-consuming than the verbal program, and since, on the face of it, the children expressed a more favorable reaction to the movement activities, it would appear that teaching spatial relations through action and movement is a rewarding and, to a limited degree, a significant teaching strategy.

Caldwell & Hall (1970), in a replicated study based on Gibson, Gibson, Pick & Osser's (1962) study, determined that the nursery children performed much like second graders when given a six-to-ten minute warm-up designed to give them an adequate concept of same and different. The authors summarized (1970:47):

> Obviously then, both attention and concept learning are important variables in this discrimination task. Regardless of the relative influence of these two variables, an important and obvious conclusion is that nursery school children are able to discriminate as well as second graders when given very brief but appropriate experiences.

Becker et al (1979) conducted a study to extend previous work on concept acquisition and intermodal transfer

to novel concepts and to investigate the effect of test mode and mode compatibility. All the subjects in this study received three tasks: concept training, concept generalization, and recognition. Children were randomly assigned to picture or object training conditions and assigned to picture or object test conditions so that these conditions were matched in age and acquisition performance. An analysis of variance indicated that generalization was significantly better for children receiving picture than object training. Becker et al observed that concept training was comparable with pictures and objects. They also noted that "although training mode had no significant effect on concept acquisition or retention, it did significantly affect generalization" (1979:219).

Martorella (1972) investigated the merits of "inductive vs deductive" teaching methodology. As a result of his study, he concluded (1972:37):

> While considerable research energy has been expended on the general question of the relative merits of inductive versus deductive teaching procedures, no categorical claims for the superiority of either approach can be made for classroom instruction.

Klausmeier et al (1974) reported a model of conceptual learning and development in which an invariant sequence of four successively higher levels of concept attainment was proposed: concrete, identity, classificatory and formal. McMurray et al (1977:660) noted that "the greatest amount of concept attainment that occurs in school takes place at either

the classificatory or formal levels". The attainment of a concept at the classificatory level occurs when an individual is able to generalize that two or more instances of the same concept are examples of the same class. Klausmeier et al (1974) regarded formal level concept attainment as occurring when an individual is able to: discriminate the defining attributes of a concept, give the name of the concept and each of its defining attributes; evaluate examples and non-examples of the concept using defining attributes as a bases of differentiation.

The area of concept development and learning conditions has been, and will continue to be, investigated by researchers. Indeed, there have been many varied conclusions with regard to the most effective and efficient methods of teaching concepts. Teachers should realize that pupils find concrete examples of concepts easier to understand than abstract examples of the same concepts (Reed & Dick, 1968). Children learn concepts more effectively when given the opportunity to participate in a trial-and-error discovery method (Hull, 1920). Children should recognize through instructional methodology, positive and negative instances of the concept (Englemann, 1969; Woodson, 1974). Wallace (1972) stressed the need for a concept instructional program that utilizes both the verbal and manipulative ability of the young child. Teachers should recognize the fact that the amount of information previously taught might affect the pupils' ability to recall a particular concept with understanding (Katz &

Denny, 1977). Children enjoy and benefit from instructional programs designed to increase conceptual awareness and understanding (Caldwell & Hall, 1970; Priddle & Rubin, 1977). It would appear, on the basis of the previously quoted research, that no one methodology is most efficient or effective for all pupils and all teachers. However the teacher must continually and purposefully produce a 'match' between the child and the concept instructional program.

Conclusion

The writer has examined the literature on concept development and its relationship to such variables as: age/grade, socioeconomic/sociocultural factors, intelligence/ academic achievement, sex of the pupil, language acquisition, beginning reading and learning conditions. The first observation must be that while there have been numerous research studies related to concept development, there have been a limited number of definite conclusions that have a practical value to the classroom teacher. The age of the pupil has some, but not total bearing, upon the child's level of concept development. The research in the area of socioeconomic/sociocultural factors and concept development points to the fact that there is some relationship between the child's concept development and his socioeconomic/ sociocultural background. However, researchers, such as Boehm (1966, 1971) caution teachers not to assume the absence

or presence of concepts due to socioeconomic/sociocultural background. There appears to be a correlation, albeit a guarded one, between concept development and the intellectual ability of the pupil. On the basis of the research it is difficult to make a definitive statement concerning the relationship between the sex of the pupil and the level of concept development. Researchers have found that language acquisition has a significant bearing upon the child's measurable level of concept development. Finally, the most effective and efficient methodology for teaching concepts is dependent upon the teacher and the learning style of the child.

In this chapter the writer examined the literature pertaining to concept development and its relationship to variables such as: age/grade, socioeconomic/sociocultural factors, intelligence/academic achievement, sex of the pupil, language acquisition, beginning reading, and learning conditions. In Chapter 3, the preliminary study, the sample, the experimental design, the hypotheses and the statistical tests are presented. In Chapter 4, data are summarized, results of statistical tests are reported, and the findings are discussed. Chapter 5 includes a summary of the study, conclusions drawn from the findings, and implications for research and classroom instruction.

Chapter 3

DESIGN AND PROCEDURES

The major purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks.

In this chapter, the preliminary study, sample, design, hypotheses, and statistical analyses will be described.

Preliminary Study

A pilot study, conducted earlier and described below, led to the current study. Initially the investigator examined the Boehm Test of Basic Concepts (1971). The Boehm Test of Basic Concepts is a paper-and-pencil assessment instrument designed to screen primary school children's understanding of fifty basic concepts. The concepts identified on the test are predominantly spatial, temporal, and quantitative in nature. This study was limited to spatial concepts. A survey listing twenty-eight spatial concepts identified on the Boehm Test of Basic Concepts was sent to ten nursery, ten kindergarten, and ten grade one teachers (See Appendix A). These teachers were

requested to indicate which of the twenty-eight spatial concepts they considered to be most important for a pupil's success in learning. They were asked to rate the concepts they considered to be most important for a pupil's success in learning in the following manner: the spatial concept they considered to be the most important, number one; the spatial concept they considered to be the second most important, number two; the spatial concept they considered to be the third most important, number three. Teachers were requested to identify the fifteen most important concepts for a pupil's success in learning from the list of twenty-eight. Consequently, the spatial concept they considered to be fifteenth in importance was rated as number fifteen. All thirty survey sheets were returned. The survey was analyzed by means of a total weighted analysis and a frequency count. With the total weighted analysis, the investigator allocated fifteen points for the spatial concept that teachers rated as number one. Fourteen points were allocated for that spatial concept teachers rated as number two. Finally, one point was allocated for the spatial concept that teachers rated as fifteenth on their lists of spatial concepts considered necessary for a pupil's success in learning. With the frequency count, the investigator allocated one point for a spatial concept every time it appeared on a teacher's list of concepts that were identified as being necessary for a pupil's success in learning. A point was given for the spatial concept regardless of its position on the survey. On the basis of the

two types of analyses, six spatial concepts were identified as being necessary for a pupil's success in school learning by teachers at all three levels. The six identified spatial concepts presented here are not ranked in any particular order. The results of the survey were as follows: after, beginning, behind, forward, top, and inside. The results of the survey, tabulated by both methods of analysis, may be found in Figure 3.1.

The next phase of the preliminary study was to develop paper-and-pencil and manipulative items which would measure the kindergarten pupil's understanding of the six identified spatial concepts. There were two reasons for this initial assessment. First, it was necessary to ascertain whether kindergarten pupils did understand those six spatial concepts that nursery, kindergarten, and grade one teachers considered most important for success in learning. Second, it was considered necessary to determine whether kindergarten pupils could perform to criterion on spatial concept tasks, utilizing two response modes, i.e., paper-and-pencil and manipulation. The criteria of mastery for this preliminary study were outlined as follows: four of five paper-and-pencil spatial concept items correct; two of two manipulative spatial concept items correct.

Consequently an experimental testing instrument for the purpose of measuring kindergarten pupils' performance on paper-and-pencil and manipulative spatial concept tasks was designed. The testing instrument consisted of paper-and-pencil

Concepts Considered Most Important by Nursery, Kindergarten, and Grade One Teachers on the Basis of a Total Weighted Analysis (The concept a teacher considered most important (No. 1) was allocated 15 points. The concept a teacher considered least important (No. 15) was allocated 1 point).	Concepts Considered Most Important by Nursery, Kindergarten, and Grade One Teachers on the Basis of a Frequency Count (Concepts are ranked according to the number of times they appeared on the survey).
Top	Behind
Behind	Inside
After	Top
Left	After
Right	Forward
Inside	Nearest
Beginning	Next to
Forward	Beginning
Below	Middle

Figure 3.1

Results of a Survey Sent to Nursery, Kindergarten, and Grade One Teachers to Determine which Spatial Concepts They Considered Important for Success in Learning

and manipulative items which were designed to measure kindergarten pupils' performance on the six identified spatial concepts previously outlined in this section. In all, there were thirty paper-and-pencil items (five test items per concept) and twelve manipulative items (two test items per concept).

The twenty-five kindergarten pupils who participated in this initial assessment were drawn from a Winnipeg school in the same school division from which the sample for the actual study was drawn. The results of this initial assessment are presented in Figure 3.2. Through the paper-and-pencil response mode the percentages of pupils who demonstrated mastery of the six identified spatial concepts were as follows: inside, ninety-six percent; top, eighty-four percent; after, sixty-four percent; forward, forty-four percent; behind, forty-four percent; beginning, sixteen percent. Through the manipulation response mode the percentages of pupils who demonstrated mastery of the six identified spatial concepts were as follows: inside, ninety-six percent, top, ninety-six percent; after, sixty percent; forward, fifty-two percent; behind, thirty-two percent; beginning, twelve percent. A pictorial representation of a comparison between the number of kindergarten pupils who demonstrated mastery (two of two items correct) of the six identified spatial concepts through the manipulation response mode and the number of kindergarten pupils who demonstrated mastery (four of five items correct) of the six identified

	Response Mode			
	Paper-and-Pencil		Manipulative	
Concept	No. of children who demonstrated mastery (4 of 5 items correct)	Percentage of children who demonstrated mastery	No. of children who demonstrated mastery (2 of 2 items correct)	Percentage of children who demonstrated mastery
TOP	21	84	24	96
INSIDE	24	96	24	96
AFTER	16	64	15	60
FORWARD	11	44	13	52
BEHIND	11	44	8	32
BEGINNING	4	16	3	12

Figure 3.2

Numbers and Percentages of Pupils Who Demonstrated Mastery of Six Identified Spatial Concepts During the Preliminary Assessment

spatial concepts through the paper-and-pencil response mode may be found in Figure 3.3.

The next phase of the preliminary work consisted of the development of instructional techniques for the purpose of teaching those identified concepts that nursery, kindergarten, and grade one teachers considered necessary for success in learning.

Spatial Concept Experimental Testing Instrument

The experimental testing instrument designed to measure kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks was developed from the preliminary study (see Appendix B). An item analysis was performed on the thirty paper-and-pencil items. Items which more than eighty percent of the kindergarten pupils performed with accuracy were discarded because it was felt the items would be too easy. Conversely, items which less than twenty percent of the kindergarten pupils performed with accuracy were discarded because it was felt the items would be too difficult. In addition the spatial concept 'inside' was eliminated because the majority of children (ninety-six percent) demonstrated an understanding of this concept through the two response modes. However, it was decided to incorporate the spatial concepts 'below', 'nearest', and 'next to', as these three concepts ranked high in the list of those spatial concepts that nursery, kindergarten, and

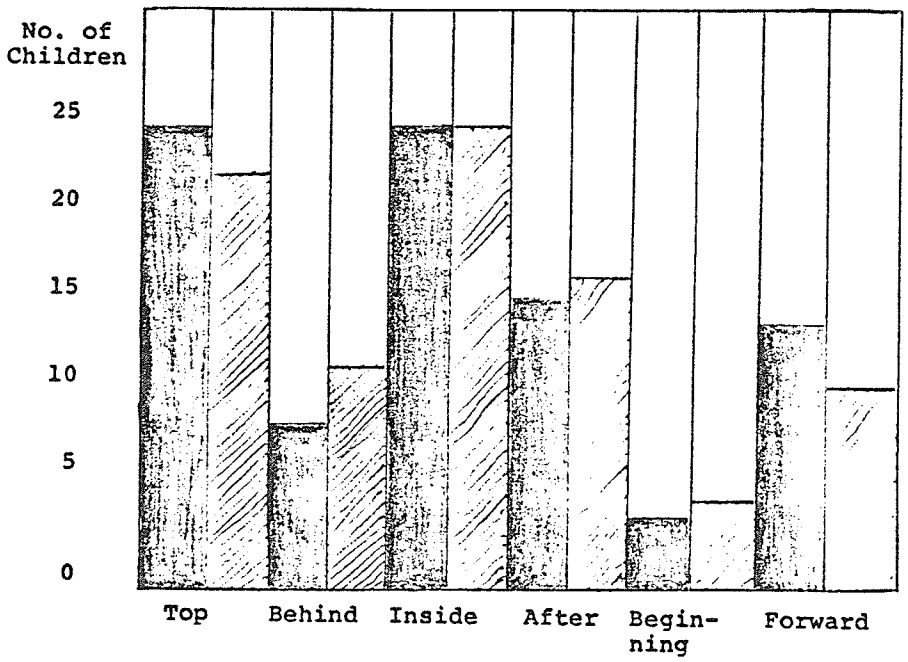

Figure 3.3

The Number of Kindergarten Pupils Who Demonstrated Mastery of Six Identified Spatial Concepts Through the Paper-and-Pencil and Manipulation Response Modes

grade one teachers considered most important for a child's success in learning.

Consequently more items were designed and administered to a different kindergarten population. Again, an item analysis was completed on seventy items and those items that did not meet the previously stated criteria were eliminated. The final paper-and-pencil component of the experimental testing instrument consisted of forty items, five per concept. The eight concepts assessed by the test were: after, beginning, behind, below, forward, nearest, next to, and top.

The investigator met with a "Research in Reading" graduate class for the purpose of establishing construct validity. The suggestions made were incorporated when possible, i.e., pictures altered, oral directions changed, etc. A split-half reliability was calculated to be .896. The Spearman Brown Prophecy Formula for estimating reliability from two comparable halves of a test was calculated to be .945.

The paper-and-pencil test items were randomly arranged. First, it was decided that the paper-and-pencil testing component would be administered in two sessions in order that the administrative directions be comparable to those found in the Boehm Test of Basic Concepts (1971). Therefore, two or three items per concept were given during each testing session. The purpose was to avoid a pupil's

illness, emotional upset, etc. affecting the total performance on one concept. Again, the items were randomly arranged within the halves of the paper-and-pencil component of the experimental testing instrument. Directions to the pupils followed when possible those outlined in the Boehm Test of Basic Concepts (1971). A pupil demonstrated mastery on the paper-and-pencil component by having four of five items correct per concept.

The manipulative component of the experimental testing instrument consisted of twenty-four items, three per concept. A manipulative spatial concept item was one in which the pupil manipulated the object or objects at the direction of the teacher in order to demonstrate an understanding of the identified spatial concept. The teacher said, "Put the marble INSIDE the box." The pupil put the marble INSIDE the box. A pupil was considered to have demonstrated mastery on the manipulative component when two of three items per concept were completed correctly.

The oral expressive language component of the experimental testing instrument consisted of twenty-four items, three per concept. An oral expressive language spatial concept task was one in which the pupil orally described what the teacher did, in order to demonstrate an understanding of the identified spatial concept. The teacher asked, "Do you know what the word INSIDE means? Try and use the word INSIDE in a story about something I will show you.". The teacher put the marble INSIDE the box and the pupil described what was done.

A pupil was considered to have demonstrated mastery on the oral expressive language component of the experimental testing instrument when two of three items per concept were described correctly.

For the purpose of this study and for the analyses of the data an oral expressive language task was considered accurate only when the actual requested concept label was uttered by the pupil. However it was observed that kindergarten pupils often supplied a synonym for the concept under investigation. While these synonyms were not tabulated into the results, information regarding pupils' oral responses may be found in Appendix C.

Sample

Five classroom groups of kindergarten pupils from two schools in the same school division participated in the main study. Morning and afternoon kindergarten classes were used. The children from each classroom were assigned randomly to one of five conditions. These five conditions are described in the section entitled Procedures in this chapter. Further information regarding the design of the study and the number of kindergarten pupils placed in each condition may be found in Figure 3.4.

Design

The design of the study may be found in Figure 3.4. The independent variable in this study was the absence

Condition	No. of Pupils in the Condition	Description of Treatment for Pupils in Each Condition		
Condition 1	27	Pre-test Boehm Test of Basic Concepts Form A (Paper-and-Pencil)	Spatial Concept Instructional Program	Post-test Boehm Test of Basic Concepts Form B (Paper-and-Pencil)
Condition 2	26	Experimental Testing Instrument (Paper-and-Pencil, Manipulative, and Oral Expressive Language)	_____	_____
Condition 3	26	_____	Spatial Concept Instructional Program	Experimental Testing Instrument (Paper-and Pencil, Manipulative, and Oral Expressive Language)
Condition 4	26	_____	_____	Experimental Testing Instrument (Paper-and-Pencil, Manipulative, and Oral Expressive Language)
Condition 5	26	Pre-test Boehm Test of Basic Concepts Form A (Paper-and-Pencil)	_____	Post-test Boehm Test of Basic Concepts Form B (Paper-and-Pencil)

Figure 3.4

Design of the Study and Number of Kindergarten Pupils Found Initially in Each Condition

or presence of the spatial concept instructional program. The five conditions were built into the experiment to assess the various aspects of the instructional program. The dependent variables in this study were the Boehm Test of Basic Concepts, Forms A and B, and an experimental testing instrument consisting of a paper-and-pencil, a manipulative, and an oral expressive language component.

Each child was placed randomly into one of the five conditions. The type of measure each child received on the eight identified concepts was dependent upon the condition (One to Five) into which the child was placed (See Figure 3.5). The total scores on the Boehm Test of Basic Concepts, Forms A and B, were computed for each pupil in Conditions One and Five for both the pre-test and post-test measures. The total scores on the experimental testing instrument were analyzed for each pupil in Condition Two (pre-instruction testing; pupils did not participate in the instructional program, Condition Three (post-instruction testing; pupils participated in the instructional program), and Condition Four (post-instruction testing; pupils did not participate in the instructional program). In addition, the scores obtained for the paper-and-pencil, the manipulative, and the oral expressive language components were analyzed separately between and within conditions for the pupils randomly placed in Conditions Two, Three, and Four.

Measurement	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5
Boehm Test of Basic Concepts Form A & B Total Scores	X				X
Boehm Test of Basic Concepts Form A & B Scores for eight identified concepts	X				X
Experimental Concept Test Total Score		X	X	X	
Experimental Concept Test Paper-and-Pencil		X	X	X	
Experimental Concept Test-Manipulative		X	X	X	
Experimental Concept Test Oral expressive language		X	X	X	

Figure 3.5

Measurements Obtained for the Kindergarten Pupils in Each Condition

Procedures

Before the pre-test was administered, the kindergarten pupils were given an opportunity to meet with the investigator in a small-group situation, i.e., four or five pupils at a time. These introductory sessions occurred in the same area in which the testing and instructional sessions were to take place. The investigator conducted each introductory session in much the same manner. The children talked and listened to themselves on the tape recorder, pieced together a giant puzzle, and heard a story.

Pre-test

The kindergarten pupils in Conditions One, Two, and Five received a pre-test before the implementation of the spatial concept instructional program. The tests, the Boehm Test of Basic Concepts, Form A, and the experimental testing instrument were administered in a random order. In this way no one group of pupils could benefit continually as a result of 'prime' testing time. The three components of the experimental testing instrument, i.e., the paper-and-pencil, the manipulative, and the oral expressive language, also were randomized. This was to prevent a 'practice effect' possibly resulting from a particular order always being used in the administration of the testing component. It was felt that if the oral expressive language component was always administered

last, for example, this might have some bearing upon the outcomes.

The Boehm Test of Basic Concepts, Form A, (1971) and the experimental testing instrument (the paper-and-pencil component) were administered to small groups of four and five pupils at a time. Both testing packages were completed in two sessions, with Booklet 1 being administered one day and Booklet 2 another day. The manipulative and the oral expressive language components were administered individually to each pupil in Condition Two.

Spatial Concept Instructional Program

Following the pre-test, spatial concept lessons were developed for the kindergarten pupils in Conditions One and Three. Again the lessons were conducted in a small-group situation, i.e., four or five pupils at a time. In all there was a total of ten groups of pupils, five groups in each school. The instructional groups were randomized within each school in order that no one group received instruction at the same time every day. In this way no one group received instruction during 'prime' learning time, i.e., before recess. The pupils received their instruction in an area apart from the regular classroom. In total, each group received seven teaching sessions. These sessions occurred every second day when possible. If a teaching session was to take place on a holiday, an in-service day, or a particular school activity day the session was postponed until the next teaching day.

The concept 'nearest' was not taught in the spatial concept instructional program because it was determined through the analysis of the paper-and-pencil items on the Boehm Test of Basic Concepts, Form A, and the experimental testing instrument that the majority of pupils (90.54 percent) understood this concept. Consequently the seven concepts taught in the spatial concept instructional program were: after, beginning, behind, below, forward, next to, and top. The concept to be taught on any particular day was chosen randomly.

Each session, except the first, consisted of a review of the previously taught concept and the introduction of the new concept (See Appendix D). The seventh session included, as well as the introduction to the concept 'after', a general review of the six spatial concepts previously taught. A pupil was eliminated from the study if he or she missed two consecutive lessons, i.e., the introductory session plus the review session for any one particular concept. The sessions were approximately twenty to twenty-five minutes in length.

Every attempt was made to ensure that one group of pupils did not have an advantage over the other groups in the instructional sessions. The investigator prepared a script and followed it when possible. Every attempt was made to ensure that the pupils heard, saw, and said the concept an adequate number of times. The activities used within each session were arranged in such a manner that the child progressed from the concrete to the abstract.

Post-test

The pupils in Conditions One, Three, Four, and Five (See Figure 3.4) received a post-test after the seven instructional sessions. The Boehm TEst of Basic Concepts, Form B, (1971) and the same form of the experimental testing instrument again were administered in a random order in the post-test situation. Because there was only one form of the experimental testing instrument, it was necessary to incorporate into the design of the study a means of comparing kindergarten pupils' performance on spatial concept tasks before and after the spatial concept instructional program had occurred. The pupils randomly placed into Condition Two had the experimental testing instrument administered to them as a pre-test. The pupils randomly placed into Condition Four had the experimental testing instrument administered to them as a post-test. Because these were two randomly selected groupings the same form of the experimental testing instrument was given and the kindergarten pupils' performance was compared. Again the three components of the experimental testing instrument paper-and-pencil, manipulative, and oral expressive language were randomized for each pupil. Again, the Boehm Test of Basic Concepts, Form B, (1971) and the experimental testing instrument, the paper-and-pencil component, were administered in two sessions to small groups of four or five children. The manipulative and the oral expressive language components of the experimental testing instrument were administered individually to each pupil

within Conditions Three and Four.

Descriptions of Conditions

Condition One

The pupils in this Condition received the Boehm Test of Basic Concepts, Form A, as a pre-test. They then participated in a spatial concept instructional program designed to improve kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks. At the conclusion of the seven instructional sessions they received the Boehm Test of Basic Concepts, Form B, as a post-test. This Condition was introduced into the design of the study because it would enable the investigator to determine if the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument were related as measurement instruments in assessing kindergarten pupils' performance on spatial concept tasks. Second, the data gained from the pupils in Condition One would help the investigator determine if the spatial concept instructional program had been effective, in that a comparison of pre- and post-test data could be made.

Condition Two

The pupils in this Condition received the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component as a pre-test. This Condition was introduced into the design for a number of

reasons. First, it would enable the investigator to determine if the Boehm Test of Basic Concepts, Form A, and the experimental testing instrument were related as measurement instruments in assessing kindergarten pupils' performance on spatial concept tasks. In addition, it would assist the investigator in determining if the spatial concept instructional program had been effective. Lastly, the introduction of Condition Two into the design enabled the investigator to use only one form of the experimental testing instrument.

Condition Three

The pupils in this Condition participated in a spatial concept instructional program designed to improve kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks. At the completion of the seven instructional sessions each pupil received the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component as a post-test. This Condition was introduced into the design of this study because it enabled the investigator to determine the effects of the spatial concept instructional program. Kindergarten pupils' performance scores in Conditions Two, Three, and Four were compared. The presence of Condition Three in the design also enabled the investigator to determine if the Boehm Test of Basic Concepts, Form B, and the experimental testing instrument were related as measurement

instruments in assessing kindergarten pupils' performance on spatial concept tasks after they had participated in the spatial concept instructional program.

Condition Four

The pupils in this Condition received the experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language components as a post-test. The presence of Condition Four permitted the investigator to compare kindergarten pupils' performance in this Condition with kindergarten pupils' performance in Condition Three in order to determine the effectiveness of the spatial concept instructional program. The investigator was also able to compare kindergarten pupils' performance on the experimental testing instrument when it was used in a pre-test situation and kindergarten pupils' performance on the experimental testing instrument when it was used in a post-test situation. A comparison of kindergarten pupils' scores in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) and kindergarten pupils' scores in Condition Four (post-instruction testing; pupils did not participate in the instructional program) enabled the investigator to determine if there was a maturational effect.

Condition Five

The pupils in this Condition received the Boehm Test of Basic Concepts, Form A, as a pre-test. They also received

the Boehm Test of Basic Concepts, Form B, as a post-test. The kindergarten pupils randomly placed into this Condition did not participate in the spatial concept instructional program. This Condition was introduced into the design of the study because it would initially help the investigator determine the effectiveness of the spatial concept instructional program. A comparison of kindergarten pupils' performance in Condition One with kindergarten pupils' performance in Condition Five during the pre-test was a measure to ascertain if the two groups were similar in performance before the spatial concept instructional program was introduced.

Statement of Hypotheses

The major purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks. Several main questions were considered and null hypotheses were formulated in relation to three of the four questions. The fourth main question was broken down into three sub-questions.

Question 1. What is the relationship between the Boehm Test of Basic Concepts, Forms A and B, and an experimental testing instrument designed to measure kindergarten pupils' performance on spatial concept tasks?

Null Hypothesis 1.1 - There is no significant relationship between kindergarten pupils' performance on the Boehm Test of Basic Concepts, Form A, and kindergarten pupils' performance on an experimental testing instrument designed to measure manipulative, paper-and-pencil, and oral expressive language tasks.

Null Hypothesis 1.2 - There is no significant relationship between kindergarten pupils' performance on the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on an experimental testing instrument, after the kindergarten pupils have participated in a spatial concept instructional program designed to improve paper-and-pencil, manipulative, and oral expressive language performance on spatial concept tasks.

Question 2. What are the effects of a spatial concept instructional program designed to improve kindergarten pupils' performance on spatial concept tasks as measured by the Boehm Test of Basic Concepts, Form B, and an experimental testing instrument?

Null Hypothesis 2.1 - There is no significant difference, as measured by the Boehm Test of Basic Concepts, Form B, between the performance of kindergarten pupils who participated in an instructional program designed to improve performance on spatial concept tasks and the performance of kindergarten pupils who did not participate in the instructional program.

Null Hypothesis 2.2 - There is no significant difference, as measured by an experimental testing instrument, between the performance of kindergarten pupils who participated in an instructional program designed to improve performance on spatial concept tasks and the performance of kindergarten pupils who did not participate in the instructional program.

Question 3. What percentage of subjects perform to criterion on the paper-and-pencil, manipulative, and oral expressive language components of the experimental testing instrument?

Question 3.1 - What percentage of pupils perform to criterion (four of five items correct) on paper-and-pencil spatial concept tasks?

Question 3.2 - What percentage of pupils perform to criterion (two of three items correct) on manipulative spatial concept tasks?

Question 3.3 - What percentage of kindergarten pupils perform to criterion (two of three items correct) on oral expressive language spatial concept tasks?

Question 4. To what degree do manipulative, paper- and -pencil, and oral expressive language tasks relate as measures of the kindergarten pupils' performance on spatial concept tasks?

Null Hypothesis 4.1 - There is no significant relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils'

performance on paper-and-pencil spatial concept tasks.

Null Hypothesis 4.2 - There is no significant relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks.

Null Hypothesis 4.3 - There is no significant relationship between kindergarten pupils' performance on paper-and-pencil spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks.

A .05 level of significance was set as necessary before any effects would be considered statistically significant.

Statistical Analysis

The data were analyzed using the Statistics on Line (SOL) programs ST 32, Multiple Linear Regression and Correlation, and ST 13, Two-sample t-test. Descriptive statistics were used for Question 3 with its three sub-questions. Program ST 32, Multiple Linear Regression and Correlation, was used to answer Question 1 (null hypotheses 1.1 and 1.2) and Question 4 (null hypotheses 4.1, 4.2, and 4.3). Program ST 13, Two-sample t-tests, was used for Question 2 (null hypotheses 2.1 and 2.2).

Summary

In this chapter, the preliminary study, sample, design,

procedures, hypotheses, and statistical analyses have been described. The preliminary study formed the basis of the present study. The treatment, design and hypotheses were developed as a result of the findings collected during the preliminary study. In Chapter 4 the findings and analyses of the actual study will be reported and discussed. Chapter 5 will give a summary as well as the main conclusions and implications for classroom practice and research.

Chapter 4

FINDINGS AND ANALYSIS

Prior to the presentation of the findings, the design and procedures of this study are reviewed briefly.

The main purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks. Kindergarten pupils' performance on the Boehm Test of Basic Concepts, and the experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language components were analyzed in an attempt to determine the effectiveness of these instruments as measures of kindergarten pupils' performance on spatial concept tasks. In addition, the effects of a spatial concept instructional program were measured by comparing the groups of kindergarten pupils who did not participate in the program with the groups of kindergarten pupils who did participate in the program (See Figure 4.1). The data collected from this investigation were analyzed in terms of the two dependent variables, the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language

Condition	Number of Kindergarten Pupils in each condition	Description of Each Condition		
Condition 1	24	Pre-test Boehm Test of Basic Concepts Form A	Spatial Concept Instructional Program	Post-test Boehm Test of Basic Concepts Form B
Condition 2	25	Experimental Testing Instrument (Paper-and-Pencil, Manipulative, and Oral Expressive Language Components	_____	_____
Condition 3	23	_____	Spatial Concept Instructional Program	Experimental Testing Instrument (Paper-and-Pencil, Manipulative, and Oral Expressive Language Components
Condition 4	23	_____	_____	Experimental Testing Instrument (Paper-and-Pencil, Manipulative, and Oral Expressive Language Components
Condition 5	25	Boehm Test of Basic Concepts Form A	_____	Boehm Test of Basic Concepts Form B
	120 Total			

Figure 4.1

Number of Kindergarten Pupils and Description

of the Five Conditions Present in the Study

components. The data also was viewed in terms of the independent variable with its two levels of operation, the absence of the spatial concept instructional program and the presence of the spatial concept instructional program. This chapter includes the presentation and analyses of the data.

Analysis of the Data

The findings and analyses of the data will be presented under the four main questions previously stated in Chapter 3. The specific null hypotheses related to each main question are also presented.

Question 1. What was the relationship between the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument designed to measure kindergarten pupils' performance on spatial concept tasks? Two null hypotheses were formulated relating to this question. The results and analyses pertaining to each null hypothesis will be discussed in this section.

Null Hypothesis 1.1 - There was no significant relationship between kindergarten pupils' performance on the Boehm Test of Basic Concepts, Form A, and kindergarten pupils' performance on the experimental testing instrument designed to measure paper-and-pencil, manipulative, and oral expressive language tasks. This null hypothesis was broken down further into two null hypotheses.

Null Hypothesis 1.1.1 - There was no significant relationship between kindergarten pupils' performance on the

total fifty concepts of the Boehm Test of Basic Concepts, Form A, and kindergarten pupils' performance on an experimental testing instrument designed to measure paper-and-pencil, manipulative, and oral expressive language tasks for the eight identified spatial concepts.

Table 4.1 illustrates the significance of the relationship between kindergarten pupils' performance on the total fifty concepts of the Boehm Test of Basic Concepts, Form A, (Condition One) and kindergarten pupils' performance on the experimental testing instrument designed to measure paper-and-pencil, manipulative, and oral expressive language tasks for eight identified spatial concepts (Condition Two). The total scores on the Boehm Test of Basic Concepts, Form A, (Condition One) were not related to the total scores on the experimental testing instrument which included a paper-and-pencil, a manipulative, and an oral expressive language component (Condition Two). The degree of the relationship (-0.02) was not significant at the .05 level as a critical r value of .4227 was needed. There was no relationship that reached the .05 level of significance between the Boehm Test of Basic Concepts, Form A, (Condition One) and any of the specific components of the experimental testing instrument (Condition Two). See Table 4.1.

Table 4.1 points out that the Boehm Test of Basic Concepts, Form A, and the experimental testing instrument with its three components measured different aspects of kindergarten pupils' performance on spatial concept tasks.

Table 4.1

Correlation Matrix of Pre-test Instruments Used to Determine Kindergarten Pupils' Performance in Condition One and Condition Two on Spatial Concept Tasks

	Boehm Test of Basic Concepts - Form A		Experimental Testing Instrument			
	Eight Identified Spatial Concepts	Total Score	Paper-and-Pencil	Manipulative	Oral Expressive Language	Total Score
	1	2	3	4	5	6
1	1.00					
2	.89	1.00				
3	0.02	0.06	1.00			
4	0.17	0.22	0.88	1.00		
5	-0.31	-0.31	0.62	0.56	1.00	
6	-0.06	-0.02	0.95	0.90	0.81	1.00

Critical r value = .4227 (significant at the .05 level) N = 24

The extent to which the two measurement instruments were related was not significant at the .05 level.

To further determine if the Boehm Test of Basic Concepts, Form A, and the experimental testing instrument with its three components were related as measurement instruments, the investigator analyzed the data collected from the kindergarten pupils in Condition Five (Boehm Test of Basic Concepts, Form A) and the data collected from the kindergarten pupils in Condition Two (experimental testing instrument).

Table 4.2 outlines the significance of the relationship between kindergarten pupils' performance on the total fifty concepts of the Boehm Test of Basic Concepts, Form A, (Condition Five) and kindergarten pupils' performance on the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component (Condition Two). The total scores on the Boehm Test of Basic Concepts, Form A, (Condition Five) were not significantly related (-0.08) to the total scores on the experimental testing instrument which included a paper-and-pencil, a manipulative, and an oral expressive language component (Condition Two). A relationship to the extent of -0.08 was not considered significant at the .05 level as the Critical Value of the Pearson Product Moment Correlation Coefficient needed was .3809. There was no relationship that reached the .05 level of significance between the Boehm Test of Basic Concepts, Form A, (Condition Five) and any of the specific components in

Table 4.2

Correlation Matrix of Pre-test Instruments Used to Determine Kindergarten Pupils' Performance in Condition Five and Condition Two on Spatial Concept Tasks

	Boehm Test of Basic Concepts - Form A		Experimental Testing Instrument			
	Eight Identified Spatial Concepts	Total Score	Paper-and-Pencil	Manipulative	Oral Expressive Language	Total Score
	1	2	3	4	5	6
1	1.00					
2	0.81	1.00				
3	-0.04	0.06	1.00			
4	-0.18	-0.04	0.88	1.00		
5	-0.27	-0.27	0.62	0.60	1.00	
6	-0.17	-0.08	0.94	0.91	0.83	1.00

Critical r value = .3809 (significant at the .05 level) N = 25

the experimental testing instrument (Condition Two). See Table 4.2.

The Boehm Test of Basic Concepts, Form A, and the experimental testing instrument with its three components measured different facets of the kindergarten pupils' concept development. Analyses of the information gathered from the kindergarten pupils in Condition One and Condition Five (Boehm Test of Basic Concepts, Form A) and the information gathered from the kindergarten pupils in Condition Two (experimental testing instrument) confirmed this statement. Table 4.1 and Table 4.2 illustrate the lack of similarity between the two measurement instruments.

The null hypothesis 1.1.1 that there was no significant relationship between kindergarten pupils' performance on the total fifty concepts on the Boehm Test of Basic Concepts, Form A, and kindergarten pupils' performance on an experimental testing instrument designed to measure paper-and-pencil, manipulative, and oral expressive language tasks was accepted for the pre-test condition.

Null Hypothesis 1.1.2 - There was no significant relationship between kindergarten pupils' performance on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form A, and kindergarten pupils' performance on an experimental testing instrument designed to measure paper-and-pencil, manipulative, and oral expressive language tasks for the eight identified spatial concepts.

Table 4.1 points out the significance of the relationship between kindergarten pupils' performance on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form A, (Condition One) and kindergarten pupils' performance on an experimental testing instrument designed to measure paper-and-pencil, manipulative, and oral expressive language tasks for the eight identified spatial concepts (Condition Two). The scores for the eight identified spatial concepts on the Boehm Test of Basic Concepts, Form A, (Condition One) were not significantly related to the total scores on the experimental testing instrument which included a paper-and-pencil, a manipulative, and an oral expressive language component (Condition Two). The degree of the relationship (-0.06) was not significant at the .05 level as a critical $_{r}$ value of .4227 was needed.

When the investigator isolated the scores for the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form A, (Condition One) and isolated the paper-and-pencil component of the experimental testing instrument (Condition Two), the degree of the relationship (0.02) still was not significant at the .05 level. The experimental testing instrument with five paper-and-pencil items per concept provided a different measure of kindergarten pupils' spatial concept development than that obtained from the Boehm Test of Basic Concepts, Form A, with one paper-and-pencil item per concept.

To further ascertain whether the scores for the eight identified spatial concepts on the Boehm Test of Basic Concepts, Form A, and the scores on the experimental testing instrument were related, the investigator analyzed the data gathered from the kindergarten pupils in Condition Five (Boehm Test of Basic Concepts, Form A) and the data gathered from the kindergarten pupils in Condition Two (experimental testing instrument).

Table 4.2 illustrates the significance of the relationship between kindergarten pupils' performance on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form A, (Condition Five) and kindergarten pupils' performance on an experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component (Condition Two). The scores for the eight identified spatial concepts on the Boehm Test of Basic Concepts, Form A, (Condition Five) were not significantly related to the total scores on the experimental testing instrument which included a paper-and-pencil, a manipulative, and an oral expressive language component (Condition Two). The degree of the relationship (-0.17) was not significant at the .05 level as a critical $_{r}$ value of .3809 was required.

When the investigator isolated the scores for the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form A, (Condition Five) and isolated the paper-and-pencil component of the experimental testing

instrument (Condition Two), the degree of the relationship (-0.04) still was not significant at the .05 level (See Table 4.2). Again, the experimental testing instrument with five paper-and-pencil items per concept provided a different measure of kindergarten pupils' spatial concept development than that obtained from the Boehm Test of Basic Concepts, Form A, with one paper-and-pencil item per concept.

Therefore the null hypothesis 1.1.2 was accepted because analyses showed no significant relationship between kindergarten pupils' performance on the eight identified spatial concepts, as measured by the Boehm Test of Basic Concepts, Form A, and kindergarten pupils' performance on the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component.

Null Hypothesis 1.2 - There was no significant relationship between kindergarten pupils' performance on the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on an experimental testing instrument, after the kindergarten pupils had participated in a spatial concept instructional program designed to improve paper-and-pencil, manipulative, and oral expressive language performance on spatial concept tasks. This null hypothesis was broken down into two subsequent hypotheses.

Null Hypothesis 1.2.1 - There was no significant relationship between kindergarten pupils' performance on the total fifty concepts of the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on an experimental

testing instrument, after the kindergarten pupils had participated in a spatial concept instructional program designed to improve paper-and-pencil, manipulative, and oral expressive language performance on spatial concept tasks.

The information collected from the kindergarten pupils in Condition One (Boehm Test of Basic Concepts, Form B) and the information collected from the kindergarten pupils in Condition Three (experimental testing instrument) was analyzed in order to determine the extent of the relationship between kindergarten pupils' performance on the total fifty concepts of the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on the experimental testing instrument, after the pupils had participated in a spatial concept instructional program.

Table 4.3 shows the degree of the relationship (-0.13) between the total score on the fifty concepts of the Boehm Test of Basic Concepts, Form B, (Condition One) and the total score on the experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language components (Condition Three), after the kindergarten pupils had participated in a spatial concept instructional program. This relationship (-0.13) between the two measurement instruments was not significant at the .05 level as the Critical Value of the Pearson Product Moment Correlation Coefficient needed was .4227 (See Table 4.3). The Boehm Test of Basic Concepts, Form B, did not relate significantly to the total experimental testing instrument.

Table 4.3

Correlation Matrix of Post-test Instruments Used to Determine Kindergarten Pupils' Performance in Condition One and Condition Three On Spatial Concept Tasks

	Boehm Test of Basic Concepts Form B		Experimental Testing Instrument			
	Eight Identified Spatial Concepts	Total Score	Paper-and-Pencil	Manipulative	Oral Expressive Language	Total Score
	1	2	3	4	5	6
1	1.00					
2	0.49	1.00				
3	0.21	0.24	1.00			
4	0.30	0.29	0.28	1.00		
5	-0.08	-0.44	0.05	0.20	1.00	
6	0.12	-0.13	0.53	0.57	0.82	1.00

Critical r value = .4227

Significant at the .05 level

N = 23

Therefore the null hypothesis 1.2.1 that there was no significant relationship between kindergarten pupils' performance on the total fifty concepts of the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on an experimental testing instrument, after the kindergarten pupils had participated in a spatial concept instructional program designed to improve paper-and-pencil, manipulative, and oral expressive language performance on spatial concept tasks, was accepted.

Null Hypothesis 1.2.2 - There was no significant relationship between kindergarten pupils' performance on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on an experimental testing instrument, after the kindergarten pupils had participated in a spatial concept instructional program designed to improve paper-and-pencil, manipulative, and oral expressive language performance on spatial concept tasks.

Null Hypothesis 1.2.2 was accepted. The extent of the relationship was not significant between kindergarten pupils' performance on the eight identified spatial concepts, as measured by the Boehm Test of Basic Concepts, Form B, and kindergarten pupils' performance on an experimental testing instrument, after the kindergarten pupils had participated in a spatial concept instructional program designed to improve paper-and-pencil, manipulative, and oral expressive language performance on spatial concept tasks.

Table 4.3 points out that the relationship between kindergarten pupils' performance on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form B, (Condition One) and kindergarten pupils' performance on the experimental testing instrument (Condition Three), after the pupils had participated in a spatial concept instructional program, was not significant (0.12) at the .05 level.

When the scores for the eight identified spatial concepts, as measured by the Boehm Test of Basic Concepts, Form B, (Condition One) and the scores for the paper-and-pencil component of the experimental testing instrument (Condition Three) were analyzed, the degree of the relationship was found to be (0.21). This was not significant at the .05 level as the Critical Value of the Pearson Product Moment Correlation Coefficient needed was .4227.

To conclude, Question 1. may be answered in the following manner: The relationship between the Boehm Test of Basic Concepts, Forms A and B, and an experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component, was not significant at the .05 level before or after the spatial concept instructional program had occurred.

Analyses of the data confirms the fact that the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component measure different

aspects of kindergarten pupils' spatial concept development. Indeed, when the investigator examined the paper-and-pencil component of the experimental testing instrument (five items per concept) and the Boehm Test of Basic Concepts, Forms A and B, (one item per concept) the relationship still was not significant.

Further, it appears that in a pre-test situation, the paper-and-pencil component of the experimental testing instrument was related to a significant degree (0.88) to the manipulative component of the experimental testing instrument (See Tables 4.1 and 4.2). In a pre-test situation, the Boehm Test of Basic Concepts, Form A, (eight identified spatial concepts) was not significantly related (0.17; -0.18) to the manipulative component of the experimental testing instrument See Tables 4.1 and 4.2 respectively).

Again, it appears that in a pre-test situation the paper-and-pencil component of the experimental testing instrument was related to a significant degree (0.62) to the oral expressive language component of the experimental testing instrument (See Tables 4.1 and 4.2). In a pre-test situation, the Boehm Test of Basic Concepts, Form A, (eight identified spatial concepts) was not related to a significant extent (-0.31; -0.27) to the oral expressive language component of the experimental testing instrument (See Tables 4.1 and 4.2 respectively).

Question 2. What were the effects of a spatial concept instructional program designed to improve kindergarten pupils' performance on spatial concept tasks, as measured by the Boehm Test of Basic Concepts, Form B, and an experimental testing instrument? Two null hypotheses were formulated relating to this question. The results and analysis pertaining to each of these null hypotheses will be discussed in this section of the chapter.

Null Hypothesis 2.1 - There was no significant difference, as measured by the Boehm Test of Basic Concepts, Form B, between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program.

This null hypothesis was broken down further into two null hypotheses.

Null Hypothesis 2.1.1 - There was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the scores on the Boehm Test of Basic Concepts, Form B, for the eight identified spatial concepts.

To determine the effects of the spatial concept instructional program, the investigator compared the

performance of kindergarten pupils in Condition One (pupils participated in the instructional program) with the performance of kindergarten pupils in Condition Five (pupils did not participate in the instructional program). Performance was assessed on the basis of the eight identified concepts as measured by the Boehm Test of Basic Concepts, Form B. The Statistics on Line program used for the analysis was ST 13, correlated t-tests. The results outlined in Table 4.4 indicate that the presence of the spatial concept instructional program made a significant difference at the .05 level, $t = 6.579$, to kindergarten pupils' performance on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form B. In addition, the investigator compared the performance of the kindergarten pupils in Condition One (pupils participated in the instructional program) before and after the instructional program had occurred. Again, the results indicate that the presence of the spatial concept instructional program did make a significant difference at the .05 level, $t = 6.089$, to kindergarten pupils' performance on those spatial tasks that pertained to the eight identified spatial concepts (See Table 4.5). A comparison of pre- and post-instructional data related to the performance of kindergarten pupils in Condition Five (pupils did not participate in the instructional program) indicates there was no significant difference in kindergarten pupils' performance if they had not participated in the spatial concept instructional program, $t = 0.524$ (See Table 4.6).

Table 4.4

Means and T-Test for Effects of the Spatial Concept Instructional Program - Boehm Test of Basic Concepts, Form B (Eight Identified Concepts) Condition 1 vs. Condition 5

	Mean	S.D.	D.F.	T-Ratio
Presence of Instructional Program - Condition 1	7.500	0.722	47	
Absence of Instructional Program - Condition 5	5.600	1.225		6.579*

*significant at the .05 level

Table 4.5

Means and T-Test for Effects of the Spatial Concept Instructional Program - Boehm Test of Basic Concepts, Forms A and B (Eight Identified Spatial Concepts) Condition 1

	Mean	S.D.	D.F.	T-Ratio
Kindergarten Pupils' Performance before Instruction Condition 1	4.500	2.303	46	
Kindergarten Pupils' Performance after Instruction Condition 1	7.500	0.722		-6.089*

*significant at the .05 level

Therefore the null hypothesis 2.1.1 that there was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the scores on the Boehm Test of Basic Concepts, Form B, for the eight identified spatial concepts was rejected. Analysis of the data collected indicated that the presence of the spatial instructional program made a significant difference at the .05 level.

Null Hypothesis 2.1.2 - There was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the scores on the Boehm Test of Basic Concepts, Form B, for the total fifty concepts.

The performance of kindergarten pupils in Condition One (pupils participated in the instructional program) was compared with the performance of kindergarten pupils in Condition Five (pupils did not participate in the instructional program). Performance was assessed using the scores on the Boehm Test of Basic Concepts, Form B, for the total fifty concepts. The results described in Table 4.7 indicate that the presence of the spatial concept instructional program was not a significant factor when one compared the data gathered

Table 4.6

Means and T-Test for Effects of the Absence of the Spatial Concept Instructional Program - Boehm Test of Basic Concept, Forms A and B (Eight Identified Spatial Concepts) Condition 5

	Mean	S.D.	D.F.	T-Ratio
Kindergarten Pupils' Performance before Instruction Condition 5	5.360	1.934	48	
Kindergarten Pupils' Performance after Instruction	5.600	1.225		-0.524*

*not significant at the .05 level

Table 4.7

Means and T-Test for Effects of the Spatial Concept Instructional Program - Boehm Test of Basic Concepts, Form B (Total Score) Condition 1 vs. Condition 5

	Mean	S.D.	D.F.	T-Ratio
Presence of Instructional Program - Condition 1	34.458	6.666	47	
Absence of Instructional Program - Condition 5	31.280	6.354		1.709*

*not significant at the .05 level

on the scores of the Boehm Test of Basic Concepts, Form B, for the total fifty concepts for the kindergarten pupils in Condition One (pupils participated in the instructional program) with the scores of the Boehm Test of Basic Concepts, Form B, for the total fifty concepts for kindergarten pupils in Condition Five (pupils did not participate in the instructional program). The lack of significance observed, $t = 1.709$, when one analyzed the performance of the two groups of kindergarten pupils as measured by the total scores on the Boehm Test of Basic Concepts, Form B, might be explained by the fact that the Boehm Test of Basic Concepts screens primary children's understanding of fifty concepts, eight of which were included in this study; whereas, the spatial concept instructional program described in this study was designed to improve kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks specifically on the eight identified spatial concepts. This may be an indication that teaching activities geared to identified specific concepts improves kindergarten pupils' performance only on identified concepts.

A pre- and post-test comparison was made of the performance of kindergarten pupils in Condition Five (pupils did not participate in the instructional program) as measured by the scores on the Boehm Test of Basic Concepts for the total fifty concepts. Testing occurred before and after the instructional program had taken place. The difference between pre- and post-test performance was not significant at the .05

level, t = -0.787 (See Table 4.8). This finding tends to lend support to the effectiveness of the spatial concept instructional program.

The investigator compared the pre-test and post-test data collected for the kindergarten pupils in Condition One (pupils did participate in the instructional program). A significant difference was noted between the performance of the kindergarten pupils in Condition One before they had participated in the spatial concept instructional program and their performance after they had participated in the spatial concept instructional program, t = -2.413 (See Table 4.9).

The null hypothesis 2.1.2 that there was no significant difference between the performance of kindergarten pupils, who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the scores on the Boehm Test of Basic Concepts was accepted but accepted only in part. There was a significant difference among performance of kindergarten pupils when one analyzed the data in terms of the eight identified spatial concepts.

The second null hypothesis that was generated from the question regarding the effects of a spatial concept instructional program designed to improve kindergarten pupils' performance on spatial concept tasks as measured by the Boehm Test of Basic Concepts, Form B, and an experimental testing

Table 4.8

Means and T-Test for Effects of the Absence of the Spatial Concept Instructional Program - Boehm Test of Basic Concepts, Forms A and B (Total Score) Condition 5

	Mean	S.D.	D.F.	T-Ratio
Kindergarten Pupils' Performance before Instruction Condition 5	29.600	8.583	48	
Kindergarten Pupils' Performance after Instruction Condition 5	31.280	6.354		-0.787*

*not significant at the .05 level

Table 4.9

Means and T-Test for Effects of the Spatial Concept Instructional Program - Boehm Test of Basic Concepts, Forms A and B (Total Score) Condition 1

	Mean	S.D.	D.F.	T-Ratio
Kindergarten Pupils' Performance before Instruction Condition 1	28.667	9.685	46	
Kindergarten Pupils' Performance after Instruction Condition 1	34.458	6.666		-2.413*

*significant at the .05 level

instrument was as follows:

Null Hypothesis 2.2 - There was no significant difference between the performance of kindergarten pupils who participated in an instructional program designed to improve performance on spatial concept tasks and the performance of kindergarten pupils who had not participated in the instructional program, as measured by an experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language components. This null hypothesis was broken down into four other hypotheses.

Null Hypothesis 2.2.1 - There was no significant difference between the performance of kindergarten pupils who participated in an instructional program designed to improve performance on spatial concept tasks and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the total test score of the experimental testing instrument.

To determine whether null hypothesis 2.2.1 was accepted or rejected the investigator compared the total scores on the experimental testing instrument for the kindergarten pupils in Condition Three (pupils participated in the instructional program) with the total scores on the experimental testing instrument for the kindergarten pupils in Condition Four (pupils did not participate in the instructional program). The data was analyzed using Two-sample t-tests (SOL ST 13). The findings indicate that there was a significant difference at the .05 level, $t = 4.128$, between

the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the total test score of an experimental testing instrument. The null hypothesis 2.2.1 that there was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the total test score of an experimental testing instrument was rejected. There was a significant difference at the .05 level (See Table 4.10).

Null Hypothesis 2.2.2 - There was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program as measured by the paper-and-pencil component of the experimental testing instrument.

To determine whether hypothesis 2.2.2 was accepted or rejected the scores on the paper-and-pencil component of the experimental testing instrument for the kindergarten pupils in Condition Three (pupils participated in the instructional program) were compared with the scores on the paper-and-pencil component of the experimental testing instrument for the

Table 4.10

Means and T-Test for Effects of the Spatial Concept Instructional Program - Experimental Testing Instrument (Total Test Score)

Condition 3 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils who participated in the Instructional Program Condition 3	78.087	5.169	44	
Pupils who had not participated in the Instructional Program Condition 4	62.348	17.541		4.128*

*significant at the .05 level

Table 4.11

Means and T-Test for Effects of the Spatial Concept Instructional Program - Experimental Testing Instrument (Paper-and-Pencil)

Condition 3 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils who participated in the Instructional Program Condition 3	37.348	2.080	44	
Pupils who had not participated in the Instructional Program Condition 4	30.087	8.101		4.163*

*significant at the .05 level

kindergarten pupils in Condition Four (pupils did not participate in the instructional program). Two-sample t-tests (SOL ST 13) were used to compare the data. A significant difference was found at the .05 level, t = 4.163 (See Table 4.11). The null hypothesis 2.2.2 was rejected as there was a significant difference, at the .05 level, between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the paper-and-pencil component of the experimental testing instrument.

Null Hypothesis 2.2.3 - There was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the manipulative component of the experimental testing instrument.

To determine whether hypothesis 2.2.3 was accepted or rejected the scores on the manipulative component of the experimental testing instrument for the kindergarten pupils in Condition Three (pupils participated in the instructional program) were compared with the scores on the manipulative component of the experimental testing instrument for the kindergarten pupils in Condition Four (pupils did not participate in the instructional program). A significant

difference at the .05 level was noted, t = 3.155, between the performance of kindergarten pupils who had participated in an instructional program, designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program as measured by the manipulative component of the experimental testing instrument (See Table 4.12). Therefore, the null hypothesis 2.2.3 was rejected as there was a significant difference at the .05 level between the kindergarten pupils' performance in Condition Three (pupils participated in the instructional program) and the kindergarten pupils' performance in Condition Four (pupils did not participate in the instructional program), as assessed by the manipulative component of the experimental testing instrument.

Null Hypothesis 2.2.4 - There was no significant difference between the performance of kindergarten pupils who participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the oral expressive language component of the experimental testing instrument.

To determine whether hypothesis 2.2.4 was accepted or rejected the scores on the oral expressive language component of the experimental testing instrument for the pupils in Condition Three (pupils participated in the instructional program) were compared, using Two-sample t-tests, with the scores on the oral expressive language component of

Table 4.12

Means and T-Test for Effects of the Spatial Concept Instructional Program - Experimental Testing Instrument (Manipulative) Condition 3 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils who participated in the Instructional Program Condition 3	22.739	1.630	44	
Pupils who had not participated in the Instructional Program Condition 4	18.957	5.514		3.155*

*significant at the .05 level

Table 4.13

Means and T-Test for Effects of the Spatial Concept Instructional Program - Experimental Testing Instrument (Oral Expressive Language) Condition 3 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils who participated in the Instructional Program Condition 3	18.000	3.826	44	
Pupils who had not participated in the Instructional Program Condition 4	13.304	5.950		3.183*

*significant at the .05 level

the experimental testing instrument for the kindergarten pupils in Condition Four (pupils did not participate in the instructional program). The findings showed a significant difference at the .05 level, t = 3.183, between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the oral expressive language component of the experimental testing instrument (See Table 4.13). Consequently the null hypothesis 2.2.4 was rejected as there was a significant difference at the .05 level between the performance scores of the two kindergarten groups.

Therefore, it may be concluded that null hypothesis 2.1 was accepted only in part. There was no significant difference as measured by the Boehm Test of Basic Concepts, Form B, (total fifty concepts) between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program t = 1.709 (See Table 4.7). However, when the data was analyzed using only the scores for the eight identified spatial concepts, a significant difference at the .05 level, t = 6.579, was observed between the kindergarten pupils' performance in the two groups (See Table 4.4).

This difference might be explained by the fact that the Boehm Test of Basic Concepts, Form A, is a screening instrument based on fifty basic concepts. The spatial concept instructional program designed for this study consisted of seven of the fifty concepts assessed on the Boehm Test of Basic Concepts. Therefore, the instructional program was geared only to a portion of the Boehm Test of Basic Concepts and knowledge of specific concepts does not appear to generalize to other concepts.

The null hypothesis 2.2 that there was no significant difference between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the experimental testing instrument was rejected completely. A significant difference was observed at the .05 level, when the total scores on the experimental testing instrument were analyzed, $t = 4.128$ (See Table 4.10). A significant difference at the .05 level was noted when the performance scores on the paper-and-pencil component for the two groups of kindergarten pupils were compared, $t = 4.163$ (See Table 4.11). A significant difference was observed between the two groups of kindergarten pupils' performance when the scores on manipulative component of the experimental testing instrument was compared ($t = 3.155$; See Table 4.12). A significant difference was noted ($t = 3.183$) for the oral expressive language component of the experimental

testing instrument when the investigator compared the performance scores of kindergarten pupils who had participated in the instructional program with the performance scores of kindergarten pupils who had not participated in the instructional program (See Table 4.13).

To further determine the effectiveness of the spatial concept instructional program, the investigator compared the performance scores of the kindergarten pupils in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) with the performance scores of the kindergarten pupils in Condition Four (post instruction testing; pupils did not participate in the instructional program). The main purpose of this comparison was to determine whether the difference described between kindergarten pupils' spatial concept task performance in Condition Three (pupils did participate in the instructional program) and kindergarten pupils' spatial concept task performance in Condition Four (pupils did not participate in the instructional program) might be attributed to the spatial concept instructional program or some other factor such as maturational growth. The investigator administered the experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language components to the kindergarten pupils in Condition Two (pre-instruction testing) in the middle of January, 1980. The same testing instrument with its components was administered to another group of kindergarten pupils in Condition Four (post-instruction

testing) during the second and third week of March, 1980. Kindergarten pupils were randomly placed into Conditions Two and Four. Neither group of kindergarten pupils had participated in the spatial concept instructional program. The data was analyzed using Two-sample t-tests (SOL ST 13). The results will be reported in the following section.

There was no significant difference between the kindergarten pupils' performance in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) and the kindergarten pupils' performance in Condition Four (post-instruction testing; pupils did not participate in the instructional program) when the total scores on the experimental testing instrument were analyzed, $t = 0.873$, (See Table 4.14).

The difference between kindergarten pupils' performance in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) and kindergarten pupils' performance in Condition Four (post-instruction testing; pupils did not participate in the instructional program) was not significant at the .05 level, $t = 0.711$ when the paper-and-pencil component of the experimental testing instrument was analyzed (See Table 4.15).

There was no significant difference between kindergarten pupils' performance in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) and kindergarten pupils' performance in Condition Four (post-instruction testing; pupils did not

Table 4.14

Means and T-Test for Effects of Two Months Time Span between Administration of Experimental Testing Instrument (Total Test Score) Condition 2 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils' Performance as measured in January, 1980-Condition 2	58.000	16.939	46	
Pupils' Performance as measured in March, 1980-Condition 4	62.348	17.541		-0.873*

*not significant at the .05 level

Table 4.15

Means and T-Test for Effects of Two Month Time Span between Administration of Experimental Testing Instrument (Paper-and-Pencil) Condition 2 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils' Performance as measured in January, 1980-Condition 2	28.400	8.317	46	
Pupils' Performance as measured in March, 1980-Condition 4	30.087	8.101		-0.711*

*not significant at the .05 level

participate in the instructional program) on the manipulative component of the experimental testing instrument, t = -1.367 (See Table 4.16).

There was no significant difference at the .05 level between the kindergarten pupils' performance in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) with the kindergarten pupils' performance in Condition Four (post-instruction testing; pupils did not participate in the instructional program) on the oral expressive language component of the experimental testing instrument, t = -0.401, (See Table 4.17).

The significant differences observed between the pupils' performance in Condition Three (pupils did participate in the instructional program) and the pupils' performance in Condition Four (pupils did not participate in the instructional program) on the total score and the three components of the experimental testing instrument were not apparent when one analyzed the kindergarten pupils' performance in Condition Two (pre-instruction testing) and the kindergarten pupils' performance in Condition Four (post-instruction testing) on the experimental testing instrument with its three components. Therefore the difference in performance that was observed after the instructional program had occurred might be attributed to some factor other than a maturational effect.

The spatial concept instructional program described in this study does appear to have a significant effect upon kindergarten pupils' performance on paper-and-pencil,

Table 4.16

Means and T-Test for Effects of Two Month Time Span between Administration of Experimental Testing Instrument (Manipulative) Condition 2 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils' Performance as measured in January, 1980-Condition 2	17.000	4.378	46	
Pupils' Performance as measured in March, 1980-Condition 4	18.957	5.514		-1.367*

*not significant at the .05 level

Table 4.17

Means and T-Test for Effects of Two Month Time Span between Administration of Experimental Testing Instrument (Oral Expressive Language) Condition 2 vs. Condition 4

	Mean	S.D.	D.F.	T-Ratio
Pupils' Performance as measured in January, 1980-Condition 2	12.600	6.185	46	
Pupils' Performance as measured in March, 1980-Condition 4	13.304	5.950		-0.401*

*not significant at the .05 level

manipulative, and oral expressive language tasks. Therefore, Question 2 may be answered as follows: There was a significant difference between kindergarten pupils' performance after they had participated in a spatial concept instructional program, as measured by the Boehm Test of Basic Concepts, Form B, (eight identified spatial concepts) and the experimental testing instrument, total score or any of its three components. The spatial concept instructional program did have an effect upon performance on tasks related to the eight identified spatial concepts.

Question 3. What percentage of subjects performed to criterion on the paper-and-pencil, the manipulative, and the oral expressive language components of the experimental testing instrument? The data collected for the investigation pertaining to this question mainly was descriptive in nature. The results accumulated are reported in the following section under three sub-questions.

Question 3.1 - What percentage of kindergarten pupils performed to criterion (four of five items correct) on paper-and-pencil spatial concept tasks?

The information pertaining to this question will be outlined for the pupils in Condition Two (pre-instruction testing; pupils did not participate in the instructional program), Condition Three (post-instruction testing; pupils participated in the instructional program), and Condition Four post-instruction testing; pupils did not participate in

the instructional program). Data will be presented for the number of pupils who performed to criterion in each Condition for each of the components of the experimental testing instrument. Then, data will be presented for the percentage of pupils who performed to criterion in each Condition for each of the components of the experimental testing instrument. Additional data pertaining to each of the eight identified spatial concepts might be found by referring to Table 4.18.

Paper-and-Pencil Component

In Condition Two (pre-instruction testing; pupils did not participate in the instructional program) an average of 15.25 pupils of the twenty-five pupils (61 percent) performed to criterion (four of five items correct) on the paper-and-pencil tasks of the experimental testing instrument.

In Condition Three (post-instruction testing; pupils participated in an instructional program) an average of twenty-two of the twenty-three pupils (95.65 percent) performed to criterion (four of five items correct) on the paper-and-pencil tasks of the experimental testing instrument.

In Condition Four (post-instruction testing; pupils did not participate in the instructional program) an average of fifteen of the twenty-three pupils (65.22 percent) performed to criterion (four of five items correct) on the paper-and-pencil tasks of the experimental testing instrument.

In total 73.96 percent of the pupils in Conditions

Table 4.18
Number and Percentage of Kindergarten Pupils Who Demonstrated Mastery in the Eight Identified Spatial Concepts Through the Three Response Modes

Concept		Condition 2 N=25			Condition 3 N=23			Condition 4 N=23		
		Paper-and-Pencil	Manipulative	Oral Exp. Lang.	Paper-and-Pencil	Manipulative	Oral Exp. Lang.	Paper-and-Pencil	Manipulative	Oral Exp. Lang.
AFTER	Raw Score	14	21	13	22	22	16	15	17	11
	Percentage	56.0	84.0	52.0	95.65	95.65	69.57	65.22	73.91	47.83
BEGINNING	Raw Score	15	15	9	23	23	15	14	15	10
	Percentage	60.0	60.0	36.0	100	100	65.22	60.87	65.22	43.48
BEHIND	Raw Score	14	8	20	23	18	20	10	13	18
	Percentage	56.0	32.0	80.0	100	78.26	86.96	43.48	56.52	78.26
BELOW	Raw Score	11	18	11	17	23	21	13	20	15
	Percentage	44.0	72.0	44.0	73.91	100	91.3	56.52	86.96	65.22
FORWARD	Raw Score	9	20	17	23	22	21	12	20	19
	Percentage	36.0	80.0	68.0	100	95.65	91.3	52.17	86.96	82.61
NEAREST	Raw Score	22	22	6	23	22	10	19	20	5
	Percentage	88.0	88.0	24	100	95.65	43.48	82.61	86.96	21.76
NEXT TO	Raw Score	21	19	11	23	23	18	19	21	12
	Percentage	84.0	76.0	44.0	100	100	78.26	82.61	91.3	52.17
TOP	Raw Score	16	24	18	22	23	23	18	22	18
	Percentage	64.0	96.0	72.0	95.65	100	100	78.26	95.65	78.26

Two, Three, and Four who participated in this study were able to demonstrate mastery in their understanding of the eight identified spatial concepts through the paper-and-pencil response mode.

Manipulative Component

Question 3.2 - What percentage of kindergarten pupils performed to criterion (two of three items correct) on manipulative spatial concept tasks?

In Condition Two (pre-instruction testing; pupils did not participate in the instructional program) an average of 18.38 of the twenty-five pupils (73.5 percent) performed to criterion (two of three items correct) on the manipulative tasks of the experimental testing instrument.

In Condition Three (post-instruction testing, pupils participated in the instructional program) an average of twenty-two of the twenty-three pupils (95.65 percent) performed to criterion (two of three items correct) on the manipulative tasks of the experimental testing instrument.

In Condition Four (post-instruction testing; pupils did not participate in the instructional program) an average of 18.5 of the twenty-three pupils (80.43 percent) performed to criterion (two of three items correct) on the manipulative tasks of the experimental testing instrument.

In total 83.19 percent of the kindergarten pupils in Conditions Two, Three, and Four who had participated in this study were able to demonstrate mastery in their understanding

of the eight identified spatial concepts through the manipulative response mode.

Oral Expressive Language Component

Question 3.3 - What percentage of kindergarten pupils performed to criterion (two of three items correct) on oral expressive language spatial concept tasks?

In Condition Two (pre-instruction testing; pupils did not participate in the instructional program) an average of 13.13 of the twenty-five pupils (52.5 percent) performed to criterion (two of three items correct) on the oral expressive language tasks of the experimental testing instrument.

In Condition Three (post-instruction testing; pupils participated in the instructional program) an average of eighteen of the twenty-three pupils (78.26 percent) performed to criterion (two of three items correct) on the oral expressive language tasks of the experimental testing instrument.

In Condition Four (post-instruction testing; pupils did not participate in the instructional program) an average of 13.5 of the twenty-five pupils (58.70 percent) performed to criterion (two of three items correct) on the oral expressive language tasks of the experimental testing instrument.

In all, 63.15 percent of the kindergarten pupils in Conditions Two, Three, and Four who participated in this study were able to demonstrate mastery in their understanding

of the eight identified spatial concepts through the oral expressive language response mode.

In conclusion, Question 3 may be answered in the following manner: The average percentage of subjects in Conditions Two, Three, and Four who performed to criterion (four of five items correct) on the paper-and-pencil tasks was 73.96 percent. The average percentage of subjects in Conditions Two, Three, and Four who performed to criterion (two of three items correct) on the manipulative spatial concept tasks was 83.19 percent. The average percentage of subjects in Conditions Two, Three, and Four who performed to criterion (two of three items correct) on the oral expressive language spatial concept tasks was 63.15 percent.

It was noted that more pupils performed to criterion on the manipulative spatial concept tasks than on the paper-and-pencil spatial concept tasks and the oral expressive language spatial concept tasks. More of the kindergarten pupils in Condition Three (post-instruction testing; pupils had participated in the instructional program) performed to criterion on the three components of the experimental testing instrument, i.e., paper-and-pencil, manipulative and oral expressive language. This might be an indication of the effectiveness of the spatial concept instructional program.

Question 4. To what degree did the paper-and-pencil, the manipulative, and the oral expressive language tasks relate as measures of the kindergarten pupils' performance on spatial concept tasks? Three null hypotheses were formulated

in relation to this question.

Null Hypothesis 4.1 - There was no significant relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils' performance on paper-and-pencil spatial concept tasks.

To determine if hypothesis 4.1 was accepted or rejected the investigator examined the raw scores that the kindergarten pupils had obtained in Condition Two (pre-instruction testing; pupils did not participate in the instructional program), Condition Three (post-instruction testing; pupils participated in the instructional program), and Condition Four (post-instruction testing; pupils did not participate in the instructional program). The raw scores for the experimental testing instrument with each of its components, paper-and-pencil, manipulative, and oral expressive language were converted into percentages. By means of Multiple Correlations (SOL ST 32) the investigator determined the extent of relationships that existed among the total score percentages of the experimental testing instrument and each of the three components as measures of kindergarten pupils' performance on spatial concept tasks (See Table 4.19). The results will be discussed in this section.

Table 4.19 shows the extent of the relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils' performance on paper-and-pencil spatial concept tasks as measures of

Table 4.19

Correlation Matrix of Kindergarten Pupils Performance in Conditions Two, Three, and Four on the Total Experimental Testing Instrument and its Three Components, Paper-and-Pencil, Manipulative and Oral Expressive Language

	Experimental Testing Instrument			
	Paper-and-Pencil	Manipulative	Oral Expressive Language	Total
1	1.00			
2	0.85	1.00		
3	0.66	0.65	1.00	
4	0.94	0.91	0.85	1.00

Critical Value at .05 level = .2319

N = 71

kindergarten pupils' performance on spatial concept tasks. The degree of the relationship between the two measures of kindergarten pupils' performance was significant at the .05 level (.85). The Critical Value of the Pearson Product Moment Correlation Coefficient needed was .2319. The null hypothesis 4.1 was rejected as the extent of the relationship between manipulative spatial concept tasks and paper-and-pencil spatial concept tasks as measures of kindergarten pupils' performance was significant at the .05 level (.85) See Table 4.19.

Null Hypothesis 4.2 - There was no significant relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks.

The degree of the relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks may be seen in Table 4.19. The extent of the relationship between the two measures of kindergarten pupils' performance, manipulative spatial concept tasks and oral expressive language spatial concept tasks, was significant at the .05 level (.65). The Critical Value of the Pearson Product Moment Correlation Coefficient needed was .2319. The null hypothesis 4.2 was rejected as there was a significant relationship between kindergarten pupils' performance on manipulative spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks.

Null Hypothesis 4.3 - There was no significant relationship between kindergarten pupils' performance on paper-and-pencil spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks.

Table 4.19 shows that the extent of the relationship between kindergarten pupils' performance on paper-and-pencil spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks was significant at the .05 level (.66). The Critical Value of the Pearson Product Moment Correlation Coefficient needed was .2319. Therefore the null hypothesis 4.3 was rejected as the relationship between kindergarten pupils' performance on paper-and-pencil spatial concept tasks and kindergarten pupils' performance on oral expressive language spatial concept tasks was significant at the .05 level. Therefore, the two measures, paper-and-pencil spatial concept tasks and oral expressive language spatial concept tasks, were related as assessment instruments in determining kindergarten pupils' performance on spatial concept tasks.

In conclusion, the components of the experimental testing instrument, i.e., paper-and-pencil, manipulative, and oral expressive language were related to a significant extent as measures of kindergarten pupils' performance on spatial concept tasks. However, kindergarten pupils' performance on the manipulative component of the experimental testing instrument was more similar to kindergarten pupils' performance

on the paper-and-pencil component of the experimental testing instrument (.85), than was kindergarten pupils' performance on the oral expressive language component of the experimental testing instrument (.66). This difference in the degree of similarity might be explained by the fact that the kindergarten pupils had to produce the exact verbal label of the spatial concept under investigation if they were to be given credit for mastery of the spatial concept. As previously stated in Chapter 3 often kindergarten pupils supplied synonyms for the spatial concept required (See Appendix C). If the investigator had accepted synonyms for the requested concept the extent of the relationships among the three measurement devices, i.e., paper-and-pencil, manipulative and oral expressive language might have been greater.

Question 4 may be answered as follows: The paper-and-pencil, the manipulative, and the oral expressive language tasks were related to a significant extent as measures of kindergarten pupils' performance on spatial concept tasks.

Chapter 5

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Introduction

The main purposes of this study were to determine the degree to which kindergarten pupils possess certain selected spatial concepts and to investigate the effects of a spatial concept instructional program upon kindergarten pupils' performance on paper-and-pencil, manipulative, and oral expressive language tasks.

Kindergarten pupils' performance on the Boehm Test of Basic Concepts and the experimental testing instrument with its paper-and-pencil, its manipulative, and its oral expressive language components were analyzed in an attempt to determine the effectiveness of these instruments as measures of kindergarten pupils' performance on spatial concept tasks.

In addition, the effects of a spatial concept instructional program were measured by comparing the performance of kindergarten pupils who had participated in the spatial concept instructional program with the performance of the kindergarten pupils who had not participated in this program.

The dependent variables in this study were the Boehm Test of Basic Concepts (Forms A and B), and an experimental testing instrument with its paper-and-pencil, its manipulative,

and its oral expressive language components. The independent variable in this study was the spatial concept instructional program. The independent variable had two levels of operation, the presence of the spatial concept instructional program and the absence of the spatial concept instructional program.

Theoretical Background

Previous research has shown a need for further exploration of basic concept assessment procedures. Concerns have been raised about paper-and-pencil testing as a sole method of evaluating a pupil's conceptual performance level especially for young children (Beagles-Roos and Greenfield, 1979; Boehm, 1966; Carroll, 1964; Meissner, 1975; Newcombe et al, 1977). The need for a 'match' between the level of development of the child and the nature of the task requirement incorporated into the assessment instrument has been emphasized (Blank, 1974; Borke, 1975).

There has been limited research into instructional programs designed to teach basic concepts. Studies support the hypothesis that basic concepts can be taught (Meissner, 1975; Moers and Harris, 1978; Priddle and Rubin, 1977). However, the necessity of further exploration into the ingredients of an effective instructional program was stressed.

The writer examined the literature on concept development and its relationship to variables such as: age/grade, socioeconomic/sociocultural factors, intelligence/

academic achievement, sex of pupil, language acquisition, beginning reading, and learning conditions.

The age of the pupil was a variable to be given consideration in the evaluation of a pupil's concept development (Boehm, 1966; Bruner and Olver, 1965; Denny and Moulton, 1976; Faw and Wingard, 1977; Meissner, 1975).

The research in the area of socioeconomic/sociocultural factors and concept development demonstrated that there was a definite relationship between a pupil's concept development and his/her socioeconomic/sociocultural background. It was stressed that the socioeconomic status of the pupil had a direct influence upon the pupil's conceptual development (Boehm, 1966; Dixon and Saltz, 1977; Downing et al, 1970; Houck et al, 1973; Nazarro and Nazarro, 1973).

Klausmeier et al (1974:187) concluded after summarizing much of the existing literature that "almost invariably a strong, positive relationship is noted between achievement level and concept development". However some of the literature examined demonstrated the need on the part of the educator to be aware of intervening variables such as: motivation, emotional stability, sociocultural background, testing instruments, etc. (Boehm, 1966).

A limited number of research studies exploring the relationship between the sex of the pupil and the level of concept development were examined but the investigator was unable to draw any definite conclusions because of the diversity of findings (Archer, 1975; Boehm, 1966; Bruner and

Olver, 1965; Friedman and Seely, 1976; Meissner, 1975; Pishkin and Willis, 1974).

There has been evidence that language acquisition has a significant bearing upon the pupil's measurable level of concept development (Clark, E., 1973; Clark, H., 1973; French and Brown, 1977; Friedman and Seely, 1976; Friedenberg and Olson, 1977).

The relationship between the knowledge of concepts and beginning reading has come under investigation. Initially it appears there is a positive relationship between the two variables (Downing et al, 1977; Hardy et al, 1974; Hoffman and Fillmer, 1979; Kress, 1955; MacGinitie, 1976).

One general conclusion that might be drawn from the research studies exploring the development of instructional programs for the teaching of basic concepts is that the most effective instructional programs appear to occur when there is a 'match' between instructional procedures and the learning style of the pupil (Archer, 1975; Becker et al, 1979; Caldwell and Hall, 1970; Engelmann, 1969; Katz and Denny, 1977; Priddle and Rubin, 1977).

Methodology

The pupils who participated in this study were one hundred and twenty kindergarten children from five classes in two elementary schools in the same school division in Winnipeg, Manitoba. Morning and afternoon kindergarten pupils were used. The children from each classroom were assigned randomly to one

of five conditions. These five conditions were described in detail in the section entitled Procedures in Chapter 3. The type of measure each child received on the eight identified spatial concepts was dependent upon the Condition (One to Five) into which the child was placed (See Figure 3.5). The pupils in Condition One and Condition Three participated in a spatial concept instructional program. This instructional program consisted of seven teaching sessions of approximately twenty to twenty-five minutes in length. The concepts stressed in this program were: after, beginning, behind, below, forward, next to, and top.

The analyses of the findings in this study have led to several main conclusions as well as some implications for further research and for classroom practice.

Findings and Conclusions

In this section the findings will be presented together with the conclusions in relation to the four main questions originally stated.

Question 1. What was the relationship between the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument designed to measure kindergarten pupils' performance on spatial concept tasks?

The extent of the relationship between the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component was significant at the .05

level. The significance of the relationship between the assessment instruments was observed when both the pre-test and post-test kindergarten pupils' performance scores were analyzed.

Analysis of the data confirms the fact that the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing instrument with a paper-and-pencil, a manipulative, and an oral expressive language component measure different aspects of kindergarten pupils' spatial concept development. When the paper-and-pencil component of the experimental testing instrument (five items per concept) and the Boehm Test of Basic Concepts, Forms A and B, (one paper-and-pencil item per concept) were examined the degree of the relationship which existed between the two measurement instruments was not significant ($r = 0.02$) at the .05 level.

Further the paper-and-pencil component of the experimental testing instrument was found to be significantly similar to the manipulative and oral expressive language components of the experimental testing instrument when kindergarten pupils' performance scores on the three components were analyzed ($r = 0.88$; $r = 0.62$, respectively). However, the Boehm Test of Basic Concepts, Form A, was not found to be significantly related to the manipulative and the oral expressive language components of the experimental testing instrument ($r = 0.22$; $r = -0.31$, respectively).

Therefore, it can be concluded that the Boehm Test of Basic Concepts, Forms A and B, and the experimental testing

instrument are assessment instruments which provide the examiner with different types of information pertaining to kindergarten pupils' spatial concept development. Even when only the paper-and-pencil tests were administered the data provided lacked significant similarity ($r = 0.06$). This lack of similarity is not surprising when the items of the two testing instruments are considered. The Boehm Test of Basic Concepts screens primary children's understanding of fifty basic concepts; whereas, the experimental testing instrument assesses kindergarten pupils' mastery of eight identified spatial concepts. However when only the eight identified spatial concepts on the Boehm Test of Basic Concepts were analyzed with the paper-and-pencil component of the experimental testing instrument the lack of similarity was still apparent ($r = 0.02$). The experimental testing instrument (five paper-and-pencil items per concept) provided the examiner with different data than the Boehm Test of Basic Concepts, Form A, (one paper-and-pencil item per concept).

On the basis of the data gathered the experimental testing instrument, the paper-and-pencil component, provides the teacher with information more similar in nature to the manipulative and oral expressive language components. For this reason educators should be encouraged to use the experimental testing instrument. Although the experimental testing instrument is more time-consuming to administer than the Boehm Test of Basic Concepts, the information gained is such that the teacher has greater insight into various facets of

kindergarten pupils' concept development.

Question 2. What were the effects of a spatial concept instructional program designed to improve kindergarten pupils' performance on spatial concept tasks as measured by the Boehm Test of Basic Concepts and an experimental testing instrument?

Analyses of the data pertaining to this question were conducted by using Statistics on Line program ST 13, two sample t-tests. To determine the effects of the spatial concept instructional program the investigator compared the performance of kindergarten pupils in Condition One (pupils participated in the spatial concept instructional program) with the performance of kindergarten pupils in Condition Five (pupils did not participate in the spatial concept instructional program). Analysis of the data collected on the eight identified spatial concepts as measured by the Boehm Test of Basic Concepts, Form B, indicated that the presence of the spatial concept instructional program made a significant difference at the .05 level, $t = 6.579$.

The performance of kindergarten pupils in Condition One (pupils participated in the instructional program) was compared with the performance of kindergarten pupils in Condition Five (pupils did not participate in the instructional program). Performance was assessed using the scores on the Boehm Test of Basic Concepts, Form A, for the total fifty concepts. The results indicated that the presence of the spatial concept instructional program was not a significant

factor, t = 1.709. The lack of significance, when one analyzed the performance of the two groups of kindergarten pupils, as measured by the total score on the Boehm Test of Basic Concepts, Form A, might be explained by the fact the Boehm Test of Basic Concepts screens fifty concepts in total; whereas the spatial concept instructional program was designed to improve kindergarten pupils' performance on seven spatial concepts. This is an indication that teaching activities geared to identified specific concepts improves kindergarten pupils' performance only on those identified concepts.

The difference between pre- and post-test performance of kindergarten pupils in Condition Five (pupils did not participate in the instructional program)was not significant at the .05 level, t = 0.787. This finding also demonstrates the effectiveness of the spatial concept instructional program.

A significant difference was noted between the performance of the kindergarten pupils in Condition One (pupils participated in the instructional program) before they had participated in the spatial concept instructional program and their performance after they had participated in the spatial concept instructional program, t = -2.413.

The investigator compared the total scores on the experimental testing instrument for the kindergarten pupils in Condition Three (pupils participated in the instructional program) with the total scores on the experimental testing

instrument for the kindergarten pupils in Condition Four (pupils did not participate in the instructional program). The data was analyzed using Two-sample t-tests (SOL ST 13). The findings indicated that there was a significant difference at the .05 level, $t = 4.128$, between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the total test scores of an experimental testing instrument.

There was a significant difference at the .05 level, $t = 4.163$, between the performance of kindergarten pupils who had participated in an instructional program designed to improve performance on spatial concept tasks and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the paper-and-pencil component of the experimental testing instrument.

The scores on the manipulative component of the experimental testing instrument for the kindergarten pupils in Condition Three (pupils participated in the instructional program) were compared with the scores on the manipulative component of the experimental testing instrument for the kindergarten pupils in Condition Four (pupils had not participated in the instructional program). A significant difference at the .05 level, $t = 3.155$ was found.

Findings showed a significant difference at the .05 level, $t = 3.183$, between the performance of kindergarten pupils who had participated in the instructional program designed to improve performance on spatial concept tasks, and the performance of kindergarten pupils who had not participated in the instructional program, as measured by the oral expressive language component of the experimental testing instrument.

To further determine the effectiveness of the spatial concept instructional program, the investigator compared the performance scores of the kindergarten pupils in Condition Two (pre-instruction testing; pupils did not participate in the instructional program) with the performance scores of the kindergarten pupils in Condition Four (post-instruction testing; pupils did not participate in the instructional program).

The main purpose of this comparison was to determine whether the difference described between kindergarten pupils' spatial concept task performance in Condition Three (post-instruction testing; pupils participated in the instructional program) and kindergarten pupils' spatial concept task performance in Condition Four (post-instruction testing; pupils did not participate in the instructional program) might be attributed to the spatial concept instructional program or some other factor such as maturational growth.

There was no significant difference between the kindergarten pupils' performance in Condition Two (pre-

instruction testing; pupils did not participate in the instructional program) and the kindergarten pupils' performance in Condition Four (post-instruction testing; pupils did not participate in the instructional program), when either the total or any of the three component scores on the experimental testing instrument were analyzed.

In conclusion, the significant differences that were observed between the kindergarten pupils' performance in Condition Three (pupils did participate in the instructional program) and the pupils' performance in Condition Four (pupils did not participate in the instructional program) on the total scores and the three component scores of the experimental testing instrument were not apparent when one analyzed the kindergarten pupils' performance in Condition Two (pre-instruction testing) and the kindergarten pupils' performance in Condition Four (post-instruction) on the experimental testing instrument with its three components. The difference in performance that was observed after the instructional program had occurred might be attributed to some factor other than maturation. The spatial concept instructional program described in this study does appear to have a significant effect upon kindergarten pupils performance on tasks related to the eight identified spatial concepts.

One of the conclusions that might be drawn from the results of this study is that teachers should recognize the value of teaching concepts to kindergarten pupils. The results indicate that spatial concepts can be taught and that

instruction does make a significant difference to kindergarten pupils' performance on spatial concept tasks.

In this study the spatial concept instructional lessons were taught to small groups of children, i.e., four or five pupils at a time. Some aspects of the spatial concept instructional program would be more feasible with class size groupings than others. The oral expressive language activities should be conducted in small groups when possible in order that the young pupil be given ample opportunity to develop and utilize his oral communication skills (Meissner, 1975).

Teachers should realize that some facets of a spatial concept require more varied teaching methodology than other facets of the same concept. For example, in this study approximately ninety percent of the kindergarten pupils in Conditions One, Two, and Five (pre-test situation) were able to recognize the spatial concept 'nearest' on a paper-and-pencil task. However, many of these same children were unable to demonstrate mastery of the spatial concept 'nearest' on the oral expressive language component. Because the pupils were given credit for mastery only when they orally provided the exact concept label it is difficult to say whether the pupils lacked understanding of the concept 'nearest' or merely were unable to provide the accurate label. The synonyms kindergarten pupils produced for the spatial concept 'nearest' leads one to suspect that the pupils possessed knowledge of the concept but they did not possess

superlative endings (See Appendix C). Teachers should take this facet of kindergarten pupils' concept development into account when developing spatial concept instructional programs. The findings in this study support Boehm's conclusion (1966) that concept attainment is developmental in nature.

In addition, teachers should consider that some concepts are represented more effectively through the paper-and-pencil response mode than others. The concept 'forward' was difficult to represent on paper as it primarily deals with movement. The paper-and-pencil tasks for assessing pupils' mastery of the concept 'forward' often had to have a qualifying prepositional phrase attached, e.g., "looking forward at you". This made it difficult to determine whether the pupils understood the concept 'forward' or were assisted by the presence of the prepositional phrase. However, the same kindergarten pupils were able to demonstrate mastery of the spatial concept 'forward' through the manipulation of small objects or the movement of their bodies. Again, the findings reported here are in agreement with Boehm (1966). Often three dimension concepts such as 'behind' are difficult to represent through a two dimensional medium.

Question 3. What percentage of subjects performed to criterion on the paper-and-pencil, the manipulative, and the oral expressive language components of the experimental testing instrument?

The average percentage of subjects in Condition Two, Three and Four who performed to criterion (four of five items correct) on the paper-and-pencil tasks was 73.96 percent. The average percentage of subjects in Conditions Two, Three, and Four who performed to criterion (two of three items correct) on the manipulative spatial concept tasks was 83.19 percent. The average percentage of subjects in Conditions Two, Three and Four who performed to criterion (two of three items correct) on the oral expressive language component of the experimental testing instrument was 63.15 percent.

It was noted that more pupils performed to criterion on the manipulative spatial concept tasks than on the paper-and-pencil spatial concept tasks and the oral expressive language spatial concept tasks. The difference between kindergarten pupils' performance on the oral expressive language component of the experimental testing instrument and the manipulative and paper-and-pencil components may have been due to the marking criterion used for the oral expressive language component. For this study kindergarten pupils were required to verbally produce the exact label for the spatial concept under investigation if they were to be accredited with mastery of the oral expressive language spatial concept. However, many of the kindergarten pupils were able to supply a synonym for the spatial concept required (See Appendix C). Pupils were not given credit for synonyms. If the marking system had been such that synonyms were taken into account, the percentage of pupils who performed to criterion on oral

expressive language components might have been higher. Teachers should realize that pupils often may possess an understanding of the spatial concept but they do not have the exact verbal label in their language. Teachers should make allowances for this fact in their instructional procedures.

Because a greater percentage of kindergarten pupils performed to criterion on the manipulative tasks (two of three items correct), it would be adviseable for teachers to use that component of the experimental testing instrument if they were forced to choose only one because of time constraints. In addition, the manipulative component of the experimental testing instrument is significantly similar to the paper-and-pencil component of the experimental testing instrument ($r = 0.85$).

Question 4. To what degree were the paper-and-pencil, the manipulative, and the oral expressive language tasks related as measures of kindergarten pupils' performance on spatial concept tasks.

By means of Multiple Correlations (SOL ST 32) the investigator determined the extent of the relationships that existed among the total score percentage of the experimental testing instrument and each of the component score percentages.

The components of the experimental testing instrument, i.e., paper-and-pencil, manipulative, and oral expressive language, were related to a significant extent (.05 level) as measures of kindergarten pupils' performance on spatial concept tasks. However, kindergarten pupils' performance on the manipulative component of the experimental testing instrument

was more similar ($r = 0.85$) to kindergarten pupils' performance on the paper-and-pencil component of the experimental testing instrument; than was kindergarten pupils' performance on the oral expressive language component of the experimental testing instrument ($r = 0.66$). Again this difference in degree of similarity might be explained by the fact that the kindergarten pupils had to produce the exact verbal label of the spatial concept required. If the investigator had accepted synonyms for the requested concept the extent of the relationships among the three measurement components, i.e., paper-and-pencil, manipulative, and oral expressive language, might have been greater.

In conclusion the experimental testing instrument assesses kindergarten pupils' mastery of eight identified concepts through three response modes, i.e., the paper-and-pencil, the manipulative, and the oral expressive language. The data presented in this investigation confirms that there are significant relationships among the three components. On the other hand, the Boehm Test of Basic Concepts is not significantly related to the components of the experimental testing instrument. Because the experimental testing instrument provides the teacher with more than one measure of kindergarten pupils' concept development and because each of the measures is significantly similar to the other two, it is felt that the experimental testing instrument is superior.

Implications for Further Research

A study of this type lends itself to further research. In this section implications for further research shall be dealt with under the headings: assessment, and instructional programs.

Assessment

Further research in the area of assessment procedures and effectiveness in determining kindergarten pupils' performance on concept tasks might be as follows:

1. Because there was only one form of the experimental testing instrument, the design of the study was structured in such a manner that two randomly selected groups of pupils were compared to measure performance growth. If another form of the experimental testing instrument were available the instrument might be used in a pre-test and post-test situation with the same group of children in the sample. This type of testing might supply additional information concerning individual pupils.

2. Additional spatial concepts might be included in an experimental testing instrument. In this particular study only eight concepts were investigated. The selection was made on the basis of a teacher survey, which listed those spatial concepts that nursery, kindergarten, and grade one teachers considered necessary for success in learning.

Additional information might be obtained if the examiner incorporated more or different spatial concepts into the measurement instrument.

3. For the purpose of this study only spatial concepts were investigated. The spatial concepts were selected on the basis of teacher-selection and also by the fact that they had been recognized by Boehm (1971) as being found frequently in primary school curricula. An investigation into the temporal and/or quantitative concepts that kindergarten pupils possess might provide information comparative in nature regarding concept development in the kindergarten pupil. This would be especially true if the investigation was carried out in a similar manner to the one described here.

4. Another means of evaluating a kindergarten pupil's performance on oral expressive language spatial concept tasks might provide additional information. This study revealed that at times kindergarten pupils appear to understand the concept under investigation but when asked to verbalize they supply a label which is a synonym for the requested concept. If another measurement device, which incorporated synonyms for concepts, were developed then it would be possible to compare the two measures of oral expressive language performance and determine which would be the most effective measure.

Instructional Programs

1. The findings in this study support the hypothesis

that the spatial concept instructional program made a significant difference to kindergarten pupils' performance on spatial concept tasks. This conclusion was based upon the analysis of pre- and post-test data. The post-test was administered approximately one or two weeks after the completion of the spatial concept instructional program. If another post-test had been administered six or eight weeks after the instructional program had been completed it might have been possible to determine whether the spatial concept instructional program described in this study, was retentive in nature. If this was not so, this factor might be given consideration when new facets of the program are developed.

2. Findings illustrate the fact that kindergarten pupils find some concepts more difficult than others. However this study demonstrates that kindergarten pupils find some aspects of a concept more difficult. The concept "nearest" was easy for the pupils when they had to demonstrate an understanding through the paper-and-pencil response mode. However, it became much more difficult when the kindergarten pupils were requested to demonstrate an understanding through the oral expressive response mode. Consequently the instructional program was developed to meet this need. If additional concepts were incorporated into the instructional program not necessarily at the same time, further information might be provided.

3. The instructional program might consist of temporal and/or quantitative concepts. If this were accomplished these

concepts could be taught using many of the same instructional techniques carried out in this study. Initially the investigator would utilize concrete learning situations. Finally he would advance to developing kindergarten pupils' understanding of the concept through abstract learning situations. This would provide the opportunity to determine whether temporal and quantitative basic concepts can be taught in a similar manner.

4. Further study might provide an opportunity to isolate various instructional techniques to assess their effectiveness. In this study the success of the spatial concept instructional program was measured on the basis of the total program, not isolated ingredients of the program. It might be that one particular aspect of the program is more effective than others.

5. The number of pupils in a learning group might be altered to determine if the size of the group affects kindergarten pupils' success in learning spatial concepts. In this study the size of the group was four or five.

6. The instructional techniques used in this study might be applied to pupils of different ages. Comparative information might be forthcoming if the instructional procedures were utilized with nursery and grade one pupils.

Implications for Classroom Practice

The findings outlined in this study support Boehm's hypothesis that kindergarten pupils do not enter school

necessarily with an understanding of all the concepts that teachers consider necessary for success in learning. Kindergarten pupils appear to understand some concepts better than others. For example, they understood 'next to' better than they understood 'beginning' (See Appendix E).

Again the kindergarten pupils were able to demonstrate their understanding of a concept more accurately through the manipulative response mode than through the paper-and-pencil, and the oral expressive response modes. The findings outlined in this study demonstrate the need of the teacher to determine if a pupil understands the specified concepts through the three response modes, i.e., paper-and-pencil, manipulative, and oral expressive language, and on the basis of the information gathered plan an appropriate program. However, if the teacher may choose only one component of the experimental testing instrument because of time commitments, she/he would be wise to choose the manipulative component. A greater percentage of the pupils in this study were able to demonstrate mastery of a concept through the manipulative response mode. In addition the manipulative component has significant similarity to the other two components.

Teachers should be aware that even though the child does not possess the necessary label for a concept, an understanding of the concept might be present in the child. This investigation supports the notion that often kindergarten pupils will express an understanding of a concept by means of a verbal synonym (See Appendix C). For example, in this study,

at times the children responded with the synonym 'beside' for the required concept 'next to'. Teachers should be ready to evaluate concept development by considering verbal synonyms as an indication that a pupil understands a concept. Teachers should be ready to use labels interchangeable in the description and explanation of concepts.

One of the implications for educators that came out of this study was the value of in-service training for teachers of young children. An in-service program could be initiated that would address itself to concept development. First, the ingredients and the effects of good assessment procedures could be discussed. Second, teachers could examine effective teaching methodology regarding concept instructional programs. Lastly, an in-service program could be development that explored young children's participation in an instructional program and the implications of young children's reactions to an instructional program.

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Appendix A

Survey Sent to Nursery, Kindergarten, and Grade One Teachers to Determine Which Spatial Concepts They Considered Important for Success in Learning

TEACHERS:

Please indicate which of the following concepts you consider most important for the pupils you teach to possess. Please number the concepts from one to fifteen, with number 1 being the concept you consider MOST IMPORTANT for learning.

Thank you.

PLEASE CIRCLE THE LEVEL YOU TEACH.

Nursery Kindergarten Grade One

CONCEPTS

Top_____	Middle_____	Nearest_____	Side_____
Through____	Farthest_____	Corner_____	Below_____
Away From__	Around_____	Behind_____	Right_____
Next To____	Over_____	Row_____	Forward_____
Inside_____	Between_____	Centre_____	Above_____
Separated__	Left_____	In Order_____	After_____
Second_____	Beginning_____	Third_____	Not first or last___

Appendix B Part I

EXPERIMENTAL CONCEPT TEST

PAPER-AND-PENCIL

PART I

DIRECTIONS

Demonstration Items

I am going to give each of you a booklet with pictures in it, a crayon and a marker. Please do not make any marks on the booklet until I tell you what to do.

Now, each of you has a booklet. Listen carefully to what you have to do.

You are going to look at the pictures in the booklet and mark an X on the picture that I tell you about. (Examiner makes an X on the blackboard.) Remember, you must listen very carefully to what I say.

Put your marker under the first row of pictures. (Examiner demonstrates to the pupils how to place the marker.) Here is a dog, a flower and a square. (Examiner points to each of the items.) Mark an X on the FLOWER. Mark an X on the FLOWER. (Examiner does this example with the pupils.)

Move your marker under the next row of pictures. (Examiner does this with the pupils.)

Mark an X on the snowman in the MIDDLE of the row. Mark an X on the snowman in the MIDDLE of the row.

Move your marker under the last row of pictures. (Examiner does this with the pupils.)

Mark an X on the dog INSIDE the house. Mark an X on the dog INSIDE the house.

Turn the page in your booklet.

TEST ITEMS

Put your marker under the first row of pictures.

1. See the animals walking down the road. Put your finger on the elephant. Mark the animal that walks AFTER the elephant as they go down the road. See the animals walking down the road. Put your finger on the elephant. Mark the animal that walks AFTER the elephant as they go down the road.

Move your marker under the next row of pictures.

2. Mark the spoon that is BEHIND the glass. Mark the spoon that is BEHIND the glass.

Move your marker under the next row of pictures.

3. Mark the leaf that is BELOW the tree. Mark the leaf that is BELOW the tree.

Move your marker under the last row of pictures.

4. Mark the one that is walking FORWARD towards you. Mark the one that is walking FORWARD towards you.

Turn the page, please.

Put your marker under the first row of pictures.

5. Mark the bird that is NEAREST the grapes. Mark the bird that is NEAREST the grapes.

Move your marker under the next row of pictures.

6. Someone placed a house, a dog and another house on a line just like this. (Examiner demonstrates to the pupils the order in which the houses and the dog were placed on the line.) Mark the house that was placed AFTER the dog on the line. Mark the house that was placed AFTER the dog on the line.

Move your marker under the next row of pictures.

7. Mark the child that is looking FORWARD at you. Mark the child that is looking FORWARD at you.

Move your marker under the last row of pictures.

8. Mark an X BELOW the pig. Mark an X BELOW the pig.

Turn the page please.

Put your marker under the first row of pictures.

9. See the animals going for a walk down the road in this direction. (Examiner demonstrates the direction in which the animals are walking to the pupils.) Mark the animal that is at the BEGINNING of the line as the animals walk down the road. Mark the animal that is at the BEGINNING of the line as the animals walk down the road.

Move your marker under the next row of pictures.

10. Mark the car that is BEHIND the gas pump. Mark the car that is BEHIND the gas pump.

Move your marker under the next row of pictures.

11. Mark the mouse NEAREST the cheese. Mark the mouse NEAREST the cheese.

Move your marker under the last row of pictures.

12. Mark the jack o'lantern that is NEXT TO the witch.

Mark the jack o'lantern that is NEXT TO the witch.

Turn the page, please.

Put your marker under the first row of pictures.

13. Mark the duck that is swimming BELOW the other duck. Mark the duck that is swimming BELOW the other duck.

Move your marker under the next row of pictures.

14. See the line of animals walking down the road in this direction. (Examiner demonstrates to the pupils the direction in which the animals are walking.) Mark the animal that is at the BEGINNING of the line as they walk down the road. Mark the animal that is at the BEGINNING of the line as they walk down the road.

Move your marker under the next row of pictures.

15. Mark the TOP of the jar. Mark the TOP of the jar.

Move your marker under the last row of pictures.

16. Mark the TOP of the rooster. Mark the TOP of the rooster.

Turn the page, please.

Put your marker under the first row of pictures.

17. See the animals. Put your finger on the bear. Mark the one that walks AFTER the bear as they go down the road in this direction. (Examiner demonstrates to the pupils the direction in which the animals are moving.) See the animals. Put your finger on the bear. Mark the one that walks AFTER the bear as they go down the road in this direction.

Move your marker under the next row of pictures.

18. Mark the butterfly NEXT TO the flower. Mark the

butterfly NEXT TO the flower.

Move your marker under the next row of pictures.

19. Mark the duck that is looking FORWARD. Mark the duck that is looking FORWARD.

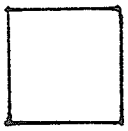
Move your marker under the last row of pictures.

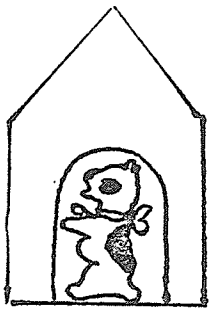
20. Mark the ball with the stripe at the TOP. Mark the ball with the stripe at the TOP.

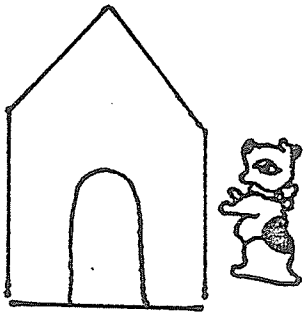
Close your booklets, please.

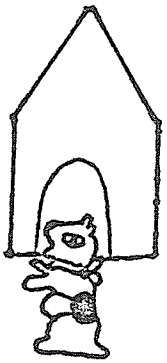
Name _____

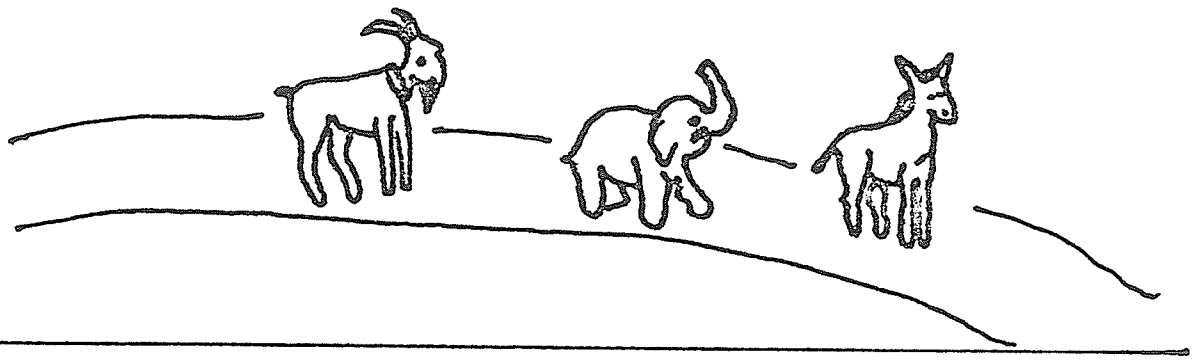
Experimental Concept Test- Part 1











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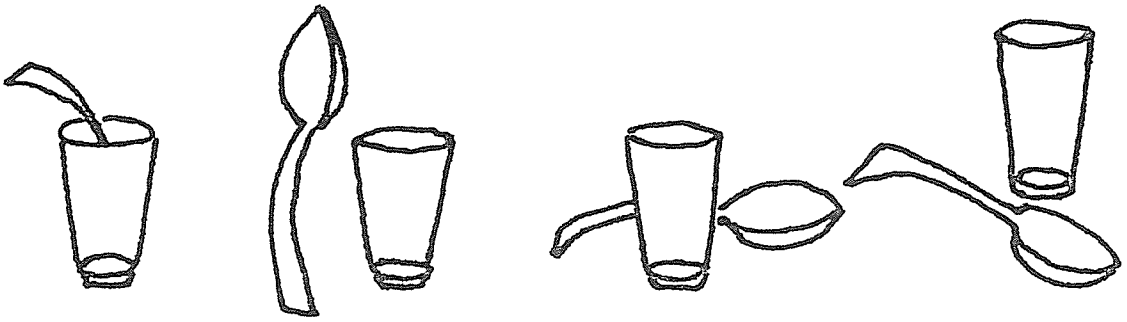

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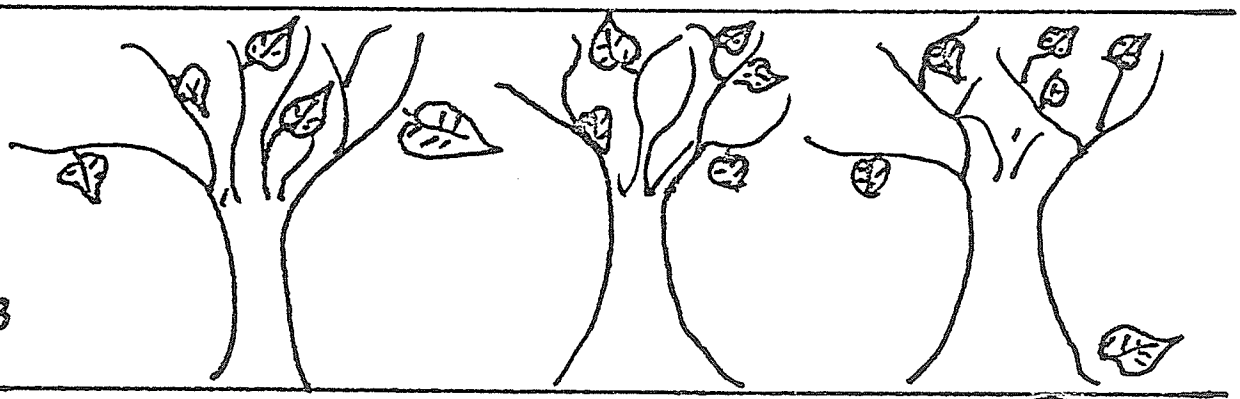

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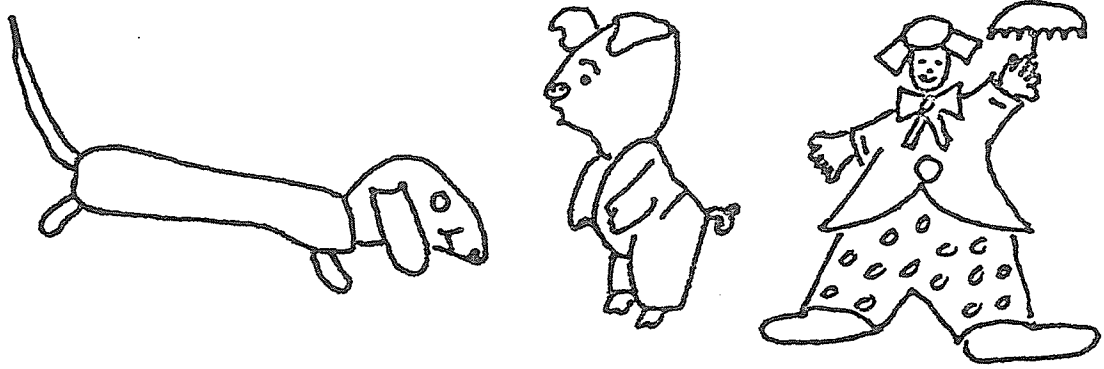

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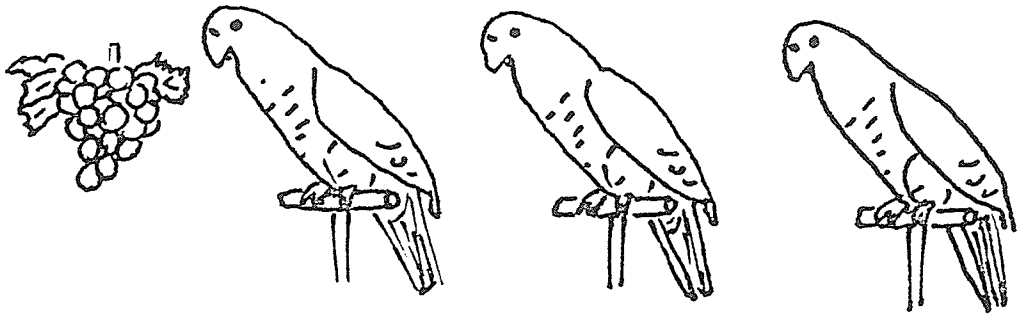

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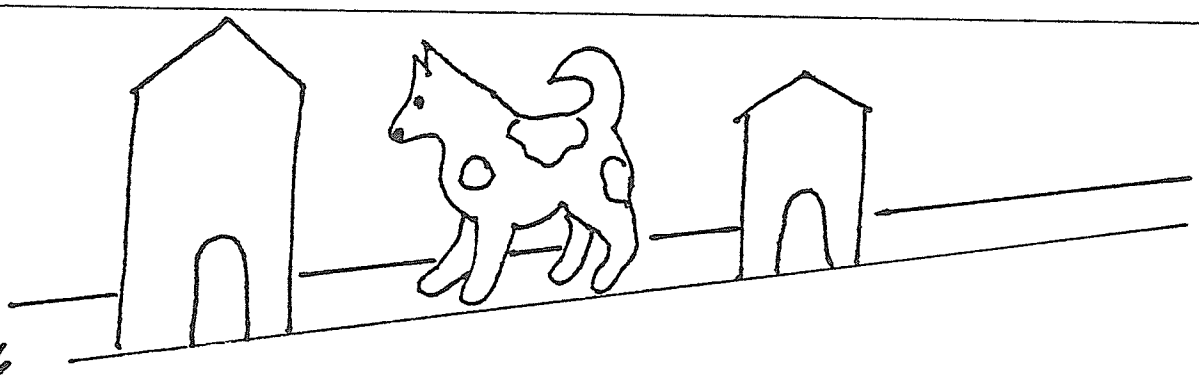

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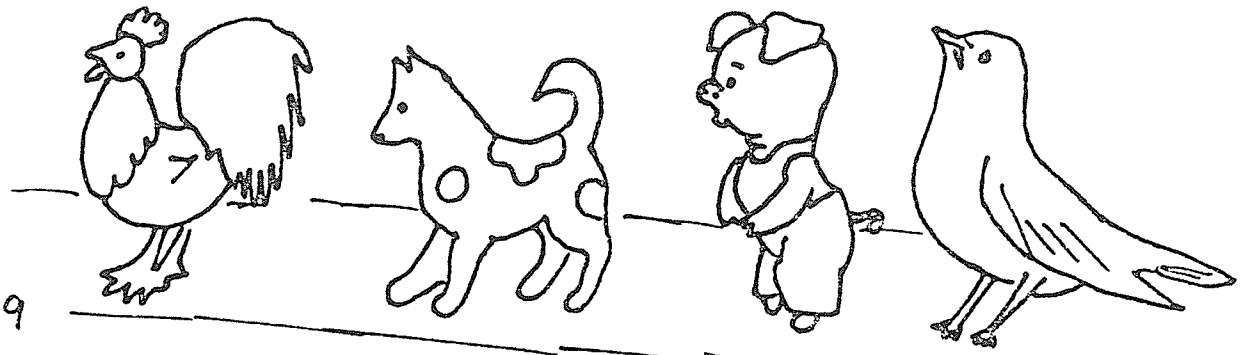

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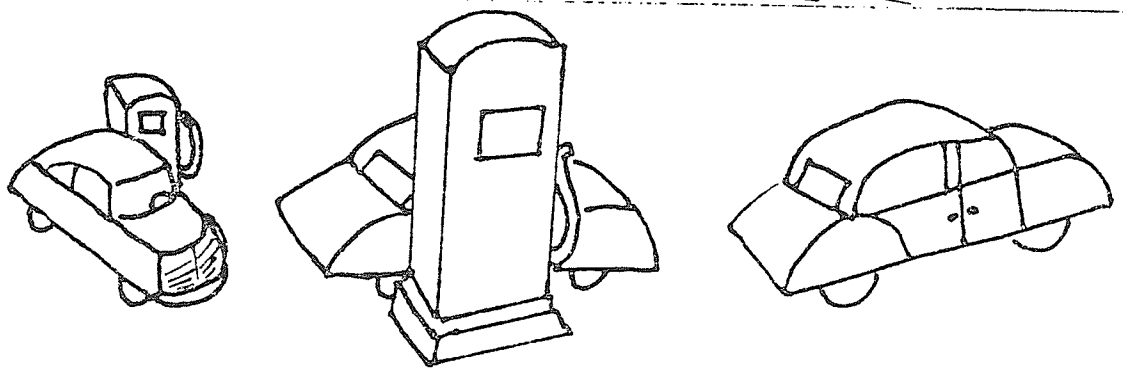

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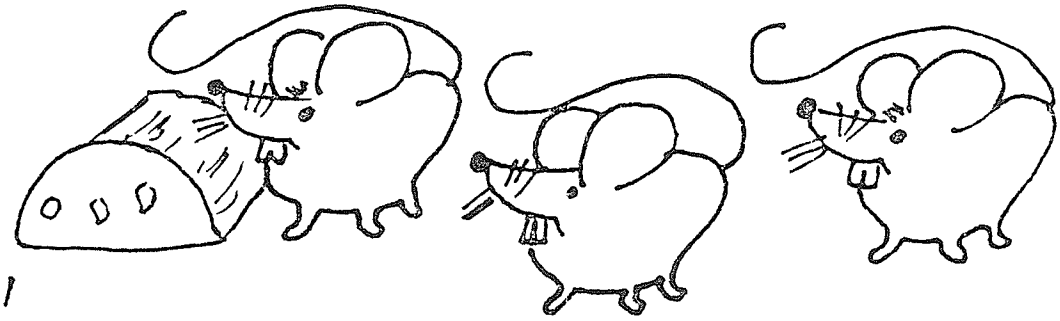

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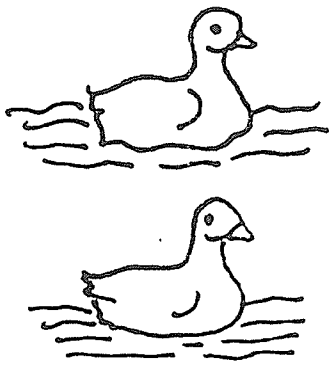

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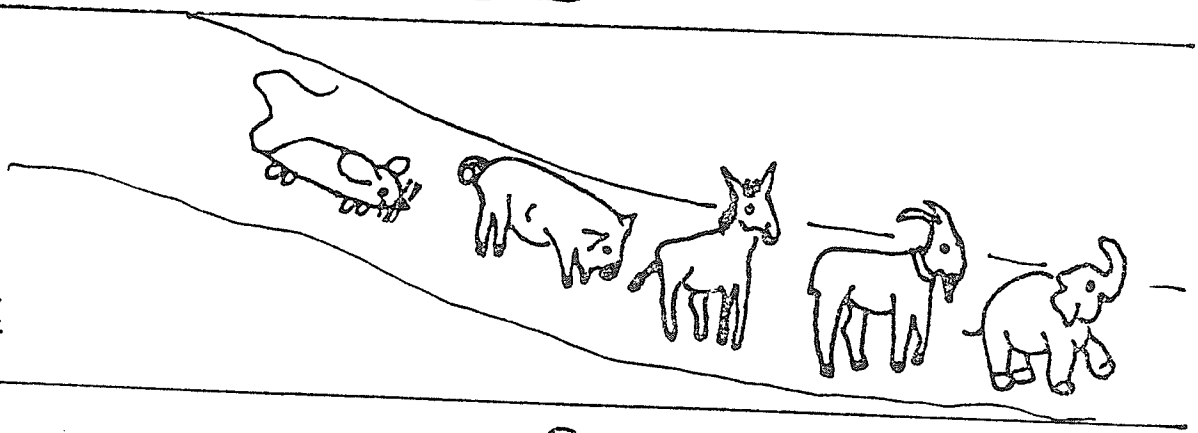

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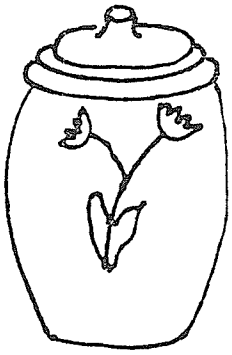

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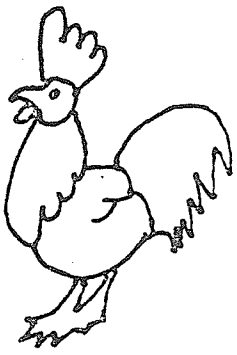

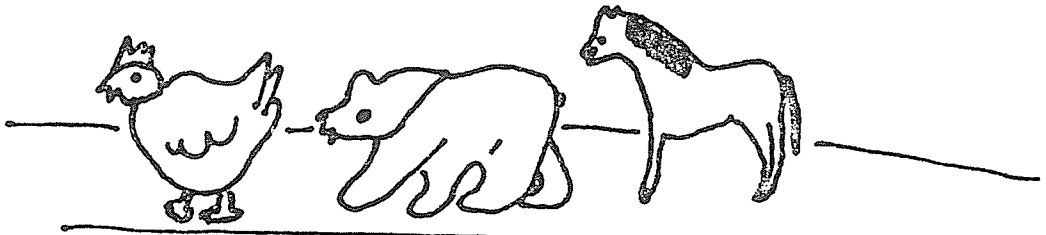

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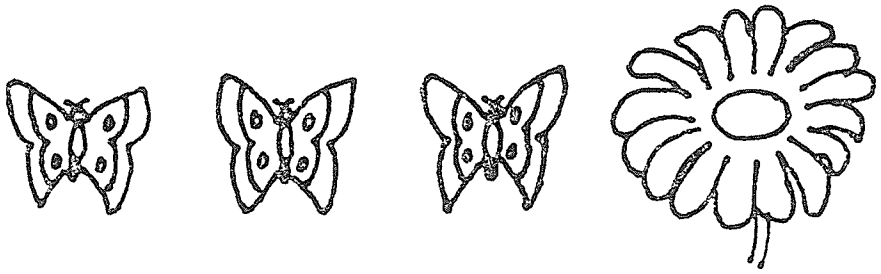

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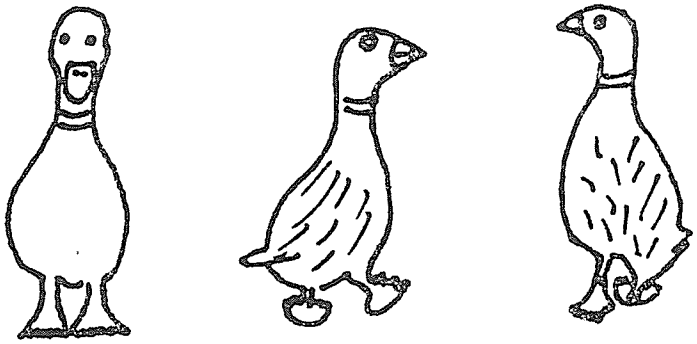

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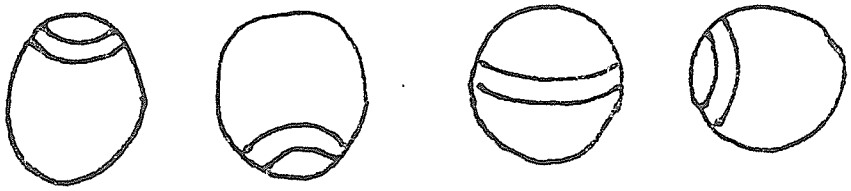

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Appendix B Part 2

EXPERIMENTAL CONCEPT TEST

PAPER-AND-PENCIL

PART 2

DIRECTIONS

Demonstration Items

I am going to give each of you a booklet with pictures in it, a crayon and a marker. Please do not make any marks on the booklet until I tell you what to do.

Now each of you has a booklet. Listen carefully to what you have to do.

You are going to look at the pictures in the booklet and mark an X on the picture that I tell you about. (Examiner makes an X on the blackboard.) Remember, you must listen very carefully to what I say.

Put your marker under the first row of pictures. (Examiner demonstrates to the pupils how to place the marker.) Here is a pot, a safety pin and a kite. (Examiner points to each of the items.) Mark an X on the SAFETY PIN. Mark an X on the SAFETY PIN. (Examiner does this example with the pupils.)

Move your marker under the next row of pictures. (Examiner does this with the pupils.)
Mark an X on the flowers INSIDE the vase. Mark an X on the flowers INSIDE the vase.

Move your marker under the last row of pictures. (Examiner does this with the pupils.) Mark an X on the jack o'lantern in the MIDDLE. Mark an X on the jack o'lantern in the MIDDLE.

Turn the page in your booklet.

TEST ITEMS

Put your marker under the first row of pictures. 21. See the trucks moving down the road in this direction. (Examiner demonstrates to the pupils the direction in which the trucks are moving.) Mark the truck that is at the BEGINNING of the line as they go down the road. See the trucks moving down the road in this direction. Mark the truck that is at the BEGINNING of the line as they go down the road.

Move your marker under the next row of pictures. 22. Mark the ball that is BELOW the elephant. Mark the ball that is BELOW the elephant.

Move your marker under the next row of pictures. 23. Mark the turtle that is crawling FORWARD towards you. Mark the turtle that is crawling FORWARD towards you.

Move your marker under the last row of pictures. 24. Mark an X BELOW the window of the house. Mark an X BELOW the window of the house.

Turn the page please.

Put your marker under the first row of pictures. 25. Mark the peanut that is NEAREST the squirrel. Mark the peanut that is NEAREST the squirrel.

Move your marker under the next row of pictures.

26. See the animals. Put your finger on the goat. Mark the animal that walks AFTER the goat as they go for a walk down the road in this direction. (Examiner demonstrates to the pupils the direction in which the animals are moving.) See the animals. Put your finger on the goat. Mark the animal that walks AFTER the goat as they go for a walk down the road in this direction.

Move your marker under the next row of pictures.

27. Mark the cat that is NEXT TO the fish. Mark the cat that is NEXT TO the fish.

Move your marker under the last row of pictures.

28. Mark the rock that is BEHIND the tree. Mark the rock that is BEHIND the tree.

Turn the page please.

Put your marker under the first row of pictures.

29. Mark the fish that is NEAREST the seal. Mark the fish that is NEAREST the seal.

Move your marker under the next row of pictures.

30. Mark the one that moves AFTER the car as they go down the road in this direction. (Examiner demonstrates to the pupils the direction in which the vehicles are moving.) Mark the one that moves AFTER the car as they go down the road in this direction.

Move your marker under the next row of pictures.

31. Mark the bear that is looking FORWARD. Mark the bear that is looking FORWARD.

Move your marker under the last row of pictures.

32. Mark the bird that is NEXT TO the scarecrow. Mark the bird that is NEXT TO the scarecrow.

Turn the page, please.

Put your marker under the first row of pictures.

33. Mark the fork that is NEXT TO the plate. Mark the fork that is NEXT TO the plate.

Move your marker under the next row of pictures.

34. Mark the BEGINNING of the train. Mark the BEGINNING of the train.

Move your marker under the next row of pictures.

35. Mark the spoon that is BEHIND the vase. Mark the spoon that is BEHIND the vase.

Move your marker under the last row of pictures.

36. Mark the car that is just BEGINNING to go up the hill. Mark the car that is just BEGINNING to go up the hill.

Turn the page, please.

Put your marker under the first row of pictures.

37. Mark the square with the marble at the TOP. Mark the square with the marble at the TOP.

Put your marker under the next row of pictures.

38. Mark the TOP of the bird. Mark the TOP of the bird.

Move your marker under the next row of pictures.

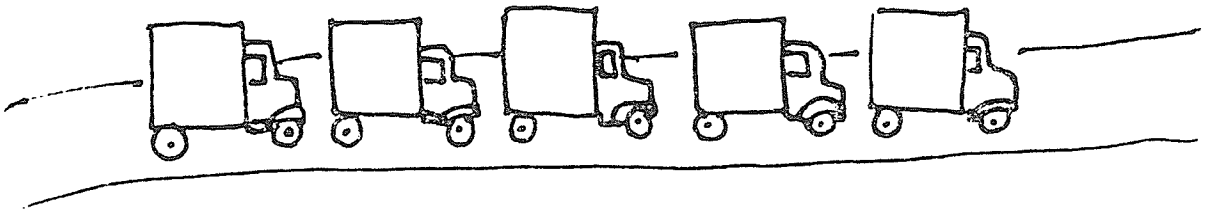
39. Mark the one that swims BEHIND the duck. Mark the one that swims BEHIND the duck.

Move your marker under the last row of pictures.

40. Mark the apple that is NEAREST the tree.

Mark the apple NEAREST the tree.

Close your booklets, please.



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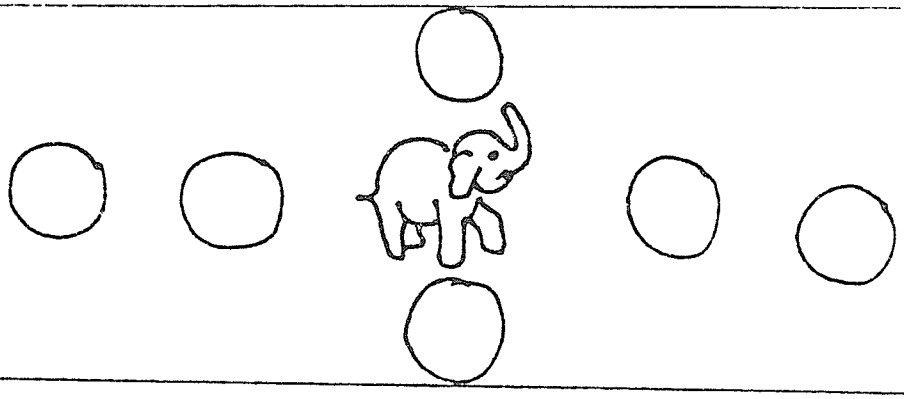

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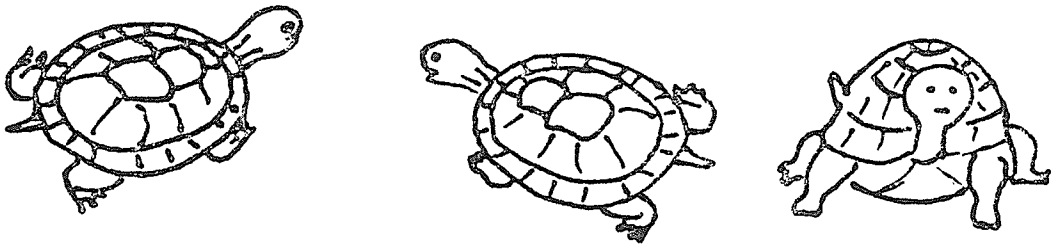

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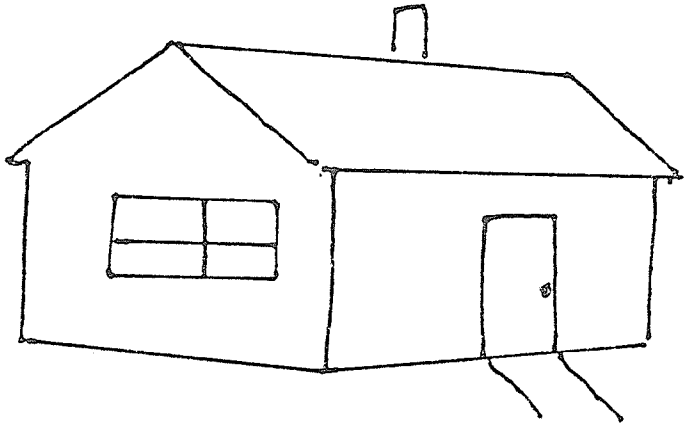

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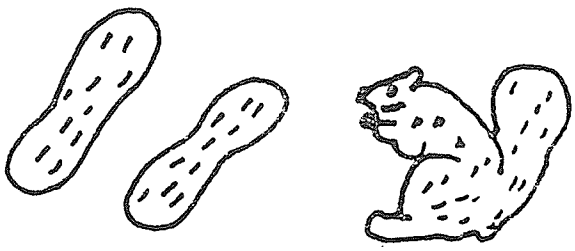

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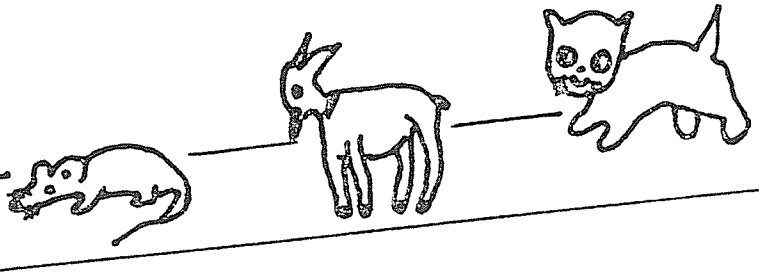

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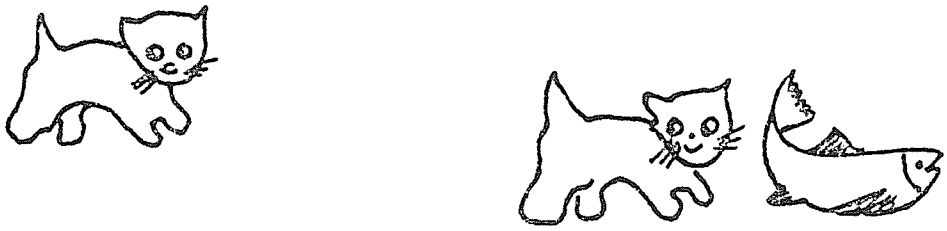

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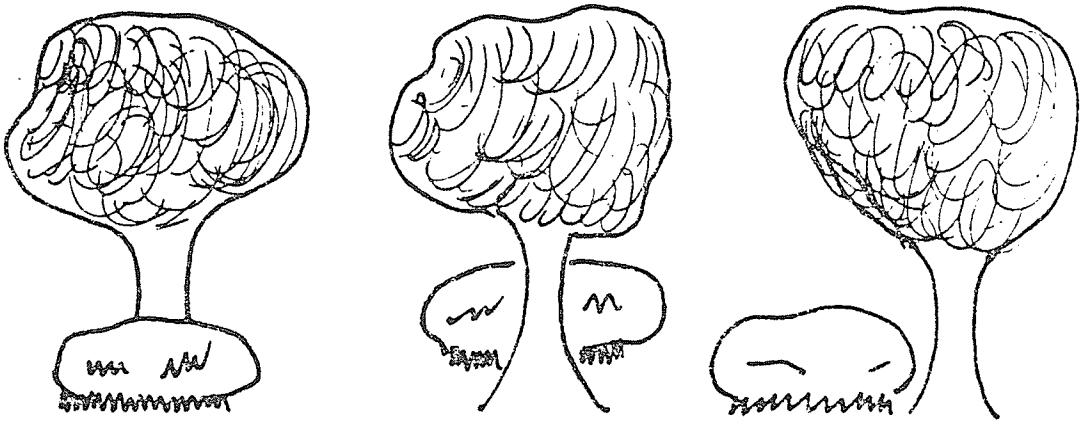

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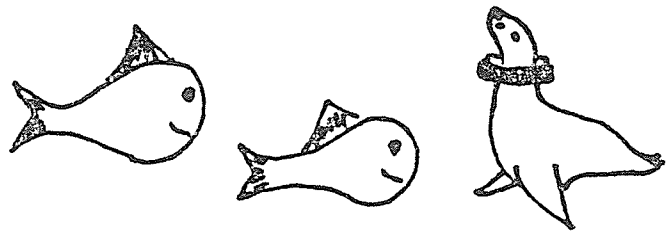

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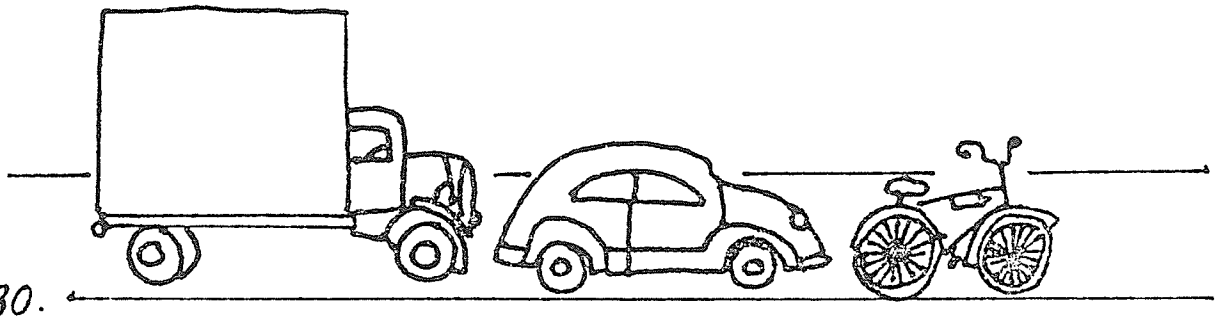

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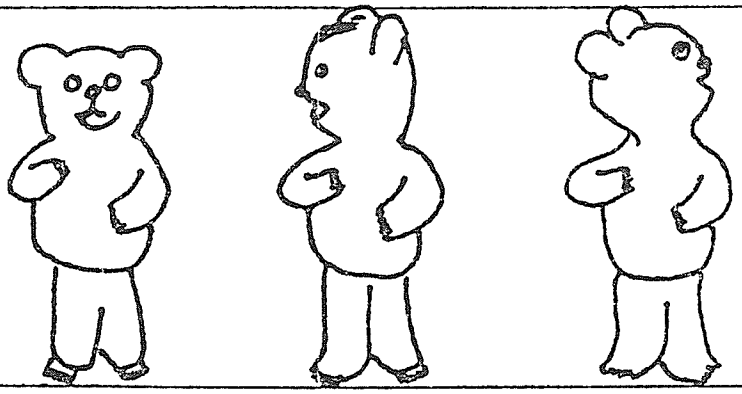

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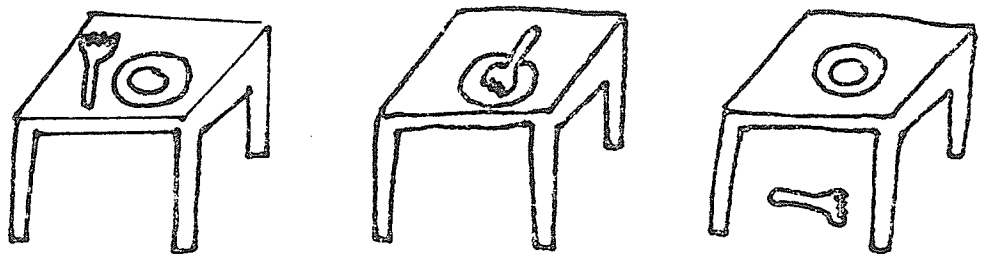

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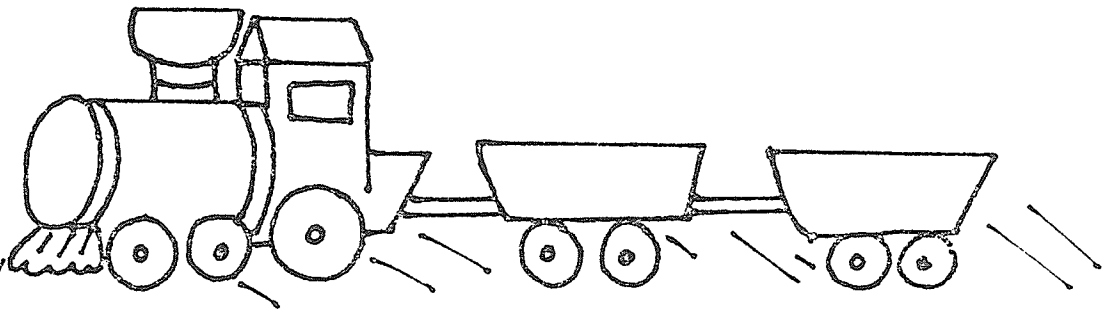

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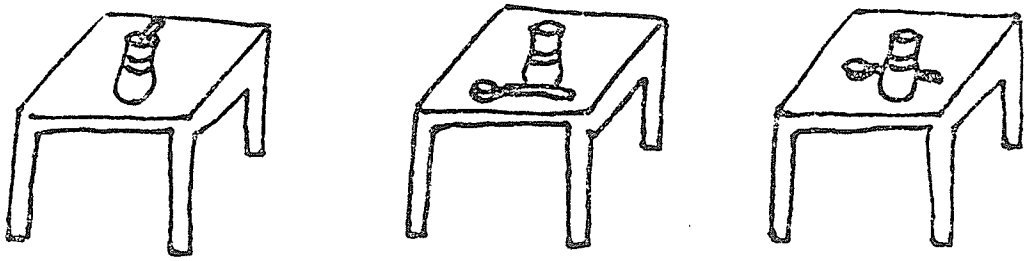

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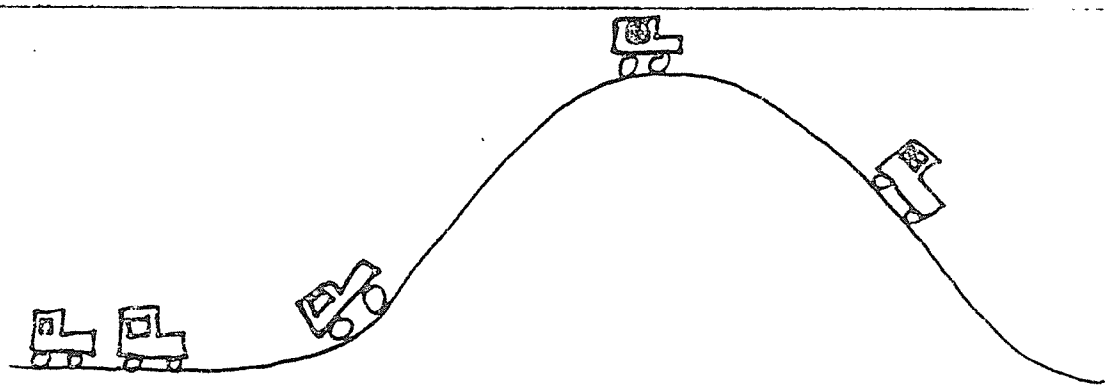

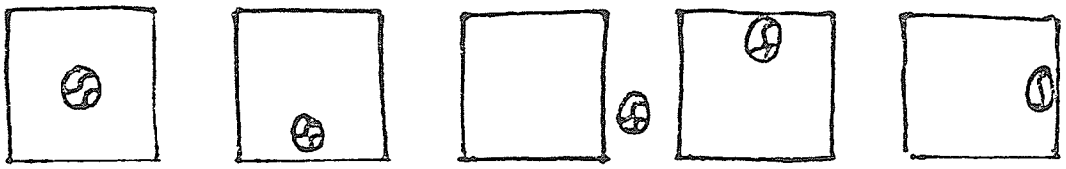

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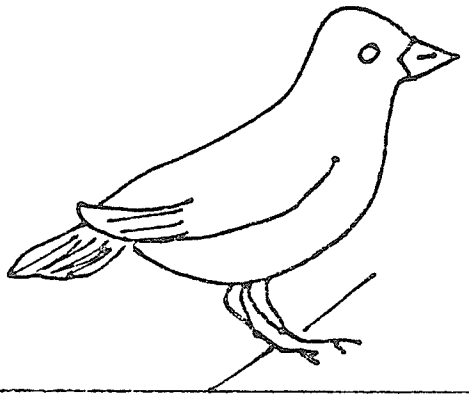

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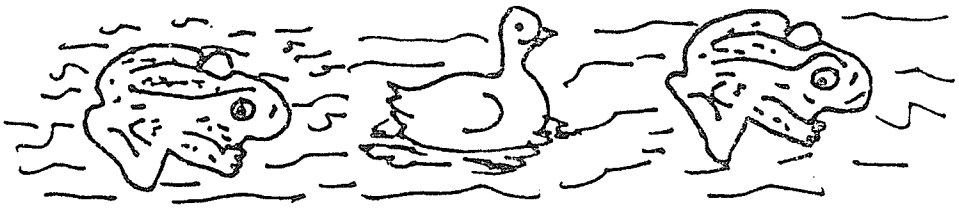

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Appendix B Part 3

EXPERIMENTAL CONCEPT TEST

MANIPULATIVE TASKS

Manipulative tasks are defined as those tasks in which the teacher presents the oral directions and the pupil manipulates the object or objects to demonstrate an understanding of the eight identified spatial concepts.

EXAMPLE

Teacher says, "Put the penny INSIDE the box".

Pupil puts the penny INSIDE the box.

EXAMPLE

Teacher says, "Put the cow in the MIDDLE of the circle".

The pupil puts the cow in the MIDDLE of the circle.

TEST ITEMS

1. Put the pencil BELOW the crayon in the bookcase.
2. Pick up the penny NEAREST the truck.
3. Place the car AFTER the truck in the line of vehicles on the road.
4. Place the block AFTER the penny on the line.
5. Put the pig BEHIND the book.
6. Put the cow BEHIND the block.
7. Put the duck at the BEGINNING of the line of animals.
8. Put the block BELOW the book in the bookcase.
9. Put the sheep NEXT TO the pencil.

10. Pick up the duck that is NEXT TO the truck.
11. Put the cup BELOW the pencil in the bookcase.
12. Pick up the animal that is at the BEGINNING of the line of animals.
13. Put the cow NEXT TO the horse.
14. Pick up the cow NEAREST the cup.
15. Make the pig move FORWARD.
16. Place the pig AFTER the block on the line.
17. Put the horse on TOP of the paper.
18. Take one step FORWARD.
19. Put the cow on TOP of the truck
20. Make the cow move FORWARD.
21. Put the sheep at the BEGINNING of the line of animals.
22. Put the penny on TOP of the book.
23. Put the block BEHIND the cup.
24. Point to the horse NEAREST the block.

Appendix B Part 4

EXPERIMENTAL CONCEPT TEST

ORAL EXPRESSIVE LANGUAGE TASKS

Oral expressive language tasks are defined as those tasks in which the teacher manipulates the object or objects and the pupil describes orally what is occurring.

EXAMPLE

The teacher says, "Do you know what the word MIDDLE means? Try and use the word MIDDLE in a story about something I will show you." (Teacher puts a cow in the MIDDLE of the circle of animals.)

EXAMPLE

The teacher says, "Do you know what the word INSIDE means? Try and use the word INSIDE in a story about something I will show you. (Teacher puts the crayon INSIDE the box.)

TEST ITEMS

1. Do you know what the word NEAREST means? Try and use the word NEAREST in a story about something I will show you. (Teacher takes away the penny NEAREST the truck.)
2. Do you know what the word BELOW means? Try and use the word BELOW in a story about something I will show you. (Teacher puts the pencil BELOW the book in the bookcase.)

3. Do you know what the word TOP means? Try and use the word TOP in a story about something I will show you. (Teacher puts her hand on TOP of her head.)
4. Do you know what the word AFTER means? Try and use the word AFTER in a story about something I will show you. (Teacher puts the truck AFTER the tractor in the line of vehicles going down the road.)
5. Do you know what the word FORWARD means? Try and use the word FORWARD in a story about something I will show you. (Teacher moves FORWARD.)
6. Do you know what the word NEAREST means? Try and use the word NEAREST in a story about something I will show you. (Teacher picks up the sheep NEAREST the pig.)
7. Do you know what the word AFTER means? Try and use the word AFTER in a story about something I will show you. (Teacher places the sheep AFTER the cow in the line of animals.)
8. Do you know what the words NEXT TO means? Try and use the words NEXT TO in a story about something I will show you. (Teacher puts the horse NEXT TO the truck.)
9. Do you know what the word TOP means? Try and use the word TOP in a story about something I will show you. (Teacher puts the sheep on TOP of the block.)
10. Do you know what the word BEGINNING means? Try and use the word BEGINNING in a story about something I will show you. (Teacher puts the block at the BEGINNING of the line of objects.)

11. Do you know what the word FORWARD means? Try and use the word FORWARD in a story about something I will show you. (Teacher makes the duck move FORWARD.)

12. Do you know what the word BELOW means? Try and use the word BELOW in a story about something I will show you. (Teacher puts the horse BELOW the book in the bookcase.)

13. Do you know what the word FORWARD means? Try and use the word FORWARD in a story about something I will show you. (Teacher makes the horse move FORWARD.)

14. Do you know what the word BEGINNING means? Try and use the word BEGINNING in a story about something I will show you. (Teacher puts the horse at the BEGINNING of the line of animals.)

15. Do you know what the word BEHIND means? Try and use the word BEHIND in a story about something I will show you. (Teacher puts the horse BEHIND the haystack.)

16. Do you know what the word BEHIND means? Try and use the word BEHIND in a story about something I will show you. (Teacher puts the penny BEHIND the block.)

17. Do you know what the word NEAREST means? Try and use the word NEAREST in a story about something I will show you. (Teacher picks up the cow NEAREST the sheep.)

18. Do you know what the word BEGINNING means? Try and use the word BEGINNING in a story about something I will show you. (Teacher puts the penny at the BEGINNING of the line of objects.)

19. Do you know what the words NEXT TO mean? Try and use the words NEXT TO in a story about something I will show you. (Teacher puts the cow NEXT TO the horse.)

20. Do you know what the word AFTER means? Try and use the word AFTER in a story about something I will show you. (Teacher puts the penny AFTER the animal in the line.)

21. Do you know what the word BELOW means? Try and use the word BELOW in a story about something I will show you. (Teacher puts the pig BELOW the sheep.)

22. Do you know what the word TOP means? Try and use the word TOP in a story about something I will show you. (Teacher puts the penny on TOP of the book.)

23. Do you know what the words NEXT TO means? Try and use the words NEXT TO in a story about something I will show you. (Teacher puts the crayon NEXT TO the paper.)

24. Do you know what the word BEHIND means? Try and use the word BEHIND in a story about something I will show you. (Teacher puts the block BEHIND the book.)

Appendix C

Synonyms Used By Kindergarten Pupils to Demonstrate Understanding of the Eight Identified Spatial Concepts

Concept	Synonym Used For Concept	Number of Pupils who used this Synonym
AFTER	behind	29
	at the last part	2
	in back of	7
	at the end of the line	1
	next to	3
	beside	7
	in the back	5
	back of	1
	at the last	1
	last one	2
	at the back of	2
	right at the very end	1
BELOW	down	7
	bottom part	1
	under	20
	underneath	3
	at the bottom	2

Concept	Synonym Used For Concept	Number of Pupils who used this Synonym
BEHIND	after	2
	beside	10
	close to	1
	next to	6
	back of	2
	at the back of	3
	near	2
	by the side of	1
TOP	on	9
	up on	2
	above	1
NEXT TO	after	6
	close to	3
	beside	24
	near	19
	right beside	3
	nearest	10
	by	1

Concept	Synonym Used For Concept	Number of Pupils who used this Synonym
NEAREST	middle	10
	near	20
	next to	13
	beside	17
	by	2
	close to	1
	closest to	2
	the first one	2
BEGINNING	in front of	18
	at the front of	4
	in front	4
	in the front of	4
FORWARD	that way	1
	frontwards	6
	front	1
	front way	2

Appendix D

Outline of Seven Spatial Concept Lessons

Lesson 1	Introduce	NEXT TO
Lesson 2	Review	NEXT TO
	Introduce	TOP
Lesson 3	Review	TOP
	Introduce	BELOW
Lesson 4	Review	BELOW
	Introduce	BEHIND
Lesson 5	Review	BEHIND
	Introduce	BEGINNING
Lesson 6	Review	BEGINNING
	Introduce	FORWARD
Lesson 7	Introduce	AFTER
	Review the	six previously taught lessons

Appendix D

Spatial Concept Instructional Program

Introduction

The spatial concept instructional program consisted of seven teaching sessions. During each session, with the exception of the first and last, a new spatial concept was introduced and the previously taught one reviewed. The format of the lessons was basically similar when possible. Because this spatial concept instructional program was one facet of a research study, attention was given to the number of times the small group of pupils, i.e., four or five in a group, had visual, aural, oral, and/or physical exposure to a particular identified spatial concept.

Objectives of the Spatial Concept Instructional Program

The objectives of the spatial concept instructional program were as follows:

1. That pupils be able to demonstrate an understanding of an identified spatial concept through the use of their bodies (e.g., Teacher says, "Go and stand on top of the box".)

2. That pupils be able to demonstrate an understanding of an identified spatial concept through the manipulation of objects at the direction of the teacher (e.g., Teacher says, "Put the cornflakes next to the ice-cream".)

3. That pupils be able to demonstrate an understanding of an identified spatial concept through their oral responses to questions posed by the teacher (e.g., Teacher puts the dog behind the book and asks, "What did I do?". Pupil responds, "You put the dog behind the book".).

4. That pupils be able to demonstrate an understanding of an identified spatial concept through their interpretation of pictures (e.g., Teacher asks, "Which animal is at the beginning of the line when they walk in this direction?").

5. That pupils be able to demonstrate an understanding of an identified spatial concept by performing paper-and-pencil tasks (e.g., Teacher says, "Draw a circle around the thing that is next to the boat".).

Spatial Concept Lesson Plan

Outlined in detail below is one of the spatial concept lessons which was part of the spatial concept instructional program.

Lesson 1 - Introduction of spatial concept next to

A. Pupils demonstrated an understanding of the spatial concept "next to" by means of their bodies.

Stand next to my shopping bag
Stand next to the chair
Stand next to the other chair
Stand next to the door
Stand next to the door

Stand next to the bookcase
Stand next to the shopping bag
Stand next to the desk
Stand next to my purse
Stand next to the box

Stand next to me
Stand next to (a pupil's name)
Stand next to (a pupil's name)
Stand next to (a pupil's name)
Stand next to (a pupil's name)

Lesson 1 - Introduction of spatial concept next to

B. Pupils demonstrated an understanding of the spatial concept "next to" through manipulation of toy objects. Teacher gave the following directions:

Put the cornflakes next to the ice cream
Put the coffee next to the orange
Put the can next to the cornflakes
Put the bananas next to the coffee
Put the carrot next to the cornflakes
Put the plum next to the orange
Put the pumpkin next to the ice cream
Put the milk next to the can
Put the coffee next to the coffee
Put the onion next to the coffee
Put the carrot next to the milk
Put the ice cream next to the money
Put the bananas next to the corn
Put the carrot next to the milk
Put the plum next to the orange

Lesson 1 - Introduction of spatial concept next to

C. Pupils demonstrated an understanding of the spatial concept "next to" through an oral description of what the teacher did with the toy objects.

Teacher asked the following questions and the pupil responded verbally.

Where did I put the orange?

Where did I put the coffee?

Where did I put the onion?

Where did I put the jar of fruit?

Where did I put the carrot?

Where did I put the orange?

Where did I put the bananas?

Where did I put the milk bottle?

Where did I put the corn?

Where did I put the coffee?

Where did I put the ice cream?

Where did I put the cornflakes?

Where did I put the bananas?

Where did I put the coffee?

Where did I put the orange?

Lesson 1 - Introduction of spatial concept next to

D. Pupils demonstrated an understanding of the spatial concept "next to" by following the teachers' directions and verbally describing what was done.

Pick up something that is next to the cornflakes
Pick up something that is next to the orange
Pick up something that is next to the ice cream
Pick up something that is next to the can
Pick up something that is next to the bananas
Pick up something that is not next to the bananas
Pick up something that is not next to the can
Pick up something that is not next to the bananas
Pick up something that is not next to the orange
Pick up something that is not next to the coffee
Pick up something that is not next to the cornflakes
Pick up something that is not next to the coffee
Pick up something that is not next to the can
Pick up something that is not next to an orange
Pick up something that is not next to the orange

Lesson 1 - Introduction of spatial concept next to

E. Pupils orally answered questions after they have viewed a picture.

What is next to alligator?
What is next to the zebra?
What is next to the elephant?
What is next to the elephant?
What is next to the bird?
What is next to the bird?
What is next to the lion?
What is next to the monkey?
What is next to the giraffe?
What is next to the zebra?
What is next to the gorilla?
What is next to the zebra?
What is next to the bird?
What is next to the reindeer?
What is next to zebra?

F. Pupils demonstrated an understanding of the concept "next to" by means of the paper-and-pencil response mode.

Put your finger on the plant.
Draw a circle around something that is next to the plant.

Put your finger on the drum.
Draw a circle around something next to the drum.

Put your finger on the baby.
Draw a circle around something that is next to the baby.

Put your finger on the bone.
Draw a circle around something next to the bone.

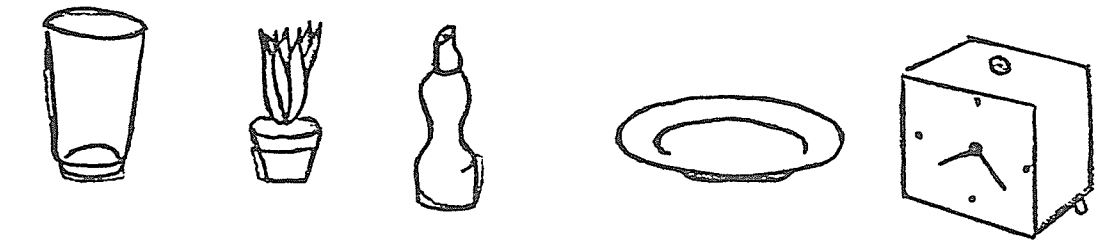
Put your finger on the plate.
Draw an X on something that is next to the plate.

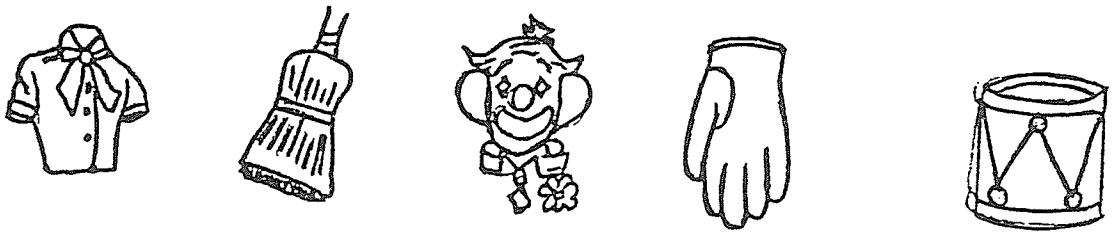
Put your finger on the blouse.
Put an X on something that is next to the blouse.

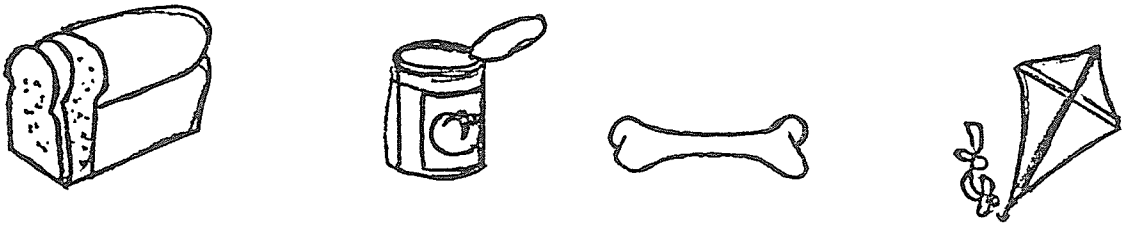
Put your finger on the dress.
Draw an X on something next to the dress.

Put your finger on the can.
Draw an X on something next to the can.

Put your finger on the glass.
Draw a line under something next to the glass.







Appendix E

Number and Percentage of Kindergarten Pupils in Conditions One, Two and Five Who Demonstrated Mastery of the Eight Identified Spatial Concepts when Measured by the Boehm Test of Basic Concepts, Form A, or the Paper-and-Pencil Component of the Experimental Testing Instrument in a Pre-test Situation

	Condition One (N=24)		Condition Two (N=25)		Condition Five (N=25)	
Concept	Number of Pupils	Percentage of Pupils	Number of Pupils	Percentage of Pupils	Number of Pupils	Percentage of Pupils
Nearest	21	87.5	22	88	24	96
After	17	70.83	14	56	19	76
Below	14	58.33	11	44	13	52
Top	13	54.17	16	64	19	76
Next to	12	50.	21	84	18	72
Beginning	11	45.83	15	60	13	52
Behind	11	45.83	14	56	18	72
Forward	9	37.5	9	36	10	40

Total Number and Percentage of Kindergarten Pupils in Conditions One, Two, and Five Who Demonstrated Mastery of the Eight Identified Spatial Concepts when Measured by the Boehm Test of Basic Concepts and the Paper-and-Pencil Component of the Experimental Testing Instrument in a Pre-test Situation

Nearest	(21 + 22 + 24) =	67	90.54%
After	(17 + 14 + 19) =	50	67.57%
Below	(14 + 11 + 13) =	38	51.35%
Top	(13 + 16 + 19) =	48	64.86%
Next to	(12 + 21 + 18) =	51	68.92%
Beginning	(11 + 15 + 13) =	39	52.70%
Behind	(11 + 14 + 18) =	43	58.11%
Forward	(9 + 9 + 10) =	28	37.84%

Appendix F

Number and Percentage of Kindergarten Pupils in Conditions One, Three, Four and Five Who Demonstrated Mastery of the Eight Identified Spatial Concepts when Measured by the Boehm Test of Basic Concepts, Form B or the Paper-and-Pencil Component of the Experimental Testing Instrument in a Post-test Situation

	Condition One (N=24)		Condition Three (N=23)		Condition Four (N=23)		Condition Five (N=25)	
Concept	Number of Pupils	% of Pupils	Number of Pupils	% of Pupils	Number of Pupils	% of Pupils	Number of Pupils	% of Pupils
Nearest	24	100	23	100	19	82.61	25	100
After	21	87.5	22	95.65	15	65.22	17	68
Below	23	95.83	17	73.91	13	56.52	11	44
Top	23	95.83	22	95.65	18	78.26	24	96
Next to	23	95.83	23	100	19	82.61	21	84
Beginning	22	91.67	23	100	14	60.87	11	44
Behind	21	87.5	23	100	10	43.48	19	76
Forward	23	95.83	23	100	12	52.17	12	48

Total Number and Percentage of Kindergarten Pupils in Conditions One, Three, Four and Five Who Demonstrated Mastery of the Eight Identified Spatial Concepts When Measured by the Boehm Test of Basic Concepts and the Paper-and-Pencil Component of the Experimental Testing Instrument in a Post-test Situation (N=95)

Nearest	(24 + 23 + 19 + 25)	91	95.79%
After	(21 + 22 + 15 + 17)	75	78.95%
Below	(23 + 17 + 13 + 11)	64	67.37%
Top	(23 + 22 + 18 + 24)	87	91.58%
Next to	(23 + 23 + 19 + 21)	86	90.53%
Beginning	(22 + 23 + 14 + 11)	70	73.68%
Behind	(21 + 23 + 10 + 19)	73	76.84%
Forward	(23 + 23 + 12 + 12)	70	73.68%