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ABSTRACT

The purpose of this research was to determine the effectiveness of using an adapted version of Creative Problem Solving (CPS) to increase problem solving activities of kindergarten students, and to determine the practical significance of using CPS as a method for increasing problem solving skills of kindergarten students. Data were collected from four groups containing 83 students. The experimental groups received 18 lessons, 30 minutes per lesson in creative problem solving for 6 weeks. The control groups participated in the regular kindergarten curriculum for the 6 weeks. All groups were pretested using Think It Through B and posttested using Think It Through C. While the effect size revealed an educationally significant effect for both the experimental and control groups, the impact on the experimental group was larger with an effect size of .8 compared with a medium effect size of .6 for the control group. The statistical analysis of the data showed no significant differences between the groups on problem solving ability after the 6-week interval. However, the results did indicate an educationally significant impact on problem solving acquisition when using creative problem solving techniques with kindergarten children. (PN)

# THE EFFECTIVENESS OF TEACHING CREATIVE PROBLEM SOLVING TECHNIQUES TO ENHANCE THE PROBLEM SOLVING ABILITY OF KINDERGARTEN STUDENTS



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## Introduction

The development of problem solving skills for children has long been of paramount importance to educators. A number of noted authorities (Dewey, 1910; Mussen, Conger, and Kagan, 1969; Piaget, 1969) have devoted time to the formulation of definitions, theories, and paradigms which explain the process of acquiring problem solving skills. Not only have the theoretical foundations of problem solving been described, but also substantial research has been provided on components of the process to lend support to the theories of how problem solving skills are attained.

Historically, the concept of cognition as a problem solving process in education dates back to Dewey's formulation of a five step definition of problem solving in How We Think (1910). Dewey defined problem solving as a process involving the following steps: a difficulty is felt; the difficulty is located and defined; possible solutions are suggested; consequences of those solutions are considered and a solution is accepted. Since that time a number of other authors have explored and defined problem solving in a variety of ways. Wallas (1926), Rossman (1931), Gordon (1961), Osborn (1963), Parnes (1967), Prince (1968), deBono (1970), and Vargui (1977) have all defined problem solving as a process of sequential steps. Nearly all of these problem solving models call for the use of strategies that include attribute listing, questioning, brainstorming, and analysis.

Khatena (1984) gives a well prepared comparison of the problem solving models in Imagery and Creative Imagination. As he noted, the first step in problem solving involves sensing and defining a problem. Dewey refers to this as a difficulty that is felt, located, or defined; Rossman sees it as an observed need or difficulty and a problem formulated. Osborn and Parnes refer to this first step as identification of a problem; Gordon and Prince describe the process as analysis and choice of a problem; deBono as encountering and Vargui simply implies problem sensing and defining. Preparation is considered the second step of the problem solving process. Wallas, Rossman, Osborn, Parnes, deBono, and Vargui make reference to this step as gathering input or information. The third step relates to the process used in problem solving. For Osborn and Parnes, this is the idea finding stage; Gordon and Prince see this as a questioning stage to promote the use of analogous thinking; and Wallas and Vargui call this incubation or unconcious activity. The final stage involves finding a solution to the problem. In all of the theories presented, a solution is sought. Dewey, Rossman, Gordon, and Prince speak of finding a specific solution, whereas for Wallas, Osborn, Parnes and Vargui an illumination occurs (Khatena, 1984).

Despite the differences in terminology, it is clear the problem solving process involves a series of well-defined sequential steps. The relationship between aspects of creative thinking and the problem solving process has not been as well defined. Three authors, Guilford, Torrance, and Parnes have developed definitions of problem

solving which specifically incorporate creative thinking. According to Guilford (1977), problem solving has a distinct relationship to creative thinking. He stated, "creative thinking produces novel outcomes, and problem solving involves producing a new response to a new situation, which is a novel outcome" (p. 161). Torrance and Myers (1970) define the creative learning process as, "becoming sensitive to or aware of problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; bringing together available information; defining the difficulty or identifying the missing element; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting them; perfecting them; and finally communicating the results" (p.22).

A third view of the relationship between problem solving and creative thinking is offered by Parnes, Noller, and Biondi (1977) who have defined problem solving as an intergrated process. This process includes problem solving skills -- fact finding, solution finding, and creative thinking skills. Creative thinking skills refer to sensitivity, awareness of problems, and deferred judgment during idea finding. The study of problem solving has, for the most part been limited to upper elementary and older level students. Very little work has been done to study the basis of problem solving skills which may begin at a very early age. Observational studies by Charlesworth (1983) and others (Case, 1984; Lundsteen and Tarrow, 1981; Odom, 1978) verify the existence of problem solving behavior in young children. However, there is a distinct absence of curricula developed specifically to enhance problem solving skills in this age group. The second area

which has been neglected in the literature is the relationship between creativity and problem solving. This relationship has not been clearly delineated. Although the relationship between aspects of creative thinking and problem solving has been defined (Guilford, 1977; Parnes, Noller, and Biondi, 1977; Torrance, 1970), limited research has been conducted to substantiate the use of creative problem solving techniques to develop problem solving skills. The majority of the research using creative problem solving techniques has been devoted to measuring differences in divergent thinking skills and creative thinking skills when instructed in creative problem solving.

## Purpose

The purpose of this research was twofold: 1) to determine the effectiveness of using an adapted version of Creative Problem Solving (Appendix A, Parnes, Noller, and Biondi, 1977) to increase problem solving abilities of kindergarten students, and 2) to determine the practical significance of using Creative Problem Solving (C.P.S.) (Parnes, Noller, and Biondi, 1977) as a method for increasing problem solving skills of kindergarten students. Furthermore, consideration was given to the interactive effects of gender and time of day (morning or afternoon placement) upon the effectiveness of the problem solving method. In addition to the statistical procedures employed, observations of language fluency were recorded. The practical or educational significance of the treatment was assessed using an effect size. Effect size is the standardized mean difference between control and experimental groups. It gives the researcher an indication of the

magnitude of differences between control and treatment groups.

To address the research objectives the following null hypotheses were examined:

$H_{0_1}$: There is no significant difference ($p \leq .05$) between experimental and control groups in problem solving ability, as measured by posttest scores on CIRCUS - Think It Through C (ETS, 1974) where preexperimental equivalence is controlled using the pretest score on Think It Through B (ETS, 1974) as a covariate.

$H_{0_2}$: There is no significant difference ($p \leq .05$) in interaction between time of day (morning or afternoon placement) and problem solving ability as measured by CIRCUS - Think It Through C (ETS, 1974).

$H_{0_3}$: There is no significant difference ($p \leq .05$) in interaction between gender and problem solving ability as measured by CIRCUS - Think It Through C (ETS, 1974).

## Method

Data were collected on four groups of kindergarten students ($n = 83$). The experimental and control groups were subdivided into morning experimental, morning control, afternoon experimental, and afternoon control. The students were randomly assigned to classes and the classes were randomly assigned to experimental and control conditions. The experimental groups received 18 lessons, 30 minutes per lesson in creative problem solving for six weeks. The control

groups participated in the regular kindergarten curriculum for the six weeks. All groups were pre- and posttested using Think It Through B as a pretest and Think It Through C as a posttest. Data from the pre- and posttests were transformed from raw scores to conversion scores and a full interaction model was computed using factorial analysis. In order to determine the pretreatment equivalence of the experimental and control groups a t -test was computed on the composite scores of the SESAT, Level I, Fall 1984, achievement test. Effect size, a measure of the practical significance of the treatment, was computed using a comparison of pre- and posttest scores on Think It Through B and C for the control and experimental groups, the results of which are expressed in standard deviation units. The data on language fluency were recorded from three observations of the experimental morning class and three observations of the experimental afternoon class brainstorming ideas on the same topics. These data were expressed in nominal form.

## Findings

This research was based on an experimental pre-posttest control group design to determine the effect of using creative problem solving techniques to enhance problem solving skills for kindergarten children. The results of the study are as follows:

1. A correlated t-test revealed no significant ($p < .05$) differences between the treatment and control groups on the variable achievement. This established the pretreatment equivalence of the experimental and control group.

2. The analysis of covariance revealed no significant ($p < .05$) differences between the treatment and control groups on posttest scores of the problem solving measure Think It Through C.
3. The analysis of covariance revealed no significant ($p < .05$) differences in interaction between time of day (morning or afternoon placement) and problem solving scores on Think It Through C.
4. The analysis of covariance revealed no significant ($p < .05$) differences in interaction between gender and problem solving skills by posttest scores on Think It Through C.
5. The computation of effect size revealed an educationally significant impact of the treatment on the experimental groups. An educationally significant effect size of .8 was observed for the relationship between pre- and posttest scores for the experimental group on Think It Through B and C.
6. The computation of effect size revealed an educationally significant effect for the control group. A medium effect size of .6 was observed for the relationship between pre- and posttest scores for the control group on Think It Through B and C.
7. The adjusted mean scores for the experimental and control groups revealed higher scores for the experimental groups over the control group when grouped by treatment. It also revealed slightly higher adjusted mean scores for the experimental group over the control group when grouped by

gender. When grouped by time of day, the experimental afternoon group evidenced the highest adjusted mean score and the control morning group the lowest adjusted mean score.

8. The language fluency scores for the experimental groups revealed increases for both morning and afternoon groups. The experimental afternoon group demonstrated the ability to generate slightly more ideas than the morning experimental group.

## Summary

The results of this research study have several implications for early childhood educators. Lundsteen and Tarrow (1981), call creative problem solving "perhaps the most important learning process (p. 359)" that can be used with young children. The use of creative problem solving skills can contribute significantly to the development of verbal ability (Mussen, Conger, and Kagan, 1969), increased self-confidence as a problem solver (Perkins, 1969), and increases in the quality and quantity of ideas produced (Parnes, Noller, and Biondi, 1977). The relationship between use of problem solving strategies and subsequent cognitive development has also been well recognized (Perkins, 1969). Thus, the use of problem solving strategies should contribute significantly to the social, emotional, and cognitive growth of young children. Early studies using creative problem solving strategies with older students have confirmed its usefulness in increasing creative and divergent thinking processes (Cartledge and Krauser, 1963; Parnes, Noller, and Biondi, 1977). This study attempted

to confirm earlier work on the effectiveness of creative problem solving, to demonstrate its usefulness with kindergarten children, and to establish these techniques as a means to increase problem solving skills for kindergarten children. Although the relationship between problem solving skill and the development of a positive self concept is recognized in the literature as an important one, it was not included in this research.

The results of this research were mixed. The statistical analysis of the data showed no significant differences between the control and experimental groups on problem solving ability after the six week treatment interval. These results do not allow the confirmation of creative problem solving techniques as a means to increase problem solving abilities for these children. Although creative problem solving is a sequentially prepared curriculum, its emphasis on divergent thinking, deferred judgment, and the generation of a wide variety of alternatives may have been incongruent with the problem solving measure used to assess differences. The availability of problem solving measures for use with young children is very limited. The goals of the creative problem solving process and the goals of the measure were initially thought to be very similar; however, the results of the data indicate this may not have been the case. Clearly, more research must be done and better measures of problem solving ability for young children must be developed.

In addition to the development of adequate problem solving measures

for young children, consideration must be given to the overall curriculum used with this particular group of kindergarten students. This is a demonstration kindergarten based upon Piagetian principles of child development. The focus is on independent learning experiences through the use of learning centers which emphasize the skills of problem solving, language development, self-expression, and logical thinking. The development of such a Piagetian-based comprehensive curriculum may lead to the enhancement of problem solving skills to the extent that the intervention treatment could not show differences between the experimental and control groups.

The lack of differentiation based on treatment may substantiate the use of this curriculum for kindergarten children. The effect size of .6 SD obtained for the control groups and .8 SD obtained for the experimental groups clearly indicated growth in problem solving skills for both groups. The experimental groups did demonstrate more relative gains in problem solving than did the control groups. The emphasis on problem solving skills as an integrated part of the ongoing kindergarten curriculum may have been effective in contributing to increased problem solving skills in the control groups. However, using creative problem solving techniques in other kindergarten classrooms not employing this type of curriculum, may have shown different results.

The lack of significant differentiation between groups based on gender or time of day taught reemphasizes the generalizability of the creative problem solving curriculum for this group of students. No

significant differences were found between male and female groups or between morning and afternoon groups.

The practical significance of using creative problem solving techniques to develop problem solving skills for kindergarten children was established. The impact of the treatment for the experimental group was educationally significant. The effect size gives a standardized measure of relative gains. An effect size of .3 SD is acceptable and an effect size of .6 SD is considered by most program evaluations as being educationally significant (Correro and Turner, 1980). The effect size for the relative gains in problem solving ability was .8, consequently the gain in problem solving skill was educationally significant for the kindergarten students in this study. This impact cannot be attributed to the treatment alone, other factors such as the intervention of the experimenter in the classroom and the kindergarten curriculum may also have had an influence on the treatment group.

The language fluency of the experimental group also showed gains. The emphasis on oral language in the creative problem solving process may have contributed to the demonstrated gains in language. Earlier research (Chase and Chi, 1980) has demonstrated that increases in language facility can contribute to increases in problem solving skills.

## Conclusions

The period of time which encompasses early childhood is one of

the most opportune ages to develop problem solving skills. Rapid developmental changes are evidenced, particularly between the ages of five to seven (Bloom, 1964). Children use a variety of strategies to solve social, emotional, and intellectual problems. Although the complexity of these problems is relative to the age of the child, supportive evidence has been accumulated to verify the existence of problem solving skills at a young age (Bloom, 1964; Case, 1984; Russell, 1956; Valett, 1978; Wadsworth, 1979). Recognition of the importance of problem solving skills has not necessarily led to the development of suitable curricula, particularly for young children. Creative Problem Solving (C.P.S., Parnes, Noller, and Biondi, 1977) is a well-researched method of encouraging persons to look at problems from a unique perspective. It is easily adapted for use with young children. The method employs techniques which emphasize sensitivity and awareness of problems, questioning strategies and discussion, generating a wide variety of ideas, and deferred judgment during idea finding. Each of these components is appropriate for use with young children. Although the results of this research did not provide conclusive evidence for the use of creative problem solving techniques to develop problem solving skills for kindergarten children, it does provide insight into areas of research which need further examination.

Clearly, the creation of more accurate and appropriate measures of problem solving skills for young children needs to be developed. These measures should be uniquely suited toward the stages of development in the young child as well as appropriate to the particular

types of problems young children attempt to solve. In addition to the establishment and evaluation f problem solving measures, the unique interrelationships which exist between the acquisition of problem solving skills and cognitive development should be investigated. Factors, such as, readiness skills, self-concept, and teacher interaction patterns may influence the subsequent development of problem solving abilities. These factors should be analyzed to determine what, if any, contribution they make to acquiring the ability to become an effective problem solver.

The research results of this study indicated an educationally significant impact on problem solving skill acquisition when using creative problem solving techniques with kindergarten children. Not only was the use of creative problem solving techniques educationally significant but it was also apparent that the innovation curriculum presented to the kindergarten students contributed to the development of problem solving skills. The curriculum of the Cooperative Demonstration Kindergarten (Correro and Turner, 1980) which emphasizes a unit-based approach utilizing learning centers which stress, among other areas, self-expression, language skills, problem solving, and logical thinking, appears to make a substantial contribution to the development of problem solving skills for young children. In combination with this curriculum, the use of creative problem solving techniques can contribute to the development of problem solving skills for kindergarten children. In order to determine the contribution of creative problem solving techniques to the acquisition

of problem solving skills for other kindergarten children, research should be conducted in a wide variety of settings which emphasize different approaches to programming for kindergarten other than that which is found at the Cooperative Demonstration Kindergarten. In view of the current study, the need is evident for continued research into the use of creative problem solving techniques with young children to develop their problem solving skills and cognitive abilities.

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APPENDIX A

Creative Problem Solving

for

Kindergarten

Creative Problem Solving for Kindergarten

This curriculum emphasizes the use of language experience activities and creative movement exercises in order to explore and define problems and challenges for young children. The focus is of the activities is designed to encourage the awareness of problems and challenges, deferred judgment during idea finding, and the generation of a wide variety of alternatives. The steps in the C.P.S. process have been adapted from the work of Parnes, Noller, and Biondi (1977); Eberle and Standish (1980); Isaksen and Treffinger (1985). The steps in the C.P.S. process are:

1. Fact Finding

   Analyzing what is known about the "mess."
   Collecting information about the problem
   Observing carefully and objectively
   Exploring all information

2. Problem Finding

   Looking at possible problems from several perspectives
   Narrowing focus
   Rewriting problem into solvable form
   Encouraging ideation and elaboration using the phrase, "In what ways might I..."
   Trying to form a plan of action

3. Idea Finding

   Generating many ideas and possible solutions
   Brainstorming for ideas or alternative solutions
   Listing as many ideas as possible

4. Solution Finding

   Choosing alternatives with potential for solving the problem
   Developing criteria for evaluation
   Apply criteria for evaluation
   Evaluate alternatives based on criteria

5. Acceptance Finding

Develop a plan of action
Consider who must accept the plan
Brainstorm concerns based on acceptance
(Maker, 1982.)