THE EFFECTS OF PROBLEM SOLVING ON THE DEVELOPMENT OF THE WHOLE CHILD

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ABSTRACT

Problem solving experiences are a critical part of the early childhood curriculum for two reasons. First, the ability to solve problems is a skill that is necessary throughout life. Second, problem solving experiences enable children to be actively involved in constructing knowledge about the environment and themselves. As children solve problems they have an opportunity to utilize previously acquired skills and knowledge, and acquire new skills and knowledge as they seek to resolve conflicts and reorganize their mental structures. The purposes of this paper were to provide a review of literature that established a rationale for utilizing problem solving, and to provide suggestions for strategies that promote effective problem solving experiences. Because problem solving is important to children's development, an outline of key elements of this paper was provided as an aid in presenting information to professionals and students of early childhood education.

CHAPTER 1

ORIENTATION OF THE PAPER

Introduction

The ability to solve problems is a skill that is necessary throughout life. Rapid and continual economic, social, and political changes in our modern society create unique and challenging problems to be solved each day. Issues such as overpopulation, environmental pollution, and advances in science and technology generate complex problems that require constant attention. As one issue comes close to being solved, another one arises. Solutions to current problems often generate problems for the future. In fact, it often seems that life is a never ending process of encountering and solving problems.

Because the role of education is to provide children with the skills, knowledge, and attitudes necessary for becoming competent, successful members of adult society (Katz & Chard, 1989), the acquisition of problem solving skills demands a fundamental place in the school curriculum. Teaching children to solve problems is vital to their preparation for an uncertain and ever changing future.

Forman and Kuschner (1983) believe that a primary goal

of education is to enable children to use their acquired knowledge to improve the quality of life through the development of general problem solving abilities. Problem solving is defined as the active use of previously acquired knowledge in new and unique situations to seek solutions, make choices and decisions, and experience cause and effect in order to resolve conflict (Bullock, 1988; Goffin & Tull, 1985).

While the ability to solve problems is essential for enhancing the quality of life, two theories of human development utilize problem solving experiences in education for a more compelling reason. The developmental theories of Jean Piaget and Erik Erikson view problem solving experiences as an essential catalyst in the process of the growth and development of the whole child (Erikson, 1963; Piaget & Inhelder, 1969). These two theories view problem solving experiences as necessary for growth and learning in all developmental domains: social, emotional, cognitive, and physical (Bredekamp, 1987; Erikson, 1963; Katz & Chard, 1989; Piaget & Inhelder, 1969).

An appropriate philosophy of early childhood education recognizes that children construct knowledge as they engage in active learning experiences (Bredekamp, 1987; Forman & Kuschner, 1983; Piaget & Inhelder, 1969). Meaningful problem solving experiences provide the framework required for the construction of knowledge. "Knowledge is

constructed as children solve the everyday problems they encounter" (Hitz, 1987, p.12).

Problem solving experiences are critical in the context of Erikson's theory of psychosocial stage development (Elkind, 1981; Erikson, 1963). Psychosocial conflicts arise as children experience a disparity between the needs and desires of their own ego, and the needs and desires of others in society (Erikson, 1963; Green, 1989). As children experience success in solving problems they build a sense of trust in themselves, in others, and their environment, while the opportunity to make choices and decisions builds a sense of autonomy. Feelings of mastery and competence develop into a sense of initiative and industry (Elkind, 1981; Erikson, 1963; Goffin & Tull, 1985). The resolution of meaningful problems is a critical factor in the growth and development of children's ego identity.

Problem solving activities are important and necessary in the early childhood setting for two reasons. First, they provide children with an essential skill that will be used throughout their lives. Second, problem solving experiences provide the most valuable and effective means for children to construct knowledge and a positive self concept that includes feelings of responsibility, curiosity, initiative, and creativity (Bullock, 1988; DeVries & Kohlberg, 1987; Erikson, 1963; Hitz, 1987; Piaget & Inhelder, 1969). For these reasons the National Association for the Education of

Young Children (NAEYC) states that problem solving opportunities are essential in a developmentally appropriate early childhood curriculum. In a NAEYC Position Statement regarding developmentally appropriate practices, Bredekamp states, "Teachers recognize that children learn from self-directed problem solving and experimentation" (Bredekamp, 1987, p.55).

In order to provide a developmentally appropriate curriculum for the care and education of young children it is necessary to know how to implement a program that allows for growth and development through problem solving (Bredekamp, 1987; DeVries & Kohlberg, 1987; Forman & Kuschner, 1983). As adults seek to provide such a program, they are faced with many choices and challenges. Decisions need to be made regarding the most effective methods, the setting, and structure of problems to be solved.

In exploring and analyzing the issues surrounding implementation of a developmentally appropriate problem solving curriculum, it becomes apparent that in order to institute a truly effective learning environment, it is necessary to adopt an all encompassing philosophy of education that recognizes and celebrates the joys and benefits of encountering and solving problems. A problem solving philosophy requires a "creative spirit" (Hitz, 1987, p.16), and a willingness to take risks in the classroom. Acceptance of a problem solving philosophy allows the

opportunity to be open to new ideas and challenges, to value the process of learning, and to learn from mistakes. Peck (1978) provides an explanation of the advantages of recognizing and embracing the joys of problem solving as a life experience:

> Yet it is in this whole process of meeting and solving problems that life has meaning. Problems are the cutting edge that distinguishes between success and failure. Problems call forth our courage and our wisdom. It is only because of problems that we grow mentally and spiritually. When we desire to encourage the growth of the human spirit, we challenge and encourage the human capacity to solve problems, just as in school we deliberately set problems for our children to solve. It is through the pain of confronting and resolving problems that we learn... It is for this reason that wise people learn not to dread but actually to welcome the pain of problems. (p. 16)

Purpose Of The Paper

The purpose of this paper is three fold. First, this paper will examine the theories of Jean Piaget and Erik Erikson to establish a theoretical rationale for the implementation of a problem solving approach to learning. Second, a review of current research which has investigated the role of problem solving experiences in early childhood education will be provided. Finally, based on information gained from theory and research, specific strategies for enhancing the development of the whole child through problem solving will be provided.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of the literature review is to provide a theoretical rationale for implementing a problem solving approach to learning, and to examine current research which has studied the implementation of problem solving activities with young children. First, an examination of the cognitive development theory of Jean Piaget (Piaget, 1954, 1976; Piaget & Inhelder, 1969) will provide insight into the process of constructing knowledge through problem solving. Second, Erik Erikson's theory of psychosocial development (Erikson, 1963) will be examined in order to understand the role of problem solving experiences in the development of self-concept and the resulting impacts on cognitive and social development. Third, a review of current research will offer information regarding the effectiveness of problem solving activities and the optimal conditions for successful outcomes of problem solving.

Cognitive Development Theory

Jean Piaget's theory of cognitive development provides a comprehensive explanation of how children learn and

develop in all developmental domains; cognitively, socially, emotionally, physically, and morally (Piaget, 1954, 1976; Piaget & Inhelder, 1969). A basic premise of Piaget's theory of cognitive development is that children construct knowledge as they actively manipulate objects in their environment (Piaget & Inhelder, 1969). The application of the principles of cognitive development theory to the learning environment is referred to as a constructivist approach to learning (DeVries & Kohlberg, 1987; Forman & Kuschner, 1983).

Piaget recognized four distinct stages of development (Green, 1989; Piaget & Inhelder, 1969): the sensorimotor stage, the preoperational stage, the concrete operational stage, and the formal operational stage. Each stage has its own unique characteristics of mental development and resultant behavior. There is a universal, invariant sequence of development from one stage to the next, with each stage building upon the knowledge acquired in the previous stage (Piaget & Inhelder, 1969).

The knowledge that children construct is determined by their biological maturation level, opportunities for active experience with and observation of objects, active social interactions with other children and adults, and opportunities to encounter cognitive conflicts which lead to equilibration (Piaget & Inhelder, 1969). All four factors are essential for development. All four factors are

interrelated in the role they play in the construction of knowledge. Each factor is, however, insufficient in itself. For example, development is never solely dependent on biological maturation. Equilibration is regarded as the most critical factor in this process. It is responsible for, and causes a change, or reorganization, in mental development (Piaget & Inhelder, 1969).

Piaget recognized three differing types of knowledge, social, physical, and logico-mathematical, each of which has a different source (Forman & Kuschner, 1983; Kamii, 1982; Peterson & Felton-Collins, 1986; Piaget & Inhelder, 1969). Social knowledge is learned from people and society. Social knowledge includes information such as names, social customs, facts, and dates. Physical knowledge is information gained from the observation of physical objects, such as observing the ability of round objects to roll.

Physical knowledge and social knowledge are assimilated into already existing schemes of knowledge (Piaget & Inhelder, 1969). Assimilation is defined by Wadsworth (1989) as "...the cognitive process by which a person integrates new perceptual, motor, or conceptual matter into existing schemata or patterns of behavior" (p. 13).

The third type of knowledge, logico-mathematical knowledge, is acquired internally as children actively manipulate objects in their environment (Piaget & Inhelder, 1969). As children construct logico-mathematical knowledge

they build broad concepts that provide a meaning and understanding of reality. Kamii (1982) states that both social and physical knowledge need to be constructed into the framework of logico-mathematical knowledge in order to have any meaning or understanding in reality.

A fundamental necessity for the construction of logico-mathematical knowledge is active experience with and observation of transformations, or changes, in objects and relationships (Forman & Kuschner, 1983). Cognitive conflict occurs when children experience a difference in perception between what is already known about an object and what is actually observed (Green, 1989; Piaget & Inhelder, 1969). In order to resolve cognitive conflict, children are required to build new thought patterns, or schemata, to accommodate the new information. Accommodation is the result of the successful resolution of cognitive conflict. The process of accommodation results in renewed mental equilibrium. Wadsworth (1989) defines accommodation as "...the creation of new schemata or the modification of old schemata. Both actions result in a change, or development of, cognitive structures (schemata)" (p. 14).

Problem solving experiences provide an opportunity and structure for the occurrence of the process of assimilation, cognitive conflict, and accommodation of ideas (Forman & Kuschner, 1983; Peterson & Felton-Collins, 1986). They are

the basis for cognitive growth in young children's learning experiences (Goffin & Tull, 1985).

In addition to explaining how knowledge is constructed throughout development, cognitive development theory provides detailed information about knowledge that is acquired in each developmental stage (Piaget & Inhelder, 1969). Children between the ages of two and seven are typically in the preoperational stage of development. Characteristics of preoperational children's thinking include egocentrism, irreversible thought patterns, and the emerging ability to use symbolic representation. Peterson and Fenton-Collins (1986) provide an additional description of preoperational children: "The thought of the preoperational child from four to seven years of age tends to be ... centered, based on visual perception and intuition and characterized by reasoning from particular to particular, rather than inductive or deductive logic" (p. 18). These characteristics define the limits of young children's perceptions of, and interactions with their world, and therefore the knowledge they construct during the preoperational stage (Forman & Kuschner, 1983).

While children construct knowledge during individual problem solving activities, social interaction is a valuable and necessary contributor to the occurrence of cognitive development (Piaget & Inhelder, 1969). Piaget stresses the need for learning through cooperative activities. DeVries

and Kohlberg (1987) provide an explanation of Piaget's concept of cooperation, "By co-operation Piaget did not mean submissive compliance or superficial good-naturedness. For Piaget, co-operation is a method of social relations, and includes conflict" (p.30). As children interact with adults and peers, they encounter ideas, situations, and behaviors that differ from their own and produce cognitive conflict.

Opportunities for solving interpersonal problems require children to decenter, to take a point of view other than their own (DeVries & Kohlberg, 1987; Goffin & Tull, 1985; Wadsworth, 1989). In this way children begin the development of social and moral growth. "The entire socialization process, from the initial establishment of autonomy to the development of empathy and diplomacy, consists of an increasing ability to decenter from one's own personal perspective" (Forman & Kuschner, 1983, p.88). Solving interpersonal problems in group settings enables children to take part in the process of developing social and moral rules that make sense and have meaning for themselves. As a result of problem solving in social interaction experiences, children develop a sense of social competence and autonomy (DeVries & Kohlberg, 1987).

As children solve problems in social situations they are required to decenter, make choices and decisions, and experience the cause and effect of their actions. These

experiences enable children to construct self-concepts that include feelings of responsibility, curiosity, initiative, and creativity while constructing knowledge about the world around them (Bullock, 1988; Hitz, 1987; Kamii, 1982).

Psychosocial Theory

Problem solving experiences are a necessary change mechanism within the framework of Erik Erikson's theory of psychosocial development. Erikson's theory provides an understanding of the development of self-concept, and ego identity as a result of biological maturation and resolution of psychosocial conflict (Erikson, 1963; Green, 1989). Development is the result of an interactive process between the individual and the environment. Epigenesis (genetically determined biological growth and maturation) is viewed as the primary agent of change and development, while encounters with, and resolution of psychosocial conflicts determine the direction which personal development will take (Green, 1989).

According to Erikson's psychosocial theory, development follows a predictable, universal sequence through eight stages of the life cycle (Erikson, 1963). Resolution of conflict within one stage paves the way for progress to each succeeding stage where a new and different conflict is encountered. The positive resolution of conflict results in a strong ego, while negative resolution of conflict results

in the development of a weak ego. Resolution of conflict at each stage of development leads to the acquisition of individual personality strengths or weaknesses, and attitudes about the world and how the individual functions in it (Erikson, 1963).

Psychosocial development begins in early infancy as children establish a sense of trust or mistrust. A sense of trust is built in an environment that is generally warm, nurturing, and consistent (Erikson, 1963). Erikson (1963) states, however, that children must endure a certain amount of conflict that occurs when the environment departs slightly from the comfort of warmth, nurturing, and consistency. Experiences with slight departures from perfection cause the psychosocial conflicts which must be resolved in order to develop an overall sense of trust and strength of hope (Erikson, 1963). Erikson (1963) considers the sense of trust to encompass not only an attitude toward the infant's environment, but also a trust in one's self (Erikson, 1963). Children who experience an environment that is generally hostile, non-nurturing, and inconsistent ultimately build a sense of mistrust, and feeling of despair (Erikson, 1963).

The self-concepts formed as an outcome of the resolution of conflicts encountered during the trust versus mistrust stage impact the resolution of conflicts encountered during the second stage of autonomy versus shame

and doubt. During the stage of autonomy versus shame and doubt, children begin to assert their independence and attempt to take responsibility for their actions. Their physical growth allows greater movement and interaction with the environment. These factors provide frequent opportunities for encountering increasingly complicated problems to solve (Erikson, 1963).

The attitudes and self concepts that children acquire during the first and second stages of development further define children's ability to cope with and solve the problems of the third stage, initiative versus guilt. Children who have a basic sense of trust and autonomy will look favorably on opportunities to take initiative in solving the problems they encounter. Having built senses of trust and autonomy, children know that their bodies and minds are capable of trying to solve problems, and if they are unable to succeed in their struggles, acceptance and assistance is available from helpful caregivers (Erikson, 1963).

The outcomes of the problems encountered during each stage continually add to children's definition of self, and sense of awareness of being a separate person. Positive problem solving experiences build strengths of hope, willpower, purpose, and competence (Erikson, 1963). Through the process of resolving conflicts, children

construct a view of themselves as competent problem solvers or helpless children (Elkind, 1989; Erikson, 1969).

Erikson places a high value on the experience of play. The conflicts that children resolve and master are accomplished through play (Erikson, 1963). Play is the arena in which children build their sense of self. "Play, then is a function of the ego, an attempt to synchronize the bodily and the social processes with the self" (Erikson, 1963, p.211). During play children can repeatedly solve the problems and accomplish the tasks that are meaningful and relevant to them. Accomplishment of an initial task may lead to further refinement and solution of a problem. As children succeed, they build a personal sense of accomplishment, of competence, and a strong ego identity. Children need the opportunity for repeated play experiences that allow them to build a sense of identity in all domains: social, emotional, physical, cognitive, and creative (Erikson, 1963).

Elkind (1989) states that free playtime is a critical element in promoting problem solving skills and in developing divergent thinking. Play allows children time for making choices and decisions, for creative experimenting, and for practicing skills required for problem solving. The problems that children encounter during play activities are personally meaningful to

children, and at their level of cognitive understanding (Elkind, 1989).

Research Related to Problem Solving

Erikson's and Piaget's theories of development provide a fundamental basis for understanding the role of problem solving in human growth and development. At the core of both theories are certain common elements that suggest foundations to establish successful practices for problem solving. Cognitive, social, and emotional development takes place in an orderly sequence as a result of the resolution of conflicts encountered. Problems should allow for active involvement in a social setting, including play, and need to be meaningful and relevant to the children (Erikson, 1963; Piaget & Inhelder, 1969).

Numerous research studies (Ames & Murray, 1982; Murray, 1972; Pepler & Ross, 1981; Sylva, Bruner, & Genova, 1974) have focused on specific elements proposed in theory to answer the technical questions regarding the structure of problems, the setting, and the social and emotional influences most valuable for implementing a problem solving approach to learning. Research (Bearison, Magzamen, & Filardo, 1986; DeVries, Reese-Learned, & Morgan, 1991) has also concentrated on measuring the positive effects of learning through problem solving.

Pepler and Ross (1981), in a study which involved 64 three- and four-year-old children, examined the effect of play with convergent and divergent materials on the ability to solve problems. The results indicated that children who played with divergent play materials generally were more creative and flexible in finding solutions to problems than children who played with convergent materials. In addition, Pepler and Ross (1981) found that play experiences with open ended, divergent play materials allowed children to transfer information gained during play to other experiences.

In two experimental studies involving 158 children in suburban Minneapolis and Delaware elementary schools, Murray (1972) studied the effect of social interaction on young (mean age = 6.7) children's ability to conserve. Both studies were conducted during a two month period. Each study involved three sessions in which the children worked individually, in groups of three, and again individually to solve problems of conservation. Following an initial pretest administered during session one, children were grouped in triads consisting of one nonconserver and two conservers. In session two, the children, working in triads, were given the same problems from the pretest to solve in group experiences. While working in triads, the children were required to discuss the problems with each other, provide explanations of their answers, and agree upon an answer acceptable to the group. During session three,

different forms of the same Concept Assessment Kit used during session one were administered on an individual basis as a posttest measure.

Murray (1972) found that children working to solve problems of conservation in social interaction triads made significant advances in ability to conserve from pretest to posttest situations. Murray (1972) concluded that communication and disagreements during social interactions provided an important framework for encountering the necessary cognitive conflict required for a reorganization of mental ideas and cognitive growth.

Research (Ames & Murray, 1982) indicates that it is the differences of opinions or beliefs encountered during social interactions that precipitates cognitive change, and not necessarily confrontations with correct information. In a study involving 96 first and second graders, Ames and Murray (1982) assigned children to solve problems in social interaction pairs on the basis of their differing opinions. Although neither group member originally possessed the correct answer to solve problems of conservation or spatial perspective, the opportunity to encounter cognitive conflict resulted in significant gains for both members in posttest scores.

Bearison, Magzamen, and Filardo (1986) conducted a study involving 106 five- to seven-year-old children which examined the most effective settings for cognitive growth

during peer interactions. Results indicated that overall children working in pairs did not perform higher or lower on problem solving tasks than children working independently, however important factors which influence cognitive growth during social interactions were determined. Bearison, Magzamen, and Filardo (1986) concluded that social problem solving experiences are most beneficial for cognitive and social growth when children a) encounter problems that are challenging at their cognitive level, rather than too easy, or too difficult; b) are allowed to verbally disagree and justify their opinions to their partners; c) are grouped with peers who are at relatively equal cognitive levels. In paired groups where all three conditions were encountered, performance on problem solving tasks was significantly higher than children working independently, or in paired groups which did not meet the three optimal conditions.

The quality and quantity of adult interventions have been found to influence children's problem solving abilities. Casey (1990) assessed the problem solving abilities of 19 children enrolled in a model preschool curriculum designed to promote planning and problem solving skills along with those of 49 children enrolled in three preschools which utilized a traditional curriculum. All four preschools in the study were similar in adhering to a developmental, Piagetian based philosophy. The model preschool differed from the others by structuring specific

individual, small group, and large group activities to promote planning and problem solving skills.

The students in all four preschools were given pretests and posttests to determine skills in planning and problem solving, as well as general cognitive abilities, including IQ. At the end of one school year, no significant differences in gains of general cognitive abilities or IQ were found between the students in the four preschools, however children enrolled in the model preschool had significantly higher abilities in organizational, planning and problem solving tasks. Casey (1990) stated that while the results of this study were limited because of the small, middle class population involved, they did provide evidence that four- and five-year-old preschool children are capable of making decisions, predicting outcomes, and following a plan to solve problems.

DeVries, Reese-Learned, and Morgan (1991) studied the effect of three different types of learning environments on 56 kindergarten children's ability to resolve interpersonal conflict. Children in a classroom which utilized a constructivist approach demonstrated a significantly higher level of ability to successfully resolve interpersonal conflicts in small group play situations than children in classrooms which utilized direct instruction (i.e. Distar), or an eclectic program (DeVries. et al., 1991).

DeVries et al. (1991) suggested that the results of the study indicated children who were provided with opportunities to solve problems during social interaction situations, as the constructivist environment allowed, gained a higher level of social moral development. In addition, when allowed to play alone without a teacher in the classroom, children in the constructivist classroom demonstrated a more autonomous understanding of social and moral rules for their behavior than children in the direct instruction or eclectic programs. Children in the constructivist classroom felt that they had a part in formulating the rules, the rules were personally meaningful to them, and they could understand and use the rules to help solve problems.

DeVries, et al. (1991) found a direct relationship between classroom teacher behavior and children's social and moral development. Teacher modeling was found to be a powerful influence in promoting problem solving abilities. Positive, warm, and encouraging teacher interactions promote problem solving in the classroom by allowing children to develop a sense of trust, and willingness to take risks in learning (DeVries et al., 1991; Erikson, 1963; Katz & Chard, 1989). "When children experience an environment in which the teacher practices cooperation ... and encourages children's feelings of community, democratic decision-making, and conflict resolution on a regular basis, children

develop greater capacities for intimacy and negotiations with others" (DeVries, et.al., 1991, p. 509).

Adult responses to children's behavior impact in a nurturing or prohibitive manner the self images that children build (Erikson, 1963). In a review of research on the effects of praise and rewards, Brophy (1981) states that praise and external rewards tend to subvert children's sense of confidence and limit children's sense of self initiative. Praise often focuses attention on competition with peers rather than learning, and results in an unwillingness to take risks necessary for solving problems and creativity. Praise, when used as reinforcement, is typically misused, ill timed, and ineffective in promoting desired behaviors.

Brophy (1981) recommends, as an effective alternative to praise, the use of encouragement that focuses on the process of children's problem solving efforts. Encouraging statements provide specific, descriptive feedback, and do not call attention to competition or comparison with other children. Statements of encouragement typically facilitate cooperation to solve tasks, build internal motivations to solve tasks and creative problem solving skills.

Adult interventions in the early childhood environment may have differing impacts on individuals and groups of children. Gold, Crombie, Brender, and Mate (1984) examined the gender differences in children's ability to solve

problems with adult intervention. Gold et al. (1984) hypothesized that because boys are traditionally allowed more opportunities for independence and active involvement with problem solving situations from a very young age, they will have developed greater problem solving abilities than girls. Specifically, Gold et al. (1984) were interested in the effect of adult models on girls' and boys' ability to successfully solve problems.

Gold et al. (1984) conducted two experiments; first with a sample of 8 year old boys and girls, second with a sample of 4 year old boys and girls. In each experiment the effect of a misleading adult model on girls' and boys' behavior was contrasted with girls' and boys' abilities to solve problems without adult intervention. One group of girls and boys watched an adult model perform a demonstration containing misleading information on how to solve a simple game problem. Following the demonstration, the children were asked to solve the problem alone. Another group of girls and boys was allowed to solve the problem through trial and error without adult intervention.

Results (Gold et al. 1984) indicated that girls were more likely than boys to persist in imitating the behavior of the model, even when the information from the model was misleading and did not lead to a successful solution. No gender differences were observed in abilities to solve problems through trial and error without adult intervention.

Gold et al. (1984) concluded that girls are more dependent on adult help to solve a problem, and are more easily influenced and mislead by adult models.

The information gained from research of problem solving and development supports the developmental theories of Erikson and Piaget. Problem solving experiences provide opportunities to encounter conflict, and to construct knowledge during the process of resolving conflict. In addition, research has been successful in providing valuable information regarding the most effective means of promoting development through problem solving.

CHAPTER 3

STRATEGIES TO PROMOTE PROBLEM SOLVING

The knowledge acquired from the developmental theories of Piaget and Erikson and from research yield insights into the most effective means of implementing a problem solving approach to learning. By structuring the learning environment, children's opportunities for social interactions, and the quality and quantity of adult interventions, it is possible to plan a program for children that will allow them to develop to their fullest potential.

Environment

Young children gain problem solving skills in an environment that is designed to allow opportunities for making choices and decisions about where to play, with whom to play, and which materials to play with (Erikson, 1963; Piaget & Inhelder, 1969). The early childhood environment is affected by the spatial arrangement, the materials available, and the daily schedule (Bredekamp, 1987; Erikson, 1963; Hohmann, Banet, & Weikart, 1979; Piaget, 1969). Each of these factors should be planned to accommodate the

developmental needs of young children in the preoperational stage of development (Bredekamp, 1987).

Space

The opportunity to solve problems during play is enhanced when children can concentrate on the activity in which they are involved without being limited by spatial constraints (Goffin, & Tull, 1985). The placement of activity areas should be carefully planned to provide a balance between areas of active movement, such as block building and gross motor development, and quiet areas such as the art or reading area.

Because young children are egocentric (Erikson, 1963; Piaget & Inhelder, 1969), and have difficulty decentering (Piaget & Inhelder, 1969), they are not always aware of their position in space relative to other children and their play activities. Care should be taken to provide adequate space in each area so that children have enough room for movement and manipulation of materials without interfering with the play of other children (Goffin, & Tull, 1985). When spatial limitations are encountered, they can become opportunities for growth through problem solving as children are encouraged to discover and create new ways to accommodate their spatial needs .

Materials

Learning materials for young children should be concrete, manipulative, and relevant to the interests of the children (Erikson, 1963; Piaget, 1954, 1969). Sand, water, a variety of blocks, construction materials and tools, playdough, clay, and art supplies are materials that can be manipulated by children in various ways and at differing levels of development (Bredekamp, 1987; Bullock, 1988; Forman, & Kuschner, 1983; Goffin, & Tull, 1985). These types of materials provide opportunities to actively experience, observe, and explore transformations. Through active experience, children encounter cognitive conflict and build relationships between objects, and between themselves and objects.

Materials that require two or more children to work or play together stimulate cooperative efforts and opportunities to encounter cognitive conflicts in social situations (Goffin, 1987; Tudge, & Caruso, 1988). When children of differing levels of cognitive development are involved in co-operative experiences, possibilities for cognitive conflict abound (Tudge, & Caruso, 1988). Children at lower levels of development encounter new ideas that require a reorganization of existing ideas. Children with higher levels of development are required to explain and justify their ideas.

Large building blocks, large cardboard boxes, a rocking boat, or sleds and wagons to pull are useful materials for encouraging cooperative activities. Dramatic play activities are highly effective in promoting social problem solving interactions during play.

Easy access to open-ended materials yields multiple possibilities for problem solving at varying levels of abilities (Erikson, 1963; Forman, & Kuschner, 1983). Trust, independence, initiative, and competence are promoted when children are given opportunities to choose their own materials and engage in activities to solve problems that are personally meaningful and interesting (Erikson, 1963).

A variety of open-ended materials should be available for children to choose as a need or desire arises (Hohmann et al., 1979). The materials that are available for children's use should be stored on child accessible shelves. The shelves should be clearly labeled with words and pictures so that children are able to find the items they need, and return them when they are finished.

The Daily Schedule

A well established, familiar schedule allows children to feel secure in participating in activities and social relationships that promote problem solving (Bredekamp, 1987; Erikson, 1963; Hohmann et al., 1979). "A consistent routine is a framework. It frees children and adults alike from worrying about or having to decide what comes next, and

enables them to use their creative energies on the tasks at hand" (Hohmann et al., 1979, p.59). Occasions that necessitate a change in the schedule can be utilized to help build problem solving skills as children find ways to accommodate a different time schedule.

The daily schedule should provide times for a variety of experiences that include opportunities for child initiated and adult initiated activities in individual, small group, and large group settings (Hohmann et al.,1979). The daily schedule should provide long, uninterrupted time periods that allow children to become involved in sustained meaningful playtime activities (Bredekamp, 1987; Holt, 1989). Children often require frequent opportunities to repeat activities before they are ready to solve new problems (Erikson, 1963; Holt, 1989).

Play

Free playtime is a necessary element in developing problem solving skills, divergent thinking, and social interactions (Pepler & Ross, 1981; Sylva, Bruner & Genova, 1976). Play experiences allow children time for making choices and decisions, for creative experimenting, and for constructing and practicing language skills. In the process of play activities children encounter numerous opportunities to solve meaningful problems that are at their own level of cognitive understanding.

It is important to point out that Forman and Hill (1984) make a distinction between random play and constructive play. Random play experiences, while they may be fun or entertaining, lack opportunities for children to be creative, or build new knowledge or skills. Constructive play experiences are structured by adults to allow children to actively experiment with and observe transformations in objects, and to explore and construct alternative ways of transforming materials. The role of adults in constructive play is to structure the environment, provide materials, observe the progress of children's activities, and ask open-ended questions that may provoke cognitive conflict (Forman & Hill, 1984; Forman & Kuschner, 1987).

Opportunities for Social Interactions

Small and large group activity times that are teacher initiated provide opportunities for children to use language to describe, discuss, and solve problems in cooperative settings (DeVries & Kohlberg, 1987; DeVries, Reese-Learned & Morgan, 1991). Group activities afford numerous instances for social development through problem solving activities. Children are required to decenter in order to consider, or understand the ideas, feelings, and needs of other children and adults.

Children encounter cognitive conflict as they share opinions, make predictions, and report on the causes and

effects of problems they explore together (Ames & Murray, 1982; Murray, 1972). Activities such as music, gross motor movements, games, and group discussions provide occasions for creative problem solving in group situations (Goffin & Tull, 1985; Hitz, 1987; Kamii & DeVries, 1980).

Adult Interventions

Adult interventions in the early childhood setting have a tremendous impact on children's problem solving activities (Brophy, 1981; Casey, 1990; DeVries et al., 1991; Erikson, 1963; Forman & Kuschner, 1983; Katz & Chard, 1989). Adults can make positive contributions to problem solving activities by establishing a secure, supportive, and challenging atmosphere, taking part in problem solving activities, and by acting as models for problem solving (DeVries & Kohlberg, 1987; Erikson, 1963; Goffin & Tull, 1985; Forman & Kuschner, 1983). Positive, warm, and encouraging adult interactions promote problem solving in the classroom by allowing children to develop a sense of trust and a willingness to take risks in learning activities (DeVries et al., 1991; Erikson, 1963; Goffin & Tull, 1985).

Adults play a crucial role in the early childhood setting by producing situations of cognitive and psychosocial conflict for young children (Copeland, 1988; Erikson, 1963; Forman & Hill, 1980; Forman & Kuschner, 1983). Forman and Kuschner (1983) state the adult's

"...general mission is to be a troublemaker... He gives the child an opportunity to sense some conflict and perhaps to experience the joy of reducing the conflict by making a discovery and inventing a solution" (p. 114). This can be done by asking questions, by helping children recognize problems, or by adding new and different materials to children's activities (Forman, & Kuschner, 1983).

Fostering Divergent Thinking

Divergent thinking skills have been found to be essential for creative problem solving (DeVries et al., 1991; Elkind, 1989; Pepler & Ross, 1981; Sylva, Bruner & Genova, 1976). Real life problems that children encounter on a daily basis in the early childhood setting are highly effective in stimulating divergent thinking because there is usually no one correct solution (DeVries & Kohlberg, 1987; Hitz, 1987). Hitz (1987) states that "vague, ill structured problems such as those frequently encountered in life" (p. 12) are most useful for development because they require creative, logical thinking. Adults should take advantage of the everyday conflicts that children encounter to develop social, emotional, and cognitive growth through problem solving.

Asking open-ended questions promotes divergent thinking skills, and stimulates children to think in new and creative ways (Copeland, 1988; Erikson, 1963; Forman & Kuschner, 1983; Katz & Chard, 1989). Tudge and Caruso (1988) suggest

that adults should refrain from providing suggestions or solutions to problems. Rather, children should be encouraged to think of possibilities for solutions to problems. "...arriving at the correct answer is less important than the process of struggling with the problem..." (Tudge & Caruso, 1988, p. 51).

The Effects of Praise and Encouragement

Adults' use of praise and external rewards has been found to limit children's sense of initiative, and result in negative competition and unwillingness to take risks (Brophy, 1981; Katz & Chard, 1989). General statements regarding children's work, such as "Great", "That's pretty", or "Wonderful" provide little concrete or constructive feedback for children to utilize in evaluation of their efforts (Brophy, 1981; Erikson, 1963; Hitz, & Driscoll, 1988; Katz & Chard, 1989). In contrast, encouraging remarks that focus on the process of children's work, and are specific and descriptive, have been found to provide children with information that can be used to concretely evaluate their work. Encouraging remarks about children's work that are made in an honest manner, on a personal level, and do not call attention to competition or comparison with other children, help to develop intrinsic motivation for learning (Katz & Chard, 1989).

Adult Models

Adults can promote problem solving in the early childhood setting by being role models (DeVries et al., 1991; DeVries & Kohlberg, 1987; Erikson, 1963; Holt, 1989). Problem solving requires a "creative spirit" (Hitz, 1987, p.16), and a willingness to take risks in learning. Adults should be open to challenges, and new ideas. This involves not only the interactions that adults have with children, but also a willingness to experiment with new and different learning experiences for children (Holt, 1989; Katz & Chard, 1989).

Adults should model the practice of learning from errors and mistakes (Erikson, 1963; Forman & Kuschner, 1983; Holt, 1989). Mistakes made by adults and children provide rich opportunities for learning. Analyzing mistakes allows for occasions to encounter cognitive conflict, assess cause and effect, and make predictions for possible future solutions. In addition, children develop trust, initiative, independence, and competence in an atmosphere that allows them to experiment and learn from mistakes without fear of failure (Erikson, 1963; Katz & Chard, 1989).

Gold, Crombie, Brender, and Mate (1984) suggest that girls are more dependent on adult help, are more influenced by adult models and are less aggressive in problem solving situations than boys. Gold et al. (1984) propose that gender differences in problem solving are a result of the

socialization processes that girls and boys encounter. Adults should be careful to provide equal opportunities and experiences for each child in order to develop the necessary attitudes for problem solving. These attitudes include a sense of trust in themselves and the environment, a sense of independence, and a sense of curiosity and initiative (Erikson, 1963). Women should remain aware of research results (Gold et al., 1984) that suggest girls are less assertive and independent in problem solving situations than boys, so that they are especially able to provide an effective female role model for problem solving. Men should use this research to understand the necessity of providing a positive problem solving model for all children.

Entering the Problem Solving Experience

Information gained from developmental theories (Erikson, 1963; Piaget, 1954, 1959; Piaget & Inhelder, 1969) and the results of research (DeVries et al., 1991; Pepler & Ross, 1981;) indicates that cognitive and social development is most enhanced when children are allowed to work independently to solve problems. However, young children often require effective adult intervention to help solve problems (Goffin, 1987; DeVries & Kohlberg, 1987). Close observation of learning activities is necessary in order for adults to determine when it is most beneficial to refrain from entering a problem solving activity, and when adult intervention is required (DeVries & Kohlberg, 1987; Forman &

Kuschner, 1983). Adults can help children define the problem, provide ways to gain necessary information and skills for solving problems, and help children evaluate possible solutions and outcomes of problems.

Church (1991) proposes a practical approach for adults to enter the problem solving process by helping children work through the following five steps:

1. Help children identify the problem. Research (Bearison, Magzamen, & Filardo, 1986) points out that children are most effective at recognizing and solving problems that are at their own cognitive level of understanding. Problems that are too easy are not interesting, while problems that are too difficult are not understandable or meaningful. When a problem is encountered during play, children may not be able to recognize, define or understand the problem until an adult helps to put it into their own cognitive context.

Knowledge of the characteristics of children operating at the preoperational stage of development can help adults understand how children "see" a problem (Forman & Kuschner, 1983). Young children's egocentricity, their tendency to center on one aspect of a situation, and their irreversible thought processes (Piaget & Inhelder, 1969), may limit their ability to understand all parts of a problem. Adults can help by asking open-ended questions that require children to examine the situation and use language to describe it. When

children are unable to define a problem, adults can help by stating a simple, objective description of the problem.

2. Encourage children to generate many possible solutions to the problem.

3. Help children to choose one solution with which to experiment. This step provides an opportunity for adults to model their positive attitudes toward problem solving. Children and adults should use their previously acquired knowledge and skills to determine together what they already know about solving the problem, what skills they already possess, and the resources they know are available. The decision to choose one solution over others may be based on a willingness to acquire new skills and knowledge. Adults can help children find the necessary resources required to solve a problem. Resources for acquiring skills and knowledge may come from such places as the classroom book shelves, the nearest library, a trip to a lumberyard, or a visit with an expert. Adults can help children learn about new and different tools that can be used to solve a problem.

4. Encourage children to predict outcomes, observe transformations, causes and effects, and evaluate the consequences of the chosen solution. Preoperational stage children are developing important representational abilities (Piaget & Inhelder, 1969). Adults and children can work together to make charts and graphs of their predictions, and the outcomes of the solutions. Children can be encouraged

to draw pictures, and dictate their ideas. Predicting and observing causes and effects is an excellent opportunity for experiencing and learning about temporal concepts such as past, present and future, various units of time (e.g., minutes, hours, etc.), and sequencing of events (Hohmann et al., 1979).

5. Provide children with the opportunity to learn from errors. Help children to realistically evaluate the outcomes of solutions. Information about parts of a solution that worked or did not work can provide important knowledge about concepts and information for choosing alternative solutions.

As children and adults work through the preceding steps together, children will acquire a knowledge of the scientific method of inquiry (Holt, 1989). Adults should be aware of the degree to which their help is needed. In some situations helping children recognize and define the problem may be the only necessary intervention. In other situations adult help may be necessary and useful throughout the entire problem solving process. The length of time and degree of complexity in solving a problem is yet another variable that will be determined by the specific problem, and the interest and attention of the children.

Summary

Development of the whole child involves more than nurturing biological maturation, or encouraging the process of assimilating new information (Erikson, 1963; Piaget & Inhelder, 1969). Positive cognitive, social, emotional, and physical development requires opportunities to be actively involved with the environment in a social context, and to encounter cognitive and psychosocial conflict (Erikson, 1963; Piaget, 1954, 1959; Piaget & Inhelder, 1969). In order to construct knowledge of self and the physical world in the meaningful context of logico-mathematical knowledge, children must be allowed to experiment, to take apart objects, to examine relationships, to restructure and create. In the process, children will encounter problems that produce cognitive and psychosocial conflicts (Erikson, 1963; Piaget & Inhelder, 1969). Problem solving experiences require the active use of previously acquired knowledge in new and unique situations to seek solutions, make choices and decisions, and experience cause and effect in order to resolve conflicts (Bullock, 1988; Goffin & Tull, 1984).

Resolution of conflicts allows children to construct new knowledge about the world and themselves (Erikson, 1963; Piaget & Inhelder, 1969). Each step of the problem solving process provides for the development of knowledge, skills, feelings, and dispositions that will be effective tools for coping with real life situations (Katz & Chard, 1989).

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APPENDICES

APPENDIX A

OUTLINE FOR PRESENTATION TO PROFESSIONALS AND STUDENTS OF EARLY CHILDHOOD EDUCATION

Outline for Presentation to Professionals and Students of Early Childhood Education

The Role of Problem Solving on The Development of the Whole Child

I. Introduction

A. Establish a rationale for problem solving experiences.

1. Problem solving skills are needed throughout life in order to maintain a good quality of life.

2. A problem solving approach to learning is a premise of a developmentally appropriate curriculum.

3. The developmental theories of Piaget and Erikson view problem solving activities as critical to development.

B. Define "problem solving": The active use of previously acquired knowledge in new and unique situations to seek solutions, make choices and decisions, and experience cause and effect in order to resolve conflict (Bullock, 1988; Goffin & Tull, 1985).

C. Explain the format of the presentation which will consist of two parts.

1. Discuss theory and research to establish a basis for problem solving.

2. Provide ways that adults can promote and utilize problem solving experiences.

II. Provide a theoretical and research basis for problem solving.

A. Constructivist theory is based on the cognitive development theory of Jean Piaget.

1. Children construct knowledge as they actively interact with their environment in social settings.

2. Children must encounter cognitive conflict (i.e. a difference in perception between what is already known and what is actually observed) in order to reorganize thought processes and develop a higher order of thinking.

3. The development that occurs as knowledge is constructed is not limited to the cognitive domain but also includes social and emotional development.

B. Erik Erikson's theory of psychosocial development is concerned with the development of the self-concept and identity, and also views problem solving activities as critical to development.

1. From a very early age, as children successfully or unsuccessfully solve the problems they encounter, they begin the process of building an understanding of the world and how they function in it.

2. Young children between the ages of birth and five progress through three stages.

a. Trust versus mistrust.

b. Autonomy versus shame and doubt.

c. Initiative versus guilt.

3. Children need to experience both positive and negative outcomes of efforts to solve problems with a majority of experiences being successful.

C. Research supports the need for, and effectiveness of problem solving activities.

1. Many research studies have focused on the role of play in problem solving.

a. Children who solve problems during play are more persistent in their efforts than children who solve problems in direct instruction situations.

b. During play, children use more diverse methods to solve problems, and develop divergent thinking skills.

c. The ability to solve problems during play is related to the relative difficulty of the problem encountered.

2. Research has provided information about the most effective environment for development through problem solving.

a. Research on the effects of adult intervention suggest that teachers' questioning techniques, and preschool design or structure has an effect on acquisition of problem solving skills.

b. Research indicates that cooperative problem solving is extremely valuable.

i. Children gain experience in seeing another child's point of view. They decenter.

ii. During cooperative problem experiences children encounter cognitive conflict from differences of opinion.

c. Research on gender differences indicates that girls are more dependent on adult help to solve problems, and are more easily influenced by adult models than boys.

III. Based on the knowledge gained from theory and research recommendations can be made for promoting problem solving experiences.

A. Redefine "problem solving".

B. Discuss the characteristics of a good problem which are proposed by Goffin & Tull (1985).

1. Problems need to be meaningful, interesting, and understandable to young children.

2. Children need to be able to encounter situations that build upon already acquired knowledge.

3. Problems should offer a challenge, and should require children to gain new knowledge and skills as solutions are sought.

4. Problem solving activities should allow for the acquisition of new knowledge and skills through concrete experiences.

5. Problems should develop divergent thinking by allowing for more than one possible solution.

6. Solutions to problems should offer children opportunities for concrete evaluation with immediate feedback.

7. Problem solving activities should often require co-operative experiences.

C. Discuss two areas for adults to influence the opportunity for children to encounter problem solving activities: the structure of the environment, and adult behavior.

1. Structure an effective physical environment.

a. Provide for choices by using learning centers, activities that allow for choices, and opportunities for a variety of social interactions.

b. Provide a variety of concrete, realistic materials that can be used at differing levels of complexity.

c. Provide enough space.

i. Young children need to move.

ii. Young children need space to use materials for solving problems without being distracted or interrupted.

d. Provide enough time.

i. Young children require sustained, uninterrupted periods of time for solving problems.

ii. Provide for a variety of time periods, including free play, group time, and outdoor time.

2. Adult behaviors have an impact on problem solving experiences.

    a. Establish an encouraging supportive atmosphere.

        i. Help children build senses of trust, autonomy, and initiative.

        ii. Help children feel secure in taking risks to find solutions to problems.

    b. Encourage divergent thinking.

        i. Ask open-ended questions.

        ii. Stress the possibility for many ways to solve a problem.

        iii. Divergent thinking allows for development of creativity, opportunities to make predictions, experience cause and effect, and to listen to someone else's point of view.

    c. Use encouragement rather than praise.

        i. Praise results in dependency on external rewards, and may inhibit performance.

        ii. Remarks of encouragement should be descriptive, focus on the process rather than the product, should be given in private, and should avoid comparisons with others.

    d. Be a model for problem solving behavior.

        i. Be willing to identify and engage in problem solving activities.

        ii. Be open to new ideas and willing to try new activities.

        iii. Remember that girls especially need the encouragement of a positive role model.

e. Enter problem solving experiences with children by using the five steps proposed by Ellen Booth Church.

i. Identify the problem. Help children understand and verbalize the problem.

ii. Generate many possible solutions to the problem.

iii. Choose one solution to experiment with and allow time for prediction of outcomes.

iv. Observe and evaluate the consequences of the solution.

v. Learn from errors.

IV. Summary.

A. Problem solving activities develop positive and effective tools for coping with real life situations.

B. Children learn best when they construct knowledge during active learning experiences where they encounter challenges and conflicts.

C. Adults can play a significant role in promoting problem solving by structuring the environment, providing opportunities for social interactions, and by effectively intervening in children's experiences.

APPENDIX B

HANDOUTS FOR PROBLEM SOLVING PRESENTATION

A Definition of Problem Solving

The active use of previously acquired knowledge in new and unique situations to seek solutions, make choices and decisions, and experience cause and effect in order to resolve conflict.

(Sources: Bullock, J. (1988). Encouraging problem solving. Day Care and Early Education, 16 24-27. Goffin, S.G., & Tull, C.Q. (1985). Problem solving: Encouraging active learning. Young Children, 40(3), 26-32.)

Characteristics of a Good Problem

1. Problems need to be meaningful, interesting, and understandable to young children.

2. Children need to be able to encounter situations that build upon already acquired knowledge.

3. Problems should offer a challenge, and should require children to gain new knowledge and skills as solutions are sought.

4. Problem solving activities should allow for the acquisition of new knowledge and skills through concrete experiences.

5. Problems should develop divergent thinking by allowing for more than one possible solution.

6. Solutions to problems should offer children opportunities for concrete evaluation with immediate feedback.

7. Problems solving activities should often require co-operative experiences.

(Source: Goffin, S.G., & Tull, C.Q. (1985). Problem Solving: Encouraging active learning. Young Children, 40(3), 26-32.)

Steps in Solving a Problem

1. Identify the problem - help children understand and verbalize the problem

2. Generate many possible solutions to the problem

3. Choose one solution to experiment with - allow time for prediction of outcome

4. Observe and evaluate the consequences of the "solution"

5. Learn from errors

(Source: Church, E.B. (1991). What do you do? Problem-solving in everyday situations. Scholastic Pre K Today, 5(6), 40-45.)

Resources for Planning Problem Solving Activities

Resource Books for Adults

Baratta-Lorton, M. (1972). Workjobs. Reading,MA: Addison-Wesley.

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Children's Books That Present Problems To Be Solved

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Asch, Frank (1982). Happy birthday moon. New York: Scholastic Books.

Asch, Frank (1983). Mooncake. New York: Scholastic Books.

Brown, Margaret Wise (1947). The golden egg book. New York: Harper & Row.

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Milne, A.A. (1926). Winnie The Pooh: A tight squeeze. Racine, WI: Western Publishing.

Thayer, Jane (1953). The popcorn dragon. New York: Scholastic Books.

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