The Relationship Between Cognitive Style and Informed Decision Making

Carol A. Grieve ©

A Thesis submitted in conformity with the requirements for the degree of Master of Education at Lakehead University.

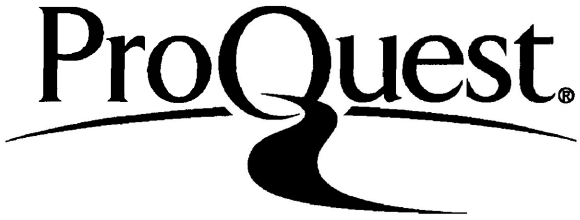

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Table of Contents

List of Figures

List of Tables

Table Page

Appendices

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ABSTRACT

The Relationship Between Cognitive Style

and

Informed Decision Making

In this study, the relationship between children's cognitive styles and their ability to use informed decision making was investigated.

Thirty-nine Grade Three students in Thunder Bay participated in a seven week, teacher-researcher designed decision making unit. This unit promoted metacognitive awareness and instructed students in a decision making method using simple, logical, age-appropriate strategies. It was the expectation that there would be an improvement in the decision making ability of these students, and that the reflective, field-independent student would perform the most efficiently in decision making activities.

The reasoning ability, the cognitive styles - reflective/impulsive and field-dependent/independent, and level of decision making were assessed. The following measures were employed to determine these variables: Raven's Coloured Progressive Matrices (Raven), Matching Familiar Figures Test (Kagan), The Children's Embedded Figures Test (Witkin), and the Draw-a-Person Test (Machover).

Each participant's performance level was then determined in a posttest situation, and again in a second posttest situation nine weeks later. Means, standard deviations and correlation coefficients were calculated.

Results indicated that there was improvement in the participants' level of decision making. This improvement was maintained at the second post test nine weeks later. Results also indicated that Grade Three students' decision making performance may be affected more by their impulsive/reflective nature than by their level of field-independence/dependence.
strategies which consider the reflective/impulsive nature of young children and incorporate age-appropriate strategies hold the greatest potential for enabling students to become efficient decision makers and critical thinkers.

CHAPTER ONE

Introduction

There is currently considerable emphasis being placed on the need for critical thinkers who can make good decisions and solve problems. Generally, at least the business and industry part in society claims that our school systems are not producing enough of these problem solvers. This need has applied some pressure to the field of education. Is it possible for our educational systems to produce learners who are able to use more effective decision making strategies to solve problems? Some educational districts are using considerable resources on thinking/problem solving types of programs. Can a learner's ability to make good decisions and solve problems be influenced? Training in decision making strategies can significantly change a learner's performance in problem solving. This positive change is likely to be influenced by other factors such as reasoning ability and cognitive style and is an important issue for investigation.

Until the 1980's, researchers paid little attention to learning strategies which assist in remembering, learning, or problem solving (Brown et al., 1983). Since then much research in the effectiveness of training strategies has been done with college students and other adults while little research has been done with elementary school aged children.

There is considerable evidence which leads the author to believe that the way in which a learner will use learning strategies such as decision making can be influenced. Brown and Bransford (1983) examined the use of learning strategies, and

concluded that explicit efforts to train metacognitive or executive processes (the extent to which a person has knowledge and control of his/her cognitive processes) may significantly improve thinking and problem solving. Processes such as decision making and problem solving are facilitated by training because the learner is helped to select, employ, and evaluate appropriate strategies (Bransford et al., 1986).

Other studies have yielded more information about learning strategy training activities. Sternberg (1987) concludes that learners need to be aware of their own learning styles as well as how to use available learning strategies, in order to be effective problem-solvers. Sternberg also refers to the independent studies of Kennedy and Miller (1976); Blackman, Holmes and Zeltin (1978); and Ringal and Springer (1980). These studies reveal that the inclusion of information about the need for and the effects of instructed routines, during and following training, enhance the transfer of learning. It was also found by Brown (1978) and Belmont, Butterfield and Borkowski (1978) that the learned strategy can be transferred to other contexts. In addition, Sternberg notes that Butterfield and Belmont (1977), and Borkowski, Cavanaugh, and Reichert (1978) concluded that the effectiveness of the strategy seems to be a function of the precision with which it was applied during training. Sternberg also cites that students maintain the strategy when they execute it well at the time of training (Paris, Newman, and

McVey, in press); and, carry out the strategy both more effectively and frequently (Brown, 1973).

Reasoning ability and cognitive styles (processing styles), in particular, field-independence/dependence (Witkin,1977) and impulsivity/reflectivity (Kagan, 1966) significantly relate to learning processes. Both Case (1978) and Brown (1973) have found that differing functional memory capacity and general abilities determine how individuals use strategies, depending on the task and the situation. The work of Witkin and Kagan shows that field-independent/reflective persons approach problem solving situations by carefully and slowly thinking through possibilities or alternatives, considering the consequences. On the opposite end of the scale, field-dependent/impulsive persons approach problem solving situations quickly, not taking the time to consider other possible solutions or their consequences.

The evidence from the research above leads to the expectation that learning strategy training in decision making will be mediated by the learner's general reasoning ability and cognitive style. That is to say that the effect of, or how a person will use the decision making training can be affected by their individual general ability and the way in which they perceive, as well as apply, this knowledge. Reasoning ability (the ability to think in a reasonable, reflective manner in order to decide what to believe or do) and cognitive style (the way in which a learner processes) are both directly linked to decision making/problem solving. Presented with the same strategies and

training in a particular skill, learners who have an impulsive cognitive style, that is, reach decisions quickly, often too quickly will likely use the strategy differently than learners who have a reflective cognitive style, that is, reach decisions more deliberately and cautiously, even when their general reasoning ability is equal. Adding the variables of different reasoning abilities and varied cognitive styles along the continuum from extreme impulsive to extreme reflective, produces a considerable number of possibilities on how effectively learners will use the training strategy.

Participants in this study were 17 males and 22 females from Grade 3, ranging in age from 93 to 110 months. The study took place over a period of sixteen weeks. Some limitations in the study involved the small sample employed, the validity of the Childrens' Embedded Figures Test with this sample, the decision making unit which had not been previously tested, and the fact that no control group was used. These limitations did not adversely affect the results of this study but provided some interesting results.

The purpose of this study was to find the relationship between cognitive style and the ways in which learners use the strategy of decision making.

In order to examine the expected relationship, both reasoning ability and cognitive style were measured by nonverbal tests: Raven's Coloured Progressive Matrices (reasoning), the Children's Embedded Figures Test and the Matching Familiar

Figures Test (cognitive style). The Purdue Elementary Problem Solving Inventory (PEPSI) was used as a measure of the dependent variable, problem-solving ability, in determining the effect of a decision making training unit.

A decision making training unit included productive thinking skills such as fluency, a framework for decision making and practice in using the strategy. Fluency (listing alternatives and criteria) was employed to find reasons why peers and adults use decision making. The framework for decision making was practised regularly after the initial instructional situation. Gradually, prompts were decreased as the use of this framework was repeated. At the end of the training unit the learners were able to use the strategy independently. It was the expectation that the learners would initiate and carry out the decision making framework more efficiently after the training had occurred.

Hypotheses

It is expected that the learner's reasoning ability as well as cognitive style will mediate the effect of decision-making training; thus the learner's problem solving ability will expand accordingly.

Specifically, it is hypothesized that:

1. reasoning ability will be independent of field dependence/independence
2. reasoning ability will be independent of impulsivity/reflectivity

3. field-dependence/ independence as measured by the CEFT will relate positively to impulsivity/reflectivity as measured by the MFFT

4. reasoning ability as measured by the CPM will relate positively to body articulation as measured by the DAP

5. performance on the final problem-solving test will relate positively with general reasoning scores as measured by the CPM

6. performance on the final problem-solving test will relate positively with field-dependence/ independence as measured by the CEFT

7. performance on the final problem-solving test will relate positively with impulsivity/ reflectivity as measured by the MFFT

8. performance on the CEFT will relate positively to the gain scores, representing changes in performance on the problem-solving tasks on PEPSI 2-1 and PEPSI 3-1

9. performance on the CPM will relate positively to the gain scores, representing changes in performance on the problem-solving tasks on PEPSI 2-1 and PEPSI 3-1

10. performance on the MFFT will relate positively to the gain scores, representing changes in the performance on the problem-solving tasks on PEPSI 2-1 and PEPSI 3-1

11. problem-solving performance will increase from PEPSI - 2 to PEPSI - 3, subsequent to the implementation of the decision-making unit.

Definitions

cognitive style:	how one perceives situations, a preferred way of reacting to environmental stimuli.
cognitive theories:	theories of intelligence based on the study of individual differences.
critical thinking:	mental processes and strategies which aid individuals in making decisions, problem solving and learning new concepts.
field-dependent:	the cognitive style of one who perceives his surroundings in a global fashion.
field-independent:	the cognitive style of one who perceives surroundings analytically.
impulsive:	one who responds quickly with decisions, usually ineffectivelly.
informed decision making:	occurs when one is prompted to make decisions and when they are also provided with information about the significance of the activities.

learning strategies:	the deliberate plans and routines used for remembering.
metacognition:	the extent to which one has knowledge of, and control of his/her own domain of cognition.
psychometric theories:	theories of intelligence based on the study individual differences.
reflective:	those who consider several alternatives before making a decision.
rehearsal:	a deliberate attempt or activity to maintain the knowledge of material.

CHAPTER TWO

Review of Related Literature

This chapter reviews theories of intelligence and describes research findings, relevant to this study, in the areas of metacognition, cognitive style, and critical thinking.

It is essential that we realize and value the fact that individuals are differentially prepared for challenges which they meet in their school life as well as their everyday life. From birth, our experiences both at home and outside the home teach us by encouraging appropriate adaptive responses and by discouraging inappropriate maladaptive responses. The informal training programs given by parents differ widely for children. The more formal school program should supplement the individual's intellectual development.

Intelligence

There are two ways of considering theories of intelligence - explicit theories are the formal accounts of intelligence which form the basis for most empirical research; implicit theories are the informal notions that we have about intelligence. These form the basis for our daily actions based on our beliefs regarding the nature of "intelligence". In a sense, implicit theories give rise to explicit theories; therefore, it is important to understand both kinds of theories (Sternberg, 1985a).

Explicit theories of intelligence are based (or at least tested) on data collected from people performing tasks presumed to measure intelligent functioning. Explicit theories of

intelligence come in many forms, the two most influential in the psychology of human intelligence being differential or psychometric theories such as that of Guilford (1956) and cognitive theories such as that of Piaget.

Explicit Theories of Intelligence

Psychometric models. According to Sternberg (1985a), differential or psychometric theories of intelligence are based on the study of individual differences among people and usually attempt to understand intelligence in the terms of a set of underlying abilities (e.g. verbal abilities, reasoning abilities). The underlying abilities are identified through a mathematical technique called factor analysis which retains subjective elements in the identification of factors. Factor structures are variable, depending on the variables employed and the subject characteristics.

The majority of psychometric theories use variables which are described by factors representing mental structures (Sternberg, 1985a).

Spearman (1927) proposed that intelligence is made up of two kinds of factors -- general factors and specific factors. Spearman made two famous proposals regarding the nature of the general factor which he called 'g'. He proposed that individual differences in 'g' might be understood in terms of differences in 1) the levels of mental energy individuals could bring to intellectual task performance; and, 2) people's abilities to use apprehension of experience, eduction of relations, and eduction

of correlates. Apprehension of experience refers to perceiving and understanding each of the terms in a given analogy. Eduction of relations refers to inference of the relation between the first two analogy terms; and, the eduction of correlates refers to the application of the rule to a new domain (Sternberg, 1985a).

Thurstone (1938) proposed that intelligence comprises seven "primary mental abilities": verbal comprehension, verbal fluency, number, spatial visualization, memory, reasoning, and perceptual speed. Guilford (1967), went on to argue that intelligence is composed of 150 distinct factors, each of which involves the three components : operation, content and product.

Psychometric models reveal assumptions. They all assume that intelligence can be understood in terms of individual differences, and that these may be described by factors which represent mental structures.

Cognitive Science

Cognitive (information-processing) theories differ in the kinds of information-processing tasks and analysis components upon which they focus according to Sternberg and Salter (1982). Cognitive theories assume that intelligence can be understood in terms of information-processing components emphasizing the speed of processing (Sternberg, 1985a).

Implicit Theories of Intelligence

Implicit theories of intelligence are based on what people think intelligence is i.e. popular, culturally supported notions.

In determining these theories of intelligence the conceptions of both experts and laypersons are used according to Sternberg and Baron (1985).

Explicit theories are of importance as they may provide the basis for rational assessment and eventually for training. Implicit theories serve as the basis of informal, everyday assessment and training of intelligence, and can suggest aspects of intelligence which are often overlooked in explicit theories.

The Triarchic Theory

Sternberg's triarchic theory of intelligence which broadens the traditional base for understanding intelligent behaviour is divided into three subtheories: the componential subtheory, the experiential subtheory and the contextual subtheory.

Traditional models of intelligence tend to focus mainly on one area of the human such as formal logic systems or methods and cognitive operations underlying these systems (processes). Some models focus on the features or the qualities of products. The triarchic theory merges three subtheories, resulting in a more realistic "whole"picture of the person and the practical relationship of the person to learning in the classroom.

The componential subtheory relates intelligence to the internal world of the individual and specifies the mental mechanisms that lead to more or less intelligent behaviour. Three kinds of processes are seen as critical to intelligent behaviour by Sternberg: metacomponents, which are higher order executive processes used in planning, monitoring, and

decision-making in task performance; performance components, which are used in actually performing tasks; and knowledge-acquisition components, which are used in learning new information or how to perform tasks (Sternberg, 1984 and Sternberg and Baron, 1985).

Sternberg (Sternberg and Baron, 1985) has identified seven metacomponents in intellectual functioning: 1) deciding what the problem is that needs to be solved; 2) selecting a set of lower-order components to use in the solution of a given task; 3) selecting one or more representations/organizations for information - the choice of organization can facilitate or impede the effectiveness of the components on item 2; and is determined by the subject and/or the task; 4) selecting a strategy to combine the lower order components and sequencing of them in a way that accomplishes the task; 5) deciding how much time to allocate to each task performance and how much time restriction will affect the quality of performance; 6) monitoring the solution or keeping track of what they have already done, what they are doing, and what they still need to do - as progress is made, adaptations are often required; 7) reacting to external feedback - understanding it, recognizing its implications and, acting upon it.

Performance components are used in the execution of various strategies for task performance and organize themselves into stages of task solution. These stages are: the encoding of stimuli, the combination of, or comparison between stimulus, and

response. Encoding components are those involved in the initial perception and storage of new information. Combination and comparison components are involved in putting together or comparing information, while response refers to the time required to execute the metacomponents.

Knowledge-acquisition components are processes used in gaining new knowledge and are selective encoding, selective combination and selective comparison. Selective encoding involves separating relevant from irrelevant information; selective combination involves combining the selectively encoded information into an integrated, logical whole; and selective comparison is the relating of newly acquired information to information acquired in the past (Sternberg and Baron, 1985).

The experiential subtheory specifies the two regions of relative novelty and making information processing automatic. In experience with tasks or situations, these two regions tap components that function intelligently. Relative novelty refers to the area of experience in which a task is fairly, but not totally, new. Making information processing automatic refers to the transition between conscious, controlled information processing and subconscious, automatic information processing. These two functions are highly related. Better ability to cope with novelty allows one to begin making information processing automatic sooner. Better ability to make information processing automatic enables one to free more resources for coping with novelty, and allowing new kinds and levels of experience.

The contextual subtheory focuses on the adaptive nature of intelligence in relation to the individual's external world. This subtheory includes the three processes of adaptation, selection, and shaping. Adaptation consists of trying to achieve a good fit between oneself and one's environment. If the fit is below what one considers satisfactory for one's life, it is viewed as maladaptive and the person tries something other than adaptation to the given environment. The individual may then attempt to select an alternate environment to attain a better contextual fit. He/she considers the alternatives available and attempts to select the environment with which he or she will attain the best fit. The third option is environmental shaping where people try to reshape their environment to increase the fit between oneself and the environment rather than merely adapting to what already exists. This shaping may be tried before selection or after it.

The triarchic theory suggests that there is no one set of behaviours that defines intelligence for everyone. All individuals adapt to their environment in different ways (Sternberg, 1984).

The ideas presented in the triarchic theory link directly to research findings in the areas of metacognition and strategy instruction.

Metacognition

The preceding information on intelligence, especially the triarchic theory,supports the idea that individuals adapt to

their environment differently. The area of metacognition helps us to understand more how individual differentiation occurs and how intellectual and thinking skills are related. Research shows how individuals become more efficient in utilizing strategies when they are aware of the strategies as well as how and why they use particular strategies.

The extent to which each person has knowledge and control of his/her cognitive processes is called "metacognition". Knowledge refers to the information that the thinker has about his/her own thinking, as well as the thinking or cognitive problem-solving of others. This is known as propositional knowledge. Control of learning is demonstrated by such activities as planning prior to undertaking a problem (example - predicting outcomes, scheduling strategies, forms of vicarious trial and error), monitoring during learning (example - testing, revising, and rescheduling strategies), and checking outcomes against criteria. The use of these activities depends on the task and the situation (Brown, 1978, 1983). Emphasis on executive or metacognitive processes (procedural knowledge) can improve thinking and problem-solving by helping the learner to select, use, and evaluate strategies (Bransford, 1986).

It is expected that learning will be enhanced when a learner concentrates on the systematic application of a plan, routine or activity, a well-established fact in older children (Brown, 1983). The efficiency of task performance depends for a large part on the appropriateness of the activities in which the person

engages, either voluntarily when trained to do so, or when prompted to do so by an externally planned task.

Strategy Instruction

Most studies of strategy development have focused on activities which enhance rote recall (Brown, 1983). However, rote recall is only one of several forms of learning and not necessarily the most appropriate form of learning for the optimum use of strategies or activities. Previous studies have also tended to involve adults and college students, and focus on the product rather than the process of thinking and problem-solving (Brown, 1983), or the task in which the student is engaged. The acquisition of systematic organization of effective routines to deploy complex strategies, such as problem-solving and decision-making, is often hindered by other partially successful strategies. Learners tend to use these partially successful yet inferior strategies as the strategies are already in use and familiar to the learner (Brown, 1983).

It is clear that people differ in the extent to which they use information to learn. Bransford et al. (1980) found that students who were prompted to use general strategies, such as problem-solving and decision-making, showed a greater ability to transfer to novel-but-related situations. Students who do not use strategies appropriate to the situation can be assisted to do so by prompting them to use either the strategy or to activate knowledge relevant to the situation. Prompting may be in the form of leading questions or direct instruction. One of the

limitations of prompting is that it may help a person to better understand and remember a particular set of information or strategies but it does not teach learners to structure their own learning activity (Bransford et al., 1986).

To become an independent learner, one needs to be able to access available knowledge and apply it appropriately (Brown, 1983; Bransford, 1986). The independent learner must be able to seek clarification or new information about the relevance of facts to develop new expertise (Brown, 1983); must be able to fit the strategy to the nature of the task; and have the ability to modify the strategy when confronted with unexpected or novel situations (Bransford et al., 1981).

Brown (1988) discussed "informed training" which is an intermediate level of instruction in which students are not only prompted to perform particular activities but are also provided with information about the significance of these strategies. In this context "significance" refers to the need for as well as the effects of the strategy. Brown (1983) cites support for the Kennedy and Miller (1976) findings which showed that a strategy is more likely to be maintained if the significance of the strategy is known. Kennedy and Miller (1976) also demonstrated that recall was improved using the strategy of rehearsal. Rehearsal involves the repeating of a small amount of information immediately upon receiving it in short-term memory. It can be covert or overt (Klausmeir, 1985). Borkowski, Cavanaugh and Riechart (1978), and Butterfield and Belmont (1977) found that

the tendency to maintain a strategy relates to the efficiency and precision with which it is carried out during training. Their findings have been corroborated by Paris, Newman and McVey (in press). Training packages need to include the following components: 1) extended practice; and, 2) information about the significance and effectiveness of strategy. Additional reinforcement by the teacher is also important in the form of praise and attention (Brown, 1983).

Studies on learning indicate that there are specific or lower order processes and general or higher order processes. Specific sets of activities (lower order processes) are powerful but limited to specific situations. General activities (higher level processes) are weaker but applicable in a broad number of situations. These general activities are necessary for the effective use or access to the more specific activities or lower order processes. As more is known about processing components, improvements can be introduced for programming in which students can learn to execute these strategies (Brown, 1983).

Limitations such as the beginning level of the learner need to be considered as knowledge differences can limit the student's success in carrying out these strategies (Brown, 1983).

Cognitive Style

The potential for individual development is evident in the previous discussion on awareness and strategy training. The following section, outlining the cognitive styles of field-dependence/field- independence and

impulsivity/reflectivity, brings forth questions on the relationship of cognitive style and the way in which strategy training is used.

Field-dependence/field-independence

The cognitive style of field-dependence/independence was first described by Witkin and his colleagues (1962). He defined field-dependence as the tendency to perceive in a relatively global fashion, while field-independence refers to the tendency to perceive surroundings analytically, with objects experienced as discrete from their backgrounds (Witkin et al., 1962). Cognitive styles are concerned with the form rather than the content of cognitive activity. They refer to individual differences as to how we perceive, think, solve problems, learn and relate to others (Witkin et al., 1977).

Field-dependent people are better at learning materials with social content, accept other people readily, and like to be with people. They are more likely to require externally defined goals and reinforcements (Sherriff & Williams, 1980; Klausmeir, 1985) than field-independent persons who interpret and restructure situations . Field-independent persons are less attentive to social cues and prefer to work with abstract ideas and principles, set their own goals, and do not require external reinforcement (Klausmeir, 1985).

In 1950, Witkin developed a paper and pencil test called the Embedded Figures Test (EFT). Subjects are asked to locate and/or break up a complex design in order to locate a hidden figure

within the complex figure. Witkin's investigation generally supported the view that field-dependence is independent of intelligence. In 1977, Witkin and his colleagues concluded that field-dependence/independence appears to be more related to the "how" than the "how much" of cognitive function (Guild & Garger, 1985).

Style affects success in specific kinds of situations so educators must be sensitive to the style-related needs of learners. The knowledge of a person's cognitive style can contribute to his/her ability to use their own strengths and weaknesses. Being aware of cognitive style also helps an individual to develop more diverse strategies to facilitate success in learning (Guild & Garger, 1985).

Impulsivity-reflectivity

The cognitive style of impulsive-reflective also affects success in certain kinds of problem solving situations. Kagan (1965) referred to children who delay in the face of uncertainty until several alternatives are considered as reflective. These children make relatively fewer errors than impulsive children. Those who respond quickly and are less accurate are termed impulsive.

An impulsive response style may be associated with inefficient problem solving, failure to generalize newly learned strategies, and poor self-control in social situations although this depends on the specific problem situation. Flavell (1976) and Cameron (1984) reported that impulsives may be more prone to

make counterproductive moves which violate the strategy being used.

In his study, Cameron (1984) suggested that two of the reasons for inefficient pattern matching performance were: 1) failure to formulate an appropriate solution strategy, and 2) failure to consistently implement an effective strategy. Cameron's subjects were Grade 2, 4, and 6 students. Each subject performed two sample pattern matching problems. In the next phase, students were instructed to match a pattern by opening a window in a matching game. The windows covered possible matching patterns.

By recording the students' verbatim answers, Cameron showed that the students used "focusing", "gambling", "avoidance of nonconformative moves", "positional" or "random" solution strategies. "Gambling" strategies are those strategies which used the windows where most of the dots were one of the two colours. Using this method, students can quickly eliminate one of the two colours used. Using "avoidance of nonconformative moves", students try quickly to eliminate one choice. In the use of "positional" strategies, students use a clear design rule to find a solution (e.g. open the box in the top position or the first box). This is an efficient solution strategy. "Random" strategies used completely arbitrary methods and were inefficient. Cameron's data showed that students usually failed to employ optimal solution strategies.

Cameron's data indicated that impulsivity is associated with failure to develop and implement effective problem solving. He suggested that reflectives tend to be more strategic than impulsives when they approach problems which require detailed analysis and employ more systematic and efficient scanning strategies. He also examined the relationship between reflectivity and the strategy of "focusing". This refers to the simultaneous use of a number of different problem-solving strategies. Cameron concluded that there was a consistent yet modest, relationship between reflectivity and efficient performance (Cameron, 1984).

According to Borkowski, Reid and Kurtz (1984), cited in Sternberg (1986), metacognitive theory helps explain the failure of impulsive children to transfer newly learned strategies. This failure is also explained by the field-dependence/independence style of a person. Field-dependent persons would be inefficient or weak at interpreting and restructuring a strategy to use in a specific situation as they require external goals and reinforcement. The metacognitive characteristic associated with impulsivity is either lack of knowledge about cognitive strategies (e.g. rehearsal, elaboration) or lack of knowledge about executive processes (e.g. strategy selection, strategy modification). Impulsive children are generally deficient in both types of metacognition (Borkowski et al., 1983). As cited in Sternberg (1986), Pressley (1985) reported that early forms of metacognition teach the child about important strategy attributes

- when and how specific strategies are, and are not, applicable. General beliefs about self-efficacy emerge from repeated encounters with productive strategies, and executive routines such as strategy selection and invention, only after lower level strategies are acquired.

Critical Thinking

Critical thinking refers to the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts. The specific elements of critical thinking that people use vary widely in scope and quality across individuals, tasks and situations. The theories of, and approaches to, critical thinking are different in how broadly or narrowly the idea of critical thinking is viewed (Sternberg and Baron, 1987).

Three confluent traditions of thought are represented in work dealing with critical thinking. These are the philosophical, the psychological, and the educational viewpoints (Sternberg and Baron, 1987).

Ennis, Lipman and Paul are contemporary proponents of the philosophical tradition. They focus their attention on the requirements of formal logical systems rather than critical thinking in the classroom. This emphasis stems from two concerns. In the first place, formal logic systems do not necessarily correspond to the requirements or capabilities of children in classroom situations. The rules of logic can only suggest how people might think critically under ideal conditions ignoring the

limitations of everyday life. Secondly, personal and situational constraints must also be considered. This approach can provide us with the maximum potentials of critical thought (Sternberg and Baron, 1987).

The psychological viewpoint is represented in the work of Bransford, Bruner, Feurstein and Sternberg (Sternberg and Baron, 1987). This viewpoint is concerned with critical thinking as it is performed under the limitations of the person and the environment. The theory is valuable as it shows how people think under such limitations as the absence of full information, unlimited time, and perfect memory. Psychological theories are limited in that they are often derived from and tested on the performance of humans in laboratory rather than field situations. Theories tested in the laboratory setting are often oversimplified and do not consider real-life situations (Sternberg and Baron, 1987).

The work of Bloom (1956), Gagne (1965), Perkins (1981), and Renzulli (1976) is representative of the educational tradition and responds directly to the skills needed by children for problem-solving, decision-making and concept learning in the classroom. These theories have the advantage of being closely related to classroom observation. Often they are a pragmatic mix of the philosophical and psychological viewpoints and are not always clearly specified. Usually, these theories have not been subjected to rigorous testing as have psychological and philosophical theories (Sternberg and Baron, 1987).

One way to organize an approach to critical thinking is according to the elements involved in problem solving (Sternberg & Baron, 1987).

Decision making

The problem solving approach emphasizes the steps involved in the thinking process of decision making. If students are to acquire useful thinking/problem solving skills in the classroom, specific attention must be given to that objective. Effective thinking skills are not realized spontaneously or as a consequence of other goals. People need systematic and extensive practice to develop their thinking skills (Nickerson, in Sternberg and Baron, 1987). Nickerson argues that some of the characteristics of an effective thinker or problem solver parallel the elements of decision making. Persons with good thinking skills attempt to anticipate probable consequences of alternative actions before choosing among them, apply problem solving techniques appropriately in domains other than those in which they were learned, and recognize that there is more than one possible solution to real world problems (Sternberg & Baron, 1987).

Gubbins' Matrix of Thinking Skills developed in 1983, (Sternberg and Baron, 1987) outlines a core of thinking skills proposed by several authors (Appendix 1). The area of decision making is the instructional strategy which will be used in this study. Subcomponents of decision making include: a) stating a desired goal/condition; b) stating obstacles to the

goal/condition; c) identifying alternatives; d) examining alternatives; e) ranking alternatives; f) choosing the best alternative; and g) evaluating actions. Decision-making is a strategy which is relatively easy to fit into most curriculum areas, is applicable to many situations, and can be integrated into a unit which can be delivered in a short time period. The extent to, and the efficiency with which the students use this instructional strategy may be determined by the type of instructional unit (informed decision-making) and the cognitive style of the individual student. This investigation will examine the ways in which different cognitive styles mediate the use of this instructional strategy, and how curriculum might be modified to meet the needs of students having various cognitive styles.

To what extent is the effectiveness of instruction in critical thinking related to intelligence and cognitive style? Persons of different levels of intelligence have differing levels of awareness in respect to their metacognitive processes, therefore affecting the ways in which they will use critical thinking in practice (Brown, 1983). Witkin argued that the cognitive style of field-dependence/independence was relatively independent of intelligence, but that it does mediate the effect of instruction and the actual performance of the child (Guild & Garger, 1985).

It is expected that there will be a relationship between the cognitive style variables of impulsivity/reflectivity and field-dependence/independence and the use of informed

decision-making. The characteristics of the impulsive problem-solver and field-dependent/independent type persons have educational implications when associated with the application of decision-making skills. The reflective person, who reacts slowly after thinking things through and the field-independent person, who interprets and then restructures, are expected to be more efficient in working with abstract ideas. The reflective/field-independent person will also profit more from instruction in informed decision-making than the impulsive/field-dependent person. Later problem solving skills (after instruction) will vary depending on the cognitive style of the individual. The investigation is expected to show that, after differences in inductive reasoning ability are accounted for, the cognitive style of individuals mediates instruction in informed decision-making, a critical thinking skill.

CHAPTER THREE

Design of the Study

Participants

The participants in this study were 39 Grade 3 students from a large rural school of the Lakehead Board of Education, Thunder Bay, Ontario. The participants were 17 males and 22 females ranging from 93 months to 110 months of age. The mean age was 98 months, with a standard deviation of 3.81 months. The students were of a wide range of abilities and come from a widespread geographic area. The majority of these children are from blue collar families.

Decision-making strategies are currently being introduced to Grade 3 students at this school. As little investigation regarding the relationship between cognitive style and the use of informed decision-making has been done with young children, the researcher desired to find out what effect cognitive style has on decision-making. These participants were easily accessible to the researcher who is a classroom teacher.

Permission for this study was given by both the Lakehead Board of Education as well as the parents of the participants (see letter of permission - Appendix 3). Participation was voluntary.

Materials

During this study, instruments which measured reasoning ability, articulation of body concept, cognitive style (impulsivity-reflectivity and field-independence/dependence), and

problem-solving ability were administered. The Purdue Elementary Problem Solving Inventory was the problem-solving ability test given as a pre, post and post-post test. There was no control group used in the study. Throughout the study, a curriculum-based decision making training unit was used as an intervention device. This unit afforded the participants opportunities in which they learned and were able to apply decision-making process skills.

The instruments and the decision-making activities were administered at school during regular school hours. The researcher administered the instruments and delivered the majority of the training activities. In some of the large group training activities, the researcher's teaching partner and the resource-librarian assisted to facilitate more meaningful participation for the learners involved in the study. Staff had been trained in decision making previously and the method of delivery for each session was discussed in a team meeting so that sessions would be delivered uniformly to all students.

The Decision-Making Unit

The delivery of this curriculum-based unit was done in 16 lessons over a period of seven weeks, and involved students in approximately ten and one-half class hours of instruction. The unit included the following skills: stating a desired goal/condition, stating obstacles to the desired goal/condition, identifying alternatives (fluency and paired comparisons activities), examining alternatives (generating criteria and weighing the alternatives), choosing the superior alternative and

evaluating decisions by providing reasons for the choice. The unit was integrated into an environmental studies unit on living things. Other opportunities to reinforce the above strategies took place in other curriculum areas.

Instruments

Instruments were administered throughout the study. Assessment of learners using the following instruments took approximately 4 hours per child.

The Purdue Elementary Problem Solving Inventory (1972). This general problem solving test was administered to pretest problem solving ability before the training unit began. It was administered as a posttest seven weeks after the pretest, and, again, nine weeks after the posttest.

This test is designed for Grade 2 to 6 students. The reliability (K-20) is .79 as reported by Feldhusen et al. (1972). PEPSI was selected because it was considered to have adequate reliability for research purposes. There were no other suitable, age-appropriate tests of problem-solving available. Table 2 in the same study reports an .01 correlation between the Test of Logical Thinking (Towler, 1972), Concept Formation (Wheatley, 1972), the Lorge-Thorndike Intelligence Test, tests of reading comprehension, and Perceptual Abilities (McDaniel, 1971) and this problem-solving inventory. These correlations are significant at the .01 level and are high enough to indicate that the Purdue Inventory has criterion-related validity if the tests listed are

regarded as comparable cognitive measures. Percentile norms for Grades 2, 4, and 6 are also available.

This instrument tests ability to solve real-life problems. It is not specific to any subject content, and consists of 49 multiple-choice questions. The actual test takes about one hour to administer, and was developed for use in schools. All questions and response choices are read to students on an audio tape. At the same time, items are shown to the students on a filmstrip. Answers are marked in a test booklet by the students.

This test was given three times during the study. As a pretest, it was given on the first day of the study before any decision making activities were initiated. The posttest was administered during the seventh week of the study immediately after all decision making activities were completed. The post posttest was completed in the first week of January, approximately nine weeks after the posttest.

There are very few age/grade appropriate general problem solving tests available. This one was chosen because percentile norms as well as some information on its technical qualities were available.

The pre-test, posttest and post posttest forms were scored at the end of the study.

The Coloured Progressive Matrices (CPM). The CPM is a measure of inductive reasoning. This measure of general reasoning ability was administered because logical reasoning is regarded as one aspect of general intelligence (Sternberg, 1987) and a

learner's general abilities can determine how strategies are used (Case, 1978 & Brown, 1973). The CPM was administered to provide information about the relationship between reasoning ability and the way a learner uses decision making strategies.

Although this test has been used widely from 1947 to the present time, reliability and validity information was unavailable in the Mental Measurements Yearbook, (1985). Despite the unavailability of information, the test was used as it is practical to administer and culture fair.

The CPM was given during the second week of the study. The test is untimed and has very simple instructions. It was administered to each Grade 3 class at different times on the same day. Fifteen minutes were allowed for the test. All candidates completed it in the allowed time.

This test requires the forming of relationships among abstract items. The items consist of a set of matrices of design elements put into rows and columns, each design having a part removed. The task is to choose the missing insert from the given alternatives (Anastasi, 1988).

It was administered in the second week of the study to determine the level of general reasoning of each learner.

The CPM was scored at the end of the study according to the manual. Percentile ranks were then recorded for each learner using Table IX of the manual.

The Children's Embedded Figures Test (CEFT). The CEFT is a measure of field-dependence/independence and was administered to all participants to determine cognitive style.

As reported in the CEFT Manual (Witkin et al., 1971), the validity coefficient for 9 and 10 year olds is .71 (Table 5). Reliability for 7 and 8 year olds is .87 (Table 4).

It is an untimed test which took a maximum of 20 minutes to complete. It is simple to administer, and presents the child with the task of locating a basic shape "embedded" in a complex field. The child is presented with a series of cards, when he/she finds the basic shape, he/she outlines the location of the shape. The researcher records the time of each response.

The CEFT was given to each child individually by the researcher. In this same session, the Matching Familiar Figures Test was given. Administration took place in the fourth, fifth and sixth weeks of the study.

The researcher recorded the time for each response as well as the total time elapsed for the test as stated in the manual.

Machover Draw-A-Person Scale. This scale can be used to successfully distinguish individuals differing in extent of perceptual field dependence (Witkin et al., 1962). This is a figure drawing scale which rates the mode of field approach, since body concept and mode of field approach are related (Witkin, 1962). This "sophistication-of-body-concept" scale was developed by Machover. This scale involves a single global rating based on a number of specific criteria. The criteria are based on

directly observable characteristics of the figures rather than on the usual projective interpretations of the drawings. The children are asked to draw a person. When they have finished, they are asked to draw a person of the opposite sex.

Learners involved in the study were asked to complete the figure drawings at the end of the study. This activity was untimed, taking 20 to 30 minutes, and the learners proceeded as they were ready.

This scale was used, as it was developed on the basis of drawings made by 10 year old boys. Witkin (1962) reports a correlation of .41 between the figure drawing scales and perceptual index scores. This makes the relationship between this figure drawing scale and field dependence significant.

The two independent raters were supplied with no information on the subjects other than the fact they were Grade 3 students. The researcher was the third evaluator. Raters were not staff members at the study locale. They rated the drawings based on the specific criteria cited in Witkin (1962). Ratings assigned to each participant were an average of the three raters' scores. Interrater reliability was not assessed due to the fact that there was not available time.

Matching Familiar Figures Test (MFFT). The MFFT is a measure of impulsivity/reflectivity (Kagan, 1985) and was used as the other determinant of cognitive style.

The Mental Measurements Yearbook, 1985 reports no reliability and validity scores on the MFFT although it has been

used widely in research. Research studies available give no information. The MFFT was employed as there was no other appropriate measure of reflectivity/impulsivity available and impulsivity/reflectivity is an important construct in the study of cognitive style.

It is a pencil and paper test in which the participant matches one of the alternative figures to the one at the top of the page on the test form. There are 2 practice and ten test items. Time response is recorded for each item. Administration of the test is individual, outside of the classroom. It is untimed, taking about 20 minutes to complete.

The researcher recorded response times for each individual as well as the total test time.

All test protocols of the participants were anonymously coded for this study. All test results were evaluated and recorded at the end of the study.

Method

Before beginning data collection for this study, permission for the study to take place was given by the Lakehead Board of Education. The parents of the participating students also gave permission for their children to take part in the study (see letters, Appendices 3 and 4). Permission for space, copying and cost of copying were made with the principal, who was very accommodating.

In the two weeks before the study began, two team planning meetings were held which included the researcher, her teaching

partner and the resource-librarian. At the first meeting, the content of the decision making unit, how the material would be divided into sessions, the number of sessions necessary, accommodation for flexibility of time when necessary, and who would deliver sessions to the participants were discussed and decided. Specific dates and times for each session were also decided. The group of participants was divided into two smaller groups according to their presently assigned Grade 3 class, as this was the method least intrusive to the school timetable and other staff. The researcher then planned a timetable to include the order in which all the decision-making activities and instruments would be delivered. An additional timetable in a calendar format was completed with exact dates and times included. Copies were distributed to the other staff. The second planning meeting was held for the staff involved to: a) review the order of events; and, b) get information involving all other aspects of the study.

In the same two week period before the study began, the researcher arranged to have copies of the problem solving inventory, answer forms, decision-making and paired comparisons charts prepared.

Other preparations were also made. Arrangements were finalized for the use of: a) a private office for individual testing; and, b) library space for large group decision-making activities. Other materials such as a stopwatch, tape recorder,

filmstrip projector and screen were collected so they would be readily accessible when required.

This study consisted of two main sections: the decision-making training unit activities (intervention) and the instruments which were administered to determine both the dependent variable - problem-solving/decision-making ability; and,the independent variables of cognitive style - field-dependence/independence and impulsivity-reflectivity, and reasoning ability. Both sections occurred throughout the study.

Activities

The activities consisted of the sessions in the decision-making training unit which took place during the first seven weeks of the study. The training unit was researcher-designed and curriculum-based. All the basic components required to complete a decision-making activity were included: fluency (generation of alternatives), paired comparisons (selection of alternatives), generating of criteria, rating of alternatives using criteria, and making and evaluating their final choice. Each of the above skills was carried out four times during the study to teach the learners the components, to allow them to learn and review the process, and to have an opportunity to use the process independently. In addition, two "awareness" activities and three activities specific to the curriculum topic were carried out.

By using the above design, the following research findings were incorporated into the intervention unit. Brown's "informed

training" (1988) which not only prompts students to perform particular strategies but provides them with information about the significance (needs and effects) of the strategy was employed in this intervention unit. Kennedy and Miller (1976) also had the same results as Brown. In addition they showed that a strategy is more likely to be used when its significance has been demonstrated. The unit also included extended practice and reinforcement in the form of praise and attention by the teacher.

Introductory Training Activities (Decision-Making Process #1)

The first activity was a fluency exercise on "Possible Animals for a Project". This was related specifically to the Environmental Studies topic of "Animals Indigenous to the Local Community". The teacher researcher was the recorder. In 30 minutes, a chart was produced listing all the possible animals (alternatives) which the students could generate from their own knowledge. They were able to view the charts of both classes.

At the end of the fluency exercise, the students were given an overview of this research study in simple terms. The only concern voiced by a few students was "Does this count on our report card?" They were informed that only the "animal project" would be evaluated for the report card because it was part of their regular curriculum. They were assured that the "test" parts of the study were only to show the researcher how they worked. They seemed content with the explanation. Each teacher completed the fluency exercise separately in their own class.

The next component required for decision-making is "paired comparisons" (selection of alternatives). In this activity, each student chooses ten of the alternatives from the fluency list completed previously. For training purposes all students used the same ten choices. These choices were determined by a class vote. The two groups completed this activity separately with 2 staff monitoring the group. The children had their own "paired comparisons" chart (Appendix 6). They were instructed to list the same group of names both down the side of the chart as well as across the top of the chart in the same order. For example, if "A" on the vertical axis was "bear", then "A" on the horizontal axis must also be "bear", etc. Using the verbal instructions of the researcher, they proceeded step-by-step until they had filled in all their preferences. Then, they tallied all the A's, B's, C's, etc. which they had filled in on the chart. The totals for each choice were recorded in the far right hand column by the students. The 5 alternatives which had been chosen the greatest number of times were circled. These 5 alternatives would be used to complete the next training activity. Completion took more than the 45 minute anticipated time and required the full concentration of the learners. Six students needed assistance to complete the chart. They did a fine job with added assistance, The researcher checked the charts for proper completion.

The second fluency activity was designed to make participants aware of "How We (Learners) Use Decision-making Every Day", as well as raising their comfort level with

generating criteria. Again this activity was conducted separately by each classroom teacher. The final product was a chart listing the ways in which the learners use decision-making. The classes had an opportunity to peruse both their own class chart as well as the chart from the other class.

In the second half of this decision-making activity "Topic for an Animal Project", the learners generated criteria, rated each alternative, and ranked their choices as well as evaluated their choice verbally. On their decision-making chart (Appendix 7), they had previously listed their 5 alternatives in the appropriate column.

Generating criteria via a large group discussion with a teacher leader was an easy task for the learners. However, the wording of the criterion was somewhat troublesome to them, as none of the criteria questions may have a "yes" or "no" answer, so they can be rated. e.g. Instead of "Will the library have information on my topic?", the criteria should be rephrased as "How much information will the library have on my topic?" Using the student ideas, the researcher supplied the first 2 criteria and placed them on a large chart on the blackboard. Criteria 3 and 4 derived from either the class suggestions or from ideas of the individual students. The teacher researcher checked each student's criterion for suitable wording as they were completed.

Rating each of the alternatives came next. A scale of 1 to 5 - "5" being excellent, "4" - good, "3" - satisfactory, "2" - OK, and "1" - poor was used. Under each criteria going down the

column of alternatives, the children were instructed to use each of the numbers 1 to 5 only once. In beginning use of this chart, this tactic avoids too many "tie" situations which are confusing to young novices.

Each criteria was completed step-by-step with the teacher guiding the group. This allows the learners to: a) be certain of the question they should be asking themselves; and, b) be sure they are choosing a suitable rating. When all 4 criteria were rated for each of the 5 alternatives, each alternative row value (going across the page) was totalled and recorded in the appropriate column. The 3 highest totals were circled and the highest total starred.

Each learner's first alternative was the choice for their project, as it should have been the alternative which they preferred the most. All but three students were happy with their first choice. Topic changes were allowed if there were insufficient copies of information on that topic.

At this point, the resource-librarian and staff involved sought out enough information at an appropriate reading level to accommodate the students involved. The researcher checked the candidates' completed charts to ensure that they had finished the activity using the training procedure.

Constructing a Mind Map

The next activity was constructing a "mind map". This activity was related specifically to the Environmental Studies curriculum i.e. the animal which they had chosen for their

project. A "mind map" is a type of fluency activity which allows the learner to explore all the areas in which they have topic-related questions (Figure 2).

The teacher copied all of the suggestions onto a master mind map which was on a large piece of paper. After the session, each learner was given his own copy of the mind map (prepared by the teacher) to keep in their research folder. When the mind map was distributed to the children, the information on the map was reviewed in a large group. The learners were encouraged to make additions under existing categories or to add new categories they wished to explore. As all learners had the same broad topic, the mind map information was helpful to them.

Next, candidates used their "mind map" to place five questions which they had about their specific animal on a data sheet supplied to them by the resource-librarian. They sought out the resources and recorded the information necessary to answer their questions in this 40 minute session. Most candidates required an additional classroom session (40 to 45 minutes) to complete the data sheet. A few students required assistance in recording the information. Peer tutors assisted them.

The awareness of the learners was heightened a second time when they were required to collect information on "How Other People Use Decision-making". They collected information (as much as possible) overnight from parents, teachers, neighbours and other adults. The next day they readily listed their collected

ideas. This made them very aware of the fact that many people use decision-making for a great variety of reasons.

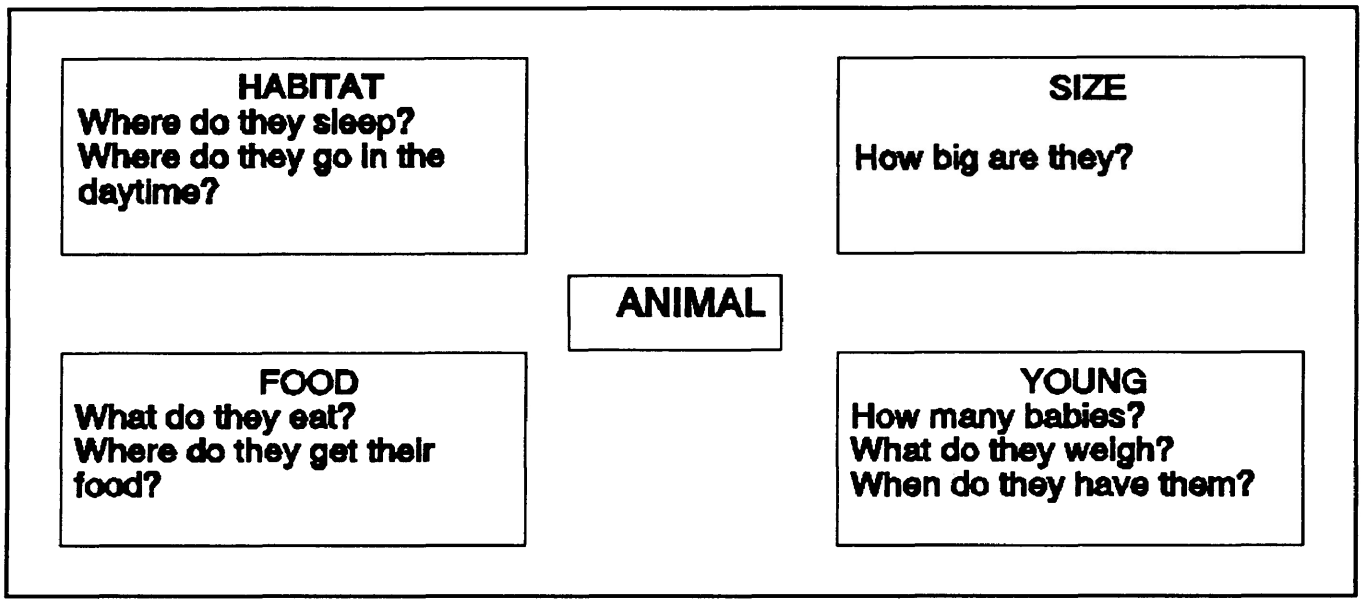

Figure 1. Example of Mind Map

Decision Making Process #2

A second opportunity to use the decision-making process was given to both groups. The topic "Friends" was used and the process was completed in two parts (Appendix 8).

In the first session, the class produced a fluency list of the qualities which they look for or expect in a friend. In the next step, they chose 10 of the ideas from the fluency chart and completed their "paired comparisons" chart which required approximately 30 minutes. This time teacher guidance in filling out this chart was for the first 2 rows only.

The next day, part two of the second session took place. The participants recorded their 5 highest scoring alternatives from

the "paired comparisons" chart in the alternative column on the decision-making chart. The class then developed 3 criteria to be used by all participants as the wording of criterion with this topic was difficult for them to complete independently. This session took 45 minutes.

The teacher researcher then had the children reiterate the remaining steps necessary to complete the decision-making process, i.e. rate each alternative using each criteria, total the chart across the rows, and circle their top three choices. This repeated the process they had learned in the first decision-making process. They completed the last three steps independently.

Decision Making Process #3

The next week, both groups had their third opportunity to use the decision-making process. The topic "My Hallowe'en Costume" was used, and the process was completed in two parts as previously. The fluency list was completed by the large group in 20 minutes.

The next day, the participants chose their 5 favourite Hallowe'en costumes using a "paired comparisons" chart. They then listed their 5 choices on the decision-making chart. The remaining steps were reviewed orally with the group, criteria developed, and they completed the chart independently. Each teacher administered these two sessions in her own classroom.

Decision Making Process #4

During Hallowe'en week, both groups completed their fourth decision-making process "Hallowe'en Party Activities". The teacher recorded the initial fluency chart for the class group listing all the possible activities for a celebration. The class then used 4 common criterion proposed by the group. The decision-making chart was completed independently. The few children who needed reminders about the steps in the process asked their peers for assistance which was readily available. This session was completed in approximately 45 minutes. No staff assistance was required in the independent section of this activity.

As each opportunity to complete the decision-making process took place, the learners became more familiar with the entire process and were able to complete the process more quickly and in a confident manner.

Schedule of Test Administration

Concurrent with the decision-making training unit, instruments which measured both the dependent variable and the independent variables were administered to the learners. These measures were administered both in groups and individually as appropriate.

All instruments were administered at appropriate times. The Purdue Elementary Problem Solving Inventory was administered as a pretest (before training began) to find the present level of problem solving skill, as a post-test (after the intervention) to

determine any changes in problem solving skill, and as a post post-test (nine weeks after the post-test) to assess long term results of the intervention. The Coloured Progressive Matrices, a measure of inductive reasoning, used to measure general ability, was given early in the study as existing reasoning ability is not changed by the intervention and the time was available during this section of the study. The Children's Embedded Figures Test and the Matching Familiar Figures Test were administered in one session. Both measure cognitive style, an independent variable in this study, and are not influenced by training. Both tests are similar in format. As time available to the teacher researcher was limited, it was expedient to complete both tests at the same time. The Draw-A-Person test is also not influenced by training activities and was completed as time was available.

Purdue Elementary Problem Solving Test (pretest)

The day after the initial fluency activity, the Purdue Elementary Problem Solving Inventory pretest was administered to one group in the morning and to the other group in the after noon of the same day. Audio and video equipment was set up by the researcher before the students came into the classroom. Each child was given a sharp pencil and a test booklet. The researcher made certain that all students could see the filmstrip clearly and that they could hear the audio tape.

The children were told that this activity would show how they would be able to handle common sense problems that they might meet in real life. They were told that they would be shown

pictures on the screen which they needed to watch closely. They would be asked questions about the pictures. They were to mark their answers in the booklets. If they had any problems, they were asked to raise their hand and the teacher would come to their desk to help them immediately. They were asked not to open the booklets until the voice on the tape asked them to do so.

The children completed the 49 item problem solving inventory with one short "stretch" time at the end of page 7 (item 27). On some of the questions, the pause allowed for the correct response to be marked by the learners seemed too lengthy. However, the students appeared to concentrate and be relaxed throughout the test period of approximately 45 minutes.

The Coloured Progressive Matrices (CPM).

The CPM, Sets A, Ab, B was administered about one week later. Thirty minutes was allowed for this session, including distribution of materials, testing, and collection of materials. The CPM is a simple, untimed test which is a measure of inductive reasoning ability (observation and clear thinking). It was administered to both groups, in separate sessions by the researcher on the same day.

The test consists of three sets of twelve items which the children work through independently after the test is explained and an example completed. In the sample question, the students were advised to take their time and to look at each possible answer carefully before choosing. Each of the possible answers for the sample was worked through step-by-step by the group.

The participants were instructed to put their heads down and to be very quiet until everyone had finished the test. They were assured that this "waiting" period would not be long. The researcher reminded them to take their time, and to choose answers carefully, as only one pattern completed the figure correctly. They then completed the test on their own.

All participants filled in their own form and had completed the test in a 10 minute time period. Tests were collected as the learners completed them, and the finish time was recorded on their form. The participants were reminded to put their heads on their desk and to be quiet until everyone had finished. The children found this test quite enjoyable! Absent students were given the CPM at another time as one group.

Test forms were scored by the researcher. Responses were marked correct or incorrect. Correct answers were totalled and the corresponding percentile, according to Table IX of the CPM manual was recorded on a master data sheet at a later date.

Children's Embedded Figures Test and Matching Familiar Figures Test

The researcher administered the Children's Embedded Figures Test (CEFT) and the Matching Familiar Figures Test (MFFT) individually to the participants in the fourth, fifth, and sixth weeks of the study. This individual session took place in a private office with no disruptions.

Both the CEFT and the MFFT were given in the same session, taking approximately forty-five minutes for most students. The

CEFT was given first, and the MFFT was done second. At the beginning of the session the children were told that they would be doing two activities.

The CEFT was explained as an exercise in which they had to find a hidden shape - a "triangle" in the first part, and a "house" shape in the second part. The shapes were shown to the candidates at the start of the corresponding test section. When they found the shape, they were instructed to say "I see it.", and to then outline the shape on the card with their finger. A running response time was recorded at each answer. The total time taken for the test as well as the number of correct responses was recorded. This information was transferred to a master sheet at the end of the study.

The MFFT was given directly after the CEFT. This test is a series of twelve matching tasks. The candidate was presented with the figure to be matched on one page. On the opposite page were six choices. The candidate was told to "find the matching one, the one that looks exactly like this one" (the researcher pointing to the sample one). They were reminded by the researcher saying "Only one is the same as this one." The child's response time for each item was recorded until they found the correct response. In scoring the test, the number of correct first responses were totalled.

These two tests were administered to the students using two school days as well as during eight teacher planning sessions.

The CEFT seemed to be the more demanding of the two tests, while the MFFT was short and seemed to be relaxing for the students.

The Purdue Elementary Problem Solving Test (posttest).

The next instrument administered was the Purdue Elementary Problem Solving Inventory post-test (six weeks after the pre-test session).

The physical setting, instructions, etc. were the same as in the pre-test. Again, there seemed to be some items in which the pause given for response time was too lengthy. Children seemed a bit impatient with the long response time in this session.

Machover Draw-A-Person Test

During the first week back to school after the Christmas break, the Machover Draw - A - Person test was administered. Individual teachers completed the Draw - A - Person test in their respective classrooms. The candidates were given time to first complete a drawing of themselves. When they were finished, they were asked to draw a person of the opposite sex. This activity was untimed. The figures were rated by two outside evaluators who did not know the children as well as the researcher. Names were removed from the papers and candidate numbers were substituted. An average of the three ratings was assigned to each participant. Interrater reliability was not computed as time was not available.

The Purdue Elementary Problem Solving Inventory (post posttest).

The post posttest was given to both groups subsequent to all activities in the training unit. The researcher administered the test to both groups. This post posttest was given nine weeks after the posttest. Set up and instructions were identical to the other sessions where this test was administered.

It is expected that the learner's cognitive style, that is, their field-dependence and level of reflectivity/impulsivity will mediate the effect of the training unit in decision making. The reflective/field-independent learner will be the most effective decision maker subsequent to participating in the training unit.

Analysis

At the end of the data collection all administered tests were evaluated according to test manuals or instructions gathered from research articles.

Data were analyzed using the computer program SPSS-X (Statistical Package for Social Sciences). Means and standard deviations were computed for the problem solving tests, PEPSI-1, PEPSI-2 and PEPSI-3, and examined to establish changes in problem-solving ability from the pretest to the posttests (PEPSI 2-1 and PEPSI 3-1). Means and standard deviations were also calculated for the independent variables. These data for the cognitive tests (CPM, CEFT, MFFT and DAP) showed how the sample used in this study compared to others in the same age group as reported in test manuals.

Pearson correlation coefficients were calculated between independent variables and the problem solving tests (dependent variables) PEPSI 1, 2 and 3. Correlation coefficients were also calculated between the measures of cognitive style (independent variables) and of reasoning ability.

The final problem-solving level as measured by PEPSI-3 and the two change or gain scores (reported in Table 4-6) on PEPSI 2-1 and PEPSI 3-1 were also correlated with the cognitive variables (CPM, CEFT, MFFT, DAP) to examine possible relationships between cognitive style (CEFT and MFFT), problem-solving, and relationships with gain scores.

Where appropriate, tests of significance (t-tests) were applied to examine differences between means and the magnitude of correlation coefficients. These statistics, with probability levels, are reported in the subsequent chapter.

CHAPTER FOUR

Results

The purpose of this study was to investigate the relationship between cognitive style and the way in which learners use the strategy of decision making.

It was expected that reasoning ability and cognitive style would mediate the effect of decision making training. In other words, students with high reasoning ability would make the best use of the skills learned in the decision making training unit. Reasoning ability was measured by the Coloured Progressive Matrices (CPM). The Machover Draw-a-Person Scale (DAP) which can be used as a measure of general reasoning, was used as a measure of articulation of body concept because it relates closely to style of field approach when scored as a measure of articulation of body concept. Cognitive style was measured by two different measures. The Children's Embedded Figures Test (CEFT) which measures field-independence/dependence and, the Matching Familiar Figures Test (MFFT) which measures reflectivity/impulsivity.

It was also expected that there would be an improvement in the decision-making ability of the learners subsequent to training, with the field-independent/reflective learners showing the most improvement in their decision making performance. It is also expected that the field-independent/reflective learners will be the most effective decision makers as they apply their decision making skills. Problem solving ability and the effect of the decision making training unit was measured by the Purdue

Problem Solving Inventory (PEPSI). This measure was administered three times - before the training unit, six weeks later at the end of the training unit, and nine weeks after the end of the training unit. In this test, the learners are expected to make the most appropriate choice in real life problem situations which are depicted in picture form and explained verbally.

Performance on Problem-Solving and Cognitive Measures

Means and standard deviations for both problem-solving and cognitive measures administered are reported in Tables 4-1 and 4-2. Due to the small number of variables employed, analysis of variance tests were not conducted for all instruments.

Table 4-1

Problem Solving Tests: Means and Standard Deviations

	Mean	SD
PEPSI-1	36.231	3.099
PEPSI-2	39.051	3.395
PEPSI-3	39.282	3.387

The Purdue Elementary Problem-Solving Inventory or PEPSI is a measure of problem solving which was developed for use with children of Grades two to six. In the test development research, Cox (1985) reports mean scores and standard deviations (in

parentheses) for disadvantaged children of Grades two and four respectively were 30.9 (3.6) and 37.5 (2.2). The learners in this study performed slightly better than the original research group of the same ages. The range of scores increased from twelve on the pretest to fifteen on the post-test, to eighteen on the final test (PEPSI-3). There was improvement on each subsequent PEPSI test shown by the mean scores in Table 4-1. On PEPSI 2-1, t= 5.46, (d.f.:38, $p < .01$). On PEPSI 3-1, t= .40, (d.f.:38, p <NS).

Table 4-2

Independent Test Variables: Means and Standard Deviations

	Mean	SD
CPM	24.615	5.688
CEFT	20.154	2.368
MFFT	6.154	2.266
DAP	2.974	1.181

CPM mean scores achieved by the learners in this study were typical for their age group. Mean score reported in the initial research study by Raven (manual- Table XI,1956) was 24.9, with a standard deviation of 5.8.

Mean score attained on the CEFT by this study group was almost twice the mean score reported in the test development

research (test manual-Table 3) which was 10.6 (Witkin, 1971). The standard deviation in this study was less than half of that reported in the development research (5.6). However, it was noted by Witkin (1971) that Stern and Clack found that socioeconomic class was related to performance. The studies of Elitcher (1967) and Mumbauer and Miller (1970) as cited in Brown (1978), confirm this finding. Therefore, caution must be exercised when applying the norms of the standardization group to children from other kinds of social backgrounds. Age effects have also been found to be significant, performance becoming more field independent with age. With increasing age children are more adept at perceiving parts of the field as discrete from an organized ground (Witkin, 1971). Both socioeconomic and age effects are discussed in the test manual by Witkin et al. (1971).

Standardized mean scores and standard deviations for the MFFT and the DAP are not reported in research. The MFFT has been used widely in research work and was an appropriate test for the age level employed in this study. In each research study the participants' performances are simply compared to others within their own group in deciding which participants are impulsive or reflective. A correct score point is given when participants guess correctly on the first try on this untimed test. Participants with a high score are considered to be reflective while those with a low score are considered to be impulsive. Kagan never published test manual and norms.

The mean scores on the PEPSI tests reveal that there was a significant increase from the pretest to the post-test. However, only a slight increase from the post-test to the second post-test occurred. This increase was not significant. It is noted that although the increase from the post-test to the second post-test failed to achieve significance. The increase from the pretest to the post-test was maintained at the second post-test.

This finding confirms that decision-making training is associated with an improvement in problem solving efficiency. The second post test results indicate that the improvement is at least maintained.

Relationships Between Dependent and Independent Variables

Problem Solving Tasks

Table 4-3 shows the Pearson correlation coefficients between the dependent variables of PEPSI-1, PEPSI-2, PEPSI-3.

Table 4-3

Correlations Between Problem-solving Tests

	1	2	3
1			
2	.5092**		
3	.4826**	.4222**	

*-p < .05, **-p < .01 (2-tailed) d.f.:38.

Table 4-3 shows that PEPSI-1, PEPSI-2, and PEPSI-3 correlate significantly at the .01 level. The anticipated relationship between the problem solving tests was confirmed. These results indicate that the students who did well on PEPSI-1, tended to perform well on PEPSI-2 and PEPSI-3. Improvement was anticipated as the training unit addresses seven of the eleven different factors involved in problem solving situations in PEPSI. Subsequent to the training unit, the learners involved would be: 1) able to assess when a situation required problem solving skills, 2) able to choose a strategy which could help them solve the problem situation, and 3) able to apply their decision making skills independently.

Cognitive Tests

In Table 4-4, relationships between the independent variables are revealed.

Table 4-4

Correlations Between Cognitive Tests

	CPM	CEFT	MFFT	DAP
CPM				
CEFT	.1374			
MFFT	.4009*	.3241*		
DAP	.2650	.1520	.2573	

*-p < .05, **-p < .01 (2-tailed) d.f.:38.

Reasoning ability measured by CPM and field independence measured by the CEFT have a low, non-significant correlation, contrary to initial hypotheses (Chapter 1) which projected that there would be some relationship between the two variables. Reasoning ability measured by the CPM and reflectiveness, measured by the MFFT, correlated at the .05 level as anticipated.

There is a moderately significant correlation between the two tests of cognitive style (CEFT and MFFT). The DAP, scored to measure the articulation of body concept (can also be scored to measure general reasoning), is considered an alternate measure of field dependence. Interestingly enough, its correlations with the independent variables of reasoning ability (CPM) and reflectivity/impulsivity (MFFT) are low. The relationship of the DAP and the CEFT is not significant.

Cognitive Skills and Problem Solving

Table 4-5 indicates that there is a significant correlation between the final results on the problem solving test (PEPSI-3) and both reasoning ability (CPM) and impulsivity/reflectivity (MFFT) as anticipated.

Table 4-5

Correlations Between Cognitive Tests and Final Problem-solving Level

	CPM	CEFT	MFFT	DAP
PEPSI-3	.4511**	.1716	.3989*	.4493**

*-p < .05, **-p < .01 (2-tailed) d.f.:38

Pearson product-moment correlations reveal a significant relationship between PEPSI-3 and the CPM, r = .45, (d.f.:38), p < .01. Table 4-5 also shows that there is a significant relationship between PEPSI-3 and MFFT, r = .39, (d.f.:38), p < .01. A significant relationship is indicated between PEPSI-3 and DAP, r = .44, (d.f.:38), p < .01.

Field independence (CEFT) fails to correlate significantly with the final problem solving scores, contrary to the initial hypotheses in Chapter 1. Lack of relationship between the CEFT and the final problem solving score suggests that the degree of field dependence which a learner possesses (shown by the ability to deal with the abstract, complicated figures of the CEFT) bears little relationship to performance on the PEPSI where the learner is required to solve the relatively simple real life problems.

In this correlational study, articulation of body concept as measured by the DAP is associated at the .01 level with problem

solving. The tendency of children with an analytical field approach, or reflective learners to have an articulated body concept was also noted by Witkin (1962). These learners analyze problem situations carefully explaining the relationship of the DAP and the final PEPSI in Table 4-5.

Table 4-6

Correlations Between Cognitive Tests and Gain Scores.

	CPM	CEFT	MFFT	DAP
GAIN 2-1	-.02	-.09	-.40*	-.16
GAIN 3-1	.05	-.14	-.03	.11

*-p < .05 , (2-tailed) d.f.:38

The gain scores for PEPSI 2-1 and PEPSI 3-1 reported in Table 4-6 indicate that only the correlation coefficient between the PEPSI 2-1 gain and MFFT (impulsive/reflective) achieved significance, r= -.40, (d.f.:38), p < .05.

It seems reasonable to conclude, that although the cognitive style measures (CEFT and MFFT) are associated with decision-making/problem-solving skills, they do not appear to relate to the degree of improvement in decision-making/problem-solving subsequent to training. This is reflected in the gain scores shown in Table 4-6.

It was initially expected (Chapter 1) that decision-making ability would be more closely related to the degree of

impulsivity/reflectivity at both post test levels. Correlations between the gain scores shown at the first post test (PEPSI 2-1) and the second post test (PEPSI 3-1) and the cognitives variables of reasoning ability (CPM), field-dependence (CEFT) and body articulation (DAP) indicate that relationships did not achieve significance. They could be due to chance and not due to the fact that the decision-making training unit was carried out nor to the hact that successful practice using decision-making skills can increase decision making performance as noted in research by Brown (1983) and Bransford (1986). No comparisons to find out the significance of the differences between the gain scores was carried out.

CHAPTER FIVE

Discussion and Conclusions

This study indicates that the cognitive style of reflectivity/impulsivity may facilitate the use of certain decision making strategies over a short term while the cognitive style of field-dependence /independence appears to have little relationship on the performance of seven to nine year old learners using the same series of decision making tasks.

Performance in Problem Solving and Maintenance of Decision-making Strategies

The learners in this study were taught a decision-making/ problem-solving strategy appropriate to their age level and needs. Subsequent to the training unit, they were knowledgeable about why and how they could use that strategy. Because the decision-making training unit used in this study was specifically designed by the teacher-researcher for children of Grade Three age, research findings of others were built into the design of the unit. Occasions when the strategy was used were relevant to the learner's age group and their everyday environment e.g. topic for a project; choosing a Hallowe'en costume; activities for a Hallowe'en party; and the qualities of a friend. Each time, the unit activities accomplished the following:

1) addressed why the strategy should be used (the need for and the effects of the strategy were discussed as a group).

2) made the students aware of the basic steps involved in the decision-making strategy.

3) demonstrated how to implement each step in the strategy.

During the study the learners seemed to be clear about the steps to be followed. Little or no difficulty was evident as they completed the decision-making process. The students seemed comfortable and confident carrying out the process even as teacher prompts were decreased. Students differ in the extent to which they use information that they know, so some prompting to initiate the use of appropriate strategies might be necessary.

Prompting can be in the form of leading questions or direct instruction. Caution must be exercised in the use of prompts as they assist the learner in remembering a set of information (the steps of the decision-making process) but do not teach learners to self-initiate the use of strategies or processes.

Over the course of seven weeks of training the students' ability to apply this set of skills improved (Table 4-1). A study by Bransford et al. (1986) supports the theory that an emphasis on executive processes improves thinking and decision-making/problem-solving skills by helping the learner select, use and evaluate strategies. The performance scores for PEPSI in Table 4-1 show the level of decision-making was maintained at the second posttest, nine weeks after the posttest.

Maintenance of the strategy has been investigated in other studies. Brown, Kennedy, and Miller (1976) concluded that

maintenance is more likely to occur if the significance (the need for, and the effects of) of the strategy is known to the learner. The learners in this study considered the significance of the strategy during all four opportunities in which they implemented the strategy. They investigated why they, and adults they know (parents, other family members, and teachers and school staff) would use decision-making strategies. Both Belmont and Butterfield (1977), and Paris, Newman and McVey (in press) as cited in Brown (1983) found that strategy maintenance was also related to the efficiency and the precision with which the strategy is carried out during training.

Cognitive Measures

Cognitive measures in this study were the Coloured Progressive Matrices (CPM), used to measure reasoning ability, the Children's Embedded Figures Test (CEFT), used to determine field-dependence/independence, the Matching Familiar Figures Test (MFFT) which measured impulsivity/reflectivity, and the Machover Draw-a-Person Scale (DAP) which was used as an alternate measure of field dependence.

The learners in this study achieved typical mean scores for their age group on the CPM as shown in the test manual , Table XI (1956). The mean scores on the CEFT were almost twice the scores reported in the test development research (test manual - Table 3). Caution needs to be exercised in interpreting the significance of performance on the CEFT according to Witkin (1971). Witkin notes that Stern and Clack, Elitcher (1967) and

Mumbauer and Miller (1979) found that socioeconomic class was related to performance on the CEFT. Therefore, comparison of the research standardization norms to groups from other social backgrounds needs to be done cautiously. Age effects have also been found to be significant with learners becoming continuously more field independent between the ages of eight and fifteen (Witkin et al., 1967). The MFFT and the DAP both give performance scores which compare the learner's impulsivity/reflectivity and articulation of body concept within the study group only;and relevant norms are not available.

The relationships between the cognitive measures offer support for previous research findings. Witkin (1977) concluded that reasoning ability (CPM) was independent of field-dependence (CEFT) but recognized that field-dependence does mediate the effects of instruction (Guild & Garger, 1985). Reflectivity/impulsivity (MFFT) is related to reasoning ability.

Problem-solving and Cognitive Skills

The relationships between the final problem-solving performance and the cognitive skills are noteworthy when compared to the anticipated outcomes of this study.

Field-independence/dependence is not related to the improved performance in using decision-making strategies (PEPSI-3). The association between field-dependent/ independent behaviours and decision-making may not be fully evident as the children used in this study are only beginning to develop this cognitive style (Witkin, 1977).

However, as expected, the level of reflectivity/impulsivity has an association with the efficiency with which a learner applies decision-making strategies, at least over a short term. Students who take their time and carefully assess the problem, then consider and weigh the consequences before making a decision are more likely to make decisions more efficiently than those who do not. Students who did well at the outset of the study continued to do well throughout the study.

All students showed improvement in decision making subsequent to the training unit. A more accurate evaluation of improvement in decision making may have been possible with the use of a control group which would allow us to determine the effect which the training unit had on the problem solving skills of the students.

Implications of the Study

The fact that change in the performances on problem-solving/decision-making measures indicate, as other research has, that some changes occur when strategies such as decision-making are employed by learners leads to the consideration of other potential research areas.

Some questions come to mind immediately. If there is an increase in problem-solving/decision-making subsequent to a seven-week training unit which is maintained after a two month period, what would be the effect if an ongoing, incremental decision-making program? Because of the student's ability to identify and deal with problem situations, would such a plan

affect the independent behaviour of students and their willingness to accept academic responsibility? Is the emphasis on only the decision making component enough training? If it is possible to increase the degree of reflectivity which learners exhibit, could the learners' decision-making performance be further enhanced? Would increased reflectivity on the part of students increase their ability to think and make decisions more efficiently?

Not only would such a program increase learners' skill in using a strategy, it would increase their repertoire of strategies and allow them the opportunity to adapt these strategies to their individual situations. It could be anticipated that learners would initiate the use of problem-solving strategies automatically when faced with a problem situation. The automatic implementation of decision making strategies would then affect their independent behaviour and their willingness to accept more academic responsibility knowing that they have the necessary skills to deal with the situation.

As reflectivity/impulsivity relates to performance in problem-solving, it would be beneficial for classroom teachers to examine the style of their students more closely and design activities in which more efficient behaviours are encouraged. As behaviours become more reflective, it is expected that performance would be more efficient considering individual capabilities.

Limitations of the Study

In this study, certain design limitations exist.

Sample

The sample used in this study was small. The placement of the teacher-researcher determined the number of Grade Three students available.

Test Validity

The validity of the relationships between field-dependence/independence as measured by the CEFT and the other measures is questionable. CEFT results have been reported to be affected by socioeconomic status (Witkin et al., 1971) which was not assessed formally in this study. The learners' ages fall at the beginning of the stage where field-independence increases (Witkin et al., 1971). The training unit did not require the learners to exhibit field-independent characteristics (i.e. to set their own goals or to restructure the way they used the strategy). Decisions made during the training unit such as what the problem situation would be were group decisions in order to facilitate instruction in the use of the decision-making process for all students. Learners, therefore, had no specific opportunity to exhibit or refine their field-independence in topic selection or in developing their own steps in the decision-making process.

However, it must be noted that some of the learners involved in this study showed evidence that they were applying and restructuring the decision-making strategy to suit their social

life on both the playground and at home. Small groups of students were using their skills to decide such age-appropriate matters as what game they would play at recess, what they would do at a "sleepover" birthday party or how they could use their recess time more constructively. Individual students were observed to be using the skills to decide such age-important issues as who they thought could be their "best" friend.

The Decision-making Training Unit

The training unit was designed by the teacher-researcher. It concentrated on several thinking skills, considered to be important components in decision-making processes and common to the problem-solving measure. The training unit format required that the learners be observant. They were required to complete both group and individual activities carefully. Awareness activities made it necessary for them to contemplate and note why we use decision-making, how we use it and why others use it. The actual components in the decision-making process were completed step-by-step in the classroom with prompting decreased to a minimum (students asking their peers if they needed reminders) in the final training opportunity. Even the most impulsive-type learners seemed to understand and apply the strategy with ease by the end of the training unit. Adjustments might be necessary in the length of time needed to internalize the skills and in the number of less-directed opportunities in which students can apply the process.

Lack of Control Group

The use of a control group may have shown the relationship of the decision-making training unit to problem-solving more clearly. Factors such as the effect of socioeconomic status, the effect of the teacher and the effect of the students' ages in determining the effect of the cognitive style of impulsivity/reflectivity make assessing the true degree of effect of training in decision making difficult. A control group may be effective in determining these effects more clearly by providing a comparative sample.

Conclusions and Recommendations

Provincial writing teams in Ontario consider developmental stages of children as they produce curriculum guidelines. It is important for teachers and boards of education involved in these writing teams to consider carefully processes which are both relevant to and critical to the development of independent, effective learners. It is important that educators first consider the development stages and range of students within each level; and secondly, that they be aware of how cognitive styles affect the performance of their students.

It is evident that the reflective or impulsive style of learners can determine how well they choose, apply and evaluate strategies. Learners also need to be made aware of the effectiveness of executive processing strategies. Further classroom research may show the extent to which teachers, despite

the differing levels of learners, could help learners to employ decision making strategies efficiently and effectively. Teachers can capitalize on the self-motivation of the learner by providing ongoing opportunities in the school and home environment which would encourage learners to choose and apply these strategies. Organizations and institutions responsible for both pre-service teacher education and continuing teacher education need to recognize the importance of problem-solving processes and implement their widespread use.

Although there are factors which place limitations on a learner's use of strategies, it may be concluded that change in executive processes such as decision-making can be made in young learners with appropriate training; and, that the cognitive style of reflectivity/impulsivity has some influence on the learner's performance. It may be useful that the planned teaching and development of these strategies be incorporated into school curriculum bringing educators closer to producing good thinkers and self-directed learners who can transfer and apply these strategies in all aspects of their environment.

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Appendix 1

Gubbins' (1985) Matrix of Thinking Skills

I. Problem Solving
   a. Identifying general problem
   b. Clarifying problem
   c. Formulating hypothesis
   d. Formulating appropriate questions
   e. Generating related ideas
   f. Formulating alternative solutions
   g. Choosing best solution
   h. Applying the solution
   i. Monitoring acceptance of the solution
   j. Drawing conclusions

II. Decision Making
   a. Stating desired goal/condition
   b. Stating obstacles to goal/condition
   c. Identifying alternatives
   d. Examining alternatives
   e. Ranking alternatives
   f. Choosing best alternative
   g. Evaluating actions

III. Inferences
   a. Inductive thinking skills
      1. determining cause and effect
      2. analyzing open-ended problems
      3. reasoning by analogy
      4. making inferences
      5. determining relevant information
      6. recognizing relationships
      7. solving insight problems
   b. Deductive thinking skills
      1. using logic
      2. spotting contradictory statements
      3. analyzing syllogisms
      4. solving spatial problems

IV. Divergent Thinking Skills
   a. Listing attributes of objects/situation
   b. Generating multiple ideas (fluency)
   c. Generating different ideas (flexibility)
   d. Generating unique ideas (originality)
   e. Generating detailed ideas (elaboration)
   f. Synthesizing information

V. Evaluative Thinking Skills
   a. Distinguishing between fact and opinion
   b. Judging credibility of source
   c. Observing and judging observation reports
   d. Identifying central issues and problems
   e. Recognizing underlying assumptions

f. Detecting bias, stereotypes, cliches
g. Recognizing loaded language
h. Evaluating hypotheses
i. Classifying data
j. Predicting consequences
k. Demonstrating sequential synthesis of information
l. Planning alternative strategies
m. Recognizing inconsistencies in information
n. Identifying stated and unstated reasons
o. Comparing similarities and differences
p. Evaluation arguments

VI. Philosophy and Reasoning
a. Using dialogical/dialectical approaches

This matrix is based upon a compilation and distillation of ideas from Bloom, Bransford, Bruner, Carpenter, Dewey, Ennis, Feuerstein, Jones, Kurfman & Solomon, Lipman, Orlandi, Parnes, Paul, Perkins, Renzulli, Sternberg, Suchman, Taba, Torrance, Upton, the Ross Test, the Whimbey Analytical Skills Test, the Cornell Critical Thinking Test, the Cognitive Abilities Test, the Watson-Glaser Critical Thinking Appraisal, the New Jersey Test of Reasoning Skills, and the SEA test.

Appendix 2

Decision Making Unit - Implementation Plan

Week One	Administer Purdue Problem Solving Inventory	1 hour
	Categorization of alternatives activity- "Plant or Animal"?	30 minutes
	Generation of alternatives for project (large group) PROJECT TOPIC-Animals Indigenous to the Local Community	30 minutes
	Selection of 5 alternatives (paired comparisons-individual activity)	30 minutes
	Discussion and fluency exercise on "How We Use Decision Making Every Day" (large group)	20 minutes
Week Two	Generate criteria for animal project (large group)	30-40 minutes
	Complete first decision making activity by: 1)rating each alternative using criteria 2)deciding on one animal for individual project	
	Administer Coloured Progressive Matrices (group test)	30 minutes
Week Three	Complete a mind map on what facts you want to find out about animal (group fluency activity)	30 minutes
	Do mind map activity on individual topic	30 minutes
	Administer Coloured Progressive Matrices to any students previously absent (group test)	30 minutes
Week Four	Administer Embedded Figures Test & Matching Familiar Figures Test	40 minutes/student
	Instruction in & completion of data sheets for individual projects. Completion involves selection of appropriate facts to the topic.	2 x 40 minutes
	Fluency on "Why Other People Use Decision Making" (large group).	30 minutes
Week Five	Completion of Embedded Figures & Familiar Figures Tests. Opportunity (in group) to use	

	decision making from weeks 1 & 2 i.e. generating and choosing alternatives, generating criteria, rating and choosing	2 x 40 minutes
Week Six	Fluency exercises of Possible Hallowe'en costumes	20 minutes
	Individual opportunity to complete decision making process. TOPIC: What to be at Hallowe'en. (Involves review of steps, individuals to complete in 2 sessions).	2 x 30 minutes
Week Seven	Individual opportunity to use decision making process. TOPIC: Friends.	2 x 30 minutes
	Administer Problem Solving Inventory (post test).	1 hour

Appendix 3

Sample Letter - Permission from Parents

Gorham and Ware Community School,
R.R. #14,
Thunder Bay, Ontario,
P7B 5E5

September 8, 1989

Dear Parents,

As part of the requirements for my Masters Degree in Education, it is necessary that I collect some data from the Grade 3 students. The collection of this data will be done in accordance with the Lakehead Board of Education's guidelines. All assesments will be kept anonymous and will not be shared.

If you desire further information about this process, please call the school (767-4241).

Please fill in and return the attached form to the school by Monday, September 11, 1989.

Your co-operation is appreciated.

Yours truly,

Mrs. C. Grieve

Mr.R. Sanderson
Principal

RS:CG:rg

- -

I (will allow) (will not allow) my child, _____
CIRCLE ONE CHILD'S NAME
to take part in the research project in the Grade 3 class during September and October.

_____
PARENT'S SIGNATURE

Appendix 4

Letter - Lakehead Board of Education Approval

THE LAKEHEAD BOARD OF EDUCATION

2135 SILLS STREET
Thunder Bay, Ontario P7E 5T2
Telephone (807) 625-5100

SCHOOLS FOR THE FUTURE

JIM McCUAIG, Director of Education

1989 05 04

Mrs. Carol Grieve
R.R. #1
KAMINISTIQUIA, Ontario
P0T 1X0

Dear Carol:

I am pleased to advise you that your research project entitled The Relationship of Cognitive Style and Decision-Making has been approved.

A copy of your application and relevant information have been forwarded to the principals at the following schools:

Gorham and Ware School

Please contact them directly. Final approval for this research rests with each individual principal. Their decision will be based on factors such as the number of projects in which their school is asked to participate; their opinion of the relevance of the research; and the staff's time considerations.

Best wishes for success with your project. This office would appreciate receiving a copy of your report upon completion.

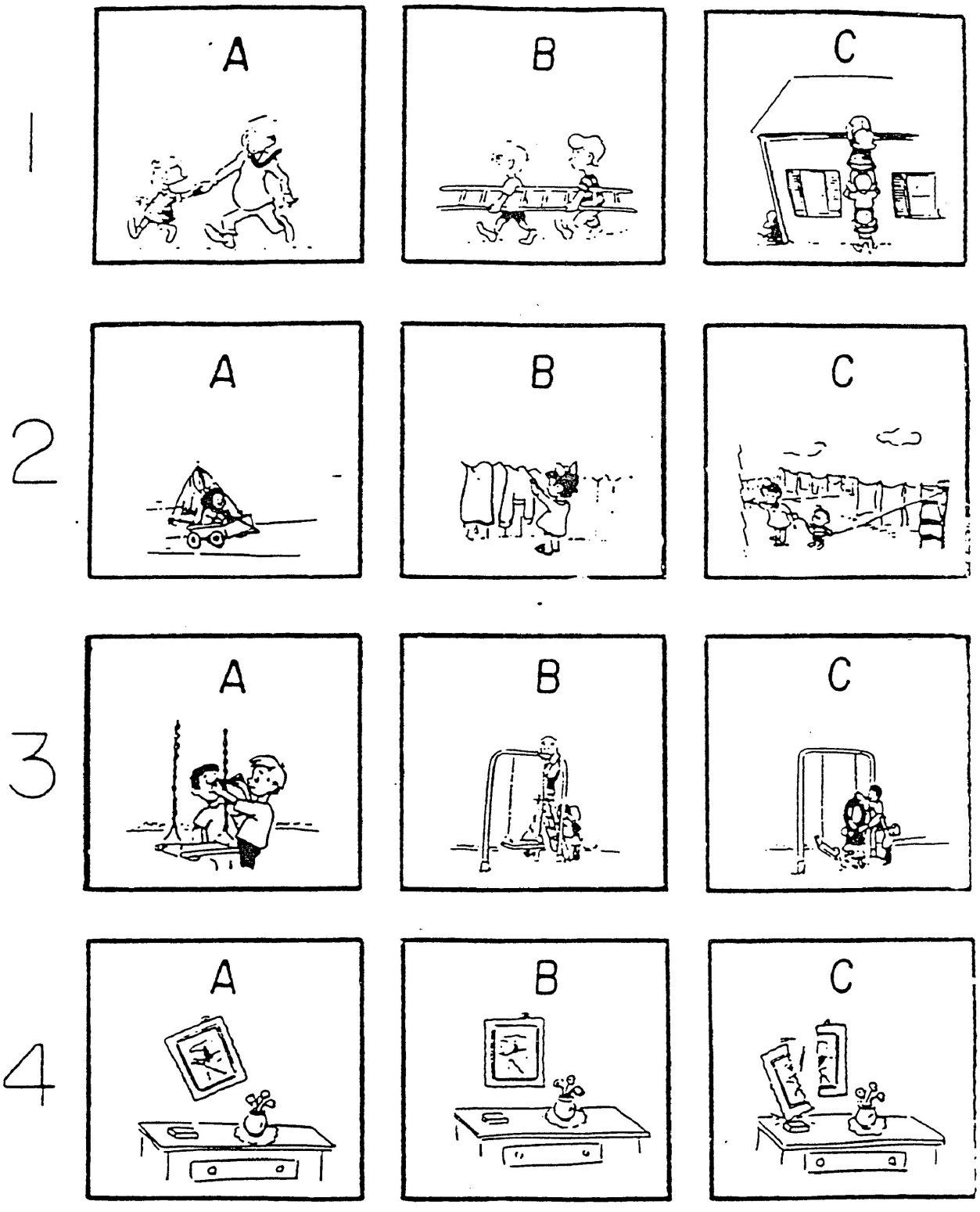
Sincerely,

Curt McMahon
Superintendent of Special Services

CM:ij
sp/4/1/research
ij4/1/cg

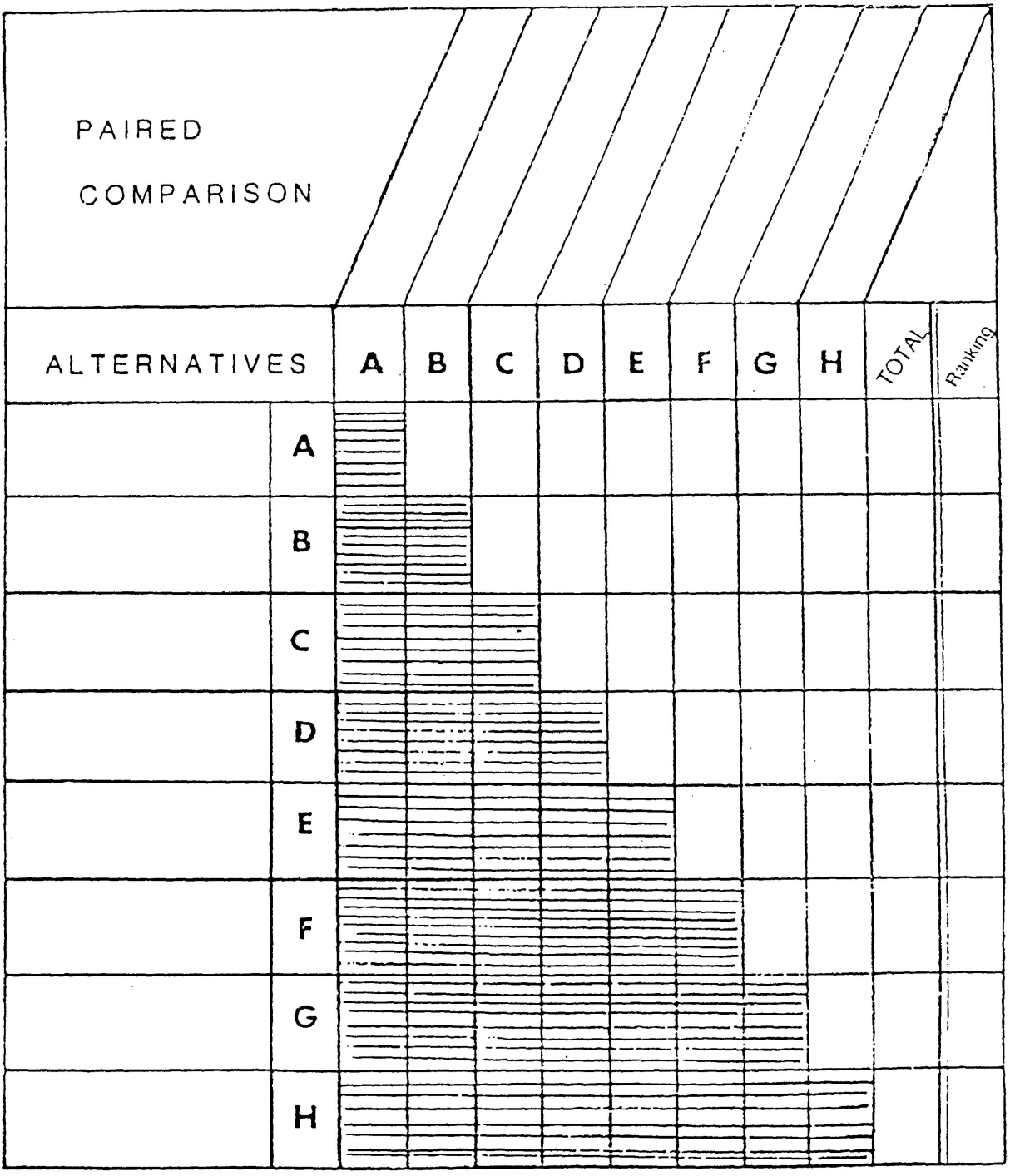
Appendix 5

Problem Solving Test - Sample Page



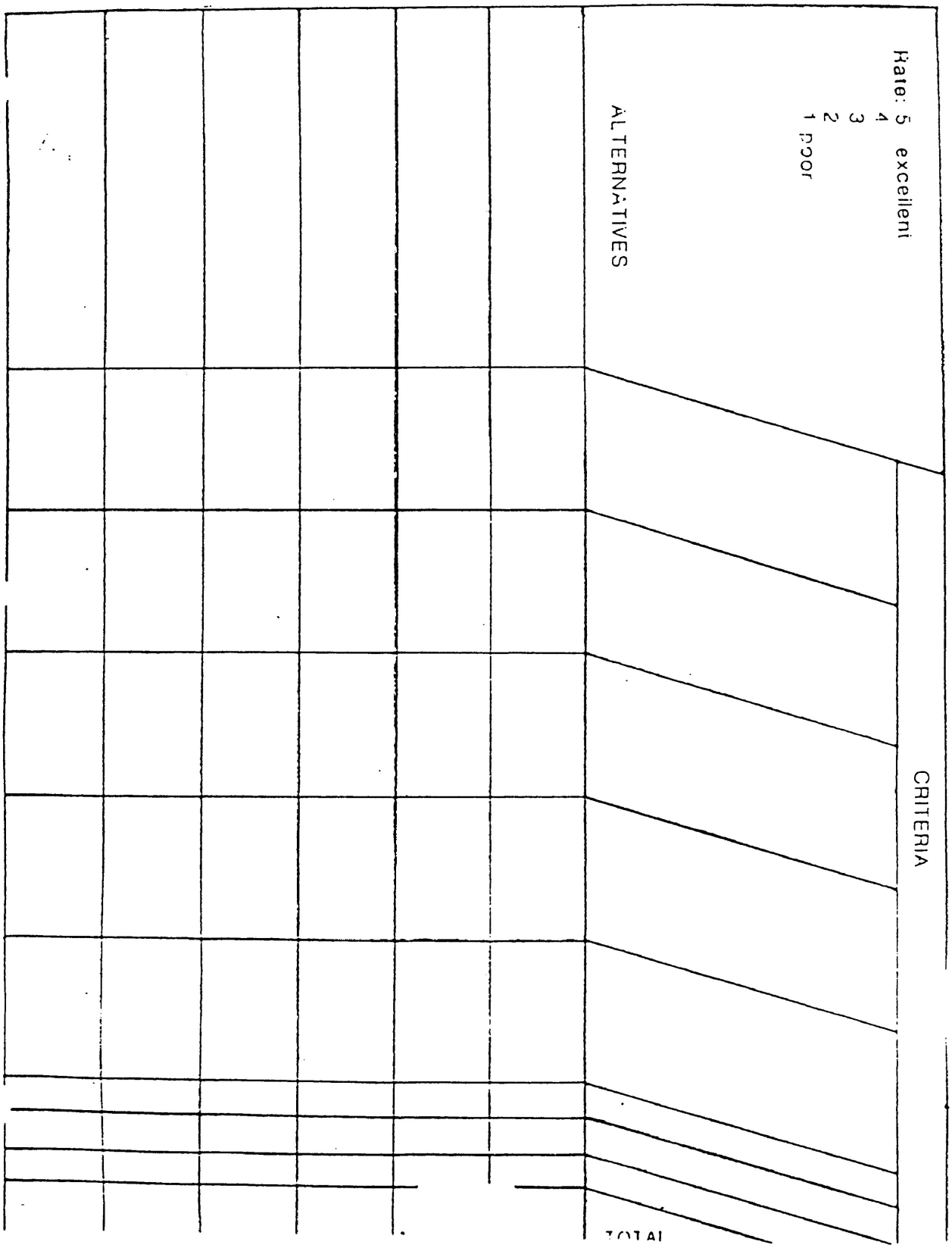
Appendix 6

Paired Comparison Chart



Appendix 7

Decision Making Chart - Sample



Appendix 8

Decision Making Chart - Completed Sample