THE UNIVERSITY OF ALBERTA

THINKING STYLES AND SELECTED ASPECTS OF INQUIRY

IN SIXTH-GRADE SOCIAL STUDIES

by

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ABSTRACT

The study investigated the ability of sixth grade elementary

students, grouped according to convergent and divergent thinking

abilities, to generate questions, facts and statements of evidence in

a social studies setting. A conventional intelligence quotient test,

the Canadian Lorge Thorndike Test, Form I, Level C was used as a

measure of convergent thinking. A word association test and an unusual

uses test were employed as measures of divergent thinking. The

following four groups were formed: high convergent-high divergent,

high convergent-low divergent, low convergent-high divergent and low

convergent-low divergent.

A sample of one hundred and five students from two elementary

schools which served areas of middle socio-economic status in Edmonton

participated in the study. They were given a pretest, instruction and

a posttest. These instruments were based on historical photographs

and provided opportunities for the students to generate questions,

facts and statements of evidence. A control group was established

which took the pretest and the posttest, but which was excluded from

the instruction.

Null hypotheses were formulated concerning significant

differences among the four groups in their ability with the three

inquiry skills; the response of the groups to instruction in the

skills; and the ability of the sexes with the skills. The responses

of the students were examined to determine if any specific difficulties with the skills emerged.

The following results were obtained:

1) There was a significant difference between the low convergent-low divergent group and the other three groups in their ability to generate questions, facts and statements of evidence.

2) The low convergent-low divergent group appeared to respond less readily to instruction than the other three groups.

3) No significant differences emerged between the sexes in their ability to generate questions, facts and statements of evidence.

4) All groups had the potential to develop the skills. However, these difficulties appeared:

a) There was a tendency to ask questions which could not be answered from the photographs.

b) Assessment of the factual content of the photographs was often inaccurate.

c) Statements of evidence were not always completely valid.

The main conclusions drawn were:

1) The teaching of inquiry and decision making at the elementary level might focus more directly on skills rather than on full processes.

2) There may be at least two broad levels of ability with the skills amongst students.

3) Some students of apparently low intelligence were able to handle the skills equally as well as students of relatively higher intelligence.

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CHAPTER 1

INTRODUCTION

The knowledge explosion which has occurred during recent decades

has revealed the impossibility of students being able to master the

great amount of factual, conceptual and methodological material in any

subject area. In addition to the actual bulk of knowledge now available,

teachers and students are faced with the problem of continual change in

the nature of that knowledge. Concepts and facts can become outmoded

or modified as new knowledge comes to light. Sometimes facts and

concepts are proved false and have to be discarded. For example, we

know now, contrary to prior beliefs, that the atom can be split and

human hearts transplanted.

Science comes readily to mind as one subject area in which the

sheer bulk of available content material has reached immense

proportions. However, the same problem applies to social studies,

which subsumes the social science disciplines of history, geography,

economics, sociology, anthropology, political science and psychology.

Attempts to teach and learn merely a body of factual knowledge in any

or all of these disciplines, under the guise of engaging in social

studies, have resulted invariably in the poor quality of education

associated with rote learning of material which often becomes outdated.

Social studies educators, along with educators in general, have become

interested in devising means through which students might cope with ever

increasing and changing bodies of knowledge.

BACKGROUND OF THE STUDY

Inquiry

In social studies, one approach to the problem has emphasized
inquiry. The basic element in this approach has been to teach students
how to inquire. Informational detail is used as a vehicle for the
development of inquiry skills. Concepts and principles are stressed
rather than factual material. In essence, the student learns how to
learn. He selects information in terms of what is currently useful
to him.

However, it should be noted that social studies educators were
interested in an inquiry-type approach to learning and teaching long
before the relatively recent emphasis on inquiry gathered momentum
during the 1960's. Problem solving and critical thinking, as well as
inquiry, have been part of social studies and general education theory
for most of the twentieth century. In the earlier period, before the
knowledge explosion was accepted as a vital problem, theorists aimed
to use the problem solving-critical thinking-inquiry approach to
produce critically minded and inquiring citizens, as Cox (1969),
noted. The use of this approach was also an attempt to develop in
young people the ability to find their own explanations, and make their
own judgements, about their political, social and economic
environments (Massialis, 1969). These aims are still firmly embedded
in the philosophy of social studies.

Russell (1956) defined problem solving as the process by which the child goes from the task or problem as he sees it, to a solution which, for him, meets the demands of the problem. Cox (1969) noted that problem solving comprised the "central dogma of inquiry" in social studies, and that students should generate their own problems. Both Russell (1956) and Cox (1969) see Dewey's (1910) work as seminal in problem solving and inquiry theory.

Dewey (1910) developed a problem solving model made up of the following five phases:

1) Recognition of a problem.

2) Analysis.

3) Suggestions of possible solutions.

4) Testing of consequences.

5) Judgement of a selected solution.

Subsequent research produced many such models, the more recent of which have become known as models of inquiry. Some of them were designed by social studies educators for use by social studies teachers. An example of a social studies inquiry model is provided by Massialis and Cox (1966). It contained these steps:

1) Orientation.

2) Hypotheses.

3) Definition of terms.

4) Exploration of hypotheses.

5) Evidencing.

6) Generalization.

Cox (1969) summed up the usual ingredients of the inquiry process as
they appeared in the various models. He noted statement of hypotheses,
derivation of implications, seeking evidence, drawing conclusions,
making generalizations, noting assumptions, differentiating between
fact and value, and drawing analogies.

Critical thinking was viewed by Russell (1956) as an all-
embracing term, covering a cluster of related abilities which were
essential to problem solving at the stage when hypotheses were being
examined. He defined it as a process of examining both concrete and
verbal materials in the light of related objective evidence, comparing
the object or statement with some norm or standard and concluding
or acting upon the judgement then made. Critical thinking, it would
appear, is best conceived of as a skill that might be developed through
the use of inquiry models.

An examination of a number of inquiry models indicated that
certain skills seemed to be basic in problem solving, critical
thinking and inquiry in social studies. Three of these skills are
fact-finding, giving statements of evidence and generating questions
or problems. This study investigated elementary students' abilities
with these skills.

Styles of Thinking

The related topics of thought processes, the intellect and
intelligence have always been of prime interest to educators and
psychologists. Though the intellect has always been regarded as a

complex phenomenon, testing for intelligence by means of intelligence quotient tests has been based on the theory of the g factor developed by Spearman and modified, though not invalidated, by Thurstone (Cattell, 1968). The g factor was regarded as a unitary, objectively defined general intelligence factor closely involved with thought processes essential to reasoning and judgement abilities.

Guilford's (1956) research indicated that the intellect was made up of many factors represented by specific abilities. He noted the existence of convergent and divergent thinking abilities, among others, in his model of the structure of the intellect. Generally, convergent thinking has been regarded as a process in which information is used to arrive at an unequivocally correct answer. Divergent thinking is viewed as a process whereby the individual uses information to seek variety and search beyond the obvious. Guilford (1956) regarded them as fundamental and independent aspects of intellect.

The discovery of the two types of thinking caused the adequacy of intelligence quotient tests as measures of intelligence to be questioned. Getzels and Jackson (1962), for example, associated divergent thinking with creativity, and claimed that the traditional intelligence quotient measures tested mainly convergent thinking and ignored divergent thinking and creativity. Tests of divergent thinking ability, known also as tests of creativity, were developed by researchers such as Torrance (1963).

Guilford's (1956) view has been modified by subsequent research. Convergent and divergent thinking are now regarded as styles of thought rather than fundamental aspects of intellect. It is now held that they are not entirely independent of each other. Nevertheless, they are viewed as distinguishable abilities (Cropley, 1969).

Styles of thinking appear to have pertinence to inquiry. Could either of these styles of thought be better suited to inquiry generally, or to the basic inquiry skills of fact-finding, giving statements of evidence and generation of questions or problems in particular? This study investigated the abilities of elementary students designated as convergent and divergent thinkers to handle these aspects of inquiry.

Transfer

If the skills of fact-finding, giving statements of evidence and generation of questions and problems are basic to the inquiry process in social studies, can they be taught? Sawrey and Telford (1968) raised this question within the framework of discussion on transfer of abilities developed in one learning situation to other learning situations. Bruner (1960) held that not only was transfer possible but also that a child could learn anything at almost any stage of his development. The study investigated whether elementary students would respond to instruction in these three inquiry skills. The study did not attempt to investigate transfer as such. However, because of the use by students of skills on one set of materials, and then the use of

the same skills on a similar, yet fresh, set, the study fell within

the framework of transfer theory.

THE PROBLEM

There were four main aspects of the problem.

1) An investigation of the ability of elementary students
designated as convergent and divergent thinkers to handle fact-finding,
give statements of evidence and generate questions or problems.

2) An investigation of the ability of elementary students
designated as convergent and divergent thinkers to respond to
instruction in the skills of fact-finding, giving statements of
evidence and the generation of questions or problems.

3) An investigation of the ability of the sexes to find facts,
give statements of evidence and generate questions or problems.

4) An examination of student responses for any difficulties
which appeared consistently.

Establishment of Groups

An immediate sub-problem concerned the establishment of the
groups of convergent and divergent thinkers. Convergent thinking
ability was established by means of the Canadian Lorge-Thorndike
Intelligence Test, Form I, Level C. Divergent thinking ability was
assessed through the administration of two divergent thinking tests:
a word association test (Getzels and Jackson, 1962) scored for fluency,

and an unusual uses test (Getzels and Jackson, 1962) scored for
originality.

A further problem emerged because of the overlap which has been
established between convergent and divergent thinking abilities.
Individuals display ability in both styles of thinking. To meet this
problem, it was decided to establish four groups on the basis of
scores in the measures of convergent and divergent thinking employed
in the investigation. Students who scored above the median on the
convergent and divergent measures were classified as high scorers.
Students who scored below the median on these measures were classified
as low scorers. This procedure produced groups designated as high
convergent-high divergent, high convergent-low divergent, low
convergent-high divergent and low convergent-low divergent.

Testing

The testing of the ability of these groups to handle fact-
finding, statements of evidence and generation of questions or
problems provided a further sub-problem. It was decided to provide the
groups with a test based on historical photographs of pioneer times
in Alberta. For the purposes of the study this test was called the
Historical Photographs Test. Photographs were chosen because it was
felt that reading difficulties could be lessened in this way. The
historical context was decided upon because history is an important
aspect of social studies. It was hoped that the photographs would
stimulate interest sufficient to encourage the students to perform

conscientiously. The students were asked to study the photographs and then write down questions or problems about pioneer times which the photographs might help to answer; facts about pioneer times; and statements about pioneer times supported by evidence from the photographs. The Historical Photographs Test included a pretest and a posttest.

Instruction

The problem of assessing the response of the groups to instruction in the skills was met by the development of an instruction booklet based, like the pretest and the posttest, on historical photographs of pioneer times in Alberta. The booklet was designed so that the instruction would be largely self-administered by the students. It provided them with practice in the skills being investigated. The material in it was covered by the students during three lessons. The investigator supervised each lesson. This approach was used to lessen the influence of various teaching styles. The investigator adopted the same technique with each group: a brief explanation at the beginning of each lesson, followed by student activity with the booklet during which the investigator clarified points for individual students as the need arose.

THE EXPERIMENTAL SETTING

The basic design of the study was the Pretest Posttest Control Group design noted by Campbell and Stanley (1963:183-194).

In this study, the independent variables were the four groups established on the basis of convergent and divergent thinking abilities. The dependent variables were the three skills being investigated.

A control group containing members of each of the groups being investigated was formed. This was done in an attempt to assess whether the instruction had had any effect. Both control and experimental groups were given the pretest and the posttest. The control group was excluded from the instruction.

A pilot study to determine the reliability, face validity and suitability of the divergent thinking tests, pretest, posttest and instruction booklet was conducted during April, 1972, at a school other than those being used in the study proper. The study itself was carried out during May, 1972.

Hypotheses Which the Study Sought to Investigate

1) There will be no significant mean differences among students designated as a) high convergent-high divergent b) high convergent-low divergent c) low convergent-high divergent d) low convergent-low divergent in their ability to generate questions as measured by the Historical Photographs Test.

2) There will be no significant mean differences among students designated as a) high convergent-high divergent b) high convergent-low diveregent c) low convergent-high divergent and d) low convergent-low divergent in their ability to generate facts as measured by the Historical Photographs Test.

3) There will be no significant mean differences among students designated as a) high convergent-high divergent b) high convergent-low divergent c) low convergent-high divergent and d) low convergent-low divergent in their ability to generate statements of evidence as measured by the Historical Photographs Test.

4) There will be no significant mean differences in improvement by students designated as a) high convergent-high divergent b) high convergent-low divergent c) low convergent-high divergent and d) low convergent-low divergent in their ability to generate questions as measured by the Historical Photographs Test, after instruction in this aspect of inquiry.

5) There will be no significant mean differences in improvement by students designated as a) high convergent-high divergent b) high convergent-low divergent c) low convergent-high divergent and d) low convergent-low divergent in their ability to generate facts as measured by the Historical Photographs Test, after instruction in this aspect of inquiry.

6) There will be no significant mean differences in improvement by students designated as a) high convergent-high divergent b) high convergent-low divergent c) low convergent-high divergent and d) low convergent-low divergent in their ability to generate statements of evidence as measured by the Historical Photographs Test, after instruction in this aspect of inquiry.

7) There will be no significant mean differences between boys

and girls designated as high convergent-high divergent in their ability to generate a) questions b) facts and c) statements of evidence as measured by the Historical Photographs Test.

8) There will be no significant mean differences between boys and girls designated as high convergent-low divergent in their ability to generate a) questions b) facts and c) statements of evidence as measured by the Historical Photographs Test.

9) There will be no significant mean differences between boys and girls designated as low convergent-high divergent in their ability to generate a) questions b) facts and c) statements of evidence as measured by the Historical Photographs Test.

10) There will be no significant mean differences between boys and girls designated as low convergent-low divergent in their ability to generate a) questions b) facts and c) statements of evidence as measured by the Historical Photographs Test.

A Question Which the Study Sought to Examine

Do sixth grade students exhibit any specific difficulties in generating questions, facts and statements of evidence?

BASIC ASSUMPTIONS

It is assumed that the instruments chosen and developed were suitable for the tasks involved.

The decision to use a conventional intelligence quotient test

as a measure of convergent thinking was based upon the work of researchers such as Cropley (1965, 1966, 1968), Getzels and Jackson (1962) and Dowd (1966).

The use of the divergent thinking tests, and the methods of scoring them, rested on their use by such prominent researchers as Guilford (1959), Torrance (1963), Klausmeier and Wiersma (1964), Feldhusen and Denny (1965) and Wober (1970). In general, the validity and reliability of tests of divergent thinking have not been fully established, but progress has been made (Cropley, 1972; Debney, 1969). The instruments appeared to be among the most reliable available, in the context of on-going research in the area, at the time the study was conducted. The tests used in the study were piloted and reliability in a test-retest situation was obtained.

It was further assumed that the tests used to determine students' ability to generate questions or problems, facts and statements of evidence were valid measures. Empirical evidence of validity cannot be provided. What appeared to be satisfactory face validity of the three investigator-designed instruments was established by piloting them with four randomly selected sixth grade students, and by subjecting them to examination by four experienced teachers of sixth grade social studies.

SIGNIFICANCE OF THE STUDY

The continuing emphasis on inquiry as something to be taught in schools suggests that as many aspects of it as possible should be

examined, especially in connection with elementary school children.
The teacher of social studies at the elementary level is faced with
the problem of knowing to what extent students are capable of performing
the various operations demanded in an inquiry process. This study
involved an attempt to isolate two styles of thinking in elementary
students, and to assess the performance of those types of thinkers on
certain aspects of inquiry. Knowledge of relationships, should they
exist, between the styles of thought and performance on these aspects
of inquiry would throw some light on this basic problem.

Extremely simple aspects of inquiry, which seem to form at
least part of an essential base for the more complex stages of the
process, were chosen for investigation. This has significance for
teaching in that the results of the study have implications for the
ability of sixth grade pupils to handle full inquiry models.

The use of instruction in the study also has implications of
use to teachers. The responses of the groups to the instruction
provided an indication of the usefulness, or otherwise, of that type
of instruction for the types of thinkers involved. Such knowledge is
of assistance in planning teaching strategies.

Comparisons of the abilities of the sexes with basic inquiry
operations was included in the study. Research into creativity has
produced somewhat indecisive findings as to whether or not one sex tends
to be more creative than the other. The present study attempted to
compare the performances of boys and girls who displayed similar styles

of thought.

Some research has been conducted into convergent and divergent thinking in connection with social studies. Crabtree (1967), for example, compared the effects of teacher dominated instructional strategies and strategies involving teacher-pupil cooperation on the abilities of students to produce convergent and divergent thinking responses. However, there is a need for more research into the performance of convergent and divergent thinkers in a social studies context. Strategies based on inquiry are an integral part of social studies teaching theory. Hopefully, the study provides some useful information on the relationships between inquiry and the two modes of thought in a social studies setting.

DEFINITION OF TERMS

Operational Definitions

Question (or Problem): Any question or problem which the students could discern from the photographs presented in the pretest, instruction booklet or posttest.

Fact: Any statement which appeared to be true from a study of the photographs in the pretest, instruction booklet or posttest.

Statement of Evidence: Any statement supported by a reason which could be drawn from the photographs presented in the pretest, instruction booklet or posttest.

<u>High Convergent-High Divergent</u>: Students who scored above the median in the measures of convergent thinking and divergent thinking used in this study.

<u>High Convergent-Low Divergent</u>: Students who scored above the median in the measure of convergent thinking and below the median in the measures of divergent thinking used in this study.

<u>Low Convergent-High Divergent</u>: Students who scored below the median in the measure of convergent thinking, and above the median in the measures of divergent thinking used in this study.

<u>Low Convergent-Low Divergent</u>: Students who scored below the median in the measures of convergent thinking and divergent thinking used in this study.

Functional Definitions

<u>Convergent Thinking</u>: The thought process whereby the thinker uses information to reach a uniquely correct, or recognized best, answer.

<u>Divergent Thinking</u>: The process whereby the thinker uses information to arrive at a variety of different, unanticipated conclusions.

<u>Inquiry</u> (in an educational context): The process of discovering, articulating and testing ideas and judgements about man and his environment (Massialis, 1969-70).

<u>Inquiry Model</u>: Any scheme of suggested, interrelated phases or steps involved in the process of inquiry or problem solving.

LIMITATIONS

Any interpretations of the findings of this study should be made after consideration of the following limitations.

Conceptual Limitations

Although research has indicated that convergent and divergent thinking are distinguishable styles of thought, the fact remains that they overlap to some degree. They are not mutually exclusive styles. Furthermore, research has not yet explored fully each type of thinking. It cannot be claimed that convergent and divergent thinking are unitary, if overlapping, phenomena. Research may yet reveal that they are clusters of abilities, for example.

The concept that fact finding, giving statements of evidence and generating questions or problems are basic elements of inquiry rests largely on apparent logic. There remains the possibility that inquiry or problem solving can take place intuitively, without using these skills or proceeding through the phases of an inquiry model. Knowledge of human thought processes is in a continual state of flux generally, as is the knowledge of these processes in an inquiry context. Russell (1956) pointed out that inquiry models are really idealistic descriptions of what might take place during inquiry or problem solving, and that they are based on what disciplined adults might do. The thinking of an immature child could well be something very different.

Methodological Limitations

The sample was limited to sixth grade children at two schools
in a middle income area within the Edmonton Public School system. Only
very cautious generalization is possible in such a situation.

A further limitation concerns the scoring of the unusual
uses tests employed in the study. Although criteria such as
appropriateness and unusualness were applied, the scoring inevitably
was affected by the subjectivity of the scorer, who was, in this study,
the investigator. Furthermore, norms are not available for this type
of testing. The divergent thinking ratings for the study were,
therefore, applicable only to the group tested. Those students who
were rated as highly divergent thinkers were high only in relation to
the group involved in the study.

The subjectivity of the investigator as scorer must be
considered as a limitation in the cases of the pretest and the post-
test as well as the divergent thinking tests.

All techniques for analyzing the data were not decided upon
prior to the study. It was felt that the study might provide worth-
while data over and above that concerned with the main questions.
Hence the study was not designed with specific data analysis techniques
in mind, and may have lost something in experimental rigour because of
this.

No attempt was made to account for the effects of past

experience or instruction in generation of problems or questions,
facts and statements of evidence.

OUTLINE OF THE REPORT

The present chapter states the problem and provides an overview
of the study. In Chapter 2, research related to the problem and
the study will be reviewed. Chapter 3 will be devoted to a detailed
description of the conduct of the study. Chapter 4 will outline the
procedures used to analyze the data and report the results of the
analysis of data and other observations made during the study.
Chapter 5 will summarize the study and discuss conclusions,
implications and suggestions for further research.

CHAPTER 2

SURVEY OF LITERATURE

INTRODUCTION

Research for this study has had to take account of theories

which have been developed in connection with inquiry, convergent

thinking and divergent thinking. Therefore, the review in this

chapter has been divided into two main sections. The first section

will be devoted to inquiry. Since convergent and divergent thinking

cannot be discussed adequately without reference to creativity, these

three topics will be reviewed in the second section.

INQUIRY

Reasons for Teaching Inquiry or Problem Solving Methods

Fenton (1967:6-27) noted the knowledge explosion and continual

change in the nature of knowledge as reasons for teaching inquiry

in the schools. Massialis (1969) and Cox (1969) stressed the

importance of teaching inquiry as a means of producing people able to

make informed judgements about social institutions, and citizens

capable of thinking critically and inquiringly. These opinions are

supported throughout the literature on inquiry.

Fenton (1967:6-27) in amplification of his argument for

teaching inquiry, pointed out that the prospect of greater leisure

time in society rendered imperative the teaching of inquiry as a means

of ensuring useful and productive employment of that time. He

strengthened his argument by noting that the changing nature of
knowledge often caused information to become obsolete within a few
years. Banks and Hogan (1968) claimed that the teaching of inquiry
in history would prevent students from becoming disillusioned when
interpretations changed.

The problem of coping with change, not only in knowledge,
but also in society generally, has long been recognized. Kilpatrick
(1926) advocated the teaching of problem solving as a means of meeting
the challenge of an ever-changing society. Miklos and Miklos (1971)
stressed the need to teach inquiry skills in order to give students a
means of coping with societal change.

Support for the teaching of inquiry methods, from another
point of view, was noted by Hullfish and Smith (1961). They claimed
that the teaching of modes of inquiry to young people was essential
as a basis of continued learning during adult life. This type of
argument can be traced back to the ideas of theorists such as Gray
(1935), who advocated the teaching of problem solving as a means of
producing democratically minded citizens. In more recent times,
Leef (1968) viewed the ability to inquire as an essential element in
the development of critical thinking skills necessary to analyze the
media.

Inquiry has been seen as the means by which social studies can
be organized into a manageable subject area. Broudy (1962), in
discussion of the problem of curriculum in connection with social

studies, noted:

> But we are faced with the impossible task of
> studying all the numerous disciplines which can
> be included properly under the social studies. . . .
> it is difficult to make any selection that is
> big enough to be useful, yet small enough to
> be manageable. . . . there is a welter of
> conflicting theories that excite the scholar
> but only confuse the beginner. (p. 324)

Broudy suggested that an inquiry-based course was one way of meeting the difficulty. Engle (1963) advocated using inquiry as the structure of social studies in the absence of any recognized interdisciplinary framework.

Examination of the structures of the disciplines during the recent decade has added to the interest of educators in methods of inquiry. Bruner (1960) saw merit in disciplinary processes, which he defined as modes of inquiry, being used as part of the bases for curriculums in school subjects. He maintained that the methods of inquiry used in schools by students should be the same as those used by scholars. Foshay (1962), and King and Brownell (1966) held similar views. A very detailed argument for the general application of inquiry as a basis for curriculum planning was put forward by Parker and Rubin (1966). They proposed teaching a general inquiry method which would be applicable in as many subject areas as possible.

Ausubel (1967) claimed that modern interest in inquiry began in the Progressive Education movement. This movement, according to Ausubel, was a reaction against the "empty formalism" of much

educational practice. Although Ausubel claimed that the reaction led to an overexaggeration of the value of pupil activity, such as that involved in unstructured and undirected inquiry, he also noted that experience in handling inquiry was essential for grasping scientific method and problem solving, and was useful with elementary students as a preliminary to more abstract work.

Problem Solving, Inquiry and Reflective Thinking

Problem solving is equated with inquiry by modern theorists. Miklos and Miklos (1971) noted that problem solving, inquiry and also discovery are used as synonymous terms. Beyer (1971) argued that inquiry revolved around defining a problem. Chapin and Gross (1972) defined inquiry as a term inclusive of discovery learning, induction and problem solving. They claimed, however, that inquiry differs from problem solving in that inquiry emphasizes hypotheses and generalizations.

Kaltsounis (1970) equated the inquiry method with the problem solving approach. The first phase of Goldmark's (1968) method of inquiry was the delineation of a problem to be solved. Inquiry and problems are inseparable, according to Cox (1969).

Massialis and Cox (1966) used the term reflective thinking in connection with inquiry, and Chapin and Gross (1972) noted that the terms inquiry and reflective thinking were interchangeable.

Problem Solving and Inquiry Models

Theorists have concluded that the ability to inquire, or to engage in the thinking processes necessary for effective inquiry, must be developed in students through constant practice. Massialis and Smith (1965) claimed that ability in reflective thinking can, and should, be established and developed by use of models with distinct phases or steps. Branson (1971) noted that undisciplined thought would not produce sound problem solving or inquiry abilities. Fenton (1966:188-189) maintained that steps in the historical mode of inquiry should be taught, and that each skill associated with the model should be practised explicitly over and over again.

Constant practice in the use of inquiry models was advocated by McFarren (1969). He realized that learning by inquiry is a lengthy and difficult process. Problems with the implementation of inquiry strategies in the schools have arisen because the phases of inquiry models and attendant skills have not been practised thoroughly (Cox, 1969). Russell (1956), while discussing critical thinking, an omnibus term which he used as being inclusive of problem solving and inquiry, argued that practice in models of inquiry should be given early in children's educational experience.

The need for practice was implicit in the theory behind early problem solving models such as that of Dewey (1910). It continues to be a factor in the more modern models. A model with clearcut phases can be mastered with constant practice. Problem

solving models provided a framework within which the development of thinking skills could take place as the phases were mastered through practice. The earlier outlines were usually referred to as problem solving models. More recently, similar frameworks have been labelled inquiry models. They are applicable to most subject areas and some have been adapted for use in social studies.

Some Problem Solving Models

A survey of earlier models indicated something of the range of variations in their frameworks and also the similarities among them. Gray (1935) suggested a five-phase model:

1) Sensitivity to problems.

2) Knowledge of problem conditions.

3) Suggested solutions or hypotheses.

4) Subjective evaluation.

5) Conclusion or generalization.

Johnson (1944) provided a more condensed version than Gray:

1) Orienting to the problem.

2) Producing relevant material.

3) Judging the solution.

Polya (1945), working in a mathematics setting, proposed the following problem solving phases:

1) Understanding the problem.

2) Making a plan.

3) Carrying out the plan.

4) Looking back on the completed solution.

Rather more sophisticated models were produced by Humphrey (1948), Burack (1950) and Vinacke (1952). Humphrey and Burack introduced more precision and detail than had appeared in earlier models. Their outlines were longer. Humphrey included six phases in his problem solving process:

1) A problem situation.

2) Motivating factors.

3) Trial and error.

4) Use of association and images.

5) A flash of insight.

6) Some application in action.

Burack's (1950) model was even more detailed than that of Humphrey (1948). Burack outlined eight phases:

1) Clear formulation of the problem.

2) Preliminary survey of the material.

3) Analysis into major variables.

4) Location of critical features.

5) Application of past experience.

6) Varied trials.

7) Elimination of sources of error.

8) Visualization.

Although Vinacke (1952) compressed the process into five steps, his terminology incorporated the ideas in the longer models. Vinacke's outline was as follows:

1) Recognition of the problem.

2) Manipulation and exploration of some kind.

3) Analysis.

4) Partial solving.

5) Emotional responses.

Farley and Overton (1951) developed a very detailed model for problem solving by groups of students:

NAMING THE PROBLEM

Assumptions about it.   Own experiences with it.

DISCUSSING THE PROBLEM

Outstanding attitudes   Facts concerning it.

about it.

Ways of Uncovering Attitudes   Ways of Discovering Facts

1. Reading.   1. Reading.

2. Seeing motion pictures.   2. Seeing motion pictures.

3. Understanding oneself.   3. Field trips.

4. Understanding others.   4. Inviting speakers to

                                            the classroom.

                                         5. Interviewing.

PROPOSING SOLUTIONS

TO THE PROBLEM

ACTING IN TERMS

OF THE

SOLUTIONS (pp. 403-409)

All the models stress the need to start with a problem, to gather and process relevant data, and to proceed to a solution. Although formulation and testing of hypotheses is not mentioned explicitly in many of them, these processes appear to be implicit in phases such as "trial and error" (Humphrey, 1948), "varied trials" (Burack, 1950) and "partial solving" (Vinacke, 1952).

Some Inquiry Models

The more recent models, known as inquiry models, have the same basic framework as the earlier problem solving models. The models discussed in the following section of the review have been proposed for use in social studies.

Miklos and Miklos (1971) gave a basic outline for an inquiry model:

1) Definition of a problem.

2) Hypothesizing.

3) Drawing logical inferences.

4) Gathering relevant data.

5) Generalizing.

Beyer (1971) suggested the following sequence:

1) Definition of a problem.

2) Hypothesizing answers to this problem.

3) Testing the hypotheses against evidence.

4) Drawing conclusions.

Taba's (1967) three-phase model incorporated implicitly all the usual

steps in inquiry models:

1) Concept formation, or the organization of an aggregate of information into a system of classes and groups.

2) Interpreting data, inferring and generalizing.

3) Application of principles.

Twelve aspects of critical thinking were delineated by Ennis (1962). Though these aspects do not form an inquiry model, a sampling of them indicates that they include much that pertains to inquiry. For example, Ennis noted the ability to recognize ambiguity and contradictions in reasoning, to make specific statements, to test reliability of observations, and to identify problems as skills essential to critical thinking. Eleven thinking operations connected with inquiry were outlined by Cartwright (1962). As with Ennis, these operations did not form an inquiry model. Rather, they amounted to a list of thinking skills essential for sound inquiry procedure. They included observing from first hand experience, identifying and analyzing problems, formulating and testing hypotheses, collecting data, and stating and defending a position. While not providing an inquiry model, Suchman (1967) maintained that the ability to manipulate data was essential to successful inquiry.

Massialis and Zevin (1967), working with secondary social studies students, used a model which included:

1) Identification and definition of problems.

2) Looking at alternatives.

3) Formulating hypotheses.

4) Gathering relevant information.

5) Supporting hypotheses by evidence.

Goldmark (1968) provided an inquiry model for use in social studies.
It contained the following phases:

1) Problem.

2) Recognition that inquiry is required.

3) Abduction of alternative hypotheses.

4) Gathering data.

5) Analyzing alternative hypotheses.

6) Identifying the criteria.

7) Identifying values and assumptions.

8) Inquiry into inquiry.

Another model for use in social studies was developed by Fenton (1966),
and it has similarities with that of Goldmark. Fenton's model
included:

1) Recognition of a problem from data.

2) Formulating hypotheses.

3) Recognition of the implications of hypotheses.

4) Gathering data.

5) Analyzing, evaluating and interpreting data.

6) Evaluating hypotheses in the light of data.

Massialis and Cox (1966) employed an inquiry model which commenced
with an orientation phase and proceeded through stages connected with
hypotheses, definition of terms, exploration and evidencing and
generalization.

The emphasis upon problems in inquiry models is obvious from an examination of the frameworks outlined above. The explicit emphasis upon hypothesizing is also clear, as Chapin and Gross (1972) indicated. The phases in the models lend themselves to being mastered by constant practice, as in the case of the problem solving models.

Valuing and Decision Making

The most recent development in the use of inquiry has been concerned with valuing and decision making. The terms "valuing process" and "decision making process" are synonymous.

Massialis and Cox (1966) drew attention to a culture crisis in society, which they felt stemmed from change as a result of the interaction of pluralist values. They felt that the teaching of inquiry methods would assist students to cope with this situation. Other theorists, such as Raths (1966), have argued that the continual flux of values in modern society necessitates that students be taught how to clarify their values and also the value-positions of others. The inquiry method was seen as a useful device for this purpose, but modification of it was felt to be necessary.

Raths (1966) developed a valuing process which included the following phases:

1) Choosing: Identification of all known alternatives; assessment of the consequences of all known alternatives; choosing freely from among alternatives.

2) Prizing: Being happy with the choice; affirming the

choice willingly and in public, if necessary.

    3) Acting: Acting on the choice; repeating the action
consistently in some pattern of life.

Kaltsounis (1971) has advocated a valuing process containing the
following phases:

    1) Children are presented with an unresolved controversial
issue.

    2) Children suggest as many alternatives as possible.

    3) Children consider the consequences of each alternative.

    4) Children express feelings about each alternative.

    5) Children should come to decisions.

    A decision making process was put forward by Brim (1962). It
included these phases:

    1) Identification of the problem.

    2) Obtaining necessary information.

    3) Production of possible solutions.

    4) Evaluations of such solutions.

    5) Selection of a strategy for performance.

    6) Actual performance of an action, subsequent learning and
revision.

Clegg and Hills (1966) employed a valuing process which contained the
following steps:

    1) Observations. Determination of facts.

    2) Discrimination of relevant information.

    3) Enumeration of alternatives.

4) Noting consequences.

5) Decision on a course of action.

An extremely detailed and sophisticated outline of skills involved in

the valuing process was provided by Oliver and Shaver (1966). It was

for use by secondary pupils and included these skills:

1) Abstracting general values from concrete situations.

2) Using general value concepts as dimensional constructs.

3) Identifying conflicts between value constructs.

4) Identifying a class of value situations.

5) Discovering or creating value conflict situations which are

analogous to the problem under consideration.

6) Working towards a general qualified position.

7) Testing the factual assumption behind a value position.

8) Testing the relevance of statements.

A salient point emerging from valuing and decision making

processes such as these is the prominence of inquiry as their basic

ingredient. The feature which distinguishes them from inquiry or

problem solving models is their emphasis on decision, commitment to

a personal value position and action on that commitment. In decision

making and valuing, the inquiry method has been applied to the

affective domain of personal values, thus taking it a step further

than the solution of, perhaps, a relatively impersonal problem.

The models presented above indicate that the initial phases

of decision making and valuing are, in fact, inquiry phases. Theorists

have recognized that effective valuing and decision making depend upon

sound inquiry. For example, Kaltsounis (1970, 1971) noted that decision

making rests upon adequate inquiry, and claimed that inquiry should be

presented as a vehicle for the development of decision making skills

and not as an end in itself.

Some Essential Skills in Inquiry and Decision Making

Theorists have pointed out that certain processes and skills

are essential to inquiry and, therefore, decision making. Cox (1966)

summarized the processes and skills usually noted explicitly in the

various models. Cox's summary was referred to in Chapter I of this

study, but it bears repeating here. The processes were: Stating

hypotheses; deriving implications; seeking evidence; drawing

conclusions; drawing analogies; differentiating fact and value.

An examination of the models mentioned in this chapter provides support

for Cox's (1966) assessment of the essential inquiry processes.

Further support is provided by Kaltsounis (1971) who listed skills

such as observing, classifying, analyzing, inferring, hypothesizing,

supporting hypotheses and drawing conclusions as being necessary

before sound inquiry could be achieved.

It would appear that mastery of such skills is necessary for

the full implementation of inquiry teaching-learning strategy.

Suchman (1967), in a perceptive study of inquiry, noted that, ideally,

inquiry should be under the autonomous control of the learner. Only

when the learner has gained full control of the various phases can

inquiry become an intellectual tool capable of being employed by the

individual to advance his knowledge, to cope with change, to form and

evaluate opinions, attitudes and values, and to make decisions.

Chapin and Gross (1972) made an explicit statement concerning the need

for mastery of basic inquiry skills before the inquiry process as a

whole can be effective:

> Most of the inquiry-oriented projects presume that the
> student has acquired most of the traditional social
> studies skills. . . . students need nearly total
> command of traditional social studies skills such as
> the ability to find information or differentiate
> between a fact and an opinion before they can carry
> out very effective inquiry. (p. 153)

It is argued, for the purposes of this study, that autonomy of

control over inquiry and the presumption of mastery over such skills

as hypothesizing, generalizing, drawing conclusions, establishing facts

and differentiating between fact and opinion rest on an assumption of

mastery over even more basic skills. Three of these skills, it is

suggested, are the ability to recognize what appears, initially, to

be a fact; the ability to ask questions which data might answer or

which incorporate problems; and the ability to make statements supported

by evidence about a topic, question, problem or theme.

These very basic skills have not been ignored in the literature,

but it is felt that their importance has not been fully stressed in

the effort to outline ideal inquiry and decision making models. A

number of theorists have made passing references to them.

Hunt and Metcalf (1969) noted that facts are necessary,

provided that they are in a useful context such as evidence. They

claimed that facts and evidence are essential for testing hypotheses.
Banks and Hogan (1968) pointed out that inquiry, to the historian,
involves asking questions. Massialis and Cox (1966:67, 70, 113)
indicated the importance of being able to use evidence when
conclusions have to be drawn. They pointed out that hypotheses rest
on evidential support and that facts are the essential element in
evidence. Kilpatrick (1926) saw that facts had to be established in
the early stages of the Dewey (1910) problem solving model, a comment
that can be applied to all inquiry and decision making models.
Russell (1956:362) stated that discussion during inquiry should be
based on facts. He argued that children have to acquire simple facts
such as names, dates and places before they can participate
intelligently and productively in inquiry activities about social
problems.

Inquiry Models and Elementary Students

Another point which emerges from a survey of the literature
on inquiry concerns the complexity of some of the models and their
appropriateness for use by elementary pupils. Some of the models,
such as Fenton's (1966), were designed for use by secondary pupils.
The skills outlined by Oliver and Shaver (1966), in connection with
valuing, applied to secondary students also. Goldmark's (1968)
model was illustrated largely by examples taken from the secondary
level. Nevertheless, attempts to teach inquiry to elementary students
have been made. In recent times, the teaching of decision making
processes to elementary students has been advocated (Experiences in

Decision Making, 1971). Since inquiry and decision making appear to rest ultimately on very basic skills, an investigation of the ability of elementary students to deal with these skills was felt to be useful. It could shed light on the ability of elementary students to deal with basic aspects of inquiry, which, in turn, could provide an indication of their ability to handle more complex skills and processes.

Summary of Review on Inquiry

The review indicated that the teaching of inquiry or problem solving methods has been advocated as a means of producing citizens who can think in a disciplined manner. Models have been devised to facilitate the acquisition of inquiry skills through constant practice. Problem solving and inquiry models have provided the basis upon which decision making or valuing processes have been developed. Effective decision making depends upon sound inquiry, which in turn depends upon virtual total mastery by the learner of the basic processes and skills of inquiry. Mastery of these basic processes, such as hypothesizing, rests, in part, upon even more elementary abilities, such as the initial recognition of facts, the giving of evidence and the generation of questions. The literature indicated that an investigation of these abilities in elementary school children would be useful at a time when inquiry and decision making are being stressed in the methodology of social studies education.

CONVERGENT THINKING, DIVERGENT THINKING AND CREATIVITY

Basic Ideas

Scholars have long known that intellect, thinking and intelligence are multi-faceted and complex phenomena. Carey (1915) noted the existence of a general factor of intelligence, described as a fund of intellective energy and a measure of general ability, but claimed that it did not explain all mental characteristics. Often, he pointed out, children with high measures of general ability performed poorly in a specific subject. Children with low measures sometimes did well in a certain area. Carey (1915) concluded that there were a number of aspects of intellect in addition to a general factor. Subsequent research has revealed many factors of intellect, including convergent and divergent modes of thinking, which were identified statistically by Carrol (1941).

Guilford (1950; 1956; 1959) brought convergent and divergent thinking into prominence by his research on the structure of the intellect. Using the method of factor analysis, he found two major groups of factors: thinking and memory. Within thinking he discovered three divisions: cognition (discovery) factors, production factors and evaluation factors. He subdivided production into convergent thinking and divergent thinking abilities.

Convergent thinking was defined by Guilford (1959) as a process which uses information to seek a recognized best or conventional answer. Divergent thinking, according to Guilford (1959), involved

thinking in different directions, searching and seeking variety.
Divergent thinking abilities came into play when there was no uniquely
correct answer to be obtained from information. These definitions
have provided the basic framework for subsequent research. Guilford
realized that the two kinds of thinking are often used by the same
person. He noted that both types were necessary in some problem
solving situations. Nevertheless, he claimed that they were separate
factors of intellect which operated independently of each other.
Guilford (1950) also saw a connection between divergent thinking
abilities and creativity, and felt that they had not been developed
sufficiently by the schools.

Guilford's research pointed out what appeared to be a distinct
dichotomy between convergent thinking abilities on the one hand, and
divergent thinking abilities and creativity on the other. Russell
(1956) and Thompson (1959) produced concepts about thought processes
which supported the idea of this dichotomy and also the concept of a
relationship between divergent thinking and creativity. Russell
(1956:306) felt that creative thinking involved the production of
novel ideas and the achievement of something new, rather than working
towards a goal by following predetermined conditions. Thompson (1959:
185-189) spoke of imaginative thought. He described it as a process
which experimented freely with information. The thinker's goals were
often unclear.

Both Thompson and Russell had ideas about other thought
processes which appeared to parallel Guilford's concept of convergent

thinking. Russell (1956) compared creative thinking with critical
thinking and problem solving. Critical thinking was defined as
reaction to the ideas of others or to the thinker's previous ideas.
Russell felt that problem solving was an objective type of thinking
directed to some external goal. Thompson (1959) compared imaginative
thought with realistic thought. The latter was viewed as a process
which held strictly to reason and data.

The ideas outlined above provided a basis for questioning the
adequacy of the traditional measures of intelligence, intelligence
quotient tests. Taylor (1961) drew a distinction between gifted in
the sense of high intelligence quotient and gifted in the sense of
creative. He claimed that the concept of gifted should include
creativity as well as the usual intelligence quotient score. Taylor
noted the increasing numbers of factors of intellect which were being
isolated. He questioned the practice of giving a single score for
intelligence based on tests which, he claimed, incorporated very few
of those factors. Taylor felt that divergent thinking ability was
closely connected with creativity and pointed out that the development
of divergent thinking tests had begun. He claimed that persons
selected on the basis of these tests had shown a higher degree of
creative characteristics than people selected on high intelligence
quotient scores.

Getzels and Jackson (1962:14) attacked the traditional
intelligence quotient measures as inadequate. They found that such
measures required the subject to know the common association of a

stimulus and the accepted solution of a problem. In most cases, the stimulus drew the subject towards the only possible answer. No inventiveness was required. According to Getzels and Jackson (1962), conventional intelligence quotient tests evaluated mainly convergent thinking and largely ignored divergent thinking processes.

Torrance (1963:183) claimed that about seventy percent of the most creative children would be excluded from the gifted category if intelligence quotient alone were used as the criterion for giftedness. He made the claim after examining intelligence tests such as the Wechsler Intelligence for Children, the Otis Quick Scoring Test of Intelligence and the California Test of Mental Maturity.

Research such as that conducted by Taylor, Getzels and Jackson, and Torrance indicated that, among researchers, the concept of creativity had become closely associated with that of divergent thinking, while intelligence quotient, as measured by conventional tests, virtually had become equated with convergent thinking.

Cropley, in 1965, noted the view current at that time, when he reported that two distinct aspects of intellect were envisaged: convergent thinking and divergent thinking. Conventional intelligence tests were held to ignore divergent thinking abilities and to measure only convergent thinking capacity. There was a strong tendency to regard divergent thinking ability as an indication of the presence of creativity.

Testing for Convergent Thinking Ability

Conventional intelligence quotient tests have been used
consistently by researchers as measures of convergent thinking ability.
Getzels and Jackson (1962) provided a rationale for this practice:

> The conventional IQ test requires that the subject
> know the common association of a stimulus and the
> accepted solution of a problem. In many of these
> tests, the subject must respond to a stimulus for
> which only one unique answer is correct. He is
> not asked to innovate, speculate or invent. In
> short, the conventional IQ test tends towards the
> evaluation of those cognitive processes that have
> been called convergent more than those processes
> that have been called divergent. (pp. 14-16)

Getzels and Jackson (1962; 1963) relied on the Stanford-Binet and
Henmon-Nelson tests, as well as the Wechsler Intelligence scale for
Children. Torrance (1963) used the Metropolitan Test of Readiness,
among other traditional intelligence tests mentioned above in
connection with his research. Cropley (1965; 1966; 1967a; 1968) used
the Lorge-Thorndike battery of tests. Dowd (1966) employed the
Scholastic Aptitude Test as a measure of convergent thinking ability.

Some tasks apart from intelligence tests have been used as
measures of convergent thinking and labelled specifically as such.
Cropley (1966) mentioned a vocabulary test, a test on inferences and
a length estimation test as measures of convergent thinking (French,
1963). Klausmeier and Wiersma (1964) used current events, work-study
skills, problem-solving judgement and analogies as the bases for
convergent thinking tests.

A number of the measures specifically noted as convergent

thinking tests, mentioned above, are not suitable for elementary children. For example, a test of convergent thinking based on inferences, and used by Cropley (1966), is suitable only for grades eleven through sixteen.

One interesting departure from the practice of using intelligence tests as measures of convergent thinking has been provided by Wober (1970). Working with senior boarding school girls, Wober used a single test based on the principle of having one correct answer for each item. He felt that this test was sufficient to establish, for experimental purposes, a measure of convergent thinking. There were sixteen items in the test. Each item was made up of a scatter of letters from which the subjects had to find answers such as a boy's name or the name of a flower. There was one unequivocally correct answer for each item.

Testing for Divergent Thinking Abilities

Research has produced tests which are held to be measures of divergent thinking. Torrance (1963:174), a leader in the development of such tests, has stated that the basic idea behind them is "to challenge the inventiveness of children." Guilford (1959), originator of a number of divergent thinking tests, noted that such tests depended on setting tasks which required the production of a variety of responses and in which the product was not completely determined by the given information.

Getzels and Jackson (1962; 1963) used a word association test

and an unusual uses test in their research. Word association tests are
made up of a number of words, each of which has multiple meanings.
The subject is asked to write down as many different meanings as
possible for each word. Unusual uses tests involve providing the
subject with the name of a common object, and requiring that as many
uses as possible for the object be listed. Getzels and Jackson (1962;
1963) also used tests based on hidden shapes, fables and making up
problems.

Klausmeier and Wiersma (1964) used tests based on plot titles,
questions about plots, objects improvement and sentence improvement in
addition to object uses and word uses. Feldhusen and Denny (1965)
employed tests involving word uses in addition to uses for bricks,
improvements to a pencil and plot questions and titles. Cropley (1965)
used a battery of divergent thinking tests which included tasks
concerned with seeing problems, consequences, symbol production and
circles in addition to uses for tin cans. Word meanings, anagrams,
plot titles and unusual uses were incorporated into divergent thinking
tests used by Dowd (1965). Cropley (1966) expanded his earlier (1965)
battery to include tests based on hidden figures and associations, and
used much the same group in a later (1967a) study. Hutchinson (1967)
asked subjects to perform tests involving elaboration of articles,
to make meaningful statements and, to work with apparatus. Debney
(1969) and Wober (1970) worked with word association tests, Debney
(1969) using an unusual uses test as well. Cropley, as recently as
1972, worked with the tests he had used in earlier (1965; 1966; 1967a)

studies.

Scoring Divergent Thinking Tests

A number of dimensions of divergent thinking have been discovered. Researchers have attempted to measure these dimensions by the methods of scoring the various divergent thinking tests.

Eastwood (1965) has indicated the divergent thinking dimensions which have received the most attention: fluency, flexibility, originality and elaboration. The following outline of the scoring procedure for these dimensions is taken from Eastwood (1965).

Fluency refers to the number of responses made to a stimulus during a set period of time. Word association tests, for example, can be scored for fluency by counting the number of responses made to each item in the test.

Flexibility involves changing from one type or category of response to another. Scoring for flexibility involves counting the changes of category, rather than the actual number of responses. Unusual uses tests, for example, can be scored for flexibility if the number of classes or categories into which responses may be placed are counted.

Originality is the ability to make unusual responses. Unusual uses tests are commonly associated with this aspect of divergent thinking. Scoring for originality is based upon the infrequency of occurrence of responses. Scores are obtained by tabulating answers

from a group in order to find the least common responses and weighting them more heavily than others.

Tests of the dimension of elaboration use a stimulus figure or shape, to which the subject adds details. The score is the number of details added.

Some tests can be scored for more than one dimension. For example, word association tests can be scored for fluency and originality, and unusual uses tests scored for flexibility and originality.

Relationships Between Creativity and Divergent Thinking

Definitions of creativity have been based on what is viewed as the creative product, the creative process and the creative experience.

Flanagan (1963) felt that the creative product should be clever as well as satisfactory. Jackson and Messick (1965) held that a creative product should meet four criteria: Appropriateness (i.e. not absurd); unusualness (i.e. infrequent); transformation (i.e. something new and overcoming conventional restraints); and condensation (i.e. display a simplification of complexity).

Mednick and Mednick (1964) based their definition on process. They claimed that:

> Creative thinking consists of new combinations of
> associative elements, which combinations either
> meet specified requirements or are in some way
> useful . . . . the more mutually remote the
> elements of the new combination, the more creative
> is the process or solution. (p. 55)

Maslow (1959) defined creativity as experience and noted some eighteen

experiences which he viewed as associated with the creative act. These

experiences included seeing formerly hidden truths, loss of self-

consciousness and aesthetic perception.

No definition of creativity has proved universally acceptable.

The complexity of the concept of creativity has prevented the

development of such a definition, as Dacey and Madaus noted (1969).

Theoretical explanations of creativity have been attempted and

a survey of these indicates the variety of concepts of creativity and

the connection between it and divergent thinking.

Wertheimer (1954) promulgated a Gestalt view of creativity.

According to Wertheimer (1954), creativity involves

> . . . . operations of dividing into sub-wholes and
> still seeing these sub-wholes together, with clear
> reference to the whole figure. . . each step is
> taken surveying the whole situation. (pp. 41-42)

Dacey and Madaus (1969) reported a psychoanalytic concept of

creativity, in which conflict played an initiatory role. Unsolved

conflict, according to this explanation, results in neuroses, while

satisfactorily solved conflict initiates creativity. Weisberg and

Springer (1967) proposed an environmental explanation of creativity.

In their view, the creative child is the product of a home which

fosters expressiveness.

The most prominent explanation of creativity is that of

associationism and it is within the framework of this explanation that

the connection between creativity and divergent thinking can be
examined. Mednick (1962) explained thinking as a chain of associated
ideas. He defined the creative act as "the forming of associated
elements into new combinations which are useful in some specific way."
The divergent thinking tests mentioned earlier in this chapter are
based on associative theory. Basically they ask the subject to produce
ways in which objects or ideas can be used or modified to develop
something new or unusual. Since their innovation, these tests have
been regarded as attempts to measure creativity. Within the framework
of associationism creativity is operationally defined as the number of
associations the subject makes and the relative uniqueness of those
associations.

Guilford (1950; 1956; 1959; 1967) equated creative thought
with divergent thinking and its various dimensions of fluency,
flexibility, originality and elaboration, among others. Guilford's
view was supported by other researchers.

Getzels and Jackson (1962; 1963) regarded the word association
uses, fables and hidden shapes tests which they employed, as instruments
to assess creative potential. Torrance (1963) constructed tests
regarded as measures of creativity based on Guilford's concept of
divergent thinking. In addition, Torrance (1963) used materials such
as toy nurses' kits, dogs and fire trucks, asking subjects to think of
ways to change these toys to make them more fun to play with.
Torrance (1963) also employed Mother Goose stories to stimulate children
to think divergently and creatively. He posed problems from these

stories such as, "What could Mother Hubbard have done when she found
that the cupboard was bare?"

Getzels and Elkins (1964), when studying exceptional children,
concentrated on originality, a dimension of divergent thinking which
they equated with creative thinking. Feldhusen and Denny (1965) used
divergent thinking tests as measures of creativity. Cropley, in 1969,
was able to reiterate his earlier (1965) report that testing for
creativity remained based upon Guilford's ideas about divergent
thinking.

Relationships Between Convergent and Divergent Thinking

Researchers appear to have accepted the conventional intelligence
test as a measure of convergent thinking. However, the extent of the
dichotomy between convergent thinking/intelligence quotient on the
one hand and divergent thinking/creativity on the other has been
challenged and modified.

Thorndike (1963) and Marsh (1964) discerned a separate
intellectual factor which was measured by divergent thinking tests,
but they claimed that convergent thinking had some effect on the
divergent scores. Wallach and Kogan (1965) questioned the independence
of results of creativity tests from the usual measures of intelligence.
They found no grounds for the conception of a psychological dimension
of creativity existing apart from general intelligence, the
conventional measures of which are held to test convergent thinking.

Burt (1964) claimed that differences in scores on creativity tests result from differences in general ability, by which he meant the traditional concept of intelligence, rather than differences in an entirely separate intellectual capacity called creativity. Vernon (1964) supported Burt, suggesting that a more adequate measure of intelligence could be achieved by adding some divergent thinking sub-tests to the ordinary type of intelligence test.

Cropley (1965; 1966), using the Lorge-Thorndike test as a measure of convergent thinking, and a battery of divergent thinking tests which included unusual uses, seeing problems and consequences (scored for originality), found that convergent thinking and divergent thinking are not completely independent of each other. At the same time, Cropley claimed that the overlap was relatively small, and that the two types of thinking could be distinguished. Nevertheless, they were interrelated to some degree. More recently, Cropley (1967b) reiterated that an intellectual dimension called creativity had been established, and that creativity tests, by which he meant divergent thinking tests, measured something neglected by traditional measures of intelligence. However, conventional intelligence, by which Cropley meant a measure of convergent thinking, was always present. Moss and Duenk (1967), in a study of Torrance's Minnesota Tests of Creativity, claimed that some convergent thinking abilities influenced creative output. Pribram (1964) concluded that there was no neurological basis for regarding convergent thinking as separate processes. Wober (1970) felt that convergence and divergence were not clearly separable

constructs. Williams (1966) discovered significant correlations between originality-fluency results and results from conventional intelligence tests.

Attempts have been made to explain the overlap between the two types of thinking. Yamamoto (1964) suggested that intelligence quotient, viewed as a measure of convergent thinking, and creativity are related at lower levels, but independent of each other above a certain point on the intelligence quotient. Yamamoto (1964) felt that 120 was the point at which the two became independent. McNemar (1964) supported Yamamoto in principle, as did Guilford (1967) in later research. Barron (1968:184) claimed that a specifiable minimum intelligence quotient is probably necessary in order to engage in creative activity, but,

> . . . beyond that minimum . . . creativity is not a function of intelligence as measured by intelligence quotient tests.

Barron appeared to place the point of independence between the two modes of thought much lower on the intelligence quotient scale than Yamamoto.

Cropley (1969) suggested that convergent and divergent thinking are ways in which intelligence is brought to bear on the environment. Cropley used the term "intelligence" here in a special sense. He did not mean intelligence as measured by intelligence quotient tests. These tests, he claimed, measured mainly convergent thinking. By intelligence he meant a generalized source of intellectual ability, and suggested Galton's (1883) concept of "general ability", Spearman's (1909)

idea of "general mental energy" and Burt's (1962) "inate, general

cognitive ability" as examples of what he meant.

Reliability and Validity of Divergent Thinking Tests

The relationship between convergent and divergent thinking has

pertinence with regard to the reliability and validity of divergent

thinking tests. Getzels and Jackson (1962) claimed a high internal

consistency for a word association test (scored for fluency) and an

unusual uses test (scored for originality). Torrance (1963) expressed

some confidence in the reliability of tests scored for fluency,

flexibility and originality. Grover (1966) found that uses tests

scored for originality made a significant contribution to prediction

of divergent thinking scores, especially fluency. Mackler (1966)

performed research which indicated that scoring for originality

increased the reliability of divergent thinking test scores.

However, Wodtke (1964) expressed doubts as to the reliability

of divergent thinking tests, and Vernon (1964) questioned their

validity. Moss and Duenk (1967) assessed the validity of Torrance's

Minnesota Tests of Creativity. They reported that they could not

establish complete validity. Nevertheless, they noted that the tests

measured intellectual components not represented in the typical

intelligence test. Harvey and others (1970), also, found Torrance's

tests of creativity suspect with regard to validity. Sultan (1962)

claimed that Guilford's creativity factors, flexibility and originality,

were not as readily measurable among fourteen year old grammar school

students as among adults. Burt (1962) noted that the validity and
reliability of divergent thinking tests had not been fully established,
and Cronbach (1968) remarked that research into creativity was marred
by inadequate designs and analysis.

Nevertheless, a sampling of the latest research indicates that,
although the validity and reliability of divergent thinking tests has
not been fully established, progress towards this goal has been made.
Ward (1968) noted that creativity can be distinguished from abilities
represented by intelligence quotient scores. He pointed out, however,
that situational variables, such as the testing environment, had to be
taken into account.

Cropley and Maslany (1969) examined the Wallach-Kogan tests of
creativity and found that these tests measured a stable and internally
consistent intellectual mode, although this mode was significantly
related to general intelligence as measured by intelligence quotient
tests. Lytton and Cotton's (1969) research gave support for the idea
that convergent and divergent thinking abilities were amenable to
separate measurement, but they noted that they were complementary aspects
of intellectual functioning. Debney (1969) found that word association
tests had a high level of significance for creativity. He claimed
that the consensus of research indicated that creativity tests and
tests of divergent thinking largely measure what they purport to
measure. Debney (1969) attributed the lack of full validity as yet
to the absence of established criteria for creativity and the point
that no standardization had been achieved. Cropley (1972), after a

longitudinal study of creativity tests, felt that they possessed
reasonable long range predictive validity, especially if scored for
originality. His work supported research conducted by Torrance (1970b).

An important point emerging from research with regard to the
reliability of divergent thinking tests concerns the dimension of
originality. Scoring for this dimension appears to strengthen the
reliability of the tests. Eastwood (1965) pointed out that the usual
practice of scoring a number of divergent thinking tests for various
dimensions such as fluency, flexibility and originality, and then
summing the scores to obtain a divergent thinking or creativity total,
was open to question. It assumed that the various dimensions had
enough in common to be added together. Cropley (1966), aware of the
generally low reliability of divergent thinking tests, felt that this
practice could compound unreliability. He chose to score solely for
originality in an attempt to strengthen the reliability of the
divergent thinking tests he used. Dacey and Madaus (1969) noted that
originality is a major factor in creativity.

One further point concerning the validity of divergent thinking
tests needs to be noted. All researchers do not equate divergent
thinking with creativity. J. P. White is representative of this group.
White (1968) argued that creativity is not a psychological process,
but rather a label given to an observable product. He criticized the
usual concept of creativity as measured by instruments such as
divergent thinking tests. He stated that the creativity of an Einstein
was something more than divergent thinking. However, White (1968) felt

that unusual uses tests scored for originality measured something which
is related to the sort of creativity displayed by people like
Einstein, because the subject has to follow rules. At the same time,
White (1968) felt that it fell short of the type of creativity
evidenced by Einstein because there is no real point in the activity.
White felt that originality as measured by an unusual uses test could
predict the other sort of creativity typified by Einstein.

Examples of Research Based on Convergent and Divergent Thinking

Much of the research on convergent and divergent thinking has
been based on the premise that divergent thinking is an indication of
creativity. The following examples are offered as an indication of the
type of work done in this area of research.

Development of Divergent Thinking Abilities

Mednick (1962) attempted to isolate the basic processes of
creative thought, and Mackinnon (1965) tried to identify personality
characteristics associated with creative persons. Torrance (1965)
suggested that creative behavior could be developed in schools.
Covington (1968) claimed that, generally speaking, teaching for the
development of divergent thinking abilities did not take place. He
stated that children do not become creative merely by being part of
a permissive school atmosphere. According to Covington (1968), they
must learn to think divergently. He suggested that activity with
various types of problems involving the generation of possible
consequences from actions would help to develop divergent thinking

abilities.

White and Owen (1970) found that the classroom setting was an important factor in the development of creative potential in students. They claimed that creativity developed greatly where students evaluated their own work. It developed far less when peers or the teacher performed the evaluation. This finding supported that of Torrance (1965) for grades one through four. Torrance's grades five and six did not respond when teacher and peer evaluation was removed. Torrance (1965) speculated that grades five and six had become too dependent on external evaluation to work under other conditions. White and Owen's (1970) research also supported a report by Wodtke and Wallen (1965) which noted that teacher behavior could stifle the development of creativity in pupils.

Some research has been devoted to the organization of programs to develop divergent thinking skills. Klausmeier and Teel (1964) produced a program based on research skills. Covington and others (1966) developed a set of programmed lessons intended to strengthen what they called productive thinking skills in fifth and sixth grade children. Wardrop and others (1969) studied the degree to which creativity in fifth grade children could be improved by means of programmed instruction. They concluded that the technique was successful.

Haddon and Lytton (1968) detected a connection between teaching approach and the development of divergent thinking abilities in

elementary school children. They looked at schools which they classified as informal and formal. The informal schools featured a discovery-type strategy of learning. These schools, they claimed, provided an environment which developed a high level of divergent thinking.

Relationships Among Convergent Thinking, Divergent Thinking, Age, Sex and Achievement

Klausmeier and Wiersma (1964) examined relationships between sex and divergent thinking. They found that girls scored lower than boys on convergent thinking tests, but higher than boys on measures of divergent thinking.

Torrance (1962) studied the development of divergent thinking abilities in preschool and elementary children in the United States of America. He compared the results with similar studies in Australia and Germany and found that an increase in divergent thinking ability took place from three to four and a half years. A drop was noted upon entry to kindergarten, followed by a rise during third grade. Torrance (1962) discerned a severe drop during fourth grade, succeeded by an increase in fluency (but not in originality) in fifth grade. There was a recovery in originality in sixth grade.

The relationship of academic achievement to convergent and divergent thinking abilities was the focus of studies by Cline and others (1962) and Wade (1968). Cline (1962) claimed that intelligence tests combined with divergent thinking tests predicted academic

achievement no better than either singly. Wade (1968) found that
there were no significant differences between creativity and intelligence
quotient scores as predictors of school achievement. However, at
least two measures of creativity were needed for any confidence in
their accuracy as predictors.

Summary of Review on Convergent Thinking, Divergent Thinking and Creativity

From the extensive research which has been conducted into
convergent thinking, divergent thinking and creativity, the following
points, which are important for this study have emerged.

There are limitations concerning the reliability and validity
of tests used to measure convergent and divergent thinking.
Traditional intelligence quotient tests are held to measure _mainly_
convergent thinking. Researchers do not feel free to state that
intelligence quotient tests measure solely convergent thinking. Yet
intelligence quotient tests have been accepted as reasonably reliable
and valid measures of convergent thinking more readily than various
creativity tests have been accepted as reliable and valid measures of
divergent thinking.

Overlap between convergent and divergent thinking has been
accepted generally, but the point that these two modes of thought are
distinguishable has also been made. Though full reliability and
validity of divergent thinking tests have not been established, word
association tests and unusual uses tests scored for originality and

fluency have emerged as the most reliable and valid divergent thinking measures yet devised.

Although the connection between divergent thinking and creativity remains a point of controversy, the current position of research indicates that a relationship between the two exists, and a great deal of research has been conducted upon this premise.

GENERAL SUMMARY

The review indicated that certain basic skills should be mastered by students if they are to engage in sound inquiry procedures. The ability to generate questions, facts and statements of evidence appeared to be among these essential skills. The review also indicated that it was possible to group students according to their abilities in convergent and divergent thinking and that divergent thinking is associated with creativity. The current emphasis in educational thought on inquiry and creativity kindled an interest in examining the ability of elementary students, grouped on the basis of convergent and divergent thinking characteristics, to generate questions, facts and statements of evidence.

CHAPTER 3

METHOD OF CONDUCTING THE STUDY

Introduction

Specifically, this study examined the abilities of sixth grade students categorized as high convergent-high divergent, high convergent-low divergent, low convergent-high divergent, and low convergent-low divergent to generate questions, facts and statements of evidence in a social studies setting. It also examined the response of these categories of students to instruction in the skills of generating questions, facts and statements of evidence.

The investigation fell into the following phases:

1) Choice of instruments to be used in the study. These instruments included tests to establish groups based on the ability to think convergently and divergently; a pretest and a posttest to assess ability to generate questions, facts and statements of evidence in a social studies setting at the elementary level; and an instructional plan which would involve the students in the generation of questions, facts and statements of evidence.

2) The pilot study.

3) The main study.

This chapter will outline the procedures adopted in each of these phases.

INSTRUMENTS USED

The Measure of Convergent Thinking

It was decided to accept a conventional intelligence quotient test as the measure of convergent thinking for this study. This decision was made after a survey of literature on convergent thinking ability. In particular, the work of Cropley (1965, 1966, 1968) was persuasive in this regard. The Canadian Lorge-Thorndike Intelligence Test, Form 1, Level C was administered to all sixth grade pupils on a system wide basis throughout the Edmonton Public School district at the time when the study was conducted. The scores from this intelligence test were taken as measures of convergent thinking for the purposes of the investigation. This test had been administered during February, 1972, to the students who participated in the main study which took place during the following May. The scores were deemed recent enough for the purposes of the study.

The Measures of Divergent Thinking (Appendix A)

The measures of divergent thinking chosen for the study were used by Getzels and Jackson (1962). Two tests were involved: a word association test and an unusual uses test. The word association test consisted of twenty five words which had more than one meaning. The students were asked to write down as many meanings as possible for each word. The unusual uses test consisted of presenting the students with the names of five common objects and asking them to write down as many uses as possible for each object.

These were chosen chiefly because they appeared to be among the more reliable types developed at the time the study was conducted. Getzels and Jackson (1962) claimed a reliability of .87 for the word association test and .86 for the unusual uses test. The review of literature indicated that these types of tests were among the more reliable methods of measuring divergent thinking abilities, especially when they were scored for fluency (number of responses) and originality (infrequency of specific responses).

The Pretest and the Posttest (Appendix B)

These tests, which were constructed by the investigator, were based on historical photographs portraying scenes of Alberta in pioneer times. The use of photographs was felt to be an aid in overcoming the problem of possible reading difficulties among the students. Historical photographs were chosen because history is a prominent aspect of social studies, and photographs form an important element in historical evidence and data.

The theme, "Pioneer Times in Alberta", was chosen as one with which the students would be reasonably familiar, and one in which the photographs would stimulate interest. Such photographs, it is argued, provided visual, concrete material for the students to work on, and assisted in creating a situation in which all could achieve some success, thereby providing data for study and analysis.

Three photographs were chosen for both the pretest and the posttest. An attempt was made to render each set reasonably similar

in complexity of content. In each test, the first photograph was used to stimulate the generation of questions, the second was used in connection with facts, and the third was employed as a basis for making statements of evidence.

1) <u>Questions</u>. The students were asked to write down questions which the photographs might help answer about pioneer times in Alberta. To qualify as a valid response, each question had to be capable of being answered, in part at least, from the photograph. Questions which the photograph could not help answer were regarded as invalid.

2) <u>Facts</u>. In general, historians view facts as hypotheses which are accepted as true until evidence which modifies or negates them is produced. No attempt was made in this study to have the students go through the process of establishing facts according to the historical method, or treat facts as hypotheses. The purpose of the study was to investigate a prior stage to the treatment of facts as hypotheses, namely, the recognition of items that appear to be facts in view of the evidence available at the moment. Therefore, the students were given a definition of a fact for the purposes of the study. According to this definition, a fact was anything about pioneer life that appeared to be true from the photographs they were studying. A valid response was one which could be substantiated from the photographs. Invalid responses were those which could not be substantiated from the photographs.

3) <u>Statements of Evidence</u>. This section of the pretest and

the posttest aimed at investigating the students' ability to make
substantiated statements about pioneer life in Alberta, using a
photograph as the source of evidence. Valid responses were those which
used evidence from the photographs. Invalid responses contained
evidence which was not apparent in the photograph.

The Instruction Booklet (Appendix C)

The instruction booklet was designed to be largely auto-
administered by the students. It was felt that this would help
neutralize the effects of individual styles of teaching which would
occur throughout the six classes if the class teachers gave the
instruction. The investigator supervised all instruction involved in
the study.

The booklet was made up of four lessons based on three
photographs of pioneer life. It was designed so that students could
move from one lesson to the next with a minimum of instruction from
the supervisor. The instruction consisted of questions which aimed
at stimulating the pupils to ask questions, find facts and give
statements of evidence.

THE PILOT STUDY

The pilot study was undertaken to investigate the following
points:

1) The reliability of the measures of divergent thinking with
sixth grade students.

2) The suitability of the measures of divergent thinking for sixth grade students.

3) The feasibility of establishing categories based on convergent and divergent thinking abilities.

4) The validity and reliability of the pretest and the posttest for sixth grade students.

5) The suitability of the instruction booklet for sixth grade students.

The pilot study was carried out with sixth grade students at a school other than the schools used in the main study. Intelligence quotients from the Canadian Lorge-Thorndike Intelligence Test, Form 1, Level C were available as measures of convergent thinking ability.

Suitability and Reliability of the Word Association and Unusual Uses Tests

Getzels and Jackson used these tests with secondary students and it was necessary to pilot them with sixth grade students before accepting them for the main study.

No particular time limit was set in the administration of the tests. The sixth grade students, a heterogeneous group, took approximately twenty minutes to complete each test. The students were informed that the test results would not be used in their regular assessment. They were encouraged to attempt the tests in a relaxed, strain-free atmosphere. Communication with other students was not permitted.

The word association test was scored for fluency. This involved counting the actual number of valid responses. The dictionary was the final arbiter in doubtful cases. Provision was made for current slang usage. For example, many students used the word "sack" to mean defeat of an opposing sports team. Inquiries revealed that this was common usage in the area and this meaning of the word was accepted as valid in the scoring.

The unusual uses test was scored for originality. This procedure involved several phases. Initially, all valid responses were tabulated. The criteria for valid responses were those of Jackson and Messick (1965): unusualness (infrequency), appropriateness (not absurd), transformation (overcoming conventional restraints as well as being new), and condensation (simplification of complexity). The tabulation incorporated the number of times each response appeared. The total number of responses was calculated. Responses were scored according to their infrequency of occurrence, which was calculated as a percentage of the total as indicated in Table 1.

The scores in the word association test and the unusual uses test were totalled to obtain a divergent thinking score for each student. The tests were given twice, one week apart, and the scores were subjected to Spearman's reliability formula which produced a result of .85 in the test-retest situation.

The pilot established that sixth grade students could handle the tests and that the tests had some degree of reliability as to

Table 1

Scoring For Originality

Percentage of Total	Score
Plus 5%	0
Plus 4% to 5%	1
Plus 3% to 4%	2
Plus 2% to 3%	3
Plus 1% to 2%	4
1% or less	5

the ranking they produced.

Establishment of the Groups

The class enrolment of 22 was ranked in order of convergent thinking scores, which were based on the Canadian Lorge Thorndike Intelligence Test, Form I, Level C scores. The class was also ranked in the order of total scores obtained in the measures of divergent thinking. Medians were calculated and used to establish high and low scorers in each list. From this information, the students were classified into four groups designated as high convergent-high divergent, high convergent-low divergent, low convergent-high divergent, and low convergent-low divergent. It was found that the high convergent-high divergent and low convergent-low divergent groups were larger than the other two groups. Table 2 indicates the numbers in each group.

Table 2

Groups Based on Convergent and Divergent Thinking
Abilities in the Pilot Study
(N = 22)

Group	Number
High Convergent-High Divergent	7
High Convergent-Low Divergent	4
Low Convergent-High Divergent	4
Low Convergent-Low Divergent	7

The pilot study indicated that the formation of the desired groups was possible.

Validity and Reliability of the Pretest and the Posttest

A measure of face validity was established by presenting the pretest and the posttest to four experienced teachers of sixth grade social studies. These teachers made suggestions concerning the wording of the tests which were incorporated into the final format.

The tests were also presented to four sixth grade pupils with intelligence quotients ranging from 90 to 126. Some difficulties arising from ambiguity in the instructions were noted and the instructions were modified accordingly.

To assess reliability, the tests were administered twice, one week apart, to a heterogeneous group of sixth grade students. The results were subjected to Spearman's formula and produced reliability readings of .77 and .75 for the pretest and the posttest respectively.

Suitability of the Instruction Booklet

As with the pretest and the posttest, the booklet was subjected to examination by four experienced teachers of sixth grade social studies. Modifications of the wording and questions were made upon their suggestions. Four sixth grade students with intelligence quotients ranging from 90 to 118 worked through the booklet. Some problems in wording became apparent and modifications were made accordingly. It was felt that the instruction booklet was suitable for sixth grade

students and that a measure of face validity for it had been

established.

<center>THE MAIN STUDY</center>

The Sample

The study was carried out in two elementary schools made

available for the purpose by the Edmonton Public School Board. The

availability of the schools for research purposes was the chief

criterion for their use in study. The schools served areas of middle

socio-economic status.

Three sixth grade classes from each school were involved in

the study. One hundred and fifty six students were enrolled in the

six classes. The classes were not streamed according to achievement

or intelligence quotient. They can be described as heterogeneous groups.

Age was not taken into account in the study, because a single grade

was involved. Throughout the investigation, the classes remained in

their normal classrooms.

Establishment of Groups in the Main Study

The students' verbal intelligence quotients, which had been

established by means of the Canadian Lorge Thorndike Intelligence Test,

Form 1, Level C, were obtained from the records of the schools involved.

The unusual uses test and the word association tests were

administered and scored under the same conditions as obtained during

the pilot study. As in the pilot study, medians were established in both the convergent and divergent thinking scores, and the four groups designated high convergent-high divergent, high convergent-low divergent, low convergent-high divergent and low convergent-low divergent were formed. The indications received from the pilot study with regard to the numbers in each group were borne out. The high convergent-low divergent and low convergent-high divergent groups were about half the size of the other two groups.

As had been anticipated, wastage from the total enrolment occurred immediately because of students being absent during the administration of the divergent thinking tests. The numbers in the groups formed initially are shown in Table 3.

Table 3

Initial Experimental Groups Based on Convergent and
Divergent Thinking Abilities
(N = 146)

Group	Number
High convergent-high divergent	53
High convergent-low divergent	25
Low convergent-high divergent	20
Low convergent-low divergent	48

The low numbers in the high convergent-low divergent and low convergent-high divergent groups provided a problem in the establishment of a control group. Taking into account the number of students available, the investigator planned to have a minimum of twenty in each of the experimental groups. The control was intended to contain twenty, also, made up of five members of each of the four groups. The number in the low convergent-high divergent group precluded this arrangement. Finally a control group of the composition indicated in Table 4 was chosen. The representation of the groups in it was approximately proportional to the number of students in the initial groups.

Table 4

Initial Control Group Based on Convergent
and Divergent Thinking Ability
(N = 27)

Group	Number
High convergent-high divergent	10
High convergent-low divergent	5
Low convergent-high divergent	2
Low convergent-low divergent	10

Further wastage occurred because a number of students in both
the experimental groups and the control group missed either the pretest
or the posttest. The numbers in the experimental groups for which full
data was obtained are indicated in Table 5.

The control group was reduced by wastage to its final
composition as shown in Table 6.

Sex Ratios in the Experimental Groups

The numbers of each sex in the experimental groups are
indicated in Table 7.

The Investigation

After the groups had been established, the pretest was
administered, the instruction period was completed and the posttest
was given. The control group was excluded from the instruction, but
took the pretest and the posttest. They were not excluded from the
rooms, but worked at tasks of their own choosing, which were not
connected with pioneer times in Alberta. Class members who were not in
the experimental groups took the pretest, posttest and instruction.
This was done because it was felt that they might gain worthwhile
experience, even though their results were excluded from the
investigation.

When scoring had been completed, an experimental group
containing high convergent-high divergent, high convergent-low
divergent, low convergent-high divergent and low convergent-low

Table 5

Final Experimental Groups Based on Convergent
and Divergent Thinking Ability
(N = 105)

Group	Number
High convergent-high divergent	33
High convergent-low divergent	18
Low convergent-high divergent	18
Low convergent-low divergent	36

Table 6

Final Control Group Based on Convergent and
Divergent Thinking Ability
(N = 12)

Group	Number
High convergent-high divergent	7
High convergent-low divergent	2
Low convergent-high divergent	1
Low convergent-low divergent	2

Table 7

Numbers of Females and Males in the
Experimental Groups
(N = 105)

Group	Female	Male
High convergent-high divergent	17	16
High convergent-low divergent	5	13
Low convergent-high divergent	8	10
Low convergent-low divergent	14	22

divergent students was established by random selection. The numbers in

each section of this group were proportional to those in the control

group. This was done with the purpose of comparing the results of the

two groups during analysis of the data.

Experimental Design

The design used in the study was similar to the Pretest

Posttest Control Group Design (Campbell and Stanley, 1963: pp. 183-194).

Campbell and Stanley (1963) noted this approach as a true experimental

design, which controlled for internal sources of validity such as

history, maturation, regression, selection and mortality. They also

noted that the design had a weakness in external validity in that it

does not control for the interaction of testing and treatment which, in

this study, was the instruction. The design is also questionable on

other aspects of external validity such as the interaction of selection

and the treatment and reactive arrangements. Nevertheless, its strength

of internal validity makes it a robust design.

The study was carried out during a relatively short period of

time, fifteen days. This should have offset problems connected with

maturation. In any case, this design controls for maturation, and

also testing, in that these effects should occur equally in both

experimental and control groups.

The design controls for history in that the same events would

effect both control and experimental groups. This study seems to have

met one problem concerning intrasession history by dealing with both

experimental and control groups simultaneously. It should be noted, however, that the study was based on group administered tests rather than individual testing. Testing of individual students might have strengthened the design with regard to the effects of history.

The investigator felt that the design, as used in the study, suffered somewhat from the effects of selection. The schools and, therefore, the subjects were not chosen randomly, but were used largely because they were available for research purposes. The small number in the sample weakened the design.

The study appears to have gone some way towards meeting the problem of mortality in that it made use of all experimental subjects who completed the pretest and the posttest, including those who missed part of the treatment. This procedure would tend to dilute the effect of the treatment, but it would also help check a bias towards the conscientious and the healthy, as Campbell and Stanley (1963) note.

SUMMARY

This chapter has outlined and discussed the conduct of the investigation. The procedures involved in choosing instruments to establish the desired groups, and in developing the pretest, instructional plan and posttest were dealt with. The pilot study and the main study were described and the experimental design was discussed. Chapter 4 will be devoted to analysis of the data.

CHAPTER 4

ANALYSIS OF THE DATA

INTRODUCTION

This chapter will be devoted to analysis of the data obtained during the investigation. Two types of analysis will be reported: statistical analysis and descriptive analysis. The type of statistical analysis employed was a one way layout analysis of covariance (Winer, 1962, pp. 578-594). This type of analysis was chosen because it allowed differences among the four groups involved in the study to be examined after performances in the pretest had been controlled. The level of significance chosen was .05.

STATISTICAL ANALYSIS

This section will report upon the statistical analysis conducted during the investigation of hypotheses one to ten. This group of hypotheses fell readily into three subgroups:

1) The ability of the high convergent-high divergent, high convergent-low divergent, low convergent-high divergent and low convergent-low divergent groups to generate questions, facts and statements of evidence as measured by the Historical Photographs Test: hypotheses one to three.

2) The response of the high convergent-high divergent, high convergent-low divergent, low convergent-high convergent and low

convergent-low divergent groups to instruction in the generation of
questions, facts and statements of evidence as measured by the
Historical Photographs Test: hypotheses four to six.

3) The ability of the sexes within the high convergent-high
divergent, high convergent-low divergent, low convergent-high divergent
and low convergent-low divergent groups to generate questions, facts
and statements of evidence as measured by the Historical Photographs
Test: hypotheses seven to ten.

The analysis for each subgroup will be reported and commented
upon in turn. Totals of scores on the generation of questions,
facts and statements of evidence as measured by the Historical
Photographs Test will be included in the analysis for each subgroup.

The Ability of the Groups to Generate Questions, Facts and Statements of Evidence

The analysis of covariance revealed significant differences
among the groups in their ability to generate questions and facts as
measured by the Historical Photographs Test. A significant difference
emerged, also, among the groups on totals. Table 8 summarizes the
differences which appeared.

Hypothesis 1

The analysis of covariance, when applied to Hypothesis 1, as
stated on page ten, showed a significant difference among the groups
in their ability to generate questions as measured by the Historical

Table 8

Summary Table of Analysis of Covariance.
Significance Tests of Differences among the Four Study Groups
on Questions, Facts, Statements of Evidence and Totals
(N = 105)

Source	SS	df	MS	F	P
Questions	44.15	3	14.71	3.74	.01*
Facts	39.94	3	13.31	3.31	.02*
Evidence	11.19	3	3.73	2.48	.06
Totals	162.62	3	54.07	3.92	.01*

*Significant < .05

Photographs Test. The unadjusted means, variances and standard
deviations are reported in Table 9. The significant F ratio of 3.74
prompted additional analysis of the means through the use of the
Scheffé multiple comparison technique, which may be used for testing
mean differences after analysis of covariance. The results of the
multiple comparisons procedure are shown in Table 10. The significant
difference was shown to lie between the low convergent-low divergent
and the low convergent-high divergent groups.

Hypothesis 2

The analysis of covariance (Table 8), when applied to
hypothesis 2 as stated on page ten, showed a significant difference
among the groups in their ability to generate facts as measured by
the Historical Photographs Test. The unadjusted means, standard
deviations and variances are reported in Table 11. The significant F
ratio of 3.31 indicated the need for further analysis through use of
the Scheffé multiple comparison technique to ascertain the location
of the difference. Table 12 reports the results of the multiple
comparisons analysis. The multiple comparisons technique indicated
that the significant difference lay between the low convergent-low
divergent and high convergent-high divergent groups.

Hypothesis 3

The application of the analysis of covariance (Table 8) to
Hypothesis 3, as stated on page eleven, revealed that there was no
significant difference among the groups in their ability to generate

Table 9

Unadjusted Means, Standard Deviations and Variances for the
Four Study Groups on Questions
(N = 105)

Group	Mean	S.D.	Variance
High Convergent-High Divergent	5.69	1.89	3.59
High Convergent-Low Divergent	5.11	2.08	4.33
Low Convergent-High Divergent	6.38	2.17	4.72
Low Convergent-Low Divergent	4.38	2.12	4.53

Table 10

Adjusted Mean Differences among the Four Study
Groups on Questions
(N = 105)

		H.Con.- H.Div.	H.Con.- L.Div.	L.Con.- H.Div.	L.Con.- L.Div.
	MEAN	4.25	3.76	5.02	3.19
High Convergent-High Divergent	4.25	0.00	.49	.77	1.06
High Convergent-Low Divergent	3.76	0.00	0.00	1.26	.57
Low Convergent-High Divergent	5.02	0.00	0.00	0.00	1.83*
Low Convergent-Low Divergent	3.19	0.00	0.00	0.00	0.00

*Significant $< .05$ level.

Table 11

Unadjusted Means, Standard Deviations and Variances
for the Four Study Groups on Facts
(N = 105)

Group	Mean	S.D.	Variance
High Convergent-High Divergent	6.12	2.16	4.67
High Convergent-Low Divergent	4.66	2.16	4.70
Low Convergent-High Divergent	5.16	2.52	6.26
Low Convergent-Low Divergent	3.36	2.07	4.29

Table 12

Adjusted Mean Differences Among the Four Study Groups
on Facts
(N = 105)

		H.Con.- H.Div.	H.Con.- L.Div.	L.Con.- H.Div.	L.Con.- L.Div.
	MEAN	3.58	2.57	2.85	1.90
High Convergent-High Divergent	3.58	0.00	1.01	.73	1.68*
High Convergent-Low Divergent	2.57	0.00	0.00	.28	.67
Low Convergent-High Divergent	2.85	0.00	0.00	0.00	.95
Low Convergent-Low Divergent	1.90	0.00	0.00	0.00	0.00

*Significant $< .05$ level.

statements of evidence as measured by the Historical Photographs Test.
The unadjusted means, standard deviations and variances are reported
in Table 13. The Scheffé multiple comparisons technique was applied
and Table 14 indicates the results. The F ratios calculated during
multiple comparisons technique indicated that a difference approaching
significance at the .05 level existed between the high convergent-high
divergent and the low convergent-low divergent groups. Table 15
reports the F ratios which were obtained.

Totals

The investigation examined the totals of scores on the genera-
tion of questions, facts and statements of evidence by the four study
groups, as measured by the Historical Photographs Test. The unadjusted
means, standard deviations and variances are reported in Table 16.

The analysis of covariance (Table 8), when applied to the
totals, indicated a significant difference among the groups. The
significant F ratio of 3.92 caused further analysis by means of the
Scheffé multiple comparisons technique to be undertaken, in order to
locate where the difference lay. Table 17 reports the results of the
multiple comparisons analysis. The multiple comparisons technique
indicated that the significant difference lay between the high
convergent-high divergent group and the low convergent-low divergent
group.

Table 13

Unadjusted Means, Standard Deviations and Variances
for the Four Study Groups on Statements of
Evidence
(N = 105)

Group	Mean	S.D.	Variance
High Convergent-High Divergent	3.45	1.14	1.31
High Convergent-Low Divergent	3.16	1.09	1.20
Low Convergent-High Divergent	3.11	1.27	1.63
Low Convergent-Low Divergent	2.33	1.43	2.05

Table 14

Adjusted Mean Differences Among the Four Study Groups
on Statements of Evidence
(N = 105)

		H.Con.-H.Div.	H.Con.-L.Div.	L.Con.-H.Div.	L.Con.-L.Div.
	MEAN	2.63	2.34	2.38	1.79
High Convergent-High Divergent	2.63	0.00	.29	.25	.87
High Convergent-Low Divergent	2.34	0.00	0.00	.04	.55
Low Convergent-High Divergent	2.38	0.00	0.00	0.00	.59
Low Convergent-Low Divergent	0.00	0.00	0.00	0.00	0.00

Table 15

F Ratios for Comparisons Among the Four Study Groups
on Statements of Evidence
(N = 105)

Group	F	P
High Convergent-Low Divergent vs. High Convergent-High Divergent	.22	.88
Low Convergent-High Divergent vs. High Convergent-High Divergent	.16	.92
Low Convergent-High Divergent vs. High Convergent-High Divergent	.003	.99
Low Convergent-Low Divergent vs. High Convergent-High Divergent	2.30	.06
Low Convergent-Low Divergent vs. High Convergent-Low Divergent	.72	.54
Low Convergent-Low Divergent vs. Low Convergent-High Divergent	.87	.45

Table 16

Unadjusted Means, Standard Deviations and Variances
for the Four Study Groups on Totals
(N = 105)

Group	Mean	S.D.	Variance
High Convergent-High Divergent	15.27	4.41	19.45
High Convergent-Low Divergent	12.94	4.07	16.64
Low Convergent-High Divergent	14.72	4.45	19.86
Low Convergent-Low Divergent	9.97	4.00	16.08

Table 17

Adjusted Mean Differences Among the Four Study
Groups on Totals
(N = 105)

		H.Con.- H.Div.	H.Con.- L.Div.	L.Con.- H.Div.	L.Con.- L.Div.
	MEAN	8.06	6.50	8.12	5.05
High Convergent-High Divergent	8.06	0.00	1.56	0.06	3.01*
High Convergent-Low Divergent	6.50	0.00	0.00	1.62	1.45
Low Convergent-High Divergent	8.12	0.00	0.00	0.00	3.07
Low Convergent-Low Divergent	5.05	0.00	0.00	0.00	0.00

*Significant < .05 level

Comment on the Investigation of Hypotheses 1-3

The significant and near significant differences which emerged
from the analysis lay between the high convergent-high divergent, high
convergent-low divergent and the low convergent-high divergent groups
on the one hand, and the low convergent-low divergent group on the
other.

It would appear that the most interesting information obtained
concerned the non appearance of differences. Under the conditions of
this study, it seemed that there was no significant difference among
the high convergent-high divergent, high convergent-low divergent and
low convergent-high divergent groups in their ability to generate
questions, facts and statements of evidence. This result would appear
to indicate that the majority of the sample had similar potential, at
least, to handle the three elementary inquiry skills which were
investigated.

One pattern emerged from the results which appeared to be
worthy of comment, though it was not statistically significant. The
adjusted mean scores of the low convergent-high divergent group were
consistently higher or virtually equal to the mean scores of the high
convergent-low divergent group. This result seemed worthy of comment
because the mean intelligence quotient of the low convergent-high
divergent group was lower than that of the other group. Table 18
incorporates a comparison of the performances of these groups.

Table 18

Comparison of the Mean Intelligence Quotients and Adjusted Mean
Scores on Questions, Facts, Statements of Evidence and
Totals of the High Convergent-Low Divergent and
Low Convergent-High Divergent Groups
(N = 36)

Group	$\bar{X}$I.Q	$\bar{X}$ Que.	$\bar{X}$ Fa.	$\bar{X}$ Ev.	$\bar{X}$ Tot.
High Convergent-Low Divergent	116.2	5.11	4.66	3.16	12.94
Low Convergent-High Divergent	97.9	6.38	5.16	3.11	14.72

The Response of the Groups to Instruction in the Generation
of Questions, Facts and Statements of Evidence

Difficulties exist in the statistical assessment of improvement.
Experience, apart from instruction, gained between the pretest and the
posttest, could have accounted for the response to the instruction, as
could experience prior to the investigation. A novelty effect could
have operated with regard to the instruction and the investigator who
supervised it. The wastage which reduced the control group to twelve
was a further difficulty.

Nevertheless, an important aspect of the study was to examine
the reaction of the groups to the instruction. An attempt was made to
administer the instruction as uniformly as possible. The investigator
supervised all the instruction to try to minimize differences in
presentation which would occur if a number of instructors had been
involved. The instruction booklet, which was self-administered by
the students, provided each group with the same material upon which
to operate.

It was decided to report the unadjusted mean scores for the
pretest and the posttest of each group on questions, facts, statements
of evidence and totals, and to discuss them in terms of any trends or
tendencies which appeared.

Hypothesis 4

Table 19 reports the unadjusted pretest and posttest mean
scores of the four groups on the generation of questions as measured by

Table 19

Comparison of Unadjusted Pretest and Posttest Mean Scores
of the Four Study Groups on Questions
(N = 105)

Group	$\overline{X}$ Pretest	$\overline{X}$ Posttest	Diff.
High Convergent-High Divergent	4.24	5.69	1.45
High Convergent-Low Divergent	4.22	5.11	.89
Low Convergent-High Divergent	4.27	6.38	2.11
Low Convergent-Low Divergent	3.75	4.38	.63

the Historical Photographs Test. This data was gathered during the investigation of Hypothesis 4 as stated on page eleven.

Hypothesis 5

The data gathered concerning the unadjusted pretest and posttest mean scores of the four groups on the generation of facts as measured by the Historical Photographs Test is summarized in Table 20. These scores are reported in connection with Hypothesis 5 as stated on page eleven.

Hypothesis 6

The unadjusted pretest and posttest mean scores of the four groups, as measured by the Historical Photographs Test, on statements of evidence appear in Table 21. This data has been compiled in connection with hypothesis 6, as stated on page eleven.

Totals

The investigation included an examination of totals scored by the four groups on the Historical Photographs Test. Mean totals for the pretest and the posttest are indicated in Table 22.

Comment on Hypotheses 4-6

The data in Tables 19-22 indicates that all groups increased their raw scores from pretest to posttest. Although the differences appear to be small, they should be assessed in relation to the pretest means. If this is done, some of the differences appear to be

Table 20

Comparison of Unadjusted Pretest and Posttest Mean Scores
of the Four Study Groups on Facts
(N = 105)

Group	$\bar{X}$ Pretest	$\bar{X}$ Posttest	Diff.
High Convergent-High Divergent	4.81	6.12	1.31
High Convergent-Low Divergent	4.16	4.66	.50
Low Convergent-High Divergent	4.66	5.16	.50
Low Convergent-Low Divergent	2.94	3.36	.42

Table 21

Comparison of Unadjusted Pretest and Posttest Mean Scores
of the Four Study Groups on Statements of Evidence
(N = 105)

Group	$\bar{X}$ Pretest	$\bar{X}$ Posttest	Diff.
High Convergent-High Divergent	2.81	3.45	.64
High Convergent-Low Divergent	2.83	3.16	.33
Low Convergent-High Divergent	2.50	3.11	.61
Low Convergent-Low Divergent	1.83	2.33	.50

Table 22

Comparison of the Unadjusted Pretest and Posttest Mean
Totals of the Four Study Groups
(N = 105)

Group	$\bar{X}$ Pretest	$\bar{X}$ Posttest	Diff.
High Convergent-High Divergent	12.51	15.27	2.76
High Convergent-Low Divergent	11.16	12.94	1.78
Low Convergent-High Divergent	11.44	14.72	3.28
Low Convergent-Low Divergent	8.52	9.97	1.45

important, even though they cannot be said to be statistically
significant. Since the totals represent the cumulative scores in the
pretest and the posttest, the differences revealed in Table 22 (Totals)
have been selected for comment.

Table 22 indicates that the low convergent-high convergent
group registered a higher unadjusted gain than the high convergent-low
divergent group. The low convergent-high divergent group registered,
also, an unadjusted gain comparable to the high convergent-high
divergent group. These results could be important because the two
groups containing students of high convergent thinking ability had
higher mean intelligence quotients than the low convergent-high
divergent group.

The Control Group

The final composition and size of the control group caused
difficulties in using it effectively. However, an experimental group
containing members of the four study groups proportional to their
representation in the control group was selected randomly from the
students who had taken the instruction. The unadjusted mean total
scores of the two groups in the pretest and the posttest are reported
in Table 23.

There appears to have been a tendency for the experimental
group, which received instruction, to register a higher unadjusted
gain than the control group, which did not receive instruction.

Table 23

Comparison of Unadjusted Mean Total Scores in the Pretest
and Posttest of the Control and Experimental Groups
(N Control = 12   N Experimental = 48)

Group	$\bar{X}$ Pretest	$\bar{X}$ Posttest	Diff.
Control	12.33	12.58	.25
Experimental	11.16	13.50	2.34

The Ability of Females and Males Within each of the Groups
to Generate Questions, Facts and Statements of Evidence

Analysis of covariance was applied to the scores of females and
males within each of the groups on questions, facts, statements of
evidence and totals. Tables 24-27 report the results of the analysis of
covariance with respect to hypotheses 7-10 as stated on pages eleven
and twelve.

Comment on Hypotheses 7-10

The significance tests indicated that there were no significant
differences between females and males in their ability to generate
questions, facts and statements of evidence.

DESCRIPTIVE ANALYSIS

This section incorporates a report on the actual responses of
the students to the Historical Photographs Test. The report notes
specifically the cases where pretest or posttest responses are being
discussed. The remarks made in this section apply to Question 1 as
posed on page twelve. The section has been divided into three sub-
sections dealing with questions, facts and statements of evidence.

Questions

The pretest required the students to generate questions which
the photograph of men laying the railroad could help to answer.
Therefore, only those questions which could be answered partially at
least from the photograph were categorized as valid. However, a number

Table 24

Summary Table of Analysis of Covariance.
Significance Tests of Differences Between Females and
Males in the Four Study Groups on Questions
(N Females = 44   N Males = 61)

Source	SS	df	MS	F	P
Questions: High Convergent-High Divergent	1.74	1	1.74	.48	.49
Questions: High Convergent-Low Divergent	8.19	1	8.19	1.87	.19
Questions: Low Convergent-High Divergent	2.24	1	2.24	.61	.44
Questions: Low Convergent-Low Divergent	.40	1	.40	.095	.75

Table 25

Summary Table of Analysis of Covariance.
Significance Tests of Differences Between Females and
Males in the Four Study Groups on Facts
(N Females = 44   N Males = 61)

Source	SS	df	MS	F	P
Facts: High Convergent-High Divergent	2.71	1	2.71	.64	.42
Facts: High Convergent-Low Divergent	.19	1	.19	.052	.82
Facts: Low Convergent-High Divergent	2.55	1	2.55	.45	.50
Facts: Low Convergent-Low Divergent	.49	1	.49	.12	.72

Table 26

Summary Table of Analysis of Covariance.
Significance Tests of Differences Between Females and Males
in the Four Study Groups on Statements of Evidence
(N Females = 44   N Males = 61)

Source	SS	df	MS	F	P
Evidence: High Convergent-High Divergent	1.67	1	1.67	1.55	.22
Evidence: High Convergent-Low Divergent	.98	1	.98	.85	.36
Evidence: Low Convergent-High Divergent	.28	1	.28	.16	.69
Evidence: Low Convergent-Low Divergent	.77	1	.77	.36	.54

Table 27

Summary Table of Analysis of Covariance.
Significance Tests of Differences Between Females and Males
in the Four Study Groups on Totals
(N Females = 44   N Males = 61)

Source	SS	df	MS	F	P
Totals: High Convergent-High Divergent	18.43	1	18.43	1.16	.28
Totals: High Convergent-Low Divergent	13.11	1	13.11	.91	.35
Totals: Low Convergent-High Divergent	7.26	1	7.26	.59	.45
Totals: Low Convergent-Low Divergent	1.38	1	1.38	.01	.92

of responses which were invalid in terms of what the test asked the students to do, appeared worthy of comment because they were perceptive and of potential historical importance. The following lists contain some of the responses of this type which were produced by each of the groups in the pretest. These responses would appear to give some indication of the students' ability to generate questions prior to the instruction. The spelling in the responses has been edited.

High Convergent-High Divergent

What kind of work did lady pioneers do?

How many good and useful jobs were there in pioneer days?

How did they get to where they are?

What wages did they get?

Are most of the workers Chinese?

Could the men build a railroad as fast as we do today?

Did the pioneers get paid enough to make a living?

Were they working for the government?

Did those pioneers farm also?

Why were the train tracks raised higher than the ground?

When was the first train put in?

What was the major way of getting around?

What kind of cameras were used?

Did the railways face any tough competition against other ways of
travel?

Did it take more or less men than now to run an operation similar to
this?

Was the pay for doing this kind of work more or less than a job like

that these days?

Was it necessary to build railroads?

Did the pioneers like their work?

High Convergent-Low Divergent

What was the average pay?

How much pay did an engine driver or a fire stoker get?

What was the cost of travel in a train?

Were trains very popular then?

Why were the tracks up so high?

Why do you think this work had to be done?

Did they only have steam engines?

How much did it cost to lay rails?

How long did it take to make a railroad?

Did they mine in pioneer times?

Why is the locomotive behind the workmen?

How does the machine work?

Low Convergent-High Divergent

What age were the men when they started to work?

Did they get coffee breaks and lunch breaks?

What time did they start working?

What time did they finish working?

Did the pioneers use cement on their train tracks?

Did they get paid for their work?

Would the men get whipped if they didn't work?

Did black people have to work, or did the white, or did it matter?

About when did this take place?

Why are they doing this?

Where is the train going?

Did animals do some of the work?

Was it an easy or a hard life?

What cities were there?

What was the population of the cities?

What importance was this work?

Low Convergent-Low Divergent

Where did they get their lumber in pioneer times?

Did they have trained carpenters in pioneer times?

How long did they work on the project every day?

How much pay do they get a week?

Did the pioneers work for the government?

What did their houses look like?

How long does it take to make a train track?

Were the pioneers wealthy or poor?

Did the pioneers enjoy life?

Were some of the men farmers?

How old do you have to be to work at a train station?

Did they have phones in those days?

Were there many jobs for women?

These responses, though invalid in terms of the study, would have made quite an adequate basis for promoting discussion and inquiry skills. They would have provided, also, a chance to foster in the students a familiarity with the historical concept of change. Additionally, these types of questions could lead to the development of feeling for, and identification with, the past.

There did not appear to be any noticeable difference across the groups in the quality of the questions. This would appear to indicate that students within the usual range of ability at the sixth grade level, such as those who took part in the investigation, might be expected to generate useful questions when stimulated by historical data such as photographs.

The type of question which commences with "why" appeared very infrequently. However, it is felt that the type of data presented to the students and the instruction to ask questions which the photograph could help to answer militated against the generation of this type of question. Specific types of questions were not being sought. It would appear that the students had the general capacity to generate questions, and that thoughtful instruction could ensure that they would develop the ability to use a full range of questioning techniques.

An examination of the valid responses indicated that the students in the sample could assess the photographs in terms of the information that this type of data could supply. A sample answer from each of the groups is provided below. The samples of valid answers

were generated in response to the photograph of a sod house in the posttest. Responses from the posttest are used here because it is felt that they provided an indication of the students' ability after the benefit of instruction.

High Convergent-High Divergent

How did they build their homes?

What material did the pioneers use for building their houses?

What were some of the weapons the pioneers had?

What were some of the animals the pioneers had?

What kind of clothing did they wear?

Did the pioneers have fireplaces?

What were some of the animals the pioneers hunted?

High Convergent-Low Divergent

What is the house built of?

What kind of roof did they have?

Did they have any cattle heads lying around?

Did they have a stove in the cabin?

What kind of guns did they use?

Did the houses have doors?

Did they wear hats?

Were there any horses?

Low Convergent-High Divergent

Did the pioneers have weapons?

What was the weapon?

Is there anything that shows that they used the weapons?

Do you think that they had a stove in the house?

What is the house made of?

What equipment did they use?

Is the land mountainous?

Do you think that this house had any windows?

Low Convergent-Low Divergent

What are the houses made of?

What is the roof made of?

Is there a gun in the photograph?

Are the men young or old?

What is the chimney made of?

Some of these responses can be regarded as trivial. It should be remembered, however, that the students were operating within a very wide theme. This situation was created deliberately so that their general ability to formulate questions could be examined. Questions which seem trivial in such a general context could be much more relevant in a more specific situation. For example, questions about clothing and buildings could become extremely relevant when incorporated into a unit of work devoted to developing the concept of historical change by means of a study of clothing and other domestic items.

As with the invalid responses discussed above, these questions can be said to form a satisfactory basis for the development of inquiry

skills. They indicate that the students have the capacity to generate questions which can be answered by this type of data. The results appear to demonstrate that the students in the sample had the basic potential for developing the further skill of selecting data which could have relevance to a more specific topic than was used in the investigation.

An examination of the actual responses, both valid and invalid, left the overall impression that the students in this sample could generate useful questions from historical data such as photographs. The appearance of perceptive, though invalid, responses appears to indicate that students should be encouraged to range freely in their questioning, as well as being given practice in disciplining their queries in terms of the problem or theme with which they are dealing.

Facts

The test required the students to state facts about pioneer times in terms of what they saw in the photographs. Many of the facts reported were necessarily inconsequential. However, the results indicated that the students in the sample could discern what appeared to be facts from this type of data. A sample answer from each group is provided below. These responses were made in the pretest to the photograph of a man ploughing with three oxen.

High Convergent-High Divergent

Ploughing was hard work.

Oxen were used to pull a plough.

The pioneer had just started ploughing the land.

The land was flat and treeless.

The pioneer was setting up a farm.

The land had small bushes on it.

High Convergent-Low Divergent

The farmers used ploughs.

They used oxen to pull the ploughs.

They used a harness to attach the oxen to the plough.

There were lots of weeds on the land.

Black soil under the grass.

Flat land as far as you could see.

Low Convergent-High Divergent

The farmer is ploughing.

He is using oxen to pull the plough.

It is an old plough.

The field is very big.

The farmer is wearing a hat.

The farmer is pushing down on the plough.

There are three oxen.

The oxen are black.

Low Convergent-Low Divergent

There is not much good farming land.

Some pioneers had ploughs.

Some pioneers had oxen to pull their ploughs.

Some pioneers had dogs.

A sprinkling of responses from each group, but chiefly from the high convergent-high divergent group, indicated a tendency by some of the students to go beyond what was basically factual in terms of the data. Some of these responses are indicated below. The responses were made to the photograph in the pretest of a man ploughing with three oxen.

High Convergent-High Divergent

The pioneers had dogs to help them get the oxen moving.

The pioneer was setting up a farm.

The land wasn't too fertile.

The land was fertile.

The ground was hard to plough.

They worked hard all day.

One man had to do a whole field alone.

The animals did not like the hard work.

The dog ran beside the man and barked when the animals stopped.

The pioneers had a lot of land to choose from, but it took many a year to plough, grow and harvest their land.

The farmers depended much on their oxen for help on the farm.

Their work must have gone slow with the methods they used.

High Convergent-Low Divergent

The dog looks mean.

They must be tired.

The man must be strong.

The soil was rich.

Low Convergent-High Divergent

Some pioneers might have been rich.

Oxen were needed.

You had to have land to grow food.

Farmers grew food to sell and eat.

You had to have money to buy farm equipment.

It was long hours of hard work.

The soil was rich.

They had seeds.

The pioneers were poor people.

Low Convergent-Low Divergent

Each farmer would get up before the sun.

The skies in pioneer times didn't have pollution.

They were very good farmers.

They work from six in the morning to seven or eight at night.

The land was not very good.

It would take a long time to plough a big field with a pioneer's plough.

An examination of these responses indicates that students could

need training in assessing accurately the extent of the basic factual information provided by the type of data used in the investigation.

Contradictory statements, such as those concerning the wealth of the pioneers and the fertility of the soil, were produced. This would appear to indicate that students of the type involved in the investigation can create a basis for the development of the more advanced skill of establishing facts.

The overall impression gained was that these students could produce facts from the type of data used; that they might benefit from training in the skill of assessing accurately the factual content of data; and that they had the potential to progress to the more complex skill of establishing facts by examination and comparison of a number of pieces of data relevant to a selected piece of apparently factual information.

Statements of Evidence

An interesting feature of this section of the investigation was a tendency on the part of the students, especially in the pretest, to make statements of evidence which appeared to be illogical, though the overall meaning and intention of the statement was clear enough. The point, that this tendency appeared most strongly in the pretest, seems to be important because the pretest was an indication of the students' capacity and experience at that point in time. Although the test was structured in the sense that it explained how the responses were to be made, it was also unstructured in the sense that the students could put

whatever they considered relevant into either the statement or the
evidence sections of the response. These apparently illogical
statements of evidence appear to have been the students' natural style
of stating evidence.

In the pretest, students were asked to study a photograph of a
cavalcade of wagons, make statements of evidence about pioneer life, and
provide evidence from the photograph to support their statements. An
example from each of the groups of the type of response under discussion
appears below. The responses are concerned with pioneer transport.

High Convergent-High Divergent

They have horses pulling the wagons because they didn't have cars.

High Convergent-Low Divergent

They used horses and wagons because there were no cars in those days.

Low Convergent-High Divergent

Pioneers used horses because they did not have cars.

Low Convergent-Low Divergent

They had horses to pull the wagons because they didn't have cars.

It would appear that the logical statement to make would be
basically:

These pioneers did not have cars because they are using wagons.
The students appear to have used what they saw in the photograph as the

basis for their statements. They then used the inference which they drew from the data as evidence. The incidence of this type of evidential statement in connection with pioneer transport fell through the four groups. Examples from each of the four groups are provided below. The responses were made to the photograph of a cavalcade of wagons in the pretest.

High Convergent-High Divergent

They had horses pulling wagons because cars weren't around then.

They didn't have roads then because they didn't have cement then.

Proper roads could not be made because they didn't have the proper
  equipment.

Horses were used for pulling carriages because they didn't have motors.

People used horses because they had no cars.

The carts were pulled by horses because there were no engines then.

The carts had wooden and metal tires because rubber had not been
  invented.

High Convergent-Low Divergent

They used horses and wagons because there were no cars in those days.

They used horses to pull the wagons because they didn't have motors.

They used horsedrawn wagons because cars weren't invented yet.

They used horses to pull the wagons because they had no cars.

Pioneers used horsedrawn wagons because there are no cars or trains.

The wagons are following a trail because proper roads had not been made
  in pioneer times.

Low Convergent-High Divergent

Pioneers used horses because they didn't have cars.

Horses were used because they couldn't afford cars.

Pioneers travelled in wagons because cars had not been invented.

Everything was made of wood because steel and other metals were not that
popular.

Low Convergent-Low Divergent

The roads were bumpy in pioneer times because proper roads had not been
made then.

They rode in stage coaches in pioneer times because cars had not been
invented.

Horses pulled the stagecoaches because they never had motors or machines
to pull them.

They had dirt roads because the people did not have the right equipment.

This tendency would appear to suggest that the students in the
sample needed experience in making logical statements of evidence and
that it would be unwise to assume that students at the sixth grade
level have a grasp of this skill.

<center>SUMMARY</center>

Statistical Analysis

In general, a significant difference in ability to generate
questions, facts and statements of evidence emerged between the low

convergent-low divergent group and the other three groups.

No significant differences appeared amongst the high convergent-high divergent, high convergent-low divergent and low convergent-high divergent groups. It was felt that this result was noteworthy because the low convergent-high divergent group would be regarded, normally, as being of relatively low general ability according to the criterion of a conventional intelligence test.

An examination of unadjusted mean scores in the pretest and the posttest indicated that all groups appear to have responded in some degree to the instruction. The low convergent-high divergent group's performance was comparable to the performances of the high convergent-high divergent and high convergent-low divergent groups. Though the control group was not large enough to be fully satisfactory, the results obtained indicated that the instruction had had some effect on the performance of the experimental group.

No significant differences in the ability of boys and girls to generate questions, facts and statements of evidence emerged.

Descriptive Analysis

An examination of students' responses indicated that all groups could generate questions in response to data such as historical photographs. Both valid and invalid responses to this section of the study revealed an ability, across the groups, to generate useful and stimulating questions. The emergence of a number of invalid

responses would appear to demonstrate that some students at the sixth grade level could need experience in formulating questions relevant to data such as historical photographs, and, perhaps, other types of data as well.

The section on facts gave the impression that students of this type could produce facts from data such as historical photographs. At the same time, a need appeared for experience in assessing the basic factual content of this type of data.

A general difficulty appeared in the section on statements of evidence. Students tended to make statements incorporating what they saw in the photograph, rather than to employ this data as evidence. They also used the inferences which they drew from the data as evidence, rather than making these inferences the basis of their statements about pioneer life.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to present a summary of the study, the conclusions and implications which were drawn from it, and the recommendations which resulted from the conclusions.

Summary

The study was undertaken to investigate the ability of elementary school students, grouped according to convergent and divergent thinking abilities, to cope with three basic inquiry skills. These skills were the generation of 1) questions 2) facts and 3) statements of evidence. Students at the sixth grade level participated in the investigation.

A conventional intelligence test was used as the measure of convergent thinking. A word association test, scored for fluency, and an unusual uses test, scored for originality, were used as measures of divergent thinking. A pilot study indicated the feasibility of establishing groups on the basis of convergent and divergent thinking ability. The pilot study also indicated that the divergent thinking tests were suitable for sixth grade students and that the tests had some degree of reliability and face validity.

Four groups of students were established on the basis of convergent and divergent thinking ability. These groups were labelled

high convergent-high divergent, high convergent-low divergent, low

convergent-high divergent and low convergent-low divergent. A control

group containing members of each of these groups was established, but

wastage diminished it and rendered its components uneven.

The four study groups and the control group were subjected to

a pretest and a posttest which were based on historical photographs.

These tests were piloted and a degree of reliability, and also of

face validity, was established for them. The tests provided the

students with opportunities to demonstrate their ability to generate

questions, facts and statements of evidence. The four study groups

received instruction in the generation of questions, facts and

statements of evidence by means of an auto-administered instruction

booklet based on historical photographs. The control group was excluded

from the instruction.

Statistical analysis in the form of a one way layout analysis

of covariance was applied to the data produced by the four study groups.

The posttest scores were the basis for this analysis. The Scheffé

multiple comparisons technique was used to supplement the analysis of

covariance.

Ten hypotheses, stated in the null form, were proposed.

Hypotheses one to three proposed that there were no significant

differences among the four study groups in their ability to generate

questions, facts and statements of evidence. These hypotheses were

rejected because the analysis indicated that there was, in general, a

significant difference between the low convergent-low divergent group
and the other three groups in their ability to generate the three
elements of inquiry being investigated.

No significant differences emerged among the high convergent-
high divergent, high convergent-low divergent and the low convergent-
high divergent groups. The performance of the low convergent-high
divergent group was thought to be noteworthy. Since an intelligence
quotient test had been used as a measure of convergent thinking, this
group had a lower mean intelligence quotient than either of the high
convergent groups, yet its performance was comparable to that of the
other two groups.

Hypotheses four to six proposed that there were no significant
differences among the four groups in their ability to respond to
instruction in the generation of questions, facts and statements
of evidence. Because of the unsatisfactory nature of the final control
group and the difficulty of accounting for experience outside the study,
it was felt that the information received from the analysis was not
sufficiently adequate to allow decisions to be made on these hypotheses.

However, the mean raw scores in the pretest and the posttest
were examined. The results indicated that all four study groups had
responded positively. As with the results of the analysis of
covariance on ability with the skills, the performance of the low
convergent-high divergent group was comparable to the performances of
the two high convergent groups.

No hypotheses were made concerning the instruction itself.
Nevertheless, it could have had some effect on the posttest scores.
The control group was not regarded as fully satisfactory because of
the effects on it of wastage. However, this group's performance on the
pretest and posttest, when compared to that of an experimental group
selected from the four study groups, indicated that there was a tendency
for the experimental group, which took the instruction, to perform the
better. This assessment was made on the basis of raw score means.

Hypotheses seven to ten proposed that there were no
significant differences in the ability of boys and girls to generate
questions, facts and statements of evidence. No significant differences
emerged from the analysis of covariance and these hypotheses were,
therefore, accepted.

An examination of the nature of the actual responses of the
four study groups was undertaken. It was found that all groups had
generated useful and perceptive questions in response to the historical
photographs. There was, however, a tendency to ask interesting questions
which the data could not help to answer. All groups could discern
what appeared to be facts from the historical photographs. At the
same time many of the students displayed a tendency to go beyond the
basic factual content of the photographs. All groups displayed some
ability in the skill of giving evidential statements. However, a
difficulty with statements of evidence, general to the four groups,
emerged. Students tended to use as evidence the inferences they drew
from the historical photographs. These inferences did not appear in

the content of the photographs. It was felt that the inferences

should have been employed as the statement, judgement or opinion, and

that the evidence, or the reason for the statement, should have emanated

from the content of the photographs.

Conclusions and Implications

The conclusions which emerged from the study are best discussed

in the contexts of the theoretical framework of inquiry and the theory

concerning convergent and divergent thinking.

The results of the study indicated that the sixth grade students

who participated in the study demonstrated some ability to generate

questions, facts and statements of evidence when stimulated by material

such as historical photographs. This result would tend to support

those who argue that inquiry, decision making or valuing processes can,

and should, be taught to elementary students.

However, the responses showed that these students experienced

certain difficulties. They asked questions which were beyond the scope

of the photographs to answer. Their assessment of the factual content

of the photographs was often inaccurate. Their style of stating

evidence did not appear to be fully valid.

These aspects of the results would seem to suggest that caution

is necessary in the implementation of inquiry, decision making and

valuing processes at the elementary level. It could be argued, from

the results of this study, that the pupils who participated did not

have the ability to carry out independently effective inquiry or
valuing, because they did not display autonomous mastery over even
these very basic aspects of inquiry. Fenton (1966; 1967), for example
would argue that such mastery is essential for effective inquiry. The
results tended to support those who advocate continual practice in the
inquiry process by constant use of a model. The performances of the
students in the study seemed to indicate that they would need such
practice before becoming meaningful inquirers or decision makers.

The overall impression was to the effect that basic inquiry
skills can be taught to elementary students at the sixth grade level.
It was much less clear that these students could handle a full
inquiry process effectively. These impressions imply that teaching
strategies at the elementary level might be aimed at developing the
skills involved in inquiry rather than attempting to implement fully the
inquiry process. This is not to say that students who had been exposed,
throughout their elementary schooling, to carefully graded instruction
in the various skills could not implement an inquiry process by the
time they reached sixth grade. This situation could occur and
perceptive teachers would take advantage of it. The study suggests
caution in assuming that elementary pupils are ready to implement
inquiry without a deal of intensive preparation in the use of the
skills. This suggestion would apply particularly to elementary students
who are being introduced to the inquiry process for the first time.

In general, the students displayed a tendency to respond
positively to instruction in the skills investigated during the study.

This aspect of the results appeared to suggest that instruction in the skills would be profitable. The positive response to the instruction strengthened the main conclusion that the skills might be the appropriate focus of teaching strategies at the elementary level, rather than an inquiry process as a whole.

The question of the generalizability of the results arises at this point in two ways. The first concerns the actual results and the second concerns the type of stimulus used, that is, the historical photographs.

The degree of generalizability of the results rests, in large measure, upon the sample and the design of the study. The sample seemed to comprise a fairly usual group of sixth grade students. Their verbal intelligence quotients ranged from seventy to one hundred and thirty eight. They were of middle socio-economic status. The number in the sample was relatively small, but large enough, perhaps, to allow cautious expectation of a similar performance by a similar group under the same conditions as prevailed in the investigation.

The design of the study attempted to create conditions under which the basic abilities of the students could be examined. All groups being studied received a pretest and a posttest. All received the same auto-administered instruction. Teacher influence was reduced to a minimum by having the investigator supervise all instructional periods in a uniform fashion. It was felt that the students' basic abilities with the skills emerged to some degree under these conditions. Since

the sample appears to have been of a general type which occurs quite
frequently in urban areas, some generalization of the results concerning
ability, qualified by the overall limitations of the study, seems
reasonable.

Generalization from performance with historical photographs to
performance on other types of social studies data such as maps,
statistics or printed matter, is speculative. The photographs were
very easy to work from, because reading ability was not required.
However, these students encountered some difficulties in handling this
simple type of data. It might be argued that difficulties would also
occur with more complex material, and this point would reinforce the
impression that caution is needed when attempting to develop, in
elementary children, the ability to use a full inquiry process.

The groups were formed on the basis of convergent and divergent
thinking abilities. The results appear to support those who would
argue that divergent thinking ability is a factor in student
performance (Guilford; 1956, 1959; Getzels and Jackson; 1962, 1963;
Cropley; 1968, 1969). No significant difference emerged among the two
highly convergent groups and the low convergent-high divergent group.
Keeping in mind that the measure of convergent thinking used in this
study was a conventional intelligence test, it would appear that students
of relatively low intelligence, who have developed a degree of divergent
thinking ability, can handle some inquiry skills equally as well as
students of apparently higher intelligence. The result implies that
divergent thinking ability might have been a factor in the low convergent-

high divergent group's performance.

In general, there was a significant difference between the performance of the low convergent-low divergent group and the performance of the other three groups. The low convergent-low divergent group formed about thirty-five percent of the sample. The result would appear to suggest that teachers might allow for this difference when preparing instructional strategies for teaching inquiry skills. The proportion suggests that there may be at least two broad levels of ability to cater for.

A further implication concerns the knowledge that teachers should possess of the characteristics of their students. It seems that it could be useful for teachers to have some knowledge of their students' abilities in divergent thinking, as an aid in planning instructional strategies pertaining to inquiry. It may well be that deficiencies in this ability should be diagnosed and remedied by appropriate pupil activity.

Recommendations

The conclusions pointed to a number of recommendations for further research.

1) In spite of the difficulties which students experienced during the study, it was clear that a potential to benefit from teaching which focusses on inquiry skills had been demonstrated. It is suggested that development of teaching strategies which concentrate

on the various inquiry skills, or combinations of skills, should
continue.

2) Allied to the recommendation for continuing research into
appropriate teaching strategies is a recommendation concerning materials.
It would appear that a wealth of material is necessary for effective
development of inquiry skills in social studies. This investigation
used historical photographs. Ideally, however, students should practice
inquiry skills on a great variety of media. Development of such
materials would seem to be a most important element in the teaching of
beginning skills, combinations of skills and, finally, whole inquiry
models. It is suggested that research aimed at the development of
these sorts of materials should continue.

3) There is scope for further research into the abilities
of elementary children with the various inquiry skills. The more
complex skills, such as hypothesizing and generalizing might be
investigated in connection with grades three to six, for example.

4) Research into creativity and divergent thinking should
continue. The development of a procedure for assessing divergent
thinking ability or creativity which would be suitable for general use
in elementary schools could be advantageous to teachers.

5) Research into possible differences in performance with
inquiry skills when using various types of social studies material such
as maps, printed matter and statistics would have an on-going value.

The conclusions also pointed to several recommendations of a general nature concerning the teaching of social studies at the elementary level.

1) Teachers of social studies should concentrate on developing inquiry skills until students gain sufficient expertise to engage in the use of full inquiry models. A graded development starting from individual skills and proceeding through combinations of increasing complexity would perhaps be a useful conceptualization of the process.

2) Teachers should be aware of the importance of thinking styles and the effects which these styles might have on students' performances.

3) When engaged in preparing instructional strategies to develop inquiry skills, teachers might keep in mind that at least two broad levels of student ability might be involved, and plan accordingly.

4) Elementary students at the sixth grade level, at least, seem to have the potential to benefit from instruction in inquiry skills.

5) It would appear that some students of relatively low intelligence, as measured by conventional intelligence quotient tests, can cope with some of the basic inquiry skills. Teachers should be able to capitalize upon such knowledge.

The thrust of the study was directed towards the practical performance of a fairly common, heterogeneous group of sixth grade students with three very basic inquiry skills. It was felt that the study provided useful insights into possible connections between their

styles of thought and their capabilities with the skills. The development in individuals of the ability to inquire, as a basis for effective valuing and decision making, seems to embody one of the more promising means of coping with the increasing rapidity of social change. Insights of the type produced by the study seem to be valuable as aids towards more effective teaching of inquiry methods in elementary schools.

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APPENDICES

APPENDIX A

APPENDIX A

NAME _____ GRADE _____ DATE _____

WORD ASSOCIATION

Listed below are twenty-five words that have more than one meaning.

In the space following each word, you should write down as many different

meanings as you can for that word. The meanings need not be written

out in full. Writing down one word, or a short phrase, will usually

do. For example:

BARK   tree,   dog,   seal,   boat

These four words bring to mind three different meanings for the word

BARK: the outer covering of a tree; a noise made by some animals like

dogs and seals; and a kind of boat. Notice that the meanings were not

written out in full. Only some words to remind us of these meanings

were given. This is all you have to do. When you are sure of what

you have to do, you may begin.

1)	ARM	2)	BIT
3)	BOLT	4)	CAP
5)	COIL	6)	DUCK
7)	FAIR	8)	FAST
9)	FILE	10)	GRAVE
11)	HOST	12)	LEAF
13)	MORTAR	14)	PINK
15)	PITCH	16)	PLANE
17)	POKE	18)	POLICY
19)	PORT	20)	PUNCH

21) RAKE   22) SACK

23) STRAND   24) TACK

25) TENDER

NAME _____ GRADE _____ DATE _____

UNUSUAL USES

Listed below are five objects. Write down as many different uses as
you can for each object. A few examples are given in each case. You
will have about fifteen minutes. Be sure to write down some uses for
each object. Write down anything that comes to mind, no matter how
strange it may seem.

BRICKS   Build houses, doorstop

PENCILS   Write, bookmark

PAPER CLIPS   Clip paper together, make a necklace

TOOTHPICKS   Clean teeth, test cake

SHEET OF PAPER   Write on, make an aeroplane

APPENDIX B

APPENDIX B

PRETEST: QUESTIONS, FACTS AND STATEMENTS OF EVIDENCE

PIONEER TIMES IN ALBERTA

Here is a photograph taken in pioneer times.

Look at the photograph carefully and try to think of as many answers

as you can to the following question:

WHAT QUESTIONS ABOUT PIONEER LIFE COULD BE ASKED AND ANSWERED FROM WHAT

YOU CAN SEE IN THIS PHOTOGRAPH?

An example of a question which could be asked and answered from the

photograph is:

WHAT KIND OF WORK DID SOME PIONEERS DO?

REMEMBER, you do not need to answer the questions you think of.

All you have to do is think up as many questions as possible.

Write your questions in the space below.

Here is another photograph taken in pioneer times.

Look at the photograph carefully and follow the instruction below:

FROM THIS PHOTOGRAPH, WRITE DOWN AS MANY FACTS AS YOU CAN ABOUT PIONEER

LIFE.

A FACT is anything you can see to be true from looking at the photo-

graph.

An example of a FACT from this photograph is:

SOME PIONEERS WERE FARMERS.

REMEMBER, write as many facts as you can from the photograph.

Write your facts in the space below.

Here is another photograph taken in pioneer times.

Look at the photograph carefully and follow the instruction below:

FROM THIS PHOTOGRAPH, MAKE AS MANY STATEMENTS AS YOU CAN ABOUT PIONEER

TIMES.

GIVE A REASON, WHICH CAN BE SEEN IN THE PHOTOGRAPH, FOR EACH STATEMENT.

An example of a statement with a reason from this photograph is:

PROPER ROADS HAD NOT BEEN MADE IN PIONEER TIMES BECAUSE THE WAGONS
                (Statement)
ARE FOLLOWING A TRACK OR TRAIL.
        (Reason)
REMEMBER, write as many statements and reasons as possible.

Write your statements and reasons in the space below.

1) Statement

    Reason

2) Statement

    Reason

3) Statement

    Reason

4) Statement

    Reason

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POSTTEST: QUESTIONS, FACTS AND STATEMENTS OF EVIDENCE

PIONEER TIMES IN ALBERTA

Here is a photograph taken in pioneer times.

Look at the photograph carefully and try to think of as many answers as

you can to the following question:

WHAT QUESTIONS ABOUT PIONEER LIFE COULD BE ASKED AND ANSWERED FROM WHAT

YOU CAN SEE IN THIS PHOTOGRAPH?

An example of a question which could be asked and answered from the

photograph is:

WHAT KIND OF TRANSPORT DID SOME PIONEERS USE?

REMEMBER, you do not need to answer the questions you think of. All

you have to do is think up as many questions as possible. Write

your questions in the space below.

Here is another photograph taken in pioneer times.

Look at the photograph carefully and follow the instruction below:

FROM THIS PHOTOGRAPH, WRITE DOWN AS MANY FACTS AS YOU CAN ABOUT

PIONEER LIFE.

A FACT is anything you can see to be true from looking at the

photograph.

An example of a FACT from this photograph is:

SOME PIONEER BUILDINGS WERE MADE OF TIMBER.

REMEMBER, write as many facts as possible from the photograph.

Write your facts in the space below.

Here is another photograph taken in pioneer times.

Look at the photograph carefully and follow the instruction below:

FROM THIS PHOTOGRAPH, MAKE AS MANY STATEMENTS AS YOU CAN ABOUT PIONEER

TIMES.

GIVE A REASON, WHICH CAN BE SEEN IN THE PHOTOGRAPH, FOR EACH STATEMENT.

An example of a statement with a reason from this photograph is:

SOME PIONEER BUILDINGS WERE LARGE BECAUSE A TWO-STORIED BUILDING CAN BE
(Statement)   (Reason)
SEEN.

REMEMBER, write as many statements and reasons as you can.

Write your statements and reasons in the space below.

1) Statement

    Reason

2) Statement

    Reason

3) Statement

    Reason

4) Statement

    Reason

APPENDIX C

APPENDIX C

INSTRUCTION BOOKLET

TO THE STUDENT

A great deal of research is being done at Universities to try to find
out how students like yourself learn. One important question is: Can
students learn in the same ways that grown-ups do? By doing these
exercises you will be helping answer this question. The work you do in
these exercises will <u>not</u> be used for report cards or grades. We are
interested in all of your answers, even if you are not quite sure they
are correct.

In this booklet you will be asked to work in much the same way as
<u>historians</u>. <u>Historians</u> try to find out about what happened in the
past. One way they do this is to study old photographs. You will be
asked to complete three of the many tasks historians perform:

(1) Suggest problems that photographs taken long ago might help
    historians solve.

(2) Examine photographs and make lists of facts.

(3) Make statements about pioneer life and give the reasons for making
    such statements.

In this booklet there are three photographs for you to study. All the
photographs are about pioneer times in Alberta. You will have a short
lesson about each photograph. In each lesson, you should look at the
photograph carefully and then answer the questions. Do not worry about
spelling. We are more interested in your ideas than your spelling

ability. At the end of each lesson we will discuss your answers.
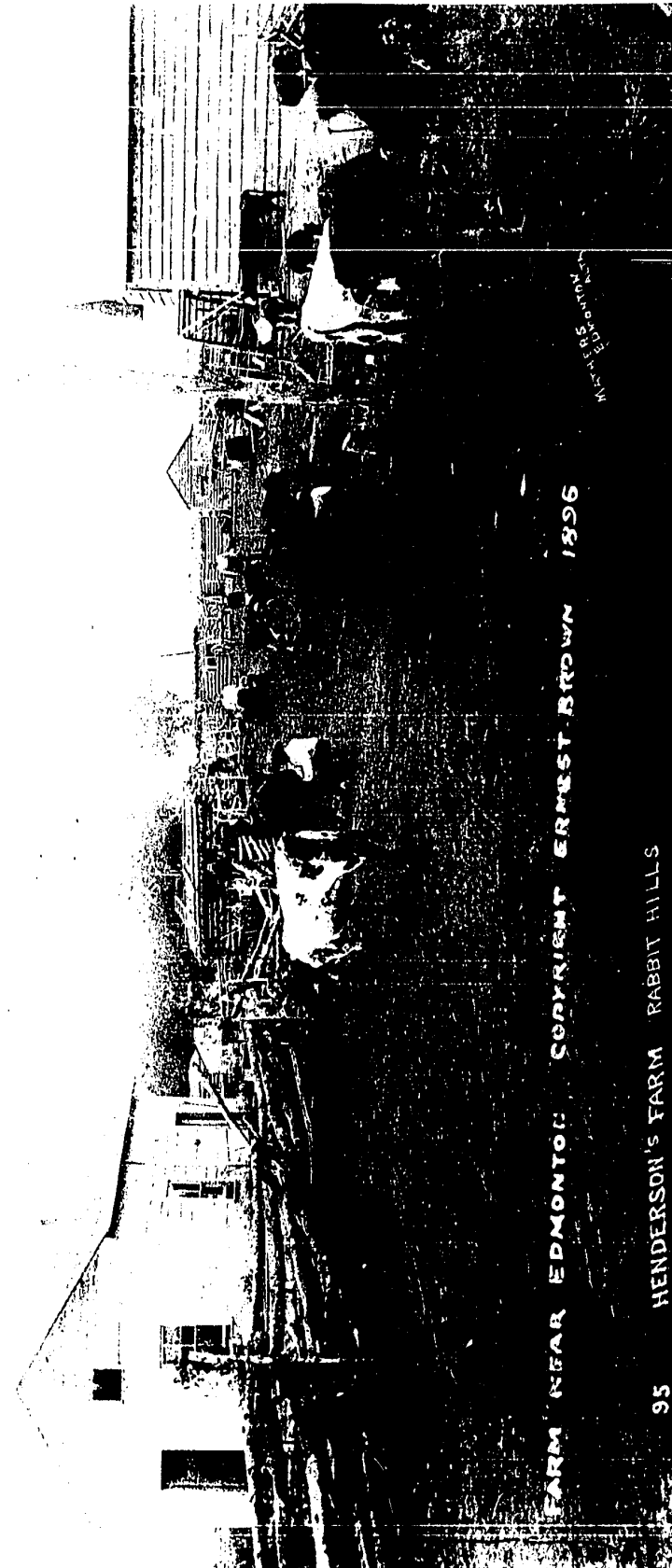
FARM NEAR EDMONTON: COPYRIGHT ERNEST BROWN 1896

95   HENDERSON's FARM   RABBIT HILLS

LESSON I

1. What are the buildings made of?

2. How were the fences made?

3. What jobs are some of the people doing?

4. Can you say anything about the countryside from looking at the photograph?

5. How did these people make a living? Give reasons for your answer.

6. What tools or equipment would these people use? Give reasons for your answer.

7. Would there have been other animals on the farm besides those in the photograph? Give reasons for your answer.

8. Write down some questions which an historian might ask about the past and which this photograph might help to answer.

LESSON 2

1. What kinds of animals can you see?

2. What tools and equipment did these pioneers use?

3. Can you say anything about the countryside from looking at the photograph?

4. Which of the animals might be of most value to the farmer? Give reasons for your answer.

5. What kinds of transport did these people use? Give reasons for your answer.

6. Does the countryside look as if it is used for growing crops? Give reasons for your answer.

7. Do you think the pioneers had easy lives? Give reasons for your answer.

8. Write down some questions which an historian might ask about the past and which this photograph might help to answer.

LESSON 3

1. What is the building made of?

2. What tools and equipment did these pioneers use?

3. In what way is the countryside different from the other two photographs?

4. Where do you think the materials for the building came from? Give reasons for your answer.

5. Where was the cooking done? Give reasons for your answer.

6. Can you tell from the photograph if these men were farmers of some kind? Give reasons for your answer.

7. If the men in the photograph were farmers, what kind might they be? Give reasons for your answer.

8. Do you think the building was used all year round? Give reasons for your answer.

9. Write down some questions which an historian might ask about the past and which this photograph could help to answer.

LESSON 4

For this lesson you should use the three photographs in the booklet. Let us suppose that you are an historian. You are studying the problem: What sort of buildings did pioneers make? Write down all the facts you can obtain about this problem from the photographs.

Suppose you are studying the problem of the tools, equipment and transport that pioneers used. Write down as many statements as you can about this problem and give reasons for each statement.

By now you should be able to list a number of questions which the photographs could help to answer. Write down as many questions as you can.