THE UNIVERSITY OF MANITOBA

A SOCIAL STUDIES COMPUTER SIMULATION:

ALTERNATIVE TREATMENTS

WITH GRADE FIVE STUDENTS

by

IRMGARD PENN

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A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

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ABSTRACT

This thesis investigated how learning principles can be used in developing instructional materials for a computer-assisted instructional (CAI) simulation game. The study also investigated two alternative treatment methods of administerating the simulation to two grade five social studies classrooms.

A simulation game named "Amnesia" was designed and used to help teach Canadian social studies content to grade five students. Two intact classes were assigned randomly to treatment. Group A consisted of the simulation with one computer for the class. Group B received one computer for every two students. Treatment continued over a period of three weeks. Subjects completed an immediate posttest and a delayed posttest three weeks after the study.

The null hypothesis (1) was accepted when there were no significant differences in achievement between groups A and B on the immediate posttest. The null hypothesis (2) was rejected when significant differences were found on the delayed posttest of the two groups. The null hypothesis (3) was rejected when significant differences between the immediate and delayed posttest of Group A were found. The null hypothesis (4) was accepted when it was found that there were no significant differences between the immediate and delayed posttests of Group B.

The findings were that:

(a) the immediate mean scores were almost the same: Treatment A (23), Treatment B (24).

(b) the delayed mean scores were not the same: Treatment A (30), Treatment B (23)

(c) the immediate and delayed mean scores of Treatment A were not the same: immediate (23), delayed (30).

(d) the immediate and delayed scores of Treatment B were the same: immediate (23), delayed (23).

The software evaluation forms completed by the students and teachers were very positive. The students indicated they learned something new from the simulation as well as had fun. The teachers all indicated that the instructional materials were well-planned, well-organized, and motivated the students to learn.

This study showed how learning principles can be incorporated into a computer learning package to enhance students learning. Thus the recommendation to educators is that software learning packages should incorporate such learning strategies as (a) the use of graphics, (b) cueing, (c) randomization, (e) immediate feedback, (f) meaningful feedback and (g) opportunities for success, to improve student learning.

Chapter I

INTRODUCTION

This study explores the use of a computer simulation as an alternative method of presenting a social studies lesson at the grade five level. Two questions were addressed. First, is a computer simulation a useful educational tool for students and teachers when used as an adjunct to regular classroom instruction? The second question addressed in the study has to do with the number of computers used during lesson presentation. Is a lesson using one computer for an entire class as effective as a lesson presentation where every child in the class has a computer?

In order to explain the importance of these questions it is first necessary to place them in the wider context of computer-assisted instruction (CAI) in the classroom.

Context of the Study

In the last few years computer hardware has changed. Changes such as portability, compactness, expanded memory, and lower cost have made it possible for computers to be used in educational settings.

Prevalence. The bar graph in Figure 1, constructed with information obtained from a Canadian national survey (TVOntario, 1983), shows the number of computers located in schools in nine Canadian provinces in 1983. There were 1610 computers in schools in Manitoba in 1983. Figure 2 represents the findings of a survey completed in Manitoba (Educational Technology Program, 1987), showing that there were 7,063 computers in schools in Manitoba in 1987. This is a dramatic increase of 5,453 computers or 438% in four years in schools in Manitoba. With the high demand for computers, it seems likely that the trend toward increasing numbers of computers in Manitoba classrooms will continue. Manitoba has 7,063 computers for a population of one million, compared with Ontario's 12,000 computers for seven million population. Given the differences in population, the number of computers in Manitoba is really very high.

Impact. Computer hardware is of no use by itself. It is institutionally relevant software that makes computer hardware an attractive reality in the classroom.

Figure 1. Number of computers in Canadian schools in 1983 for all provinces except Quebec.

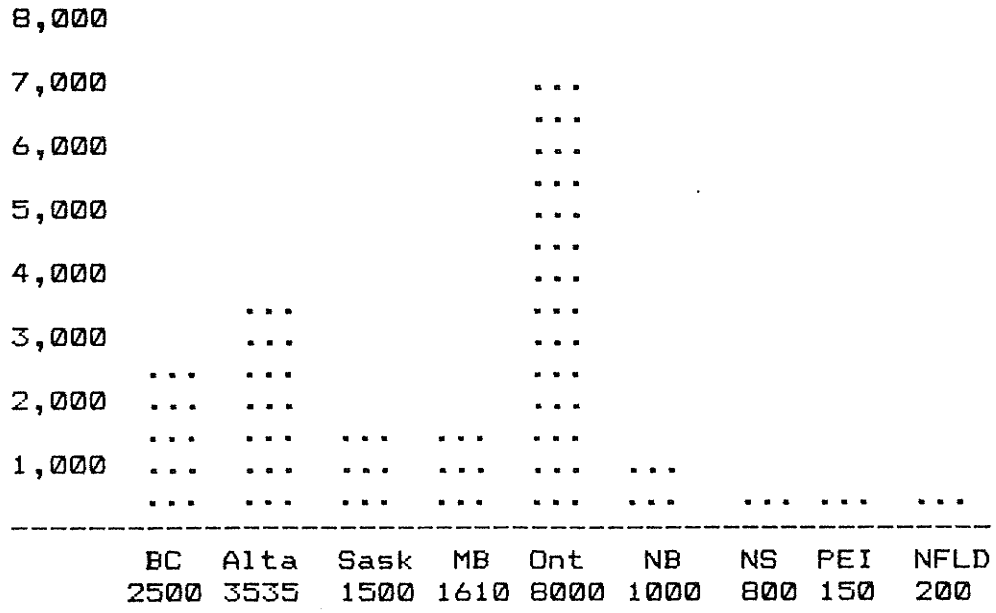
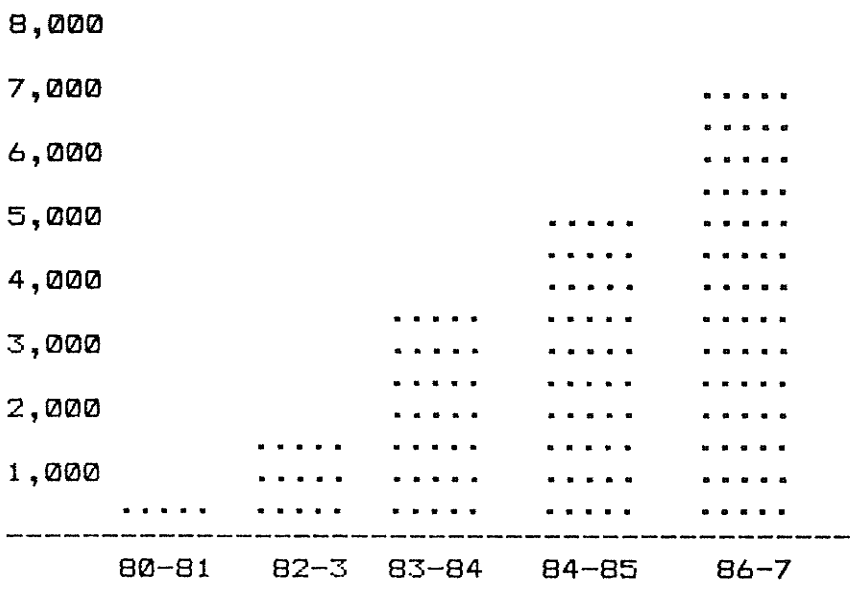


Figure 2. Number of computers in Schools in Manitoba from 1980 to 1987.



As computer usage increases in the classroom, it is important that teachers and school administrators know how to use computers and computer software effectively to benefit students. Using computers as an adjunct to teaching is one method of using computer software to clarify, explain and introduce lessons to students.

Computer-Assisted Instruction. CAI is one type of software that can be used as an educational setting. CAI can function in three ways in the classroom: (a) as an adjunct to teaching, (b) as a basic course where the computer functions as a tutor and all instruction is mediated by the computer, and (c) as a management system, where the computer provides accurate records of students mastery levels.

Simulations. Some researchers (Unwin, 1978; Thiagaragian and Stolovich, 1978) have argued that simulations, one category of CAI, have many educational benefits. A microcomputer simulation in an educational setting was chosen for this study in order to test some of the beliefs about this category of CAI. Several other categories of CAI are discussed in Chapter II.

Research has continued in order to find answers to the many questions raised by the techniques established by Pressey (teaching machines with immediate feedback), Chowder (branching programs) and Skinner (immediate feedback and positive reinforcement), (Kay, Dodd and Sime, 1968).

Baird (1986) and Norton and Resta (1986) found that computer simulations helped young students learn and remember better than students who did not receive CAI simulation. The young children's skills were also better.

The Social Studies. Researchers using simulations in social studies classrooms have reported that students had positive responses to computer simulations (Weible and McMahon, 1982). In addition, Hantula (1977) discovered that computer simulations motivated students at senior high school levels to learn about countries they might never visit. Kent (1982) found that pupil attitudes were very favourable in geography CAI classes where many students displayed great keeness and were enthusiastic enough to continue with the CAI during breaks and lunch times.

Computers have been and are being purchased by educational instutions in increasing numbers. It then becomes important to know how to use computers effectively in the educational setting. From the few studies completed using simulations in social studies classes, positive results have been recorded. Evidence such as that is encouraging educators to use computers in educational settings in new ways.

Purpose of the Study

The dramatic increase in computer equipment and software has resulted in problems pertinent to the adequacy of instructional software. The intent of the study was twofold. One main purpose was to apply proven learning principles in the development of computer-assisted instructional materials in the social studies. To test this purpose, the social studies computer simulation "Amnesia" was designed specifically for the grade five social studies curriculum.

The second purpose of the study was to investigate two methods of presenting a computer simulation. The two methods were: (a) one computer per class (Treatment A), and (b) two students per computer (Treatment B). The intent was to see if

there is a relationship between immediate and delayed measures of student achievement and method of lesson presentation when using a computer simulation in social studies at the grade five level.

The Research Questions

In order to achieve the purposes of this study the following questions were formulated:

1. How will grade five students social studies immediate test scores be affected in the following situations:

(a) the total class interacting with one computer and one simulation (Treatment A)?

(b) every two students interacting with one computer and one simulation (Treatment B)?

2. How will grade five social studies students delayed test scores be affected in the following two situations:

(a) the total class reacting with one computer and one simulation (Treatment A)?

(b) every two students interacting with one computer and one simulation (Treatment B)?

3. How will grade five social studies students immediate test scores from both treatment groups compare with delayed test scores from both

treatment groups?

4. How will the students, and their teachers, evaluate the social studies computer simulation lesson?

The Null Hypotheses

To find the answers to the preceeding questions the study was designed to permit the testing of the following null hypotheses:

HØ1: There will be no significant differences between immediate test scores of students in Treatment A and students in Treatment B as measured by an objective test.

HØ2: There will be no significant differences between delayed test scores of students in Treatment A and students in Treatment B as measured by a delayed objective test.

HØ3: There will be no significant differences between immediate and delayed test scores of students in Treatments A as measured by objective tests.

HØ4: There will be no significant differences between immediate and delayed test scores of students in Treatment B as measured by objective tests.

Limitations of the Study

The limitations of the study identified in Chapter 4 are the following: Threats to internal validity (a) history, (b) differential selection of subjects, (c) maturation, (d) testing, (e) instrumentation, and (f) mortality. Threats to external validity explained are: (a) selection-treatment interaction, (b) reactive effects, and (c) specificity of variables. The results of the study should be viewed in the context of these limitations.

Significance of the Study

Several factors contribute to the educational significance of the study:

1. Instructional materials for grade five social studies were developed using proven learning principles. A description of this process may assist future software development efforts in this area.

2. Two methods of CAI lesson presentation (Treatments A and B) were compared, using students test scores. This comparison may help schools decide how many computers to buy and how to effectively utilize the computers they now have.

3. Information on the impact of computers in

the educational system at the grade five level was collected.

4. Information that may influence teachers to change social studies programs in upper elementary classes was collected.

Definition of Terms

For the purpose of this study certain terms are defined here:

(a) Amnesia: a computer simulation developed for this study to operate on the Apple IIe.

(b) CAI: computer-assisted instruction.

(c) Test score: the number of points received on each posttest when the test had been scored.

(d) Simulation: imitation of reality.

(e) Software: the written information used to present the simulation including the students workbooks, the teacher's manual, and the computer program.

(f) Students: refers to two classrooms of grade five social studies students in Treatment groups A and B.

(g) Test or posttest: objective tests prepared for this study.

(h) Treatment A: the total class interacting with one computer and "Amnesia".

(i) Treatment B: every two students in the class interacting with one computer and "Amnesia".

Organization of the Study

The organization of the study consists of the preliminary pages, five chapters, and appendices A to Q.

Chapter I introduces the context and purpose of the study, the research questions, the null hypotheses, the limitations of the study, the significance of the study, definitions of terms, and an organizational outline of the remainder of the thesis.

Chapter II includes the background, history of simulations, simulation games, educational research, CAI categories, graphics, social studies software, CAI production systems, software evaluation and chapter summary.

Chapter III includes the pilot study, the sample, measurement instrument, treatment schedule, and statistical procedures.

Chapter IV contains the results of the data, analysis of variance, Tukey's honestly significant differences, testing the hypothesis, limitations, item difficulty index, item discrimination index, standard error of measurement, student software

evaluations and chapter summary.

Chapter V contains the statistical analysis, general comments, implications and further considerations, and the conclusions.

Chapter II

REVIEW OF LITERATURE

A review of relevant literature related to the study is presented in this chapter. The literature reviewed includes those studies related to the development of this study and includes studies discussed under the following headings: (a) background, (b) history of simulations, (c) simulation games, (d) educational research, (e) CAI categories, (f) graphics, (g) social studies software, (h) CAI production systems, (i) software evaluation, and (j) summary. In each area of discussion previous research studies will be presented and then linked to the development of "Amnesia" and other characteristics of the study.

Background

In order to examine where and how learning theories have affected CAI in the present, it is important to investigate where some established beliefs may have originated. Since this study makes use of behavioral principles in CAI, it is important to examine the origins and principles

of behavioral psychology. Three main precursors to CAI are, (a) Pressey's teaching machines, (b) Skinner's teaching machines and (c) Chowder's branching programs.

Pressey. Kay, Dodd and Sime (1968) describe Sidney Pressey's teaching machine as being a labor-saving device used to supply the student with immediate feedback while the student was answering multiple-choice questions. The machine told the student immediately whether the answer selected from a list of alternatives was correct or incorrect. The simulation developed for this study, "Amnesia", uses the ideas of immediate feedback as established by Pressey.

Skinner. Skinner's experiments of the 1940's, performed primarily on animals, provided the information for his operant conditioning and reinforcement theories (Kay, Dodd & Sime 1968). Skinner used a teaching machine, such as described in Appendix A, to present students with linear programs containing a series of fixed frames presented in the same order for each student. Skinner's claim was that if a student received confirmation that his or her answer was correct immediately, then the probability of the student

giving that response in the future was increased. The design of "Amnesia" incorporates Skinner's theories of immediate feedback and positive reinforcement but expands his ideas by providing randomization. Questions, or frames, do not appear in the same order for each student, nor do the number of questions to be answered. The student is allowed to choose the number of questions to be answered and the questions are presented in a random order, rather than a fixed format. The "Amnesia" simulation game expands Skinner's linear programming presentations by providing information in the form of clues, in a random order. In these ways, immediate feedback and reinforcement are used but with added elements of randomization and individualization.

Chowder. Chowder's proposal that the student should have a wrong answer explained before attempting another question led to his branching programs (Kay, Dodd & Sime, 1968). If the wrong answer was given, an explanation was given before the same question was presented again. "Amnesia" builds onto Chowder's idea. When a student chooses the incorrect answer in the simulation game; a clue, or piece of information, is provided for the

correct answer. "Amnesia" also expands Chowder's idea by providing various sections in the program that depend upon knowledge learned from previous sections.

History of Simulations

Since the study focuses on a computer simulation game, it is imperative to define the term simulation, to trace the history of simulations, and to examine how simulation games have been used.

What is a simulation? Simulations have been identified as representations of real-world situations. Rooze (1983) defines simulations as being designed to describe real world phenomena. Gredler (1986) explains that simulations imitate some aspect of reality.

Simulations can be traced to China over 5,000 years ago, where the first simulation used, was a war game called "weich' i" (Thiagaragian and Stolovich, 1978). In fifth century India, chess was played as an attempt to simulate battles between nations.

During World War II, pilots were trained on plane simulators (Parish, 1969). Maidenment and Bronstein (1973) report that computer simulations

were first used as an integral part of national security (Maidenment and Bronstein, 1973).

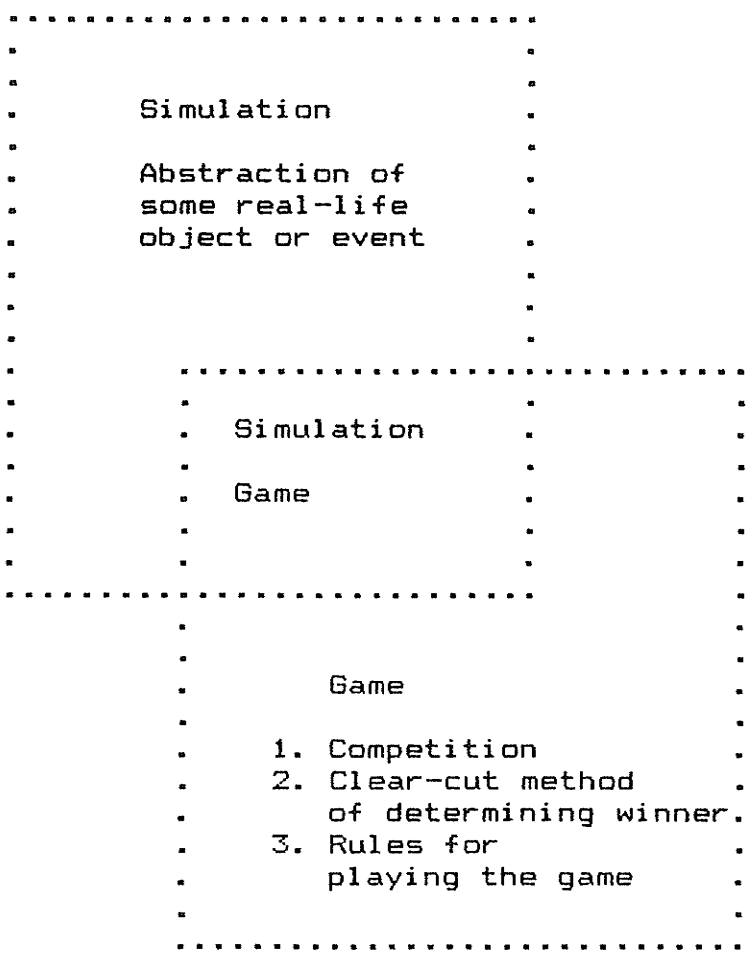
Simulation Games

Walford (1969) defines a simulation game as a simplified version of reality. Figure 3 shows how a simulation game could be diagramed with the components of a game and the characteristics of a simulation.

Simulation games are not a new teaching aid technique. The Madingly Conferences began the London Schools Geographical Group, which began to discuss the idea of using models in geography. One strand of the Madingly approach was to emphasize the importance of models to geographers. Models allow some aspects of the real world to appear in some generalized form (Walford, 1969). The term "model" is used more specifically to describe a range of simulation techniques such as case studies, role playing and computer simulations (Walford, 1969).

Simulations were first used in geography classes in the American school system. One of the most important elements of simulation games in schools was the American High School Geography

Figure 3. A simulation game is the combination of a simulation and a game.



Project (AHSGP) in the middle 1960's (Walford, 1969). AHSGP had a big influence on the United Kingdom, Australia in particular, in getting social studies teachers to think about using simulation games.

Types. The two types of simulation games, non-computer and computer simulation games, can be either educational or non-educational. An example of a non-computer simulation game is the popular game of "Monopoly". An example of an educational non-computer simulation game is "Elements", a board game designed to teach chemistry students the basics of the periodic table. (Thiagaragian, S. and Stolovich, H., 1978).

Skills. Simulation board games became very popular with teachers in the early 1950's. Teachers adopted simulations as an alternative teaching method, believing that simulations produced a superior learning environment for students (Unwin, 1978). For example, simulation games have been used to teach skills such as socialization and decision-making (Rooze, 1983). A list of skills attributed to simulations are listed in Table 1.

Table 1
Skills thought to be acquired from
Computer Simulation Games

Skill	Researcher
1. Analytical Skills: Students learn to analyze feedback, ask "what if"	Poll (1983) Rooze (1983) Miller (1984)
2. Attitudes change: Students gain empathy for real-life events	Poll (1983) Copeland (1984)
3. Basic skills: learn about specific facts	Turner (1982) Norton & Resta (1986)
4. Cognitive skills: Learn higher order skills like judgement evaluation	Miller (1984) Grover (1986) Trimble (1986)
5. Commitment: Once a game is started it is rarely left unfinished	Milner (1974) Weible and McMahon (1982)

(table continues)

Skill	Researcher
6. Decision Making: Success does not depend on memorized facts and information	Walford (1969) Miller (1984) Clements (1984)
7. Problem-Solving: Students learn to solve practical problems they may encounter in their life	Blanchaer (1983) Walford (1969) Turner (1982) Bell (1985)
8. Socialization: Through play, learn to interact with others	Walford (1969) Turner (1982) Vermette and Hall (1986)
9. Understanding: Students learn facts about the program	Rooze (1983) Weible and McMahon (1982)
10. Verbal Interaction: Students must use communication of ideas and opinions	Walford (1969) Poll (1983) Findley (1986) Turner (1982)

Advantages and Disadvantages. Rooze (1983) believes that the better computer simulations should involve active student participation, group co-operation, logical thinking, various levels or challenge, and visual stimulations. Simulations should allow application of skills, testing of student strategies, testing of student models and allow the student to ask "what if" questions (Rooze, 1983). Table 2 lists some advanages attributed to computer simulations. Table 3 shows some disadvantages attributed to simulations which may be relevant to educational simulation games.

Malone (1984) lists three characteristics a good simulation game must promote in the user: (a) challenge (b) fantasy, and (c) curiosity.

Challenge. For a game to be challenging, it must have a goal that is attainable, clear cut, and meaningful. Simulation games without a clear goal were found to be less motivating than games that had a goal (Malone, 1984). In addition, a simulation game should be difficult, but not impossible (Malone, 1984). An example of challenge used in a computer game is found in the simulation "The Great March West". The goal is to arrive at a destination alive.

Table 2

Advantages of Simulations

Advantage	Description and Researcher
1. Communication: skills	Simulations require 100% participation and involvement by students (Walford, 1969)
2. Compress time:	Years can take minutes Miller, 1984)
3. Consistency:	All students can engage at the same level of understanding (Miller, 1984)
4. Decisions:	Permit real-life decisions without suffering consequences e.g. legal action, ethical or economic (Walford, 1969)
5. Feedback:	Immediate feedback of decisions (Turner 1982, Hantula, 1977)
6. Motivation:	Motivated learning can spread to other classrooms (Walford, 1969; Maidenment and Bronstein, 1973)
7. New situations:	Dangerous experiments can be performed without actual damage (Thiagaragin and Stolovich, 1978)
8. Realistic	More realistic and relevant: presentations (Cousins, 1984)
9. Sense of importance:	Give students a sense that their actions have an impact in the world (Turner, 1982)
10. Success:	Give experience in coping with success and failure (Turner, 1982)
11. Teacher role:	Role of the teacher changes becomes facilitator (Maidenment and Bronstein, 1973)
12. Test hypotheses:	Learn to develop and test hypotheses (Copeland, 1984)

Table 3

Disadvantages of Simulations

Disadvantage	Description and Researcher
1. Availability:	Computer simulations have not been available for every area in the curriculum (Cohen, 1982).
2. Before and after:	Simulations need before and after activities (Turner, 1982)
3. Complexity:	Difficult to preview without playing them (Horn and Zukerman, 1980)
4. Interaction:	Can be threatening rather than motivating for students who do not enjoy social interactions (Maidenment and Bronstein, 1973)
5. Negative socialization:	Isolating and dehumanizing (Rooze, 1982)
6. Simplifications:	Reality may be far from the simulation and students receive an over-simplified picture (Rooze, 1983)
7. Time:	Before and after activities can take much time (Turner, 1982).
8. Measurement:	Difficulty of measuring learning (Walford, 1969)
9. Winning versus Learning	Winning rather than learning: may become the emphasis. (Walford, 1969)
10. Transfer:	The possibility that transfer does not take place (Walford, 1969)

Fantasy. Malone (1984) explains that two types of fantasies exist, extrinsic and intrinsic. Extrinsic fantasies are those in which fantasy depends on using a skill, but the skill does not depend on the fantasy. For example in the game "Arctic Paddle" (Class Software, 1985), an elementary drill and practice game, the student must answer the question correctly in order to make the kayak travel, but travelling has nothing to do with reaching the goal of getting the correct answers. Malone (1982) explains that instrinsic fantasies are the most interesting type of fantasies because they depend on a skill and the skill depends on the fantasy. Instrinsic fantasies are frequently used in computer games. For example, in a computer game called "Darts" (Malone, 1982), the skill of estimating distances is used. The player's goal is to pop the balloons and he or she can see if the answer was too high or low by looking at the graph on the screen.

Curiosity. Curiosity can be enhanced by providing novel or surprising environments through sound, music, color, change in color, animation, and graphics. Novel environments may be used as rewards, decorations, or as program enhancement.

Knowing about the background, history and characteristics of good simulation games was helpful when designing "Amnesia". Malone's suggestions that challenge, fantasy and curiosity be used in simulation games were adopted in the design of "Amnesia". "Amnesia" has a clear attainable, and meaningful goal; that of locating a designated Manitoba community. The goal in "Amnesia" is defined in the section "Learn about Amnesia", which can be accessed from the game menu. That section of the game challenges students to achieve the goal of winning the game. "Amnesia" also uses intrinsic fantasy, by using the student's knowledge to win. "Amnesia" uses a graphic map and cueing by flashing locations on the map. The map promotes and maintains sensory curosity in the way the clues are presented.

Rooze's (1983) analysis and list of skills attributed to simulation games, was used when designing "Amnesia". In "Amnesia", Manitoba is described as it actually exists in real life. Socialization skills, group co-operation, and other decision-making skills have been incorporated into "Amnesia" in the way it is presented to the class. In Treatment A the whole group must co-operate in

Table 4

Three Levels of Computer Applications and the Type of Learning Obtained

Type of learning	Software
1. "From" computers	CAI Drill and Practice Tutorial Simulations
2. "With" computers	LOGO Kidstuff Music Art (Koala Pad)
3. "About" computers	Computer Awareness Career aspects

making decisions. In Treatment B students must decide moves individually or in pairs. Students are allowed to ask "what if" questions and are able to try various theories within "Amnesia".

Trimble (1986) enthusiastically describes second generation software. In her opinion second generation software is characterized by several improvements and enhancements such as: (a) graphics, (b) packaging, and (c) the combination of many types of CAI into one program (Trimble, 1986; Grover, 1986). "Amnesia" has incorporated Trimble's suggestions of combining various types of CAI into one program. Trimble (1986) claims that educators teaching with better quality computer simulations, are not teaching "about" computers, but "with" computers (Trimble, 1986). Sandals' (1973) proposal that students learn "with", "from", and "about" computers supports Trimble's views. Table 4 lists the types of software appropriate for each type of learning. Trimble (1986) lists two main reasons for improvements in software, (a) microcomputers have improved, and (b) educational publishing houses have begun producing professional quality software.

Educational Research

What researchers say about CAI computer simulations and how simulations have been used in the educational system is discussed in this chapter. Educators and researchers are in disagreement over the role of CAI in education. Some see CAI playing a major role, others see CAI remaining much as it has over the last 10 years (Luehrman, 1982). Surprisingly little research has been completed in the area of simulations in education. A meta-analysis completed by Kulik, Bangert and Williams (1983), encompassing CAI from grades 6 through 12, found only five studies dealing with simulations. They found that students who were taught with the aid of computer simulations developed (a) positive attitudes toward computer, (b) gave favourable ratings to computer-based courses, and (c) improved their performance scores by approximately 10 points. This thesis fills the gap by providing an educational simulation study at the elementary level.

CAI versus programming. Clements and Gullo (1984), compared the affects of experiences in computer programming (using LOGO software) to experiences in CAI with six year old children. The

children's (a) cognitive style (reflective versus divergent thinking), (b) metacognitive ability, (c) cognitive development and (d) ability to describe directions were assessed. The results showed that the LOGO group did better on a posttest than a pretest on accuracy, fluency, originality and overall divergent thinking. LOGO groups required fewer probe questions and gave more accurate verbal descriptions than the CAI group. The researchers concluded that instruction in programming can increase some aspects of problem-solving with young children. This study has tried to build on the information known about programming LOGO. For example problem-solving techniques are used in a simulation at the elementary level.

Specifically designed CAI. Grover (1986) describes an experiment conducted at the elementary and kindergarten levels to determine what should be considered in cognitive software design. She investigated the ability of children to comprehend and learn from software designed in accordance with cognitive principles. The instructional design of the software considered five characteristics (a) graphics, (b) feedback, (c) cueing,

(d) opportunities for success and (e) personalization. The graphics, such as pictures of apples falling from a tree, were realistic renditions, intended to provide meaningful content to the student. Feedback was used to let the child know whether the correct answer had been chosen. The wrong answers were treated as salient information, while a small happy face appears for correct responses. Cueing was used to help children choose responses. Opportunities for success were in the cognitive programs. For example, from one to three successive errors were allowed before the correct answer was given. In addition, cognitive programs were personalized, using the child's name when possible. The cognitive software was compared with non-cognitive software using 134 preschoolers and grade one students from four schools. Grover found that children using cognitive simulations, produced higher scores than students using non-cognitive software at the kindergarten and preschool levels. Grover's study provided valuable information in designing "Amnesia" for this thesis. Graphics, cueing, reinforcers, feedback, and opportunities for success were all characteristics of the

software package "Amnesia". This study has built on the findings of Grover.

CAI versus traditional teaching. Steel, Battista and Krockover (1983) completed a one year comparison of CAI software and traditional teaching methods. The purpose of their study was to investigate the effect of CAI on the computer literacy of fifth grade students. Their instruments measured enjoyment, anxiety and achievement. They concluded that students using CAI on computers experienced a positive learning experience and that fears and anxieties about the computer were lessened. "Amnesia" was designed to provide an enjoyable experience using a simulation at the elementary level. Student evaluation surveys were used to obtain information about motivation and enjoyment.

Effective teaching strategy. The purpose of an experiment conducted by Weible and McMahon (1982) was to determine whether a computer simulation could be used as an effective teaching strategy in a social studies classroom. "The Great Depression", a social studies simulation game, developed by the researchers in order to extend student understanding of the late 1920's and

1930's, was used at the highschool level in Missouri. Working in groups of three per computer, the students manipulated personal investments in the early years of the depression. The group with the greatest number of assets at the end of the game won. Students had to select correct answers from a list of timed options. If a decision was not made in time, the opportunity to make a gain was lost. Weible and McMahon (1982) observed that students working in teams (each team worked independently making democratic decisions) worked intensely and enthusiastically throughout the simulation. Student responses on an evaluative questionnaire were overwhelmingly positive. "Amnesia" compares two student and whole class teams working with the same simulation to clarify Weible and McMahon's findings. In addition, "Amnesia" was designed as an educational simulation for elementary classes with Canadian content. As explained above, "The Great Depression" was used at the highschool level in Missouri.

Increasing awareness. Hantula (1977) has described how the computer helped increase students' awareness about another country through the simulation game "Concern". The simulation

included questions, graphics and instructions. When a question is answered correctly, a square is uncovered revealing a fragment of a graphic. Successive fragments are uncovered until a question is answered incorrectly. If a square is chosen that has already been selected, the player looses a turn. Hantula concluded that the game was very successful. He noted that many students may not have the opportunity to travel to distant countries. Nevertheless, they can learn about the country through computer games. He concluded that his students increased their understanding of a different culture. He argues that the computer simulations may provide an opportunity for social studies teachers to use an exciting machine in an educationally desirable way. "Amnesia" builds on Hantula's findings. However, the country visited in "Amnesia" is the student's own province. While Hantula's study involved highschool students "Amnesia" was used with elementary school students.

Method of presentation. Sherwood and Hasselbring (1986) compared sixth grade student achievement across three methods of presenting a computer simulation: (a) two students at one computer, (b) a class with one computer, and

(c) a non-computer class. All classes received the same science content with the simulation "Odell Lake" (Minneapolis Educational Computing Corporation, 1986). The method of the study was a posttest only, immediate and delayed. No statistically significant differences were found between the treatment groups, but there was a trend for higher scores for the total class presentation on the immediate posttest. Females did less well than males on multiple choice questions but performed better than males in the one computer class. Females performed better than males in the total class with computer but not as well as males in the paired computer group. Sherwood and Hasselbring's study was used as a template around which this study was fashioned. The methods used for the study incorporate immediate and delayed posttests as did Sherwood and Hasselbring (1986).

Although prospects for widespread computer applications in schools are readily apparent, teachers remain apprehensive (Vermette, Orr and Hall, 1986). Teachers may feel anxious and reluctant to use the technology. As research in the area of computers in education continues, new evidence such as cognitive software described by

Grover (1986), positive learning experiences described by Battista and Krockover (1983) and effective teaching strategy shown by Weible and McMahon (1982) is encouraging educators to use computers in new ways.

Even though few studies have been completed with educational computer simulations (Kulik, Bangart, and Williams, 1983) research has indicated that positive results have been obtained with computer simulations in educational settings (Battista and Krockover, 1983; Weible and McMahon, 1982; Hantula, 1977; and Sherwood and Hasselbring, 1986).

CAI Categories

The objective of this section is to discuss six categories of CAI: (a) drill and practice, (b) exploratory, (c) games, (d) problem-solving, (e) simulations, and (f) tutorials. Examples are provided for each category and the steps involved in using each type of software are outlined.

Drill and Practice. In this mode the computer is used for repetition, practice, and remediation. The purpose of drill and practice is to supplement regular instruction. Computer programs are used to drill students on facts and assist students in

practicing skills. Using drill and practice software involves the following steps: (a) A question appears on the screen. (b) The student reads and answers the question. (c) Immediate feedback and/or reinforcement is provided on the screen. (d) Then the same or another question apears on the screen, depending upon the student's answer.

Drill and practice software programs became popular in education during the early development of computer uses in education. Drill and practice CAI has been used in such curriculum areas as mathematics, language arts and spelling (Bell, 1985, Papert, 1982, Rooze, 1983). An example of a drill and practice program "Canwater" (Class Software, 1984) is based on lakes and rivers in Canada. The program is available for Apple IIe.

Exploratory. In the exploratory mode the learning experience is open-ended. It is generally associated with the computer language LOGO (Bell, 1982). LOGO involves moving the turtle, (a small triangle presented on the screen) to its "home" at the centre of the screen. In order to move the turtle, a command called a turtle command, must be given using the keyboard. The command causes the

turtle to move, hide or show itself. Through LOGO very young children are introduced to the tasks of computer programming. Cynthia Solomon (1976), explains how a five-year old child uses LOGO successfully.

Daniel Watt (1979) and Seymour Papert (1979) initiated grade six students explorations through LOGO. Their Brookline LOGO Project presents indepth case-studies of the possibilities or "powerful ideas" as Papert calls them, of the computer language LOGO. The belief is that the student acquires logical thinking skills in order to accomplish the goal of moving the turtle (Papert, 1980).

Games. The computer is used as a tool to present educational or non-educational material in an interesting or unique way. Computer games can be highly interactive. An example of a program using curiosity is "Fort Walsh" (Class Software, 1986) where players are presented with animation, still and moving graphics, and sound. "Fort Walsh" (Class Software, 1986) is an educational simulation game based on actual facts, exploring the history of western Canada. It is available for the Apple IIe, Commodore 64 and IBM.

Problem-Solving. Bell (1982) lists problem-solving as a separate CAI category. She describes problem-solving software as using previously learned skills in a new situations. Cohen (1985) suggests that through problem-solving software, the user is permitted to act as a teacher, or explorer of knowledge. For example in a computer software package called "Nomad" (Minnesota Educational Computing Corporation, 1981) the student must solve the directional problem before reaching a predetermined location.

A study completed by Elias (1985), examies computer programming as a problem-solving activity, among grade five students, using the language LOGO. Elias determined that LOGO has the potential for use in problem-solving tasks at the elementary level.

Milner (1974) suggests that through LOGO the student is allowed to work on his/her own way on problem-solving. He explains that using the computer for problem-solving simulates the way in which day-to-day problems are solved. Milner explains that there is no clear concrete method to analyze and evaluate whether a student who has used a computer for problem-solving is more able to

solve real-life problems. Milner (1974) says the following: (a) Computers can be used in areas where no other method can accomplish the same result. (b) The uniqueness of computers can be used to present important capabilities. (c) Sometimes the most economical way to present an instruction is with a computer.

Winner (1982) demonstrated how the computer may play a subordinate role to that of the classroom instructor and how problem-solving can be used to introduce new materials and collect data. He also argued that students may learn to think ahead by trying various plans to reach a desired goal.

Simulations. Simulations are based on real-life phenomen (Rooze, 1983). Computer simulations imitate some aspect of reality (Gredler, 1986) and are designed to describe real-life phenomenon (Bell, 1985). While many simulations are in the format of a game; they need not be a game. "Fail Safe" (Minnesota Educational Computing corporation, 1981) is an example of an educational microcomputer simulation game. The player takes the role of the president of the U.S.A. and has to make decisions, with the help of

eleven advisers, regarding a potential nuclear war.

Tutorials. In this mode new learning concepts are presented interspersed with questions. The types of questions can be multiple choice, true and false or completion. Tutorials are sometimes called branching programs because they route students to various exercises in the program depending on the reply of the student (Bell, 1982).

Using a tutorial involves the following steps: (a) Information is presented on the screen. (b) Questions about the concept are presented. (c) Immediate feedback is provided. It may be reinforcement for the correct or incorrect answers or it may be the answer to the question. (d) Depending on the student's response, the student is routed to a new concept, followed by questions, or the same concept, or the same concept but different presentation.

An example of a short tutorial is "Climate Graph Activity" (Class Software, 1986) curriculum fit for grade five geography and is available for the Tandy/Radio Shack.

Graphics

When considering computer capabilities, picture capabilities, or computer graphics cannot be over-looked because they are used with many CAI software designs. "Amnesia" uses a graphic map to help the students see the locations.

Deken (1983), describes 250 users of computer images. Some of these are: cartographers, architects, molecular biologists, pilots, doctors, sports people, and dancers. These professionals use computer images either to improve their service, learn more about things, or to train others.

Some contemporary artists such as Schwartz and Cohen (Deken, 1983) use computer technology to create their works. Lillian Schwartz describes herself as an artist who chooses to work with the technologies of her time. Harold Cohen uses a computer to draw abstract shapes and images on hudge canvasses measuring as much as 50 feet by 12 feet.

Pioneers of computer graphics, Michael Noll and William Feller (Deken, 1983), who designed aeroplanes using a variety of computer graphic functions. Zarnki and Burkowski, (1976) from the

University of Manitoba science department have produced a book using computer graphics. Computer-aided design (CAD), programs enable complicated architectural plans to be designed on computers. Desktop publishing (DTP) software packages such as "PageMaker" (Milt, 1986, Nov.) were designed to combine the tasks of formatting a page, pasting, enhancing, editing, as well as graphics. Today, graphics can be created electronically with graphics tablets, digitizers, scanners, or a mouse.

The graphics in "Amnesia" were created with a graphics tablet. The graphic map was programmed to appear when the student chooses one of the directions. Cueing in the form of flashing dots, help the student determine where a town is located. The map appearing in the student workbook, is a screen dump of the map in the computer simulation, except for the town names.

Social Studies Software

This section describes the software available for social studies. Several authors have noted the availability of social studies software. A hand search followed by a computer search, conducted to find what is available in Manitoba is presented in Table 5.

Turner (1982) explains that social studies CAI has not been used much in elementary schools because software has not been available. Cohen, (1982) reviewed several categories of social studies CAI: (i) drill and practice, (ii) tutorial and (iii) simulations. She found mostly poorly constructed drill and practice software. She also points out that the drill and practice software she reviewed did not differ significantly from social studies workbooks.

A search for social studies software completed in London by Hall, Kent and Wiegard (1982) also indicated a lack of software. They state that of 735 geography departments, only 35 teachers had taught at least one lesson using computers during the year. The main reason for this was lack of social studies software.

A CAI evaluation survey was conducted by King (1984) with a group of 48 pre-service teachers of the Faculty of Education, University of Manitoba. Fifty-two percent had geography as their "teaching majors". After the student teachers had examined four software packages, they completed the evaluation forms. Observations revealed that the pre-service teachers could grasp the technology

quickly even though they had little or no experience with it. Nearly all wanted more exposure to computers and 85% felt that micro-computers should have a place as a teaching aid in social studies.

Becker (1986) found that social studies software was used least in schools because of the following reasons: (a) lack of suitable software, and (b) social studies teacher's negative attitude toward computers.

An attitude survey conducted by Vermette, Orr and Hall (1986), found that teachers had more negative reactions to computerization than students. The survey showed that 90% of the students felt it was a good idea to use computers in schools, while only 58% of the teachers felt it was a good idea. Teachers gave two reasons for not seeing computers in a favourable light: (a) socialization issues, and (b) computers being isolating and dehumanizing.

A search conducted by the investigator at InfoTech software library, to establish what social studies computer programs were available in Manitoba produced the list in Table 5. Listed are the names of the programs, the grade, the type of software, and the computer used for each program.

Table 5

Social Studies Computer Programs Available in Manitoba

Program Name:	Grade/Level:				Type:			Computer:			
	E.	I.	Jr.	Sr.	d/p	s	t	A	C	T	IBM
1. The Weather	*				*			*	*		
2. Town Builder	*					*			*		
3. We & Others	*				*			*	*		
Section Totals	3	0	0		2	1	0	2	3	0	0
4. Civil War	*	*	*			*		*			
5. Economic	*	*	*			*		*			
6. 18th C.Americ	*	*	*			*		*			
7. 19th C. A.	*	*	*			*		*			
8. Mesopotamia	*	*	*			*		*			
9. State Names	*	*	*		*			*			
Section Totals	6	6	6		1	5	0	6	0	0	0
10.Arctic Paddle		*	*		*				*		
11.Canada		*	*		*			*	*	*	
12.Can. and Prov.		*	*		*				*		
13.Cangen		*	*		*			*	*		*
14.Canoe		*	*			*		*	*		*
15.Can.& CPR		*	*			*		*			
16.Canwater		*	*		*			*	*		*
17.Chopper Canada		*	*			*		*			*
18.Climate Graph		*	*				*		*		*
19.Compass Points		*	*		*				*		
20.Fort Walsh		*	*			*		*	*		*
21.Furs		*	*			*		*	*	*	
22.Jenney's Journey		*	*			*		*			*
23.Joggers-Trivia		*	*		*			*			*
24.Map Features		*	*		*				*		
25.Map Magic		*	*		*				*		
26.Medalists		*	*		*			*			
27.Nor'Wester		*	*			*		*	*		
28.NW Coast Indians		*	*		*			*	*	*	*
29.Oregon		*	*			*		*	*	*	
30.Voyageur		*	*			*		*	*	*	
31.World Geog. I		*	*		*			*			*
32.World Geog. II		*	*		*			*			*
Section Totals		23	23		13	9	1	17	16	5	11

(table continues)

Program Name:	Grade/Level:				Type:			Computer:			
	E.	I.	Jr.	Sr.	d/p	s	t	A	C	T	IBM
33.Climate Stats			*		*					*	
34.Computers in Gov.			*				*				*
35.Geology			*				*		*		
36.Great West March			*			*		*			*
37.Map Study			*		*					*	
38.Minerals/Canada			*		*				*	*	
39.Nomad			*			*		*			
40.Sumer			*			*		*			
41.Topographic Maps			*		*				*	*	
Section Totals			9		4	3	2	3	3	4	2
42.Africa			*	*		*		*			
43.Annam			*	*		*		*			
44.Carman Sandiego			*	*	*			*			
45.Changing Earth			*	*			*	*			*
46.Cleanup			*	*		*		*			
47.Climates of World			*	*			*	*			
48.Discovering Japan			*	*		*		*			
49.Earthquake			*	*		*			*	*	*
50.Hometown			*	*		*		*	*	*	
51.Japan			*	*	*		*			*	
52 Landslides			*	*			*	*			
53.Market Place			*	*		*		*			
54.Minerals			*	*		*				*	*
55.O, Deer!			*	*		*		*			
56.Odell Lake			*	*		*		*			
57.Polls and Politics			*	*		*		*			*
58.President'Choice			*	*			*				*
59.Survey Taker			*	*			*	*			
60.Solar Distance			*	*		*		*		*	*
61.Tarawands			*	*		*		*			
62.Treasure Hunter			*	*	*			*			
63.Volcanoes			*	*		*					*
64.Vrsa			*	*		*				*	*
Section Totals			23	23	3	15	6	17	2	6	8

(table continues)

Program Name:	Grade/Level:				Type:			Computer:			
	E.	I.	Jr.	Sr.	d/p	s	t	A	C	T	IBM
65.Atmosphere				*			*				*
66.Bargain				*		*		*			
67.Continent				*	*			*			
68.Country				*	*			*			
69.Crimex				*		*		*			
70.Crisis				*		*		*			
71.Elect1				*		*		*			
72.Elect2				*		*		*			
73.Energy				*		*		*			
74.Excellency				*		*		*			
75.Fail Safe				*		*		*			
76.Future				*		*		*			
77.Ground Water				*		*					*
78.Hydrolic cycle				*		*					*
79.Life in the Ocean				*	*			*			
80.Limits				*		*		*			
81.Minnag				*			*	*			
82.Newtown				*		*		*	*		
83.Policy				*		*		*			
84.States1				*	*			*	*		
85.States2				*	*			*	*		
86.Surface Water				*	*						*
87.USPOP				*			*	*			
88.Weather				*	*			*			
Section Totals				24	7		14 3	20	3	0	4
	E.	I.	Jr.	Sr.	d/p	s	t	A	C	T	IBM
Grand Totals	9	29	61	47	30	47	12	47	27	16	25

Abbreviations:

E. = elementary grades 1-4
I = intermediate grades 5-6
Jr. = junior high grades 7-9
Sr. = senior high
d/p = drill and practice
t = tutorials
s = simulation
A = Apple
C = Commodore 64
T = Tandy/Radio Shack

Of all the programs listed in Table 5, 46 (52%) are simulations. Of these simulations, 14 are for senior, 14 for junior high and senior high, 3 for junior high, 9 for intermediate, 5 for elementary, intermediate and junior high, and one for elementary.

In addition 31 (35%) are drill and practice programs. There are also 11 (12%) tutorials.

Most social studies software at the elementary level is drill and practice and there is a lack of simulations at that level.

When examining the content of the social studies programs available in Manitoba, it was found that 64% of all programs contained American content and 18% contained some Canadian content while 19% had neutral content such as weather or water studies.

This information indicates that there is a need for social studies with Canadian content at the elementary level. "Amnesia" the social studies software program developed for this study fills the lack of social studies simulations at the elementary level.

Examining the type of computer used it was noted that sixty-five programs listed in Table 5,

are for the Apple, 27 programs are for the commodore, 18 for Tandy/Radio Shack, and 25 for IBM. "Amnesia" was programmed for the Apple computer since Apple computer is used most in schools in Manitoba.

The preceding information set the stage for the development of "Amnesia" with Canadian content to be used on the Apple computer. "Amnesia" is a simulation for grade five social studies students. The program is interactive, employing behavioral and some cognitive principles such as cueing to help students. It could be classified as second generation software (Trimble, 1986) because of at least two reasons: (a) it uses graphics effectively, and (b) it incorporates various CAI categories such as drill and practice, tutorial and simulation. Students use well-planned workbooks as shown in Appendix H to help keep records of work throughout the program, encourage moves and clarify concepts.

CAI Production Systems

The purpose of this section is to discuss three methods which may be used to develop CAI materials: (a) single approach, (b) team approach, (c) production "Amnesia".

Single Approach. According to Roblyer (1983) educators choose to develop courseware on their own for three reasons. First, because other people are telling them they should. Second, to save money. Third, due to a lack of suitable programs available.

In the single approach, one person, designs the programs and the learning materials. An example of the single approach is software designed by Dr. Blanchaer (1985). Although the content is factual and has been shown to improve medical students' retention, the program requires students to answer health questions presented in a multiple choice format. It was noted that doctors would rarely encounter clinical situations in a "multiple choice" format.

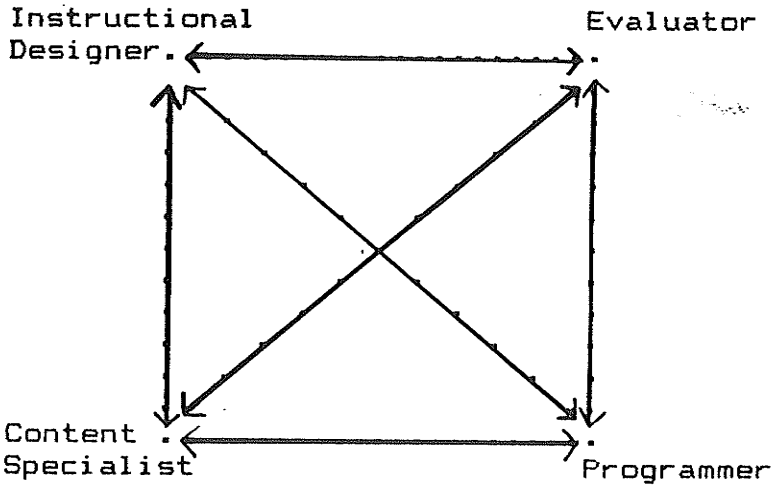
Some difficulties are associated with the single production approach. Teacher-produced software may suffer because the teacher is not aware of all the capabilities of the computer language; thus limiting the possibilities of the software. In addition, programmer-produced software often includes special effects or special programming techniques that neither enhance nor contribute to the content.

The Team Approach. In the team approach, tasks such as pedagogical design and technical development are divided between experts in each area (Bork, 1984). Other tasks such as evaluation, editing, revision, and visual design are usually done by instructional designers. Editing and revising are on-going processes done by both specialists and designers. In this approach communication is an important tool in obtaining the best possible product. An open communcication cycle, such as is indicated in Figure 4 helps to produce a quality product.

Major advantages of the team approach sited by Bork (1984) are: (a) the finished product is valid because all members have reviewed it, (b) the quality is high, (c) the cost of future products can decrease once a team is established, (d) the team can train future teams, and (e) the team has a creative edge.

Production "Amnesia". "Amnesia" was created using the advantages of each system. Flow charts shown in Appendix B, C, D, and E, were designed by the investigator. Appendix F gives a brief summary of "Amnesia". A programmer followed the flow charts and content to program the data for the

Figure 4. A communication system for a production system for producing computer-assisted instructional materials.



Apple IIe. Data is found in Appendix G.

Information, content, data, graphics, and screen page designs were completed by the investigator. Documentation, in the form of the student workbooks in Appendix H and teacher's guide in Appendix I were prepared, designed and reproduced by the investigaror first using a computer wordprocessor and then a reproducing system. The charts, maps, and pictures were also completed by the investigator.

Editing, revision, and visual design were completed by the investigator. These procedures completed the learning package "Amnesia".

Software Evaluation

Rose, Brandhorst, Glenn, Hodges, and White (1984) state that courseware materials must be evaluated carefully in two stages. First, educators need to determine whether or not a particular set of materials is appropriate for use in the social studies classroom. Second, educators must confront technical and instructional issues. With thousands of educational software programs available (Bitter, 1987), educators must make decisions about software and choose the best for their needs. Using an evaluation form is an

approved way of selecting software for the classroom (Rose, Brandhorst, Glenn, Hodges, and White, 1984).

Perreault (1985) outlines how an educator may go about obtaining suitable software and provides guidelines for developing a software checklist. He suggests that teachers consider the following when choosing software:

(a) Locate software by talking to other teachers, reading catalogues and educational journals.

(b) Make a list of the software you wish to review.

(c) Request software from a company that will allow you to preview it.

(d) Design a software evaluation guide considering two basic areas: educational content and performance.

(e) Read the documentation.

(f) Follow the directions. Start the program a number of times, thereby viewing it as a student would with interrupted classes.

(g) Go through the program giving right and wrong answers.

(h) Complete the evaluation guide you made up

(i) Select the software based on your guide.

Various organizations throughout the country have produced evaluation forms to guide educators in their evaluation of software. For purposes of this study, three were examined for the following reasons: (a) They were relevant to upper elementary software. (b) They focused on social studies, and (c) they had Canadian members or interests. The three organizations examined were: (a) Educational Software Evaluation Consortium (ESEC) (b) The National Council for the Social Studies (NCSS), and (c) Educational Products Information Exchange (EPIE).

Educational Software Evaluation Consortium

The ESEC is a non-profit evaluation consortium in which agencies share information. In 1985, the membership consisted of 28 organizations which are listed in Appendix J. Based on recommendations made by their membership, they state that strong emphasis should be placed on content and pedagogy, rather than computer-related characteristics. They identified 22 characteristics which were perceived

to be the most important in the evaluation of software. These characteristics were ranked in order of importance:

1. Correctness of content presentation.
2. Content presentation.
3. Use of the technology.
4. Integration into classroom use.
5. Ease of use.
6. Curriculum congruence.
7. Interaction for target audience.
8. Content/sequence levels.
9. Reliability.
10. User control of the program.
11. Feedback.
12. Objectives.
13. Motivation.
14. Branching.
15. Negative feedback and help.
16. Content modification.
17. Content bias.
18. Teacher documentation.
19. User support materials.
20. Color, sound, graphics, animation.
21. Screen displays.
22. Management system.

The National Council for the Social Studies

A set of guidelines for social studies microcomputer courseware evaluations were proposed by the NCSS, (Rose, Brandhorst, Glenn, Hodges, and White 1984). The guide lines were organized under the three headings: (a) knowledge, (b) skills and (c) values:

Knowledge. Social studies educators have adopted a broad-base curriculum that concentrates on the personal and social concerns of the student as well as the society. Their check list contained questions about validity, accuracy, reality oriented, significance of past and present, and bias.

Skills. Social studies education should provide students with opportunities to develop, practice and use thought skills. Students should learn how to probe, extract knowledge, think and communicate orally and with the written word. In order for students to acquire skills in critical thinking, inquiry, information processing and problem solving, social studies programs must be developed to help students make rational decisions. To evaluate software packages for the stated criteria, the teacher evaluation must contain

questions about: skills, decision-making skills, information processing skills, co-operation and participation skills.

Values. Social studies education should provide the opportunity for the student to rationally examine value issues. The student should be able to examin values that are important in their everyday lives.

Educational Products Information Exchange

EPIE, a software clearing house, has set very high standards for software. They rated only five per cent of software as "highly recommended" in 1983. Thirty per cent was rated as "recommended". The balance of the software they viewed did not meet their standards. The basic questions that they asked when rating software were:

1. For what purpose will the software be used?
2. Who will use it (grade)?
3. What is the objective of the software?
4. What are the prerequisite skills?
5. Are computer capabilities used?
6. Does the program motivate the target group?
7. Who controls the program?
8. Is the instructional design sound?
9. Are instructions clear and helpful?

10. Is feedback appropriate?

11. Is the program free of technical jargon?

12. Are the screen presentations suitable?

Software evaluation focuses on two audiences, the user and the regulator of that use. Typically, the teacher and the student are the target populations for the evaluation of educational software. The student evaluation shown in Appendix K and the teacher evaluation shown in Appendix L were developed with content based on the aforementioned expert opinions.

The issue is not whether one software evaluation procedure is chosen over another. The important thing is that the instructor (a) review the package before implementing the software in the classroom, (b) know how the software fits into the curriculum and (c) knows what is to be accomplished by it.

Chapter II Summary

The origins of CAI are based in behavioral psychology and exhibit the principles of Pressey, Skinner and Chowder. The movement of computer hardware and software from early computers to

Table 6

Movement of Computer Hardware & Software
from early computers to modern computers

From	To
Time-shared hardware	Microcomputers
Simplistic technology	Sophisticated technology
Drill and practice	Simulations
Single skill software	Second generation software
Single subject CAI (usually maths)	Diversified CAI
Expensive investment	Affordability
Studying effects of CAI	Evaluating effects of CAI
Unfriendly software	User friendly software
Non-integrated software	Integrated software

modern computers has changed as outlined in Table 6. There are several categories of CAI, one being simulations. Psychologists and teachers agree that simulations may help teach some skills.

Research has shown that computer simulations are used in schools due to the many educational advantages thought to be associated with simulations. As educational computer software is used more, users are becoming aware of CAI production systems, content and evaluating procedures.

Simulations as war games have given way to educational simulations, with qualities having challenge, curiosity and fantasy. Simulations have been used successfully incorporating graphics, cueing, reinforcers, feedback and opportunities for success. Simulations have been used as an effective teaching strategy, to increase global awareness and to measure student achievement between two methods of simulations presentation. "Amnesia" has incorporated all of the preceeding characteristics in order to provide a meaningful educational lesson in an interesting way.

All of the afore-mentioned have been described in order to clarify the situation with regard to

CAI simulations and "Amnesia".

The method chapter will describe the details of the study through a pilot study, then as a research study employing immediate and delayed posttests. The construction of the posttest is described, as are the statistical procedures used in the study.

Chapter III

METHOD

The pilot study, the sample, measurement instrument, treatment schedule and statistical procedures are described in this chapter.

The Pilot Study

A description of the following will be discussed: (a) purpose of the pilot, (b) pilot study sample, (c) the posttests, (d) procedures, (e) results, (f) software evaluations and (g) summary of the pilot study.

Purpose of the Pilot. The purpose of the pilot study was threefold. First, the pilot study was conducted to see if grade five was the appropriate grade level for the study. The second purpose was to verify the length of the study as four and a half hours. The third purpose was to verify the posttests.

The Pilot Study Sample. A pilot study was conducted at Westview School in Transcona, in Springfield School Division No. 12. The neighborhood of Westview School is surrounded by private homes in all four directions. The district

has a mixture of people, mostly of middle class income socio-economic status.

All grade five students were required to have their parents sign the permission slip attached to the Letter of Permission shown in Appendix M. Since there were three computers in the school, six students were chosen for the study. The six grade five students selected for the pilot study were chosen at random by pulling names out of a bowl containing the names of all grade five students in the school.

The Posttests. A Table of Specifications, had been prepared and used to make up the posttests. The preparation of the measurement instrument is fully described under measurement instrument of this chapter. A sample of the posttest appears in Appendix N.

Fry's Readability Graph (Fry, 1968) had been used to determine that the reading level of the software program "Amnesia" was at the grade five level. Randomly selected sections of the program were analyzed and graphed confirming that the software was written at the grade five level.

Procedures. The six subjects attended regular classes during the day and attended the social

studies classes held using the computers and "Amnesia" during their lunch hours. Each class lasted one-half hour. The schedule started March 5, 1987 and ended March 19, 1987. The schedule is shown in Table 7. Subjects completed their workbooks as they proceeded through the lessons. The student workbook appears in Appendix H.

"Amnesia" lessons were presented as a regular social studies lesson would be presented. The content was explained to the subjects. Subjects spent time with computers, recording various data and learning the content. A short review was presented. Lastly the posttest was administered.

Results. The results of the pilot test are shown in Table 8. From examining the data collected and subjects responses, the pilot study had been a success in establishing the purposes for the study.

Software Evaluations. The software evaluation forms for "Amnesia" were completed by all subjects. All subjects agreed that: (a) The program was fun. (b) They learned something new about Manitoba. (c) The program made them think. (d) They would use the program again. (e) They liked the program.

Table 7

Pilot Study Schedule

March 5, 1987	Started Pilot
March 6, 1987	
March 9, 1987	
March 10, 1987	
March 12, 1987	
March 13, 1987	
March 16, 1987	
March 17, 1987	
March 18, 1987	
March 19, 1987	Posttest

Table 8

Pilot Study Results

Subject Number	Gender	Age	Raw Score
1	M	11	23
2	M	11	19
3	M	11	10
4	F	10	27
5	F	11	14
6	F	10	10
	3F 3M	64	103
Mean		10.6	17.16

(f) It was easy to use. (g) They would like their friend to use it.

Summary of the Pilot Study. The pilot study succeeded in confirming and verifying that: (a) the content level of "Amnesia" lessons were appropriate for grade five, (b) the length of time to complete all lessons with "Amnesia" was four and a half hours and (c) the posttests were valid, written at the correct level and that the tests could be completed in one class period (half an hour).

The Sample

Subjects. The subjects in this study were grade five social studies students attending John Pritchard School in the Manitoba School Division No. 9 (River East). The population consisted of 41 students. All of the students live within the school's catchment area. John Pritchard School is located in the northwestern section of the neighborhood of North Kildonan in Winnipeg. The socioeconomic character of the area is a mixture of working class, families, single parent families, and middle and lower income families.

Groups. The students were in two class groups, A and B. Group A contained 22 students, fourteen males and eight females. Group B contained

nineteen students, ten males and nine females.

Apparatus. The groups were randomly assigned to treatment conditions. Group A received one computer for the entire class and the social studies simulation "Amnesia". Group B received one computer for every two students and the social studies simulation "Amnesia". Group A used one computer located at the front of the classroom, while group B took their lesson at the school's computer lab. Both classes received regular classroom instruction for all other courses during the study.

Measurement Instrument

The development and construction of the measurement instrument will be explained using the following topics: (a) content validity, (b) table of specifications, (c) test items and (d) test item sequence.

(a) Content Validity

Content validity is of primary concern in achievement testing. Content validity may be defined as the extent to which a test measures a representative sample of the subject-matter content and the behavioral changes under consideration (Gronlund, 1971).

(b) Table of Specifications

A Table of Specifications was constructed to insure that the content of the test was valid (Gronlund, 1971). The Table of specifications apears in Table 9.

Definition. A Table of specifications is a two-way chart which relates the desired outcomes to the course content used to bring about the behavioral changes. The chart serves as a blueprint to assist in obtaining a finished product with specified characteristics. The table of specifications provided the investigator with greater assurance that the posttest would measure the learning outcomes and content in a balanced manner (Gronlund, 1971).

Table Construction. Two lists were developed from the content of the computer simulation "Amnesia": (a) content and (b) objectives. Major areas of content were listed down the left of the table. Objectives were listed across the top. The number at the intersection of the two indicated the percentage (shown in table 9 A) or the number of items (shown in table 9 B) devoted to each area of content and each type of objective.

Table 9 (A)

Table of Specifications (in percentage)

Content:	Knows: General Specific facts	Understands: Describes relationships	Skill in: Map-reading Interpreting Application Map plotting	Total Per Cent
Town:				
a. Names	-	-	10%	10.%
b. Clues	5.0%	22.5%	5.0%	32.5%
Highways	-	2.5%	2.5%	5.0%
Directions	-	15.0%	2.5%	17.5%
Wpg.	5.0%	-	-	5.0%
Man.	2.5%	5.0%	12.5%	20.0%
Lakes	5.0%	-	-	5.0%
Parks	2.5%	2.5%	-	5.0%
Total%	20.0%	47.5%	32.5%	100.0%

Table 9 (B)

Table of Specifications (items in numbers)

Content:	Knows: General Specific facts	Understands: Describes relationships	Skill in: Map-reading Interpreting Application Map plotting	Total No. of items
Town:				
a. Names	-	-	4	4
b. Clues	2	9	2	13
Highways	-	1	1	2
Directions	-	6	1	7
Wpg.	2	-	-	2
Man.	1	2	5	8
Lakes	2	-	-	2
Parks	1	1	-	2
Total #	8	19	13	40

The major subject matter topics listed were: Town Names, Town Clues, Highways, Directions, Winnipeg, Manitoba, Lakes, Parks. The types of behavioral changes to be measured listed were: (a) Knows - general facts, specific facts, identifies specific facts, (b) Understands - describes relationships, conditional relationships, ability to identify relationships between two things, (c) Skill in - applies principles to new situations, understands general map-reading, interpretive, indicates sequence of events, ability to sumarize.

Importance. The topics and behavioral changes were weighed in terms of importance. This step depended on personal judgement guided by the amount of time devoted to each topic during instruction. The table of specifications shows how all major topics and behavioral topics are weighed, showing the number of questions for each content area. For example when finding the number of test items about Winnipeg, the number "2" (5%) is found at the intersection of "Winnipeg" and "General Facts". This means that there are two questions about that pparticular content. These relative weights were decided before the table was constructed.

(c) Test Items

Clarity. The table of specifications helped to clarify test items and prevent over-emphasis of test items. The number of test items to be devoted to each educational objective was specified on the table of specifications. By doing this testing procedures were related to objectives and there was the assurance that each objective was represented in the test according to relative importance.

Learning outcomes. A serious effort was made to make sure that student behaviors called forth by the test items were the same as behaviors defined by the specific learning outcomes. The posttest was constructed by stating the desired outcomes in behavioral terms and developing test items that would call forth the stated behavior. By following this procedure, it was assured that students progress toward objectives were being measured.

Example 1:

Specific learning outcomes: Identifies a relationship dealing with Manitoba. The question appears on the posttest worded in the following way:

Which of the flowers named below is the floral emblem of Manitoba?

(a) Prairie Carnation

(b) Prairie Crocus

(c) Prairie Lily

(d) Prairie Wild Rose

Example 2:

Specific learning outcome: evaluates known facts.

The question appears as:

Which area listed below, applies best to the part of the province of Manitoba, you learned about in the game "Amnesia"?

(a) An area of few roads

(b) An area of many roads

(c) An area of no roads

(d) An area of only gravel roads

Test items were constructed so that they would be free of grammatical structure such as verbal association. For example, the following question shows how clues in the test item due to verbal association can help the student select the correct answer without knowing the answer.

Example 1:

The floral emblem of Manitoba is the

(a) carnation

(b) prairie crocus

(c) lily

(d) wild rose

In the above example the word "prairie" in front of "crocus" provides a clue to the answer. The question appeared in the test as follows:

Example 2:

Which of the flowers named below is the floral emblem of Manitoba?

(a) Prairie Carnation

(b) Prairie Crocus

(c) Prairie Lily

(d) Prairie Wild Rose

(d) Test Item Sequence

Gronlund (1971) explained that test items should be arranged and grouped to make it easier for students to retain the same mental set throughout a section of questions. Test items on the posttest for this study were arranged in the following order (Gronlund, 1971, p. 238): (a) true-false, (b) matching, (c) short answer, (d) multiple choice, (e) interpretive, and (f) essay.

Table 10

Schedule of Study

Group A	Group B
April 22, 1987	April 18, 1987
↓	↓
April 23, 1987	April 19, 1987
↓	↓
April 29, 1987	April 20, 1987
↓	↓
April 30, 1987	April 22, 1987
↓	↓
May 1, 1987	May 4, 1987
↓	↓
May 4, 1987	May 7, 1987
↓	↓
May 7, 1987	May 8, 1987
↓	↓
May 8, 1987	May 12, 1987
↓	↓
May 11, 1987	May 4, 1987
↓	↓
May 12, 1987 Posttest	May 12, 1987 Posttest
↓	↓
June 9, 1987 Review	June 9, 1987 Review
↓	↓
June 10, 1987 Delayed Posttest	June 10, 1987 Delayed Posttest

Treatment Schedule

The treatment schedule for each group is shown in Table 10 with each session of thirty minutes duration. Each treatment group used a total of four and a half hours. Both treatment groups proceded with the study with the same format as outlined in the lessons appearing in Appendix I. Posttests were completed right after the study. Delayed posttests were completed three weeks after the study.

The sequence of events: completing the lessons, having a posttest, then completing a delayed posttest three weeks later were chosen to simulate the events that every teacher uses when completing the content of a unit in social studies in the curriculum.

Statistical Procedures

Raw scores for each subject presented were obtained by adding the number of correct responses of the 40 items on the immediate and delayed posttests. These appear in Appendix O.

The test for significant differences over repeated posttest was performed using a 2 x 2 analysis of variance (ANOVA) for the following:

(a) between subjects factor = treatment and

(b) within subjects (repeated) factor = test time.

The two variables used were

(a) treatment, and

(b) test time

The MacIntosh program "Stats Works" (Cricket Software, 1985) and the Statistical Analysis System (SAS) at the University of Manitoba, were used to help obtain the statistical results.

Tukey's honestly significant differences verified the findings of ANOVA.

Test items were analyzed using the item difficulty index (p values) and item discrimination index (D values).

Chapter IV

RESULTS

This chapter presents the results of the study. The data for each null hypothesis are presented, tested and a decision made as to the appropriate research hypothesis to retain. Also presented are Tukey's analysises, limitations, item difficulty index and discrimination index, standard error of measurement, student software evaluations, and chapter summary.

Analysis of Variance.

The Two-Way Analysis of Variance found in Table 11 was calculated with SAS. The two-way ANOVA shows that there is overall significance at the .05 level between treatment and between groups. Significance is indicated at the .01 level for interaction between time and group. Each hypothesis was tested to find exactly where the significance occured (Table 14). The summary of the means is found in Table 12. Figure 5 shows the mean scores for the immediate and delayed posttests. The raw data is found in Appendix O.

Tukey's Honestly Significant Differences

Tukey's Studentized Range Test or Honestly

Significant Differences, (HSD) were calculated with SAS and confirmed the findings of the two-way ANOVA. Table 13 displays the findings. Tukey is used in experiments with more than two groupings to indicate exactly where the significant differences are (Tukey, 1952). For this study Tukey's HSD indicate overall significance in the delayed post test groupings. The groupings of the delayed post test appearing as the different letters of "A" and "B" indicate significance. The groupings appearing with the same letters of "A", "A" and "A" signify that there is no significant interaction.

Testing the Hypotheses

Testing of each hypothesis was done using ANOVA and t-tests. The results follow:

Testing Hypothesis 1

HØ1: There will be no significant differences between immediate test scores of students in Treatment A and students in Treatment B as measured by an objective test.

The critical value needed for significance at the .Ø5 level was 4.Ø8 (df = 1 ,39). Since F= Ø.26 (Table 14) the null hypothesis was accepted.

The accepted research hypothesis is the following: There will be no significant

differences between immediate test scores of students in Treatment A and students in Treatment B as measured by an objective test.

Testing Hypothesis 2

HØ2: There will be no significant differences between delayed test scores of students in Treatment A and students in Treatment B as measured by a delayed objective test.

The critical value for hypothesis two was 4.Ø8 at the .Ø5 level and 7.36 at the .Ø1 level (df = 1, 39). Since F = 11.5Ø (Table 14) there is significance at the .Ø1 level. The null hypothesis was rejected.

The accepted research hypothesis is the following: There will be significant differences between delayed test scores of students in Treatment A and students in Treatment B as measured by a delayed objective test.

Testing Hypothesis 3

HØ3: There will be no significant differences between immediate and delayed test scores of students in Treatments A as measured by objective tests.

The critical value for hypothesis three using a t-test was 2.Ø8 at the .Ø5 level and 2.83 at the

.01 level (df = 1,21). The t-statistic is -3.84 (Table 14) and reveals significance at the .01 level. Therefore the null hypothesis was rejected.

The accepted research hypothesis is the following: There will be significant differences between immediate and delayed test scores of students in Treatment A as measured by an objective test.

Testing Hypothesis 4

H04: There will be no significant differences between immediate and delayed test scores of students in Treatment B as measured by objective tests.

The critical value for hypothesis four using a t-test is 2.10 at the .05 level and 2.88 at the .01 level (df = 18). The t-statistic is -0.545 (Table 14). Therefore hypothesis four was not significant at the .05 level. The null hypothesis was accepted.

The accepted hypothesis is the following: There will be no significant differences between immediate and delayed test scores of students in Treatment B as measured by objective tests.

Table 11

Two-Way Analysis of Variance Summary Table

Source	Sum of Squares	Deg.of Freedom	Mean Squares	F-Ratio	Prob>F
	SS	Df	MS	F	
Between Treatment	298.191	1	298.191	4.33	0.0441*
Error	2686.247	39	68.878		
Between Test Time	217.597	1	217.597	11.33	0.0017**
Time*Group Interaction	147.304	1	147.304	7.67	0.0085**
Error	748.79	39	19.199		
Total	4098.129	82			

* p< .05, F critical

**p< .01, F critical

Table 12

Summary of Means

Treatment Group	n	Age $\bar{X}$	Posttest $\bar{X}$	Delayed Posttest $\bar{X}$
A	22	10.6	24.13	30.09
B	19	10.5	23.00	23.57
Total	41			

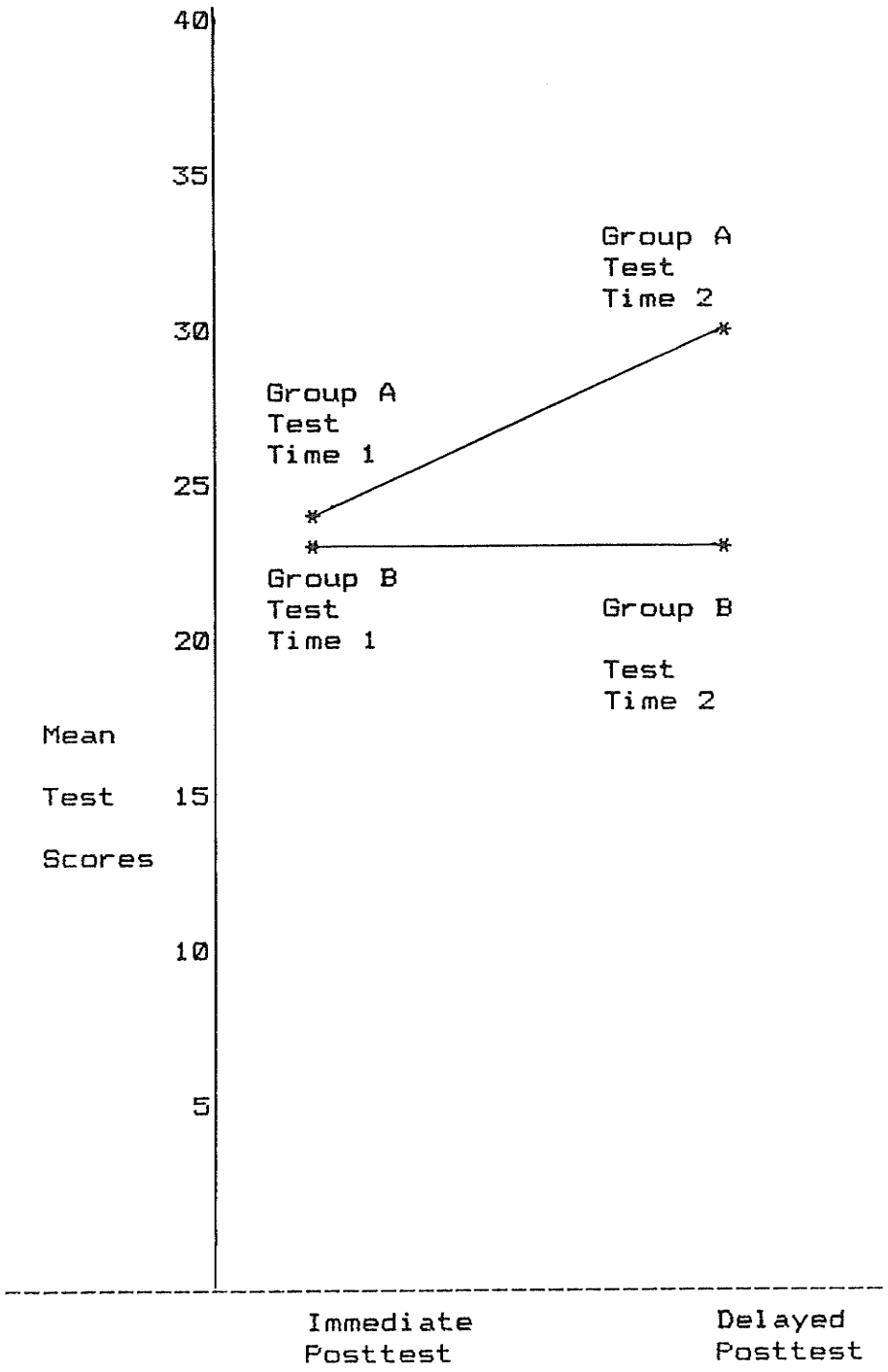


Figure 5. Mean scores for posttest and delayed posttest

Table 13

Tukey's Studentized Range Test

Grouping	Mean	N
Immediate Posttest:		
A	24	22
A	23	19
Delayed Posttest:		
A	30*	23
B	23*	19

*p<.05 critical

Table 14

Testing Hypotheses

One-Way ANOVA					
	Deg.of Freedom	Mean Square	Sum of Squares	F Value	Prob>F
	Df	MS	SS	F	
Hypothesis 1:					
Error	39	50.476			
Group	1		13.165	0.26	0.612
Hypothesis 2:					
Error	39	37.601			
Group	1		432.330	11.50	0.0016**

t-tests				
	t-statistic	Df	Mean	SD
Hypothesis 3:				
	-3.840**	21	24.1	368.833
Hypothesis 4:				
	-0.545	18	23.000	4.282

* p< .05, F critical

**p< .01, F critical

Limitations

A number of limitations are discussed here. The results of this study should be viewed in the context of these limitations. Limitations are divided into two groups: (a) threats to internal validity and (b) threats to external validity.

(a) Threats to Internal Validity

History. The fact that neither group had prior knowledge of the nature of the content of the simulation and that the specific knowledge required to answer the posttest questions reduces this threat to validity.

Differential Selection of Subjects. This refers to the fact that subjects in the comparision groups may be different from one another at the outset of the experiment. This factor can be controlled by random assignment of subjects to groups or by matching the groups. The two groups were similar on age, sex and achievement in oral reading and social studies up to March of 1987. They were both from the same school, neighborhood and socio-economic backgrounds.

The mean ages of the groups were almost the same; 10.5 for Group A and 10.6 for Group B reported in Table 12 and Appendix O. Both groups

had a range of marks from C+ to B+ with a mean class mark of B for oral reading and social studies in March 1987, before the study began.

Maturation. Maturation refers to the fact that processes that take place within the subjects who are participating in the study may affect their performance. Since this factor is a greater threat in longer studies, it is believed that maturation did not affect the study. In addition the day to day school neighborhood factors affecting students were similar for both groups.

Testing. Testing refers to the fact that experience of taking a test, may affect a subject's performance. It is likely to happen where the same test is used a number of times and the study is short. There may have been a reaction to the delayed posttest, since the exact same test was used. Since the immediate posttest and the delayed posttest was short and the same, students may have remembered or learned from the test. However all the students received the exact same immediate posttests and delayed posttests so if it was a limiting factor, then it affected both classes.

Instrumentation. This refers to the fact that changes in the measurement procedures during the

course of the study may produce differences. The same instrument was used throughout the study. The same answers were expected from same questions throughtout the study. Kuder-Richardson 21 (KR21) reliability coefficients were obtained from all tests. KR21 is used with classroom tests where items are scored dichotomously (Nitko, 1983).

k = number of items in the test

p = represents the proportion or fraction of students passing each item

(SDx) = Variance of the total test scores

$$KR21 = \left(\frac{k}{(k-1)}\right) x \left(1 - \frac{M\ (k-M)}{k(SDx)2}\right)$$

or

$$KR21 = \left(\frac{\text{No. of items}}{\text{No. of items} - 1}\right) x \left(1 - \frac{\text{Mean (items - Mean)}}{\text{No. of items} \times \text{variance squared}}\right)$$

Calculations:

A1 = Group A test time 1.

$$A1 = \left(\frac{40}{40-1}\right) x \left(1 - \frac{24.13\ (40-24.13)}{40\ (8.33)2}\right) = .899$$

B1 = Group B test time 1.

$$B1 = \left(\frac{40}{40-1}\right) x \left(1 - \frac{23\ (40-23)}{40\ (4.282)2}\right) = .478$$

A2 = Group A test time 2.

$$A2 = \left(\frac{40}{40-1}\right) \times \left(1 - \frac{30.09(40 - 30.09)}{40\ (7.702)2}\right) = .89$$

B2 = Group B test time 2.

$$B2 = \left(\frac{40}{40-1}\right) \times \left(1 - \frac{23.57\ (40 - 23.57)}{40\ (3.501)2}\right) = .216$$

Table 15 shows the summary of the above.

Kuder-Richardson 21 formula was used to estimate the reliability coefficients, thereby estimating the reliability of a test (Nitko, 1983). The closer the coefficent is to one, the more reliable the test.

The reliatility coefficients of .216 and .478 were low because they were influenced by the lower mean score. The coefficients of .899 and .890 appear to be more reliabile.

To further analyze the test the Item Difficulty Index (p value) was calculated for each item for each test and are discussed in more detail in this chapter under Item Difficulty Index. The Item Discrimination Index (D) values were calculated for each test and are discussed in this chapter under Item Discrimination Index.

Table 15

KR21 Reliability Coefficients
and
Standard Deviations

Summary

KR21 Coefficients

Group	Time	r(KR21)
A	1	.899
B	1	.478
A	2	.890
B	2	.216

t-tests

Group	Time	Standard Deviation
A	1	8.833
B	1	4.282
A	2	7.702
B	2	3.501

Statistical Regression. This study did not select subjects on any previous scores. Groups were not selected to participate in this study on the basis of their extreme scores. Therefore statistical regression was not considered a limitating factor of this study.

Mortality. This refers to the fact that a differential loss of subjects from the comparision groups may produce nonequivalent groups. All students who started in this study finished. No one quit or withdrew. Therefore no scores had to be withheld from the statistical procedures. The conclusion is that mortality was not a limitating factor of this study.

(b) Threats to External Validity.

Selection-treatment interaction. Subjects were not selected to participate in the study on the basis that they would respond favourably to the treatment. Students assignment to classes at the beginning of the year by the school were not based on their achievement scores or abilities.

Reaction of the expermental arrangement. This refers to the fact that the arrangement of the experiment itself may affect the subjects performance. It infers that the students were not

"acting normally" while the treatment was being presented. Examples of this is the Hawthorne Effect and the Novelty Effect. All students had been exposed to computers in some way before but had never used them in the social studies. Also, the teachers had never used computers to help teach social studies before.

Specificity of Variables. This refers to having a given study with specific time and specific instruments. This study was performed over a specific time with specific instruments. The more specific, the less generalizable the findings. This may have been a limiting factor of this study since the same testing instrument was used over time.

Item Difficulty Index (p)

The item difficulty for each item on for each test for each group and for each time was calculated. Item on the test were scored dichotomously (received Ø or 1). The item difficulty represented by p is the fraction of students answering one item correctly. Fraction p is relatively large for an "easy item", signifying many students got the question correct. A small

p signifies an "difficult item". The range of p is 0.00 to 1.00.

Item difficulty reflects the proportion of students responding correctly to an item and does not reflect the complexity of the mental process used in responding to an item (Nitko, 1983). Item difficulty p's are reported in Appendix P. Examination of the p's reveal data that can be used to identify concepts that (a) need to be retaught and (b) can provide feedback for students. For example items 3, 14 and 40 have the following p's:

		Item No.		
Group	Time	3	14	40
A	1	.909	.681	.045
B	1	.789	.526	.157
A	2	.909	.863	.272
B	1	.947	.736	.052

Item 3 appears to have been easy for both groups since all p's are high.

Item 14 was easier on the first test than second test for the groups. The p's are both higher on the second test signifying more students got it correct on the second test than on the first test. Item 40 appears to be difficult for all

groups since the groups are very low. The item difficulty was calculated in the following manner (Nitko, 1983 p. 288).

$$p = \frac{\left(\begin{array}{l}\text{No. students choosing}\\ \text{correct alternative}\end{array}\right)}{\left(\begin{array}{l}\text{total no. of students}\\ \text{taking the test}\end{array}\right)}$$

For item 3 for example the p's were calculated in the following manner:

Group	Time	p
A	1	p = 20/22 = .909
B	1	p = 15/19 = .789
A	2	p = 20/22 = .909
B	2	p = 18/19 = .947

Item Discrimination Index (D)

The item discrimination index (D) is the difference between the fraction of the upper group of students answering the item correctly and the fraction of the lower group of students answering it corectly (Nitko, 1983).

$$D = \left(\begin{array}{l}\text{Fraction of Upper}\\ \text{group answering}\\ \text{item correctly}\end{array}\right) - \left(\begin{array}{l}\text{Fraction of Lower}\\ \text{group answering}\\ \text{item correctly}\end{array}\right)$$

$$D = pu - pl$$

D = Net D or item discrimination index

pu = fraction of the upper scoring group answering the item correctly

pl = fraction of the lower scoring group answering the item correctly.

range = 1.00 - 1.00

Groups A and B were each divided into upper and lower groups based on the total scores as shown in Appendix Q. First, all scores of groups were arranged in descending order from large to small scores. Second, the scores were divided in half. Thirdly, the scores were divided by the number of students in each subgroup. Fourthly, the lower group score was subtracted from the upper group score of an item. All D values are shown in Appendix Q. For example for Group A Time 1, Item No. 1, D is equal to 9/11 - 8/11 = .09

Standard Error or Measurement (SEM)

The SEM were derived from t-tests and Kuder-Richardson 21 reliability coefficients shown in Table 15 earlier in this chapter.

The SEM was calculated for each test. The following formula was used (Nitko, 1983):

$$SEM = SDx \sqrt{1 - \text{reliability coefficient}}$$

Group A Test Time 1:

$SEM = 8.833 \sqrt{1-.899}$

$= 2.929$ or $= 3$

Group B Test Time 1:

$SEM = 4.282 \sqrt{1 - .478}$

$= 3.93$ or $= 4$

Group A Test Time 2:

$SEM = 7.702 \sqrt{1-.890}$

$= 2.929$ or $= 3$

Group B Test Time 2:

$SEM = 3.501 \sqrt{1 - .216}$

$= 3.09$ or $= 3$

The SEM estimates how variable the test scores would be if the tests were repeated. It indicates the average amount a person's observed scores are likely to deviate from their true scores. For SEM = 3 can be interpreted to mean that that person's obtained scores are likely to be about 3 points above or below their true score. For Group A test time 1, a student's score would be estimated to be higher or lower by 3 if the test was repeated. The SEM helps to understand the size of measurement error for a particular testing procedure (Nitko, 1983).

Student Software Evaluations

Each student completed the Student Software Evaluation appearing in Appendix K. Results of the survey appear in Appendix K.

Chapter IV Summary

Four null hypotheses were tested in this study. Two hypotheses were rejected and two were accepted. It was found that there were significant differences betweem students in (a) treatment A and B as measured by delayed test scores (hypothesis 2), and (c) treatment A as measured by the immediate and delayed posttest scores (hypothesis 3). It was found that there were no significant differences between students in (a) treatment A and treatment B on the immediate test scores (hypothesis 1), and (b) between immediate and delayed test scores of students in treatment B (hypothesis 4).

Limitations of the study were discussed indicating that testing and instrumentation may have been a limitation of this study. Item difficulty and item discrimination values were used to analyze the test items.

The next chapter will discuss the statistical analysis, general comments, implications and further considerations and conclusions.

Chapter V

DISCUSSION AND CONCLUSIONS

This chapter contains the statistical analysis, general comments, implications and further considerations and conclusions.

The focus of this study was twofold. One purpose was to apply proven learning principles in the development of computer-assisted instructional materials in a social studies grade five classroom. The other purpose was to investigate two methods of presenting the computer-assisted learning simulation. In one classroom only one computer was used; in the other classroom every two students had access to a computer.

Statistical Analysis

Each of the null hypotheses was tested through the use ANOVA analysis; first with a two-way ANOVA as found in Table 11 which indicated that there were overall significant differences. Then the one-way ANOVA and t-tests were used to indicate where the differences were. The results indicated that there were no significant differences between the two groups on the immediate posttest, but there

were significant differences on the delayed post test scores. Results revealed that there were significant differences between the immediate and delayed posttests of Group A (one computer) and that there were no significant differences between the immediate and posttests of Group B.

Hypotheses.

Null hypothesis 1 was accepted revealing that there were no significant differences between immediate posttest scores of students in Treatment A and students in Treatment B as measured by an immediate objective test.

Null hypothesis 2 was rejected revealing that there were significant differences between delayed test scores of students in Treatment A and students in Treatment B as measured by a delayed objective test.

Null hypothesis 3 was rejected revealing that there were significant differences between immediate and delayed test scores of students in Treatment A as measured by an objective test.

Null hypothesis 4 was accepted revealing that there were no significant differences between immediate and delayed test scores of students in Treatment B as measured by objective tests.

Further examination. Findings of non-significant and significant differences of the hypotheses warrant further examination. A review of the mean scores (Table 12, and Figure 5) indicates that Group A had a mean score of 24.13, while Group B had a mean score of 23.00. This slight difference measured non-significance with ANOVA as one would expect. A difference of one mark on a mean score at the grade five level on an objective test would probably not mean much to a teacher. If the mean of two methods of presenting a lesson to two classes was only one mark apart, the teacher could hardly choose one method over another based on this difference.

The mean scores are wider apart on the delayed posttest. Group A had a mean of 30.09 and Group B had 23.57 a difference of 6.52. As these means are derived from raw scores, this difference is quite a large overall difference and would probably be significant to a teacher. This confirms the findings of significance for hypothesis 2 that there were differences on the delayed test between the two groups.

The difference between means for Group A from 24.23 for the first test to 30.09 for the delayed

posttest is a difference of 5.86. The t-statistic was -3.840 at the .01 level for hypothesis 3. This difference was significant and the null hypothesis was rejected.

The mean scores for Group B were 23.00 and 23.57 being almost the same for both tests. This would suggest that there would be no significance. The t-statistic of -0.545 indicates that there are no significant differences for hypothesis 4.

General Comments

Although the results of this study are not directly comparable to past reseach due to differences in instrumentation, experimental design, sample, and statistical treatment, it is still relevant to review previous studies as was done for general tendencies relating to this study.

A principle finding of this study is that computer simulations can be used to help teach in a classroom setting. This was confirmed previously by Grover (1986), Weibel and McMahon (1982), Hantula (1977) and Sherwood and Hasselbring (1986). Research has also shown that positive learning experiences resulted when students were taught with the help of computer simulations (Battista and Krockover, 1983; Weible and McMahon 1982).

As recommended by the Manitoba Social Studies Assessment Program (1984) teachers are encouraged to use simulations, games and role-playing as a means of generating social participation in the classroom. Computers and CAI simulations could help to fill this objective. Of the social studies teachers surveyed in the report, 46% said that they used simulations a few times a year while 35% said they never used them. It was not indicated whether the simulations were computer or non-computer games. When asked how important simulations and debates were for evaluating students in the social studies classes, 47% of the teachers felt that they were not important while 42% felt they were important. Again, CAI simulations could be used to help give importance to student debates and opinions in social studies.

This study substantiated that students had a very positive learning experience with the simulation of this study. This is indicated by the remarks they made on the software evaluation and the enthusiasm with which they attended to the lessons and workbooks. They knew what their responsibilities were and eagerly attended to them. Students seemed to find the CAI simulation more

enjoyable than other types of lessons. They would waste no time getting their workbooks and being on time for the classes. Students seemed to concentrate on their CAI simulations and seemed to remember things about the lessons even four and five weeks after the lesson had ended. There was evidence of this in the last week of the school year when the teacher asked the students to talk about any aspect of the whole year. Many students cited many facts about the computer simulation "Amnesia" and related experiences they had had with the lessons.

Implications and further considerations

The present study has shown some significant benefits of a CAI simulation in a social studies setting. Social studies lessons sometimes considered boring or uninteresting and unmotivating need not be so with the help of appropriate CAI simulations. With the aid of CAI simulations important social studies skills can be enhanced.

It seems that the group with one computer benefited more from teacher mediated discussion than the other group. The students integrated the work better than the other group. In the long term it would seem better to use a single computer for

the class than a number of computers when the aim is interaction such as with a simulation game.

Future directions might include some of the following recommendations for CAI:

(a) CAI simulation games could be used in other subject areas such as science, health, guidance, language arts, history, and ESL.

(b) A multi-media CAI approach to a lesson may have some interesting results. Video controlled by the computer and CAI could be used to help teach concepts that could benefit from the use of visual pictures.

(c) Multi-media CAI approach could be used in such classes as science where not only definitions could be read and reread but pictures could be used to show scientific biological structures or experiments.

(d) Multi-media controlled by simulations could be used in the art class where famous artists' pictures could be manipulated by the students to discover new interesting things about various pictures.

(e) CAI social studies simulation games could be used in social studies classes with information gained from this study.

In the Manitoba Social Studies Assessment (1984) there was wide agreement that the social studies should emphasize skill-development, personal decision-making and that innovative teaching strategies were needed at the elementary levels in the social studies classrooms. To reach these goals several suggestions are made here. It is suggested that:

(a) The Manitoba Social Science Teachers Association (MSSTA) would probably benefit from more CAI computer in-services for teachers in their specific areas.

(b) More effective publicity about CAI software by such knowledgeable groups such as InfoTech could inform the social studies educators about CAI uses.

(c) The non-specialist (non-computer) teacher should be made aware that they do not need much equipment to have positive results and that they use modern equipment such as computers even though the school may not have very many.

(d) Teachers could be introduced to CAI in their pre-service classes at the universities in their first year.

Social studies includes a wide range of

important information including man in the modern world. Since computers are a part of people's environment now, it seems essential that modern technology such as computers are discussed and used in the classrooms.

Conclusions

This study tested four hypotheses. The null hypothesis (1) was accepted for differences in achievement between groups on the immediate post test. The null hypothesis (2) was rejected when it was found that there was a significant difference on the delayed posttest of the two groups. The null hypothesis (3) was rejected when the data showed that there was a significant difference between the immediate and delayed posttest of the group using one computer for the class. The null hypothesis (4) was accepted when it was found that there were no significant differences between the immediate and delayed posttest of students using two students per computer.

The data provided indicated that there were significant differences on students achievement of two groups of students using the computer in two different ways. The analysis of the data by ANOVA indicated that there was a significant difference

between students achievement when two groups of students were taught with the aid of a computer simulation in different ways.

The future of computers seems to be filled with promise. Some people argue that the computers are less humane and impersonal than the real teacher. The human elements of making decisions, sharing emotions such as enthusiasm, encouragement and caring can never be replaced or eliminated from the learning process but may be enhanced by the addition of computers to education.

It was found that students learned from the CAI simulation program prepared with proven psychological principles. Further, it was found that students were enthusiastic and were motivated to learn with the program. They were able to gain feelings of accomplishment and success through the simulation program.

The study has shown that a computer simulation specifically designed, can be used to help teach in a grade five social studies classroom. The study has also shown that significant differences occurred between scores of the delayed post test of two methods of presenting a computer simulation game at the grade five level.

The information gathered in the students evaluation forms was very positive. The majority of the students had fun using the game (92%) and felt they had learned something new from the program. Following is a brief summary of the students answers on the summary:

Question No.	% Yes	% NØ
1. The program was fun.	87	13
2. I liked the program.	85	15
3. I learned something new from the program.	92	8
4. The program made me think.	87	13
5. The program was easy to use.	83	17
6. The instructions were easy to use.	85	15
7. I would like to visit the towns named in the program.	83	17
8. I would use the program again.	75	25
9. I would want my friend to use the program.	80	20

The teachers ratings of the program were also very positive. They rated the questions from good to excellent. They indicated that the instructional materials were well-planned, well-organized and informative. They indicated that the program motivated the students and helped them learn many things in the program.

This study showed how learning princples were incorporated into a computer learning package to enhance student learning. The strategies of the

behaviorist and cognitive learning principles used were the following:

(1) graphics - used in placement of communities in Manitoba on a map.

(2) cueing - used when locating towns on the map.

(3) randomization - used when selecting the number of questions

randomization - used when assigning one of the communities as the "hiding place".

(4) positive reinforcers in the form of meaningful feedback - used when a student's responses were incorrect.

(5) immediate feedback - used when students responded to questions.

(6) meaningful feedback - used when students were incorrect as well as correct.

(7) opportunities for success - used in the game as well as the questions. Students were allowed three incorrect tries when trying to find the correct community.

This study suggests the need to incorporate appropriate learning principles into the design of software and learning materials of students.

Educators should use these principles when developing learning materials or should look for the use of these strategies in software intended for classroom use. The graphics display, cueing, nature of feedback and reinforcers play an important role in helping the student learn from the instructional materials.

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APPENDICES A - Q

Appendix page

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APPENDIX A

LINEAR PROGRAMME TEACHING MACHINES

Teaching machines consist of a plastic or wooden box with a transparent cover over the program. The student turns a handle which makes the foam rubber rollers advance the paper feed. Only one frame is visible to the student.

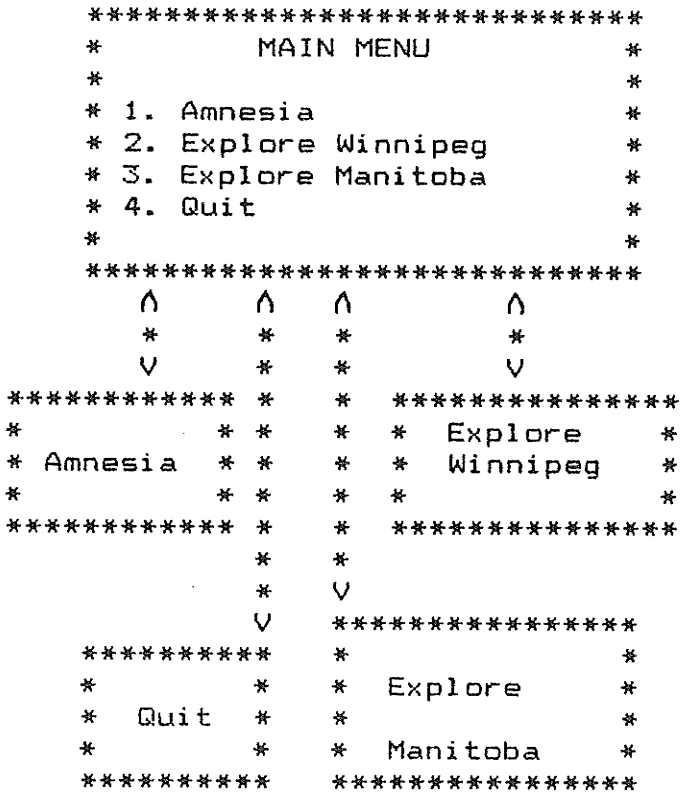
The student writes his/her response in the appropriate space and advances the program to the next frame. The program advances the response so that it is under a clear cover so the student can see it but cannot change it. The student compairs the correct answer with his response.

The Probox teaching machine was very popular and came in various different models. Some even had lights that lit up for the correct answer. Some incorporated anticheat devices. Some boxes such as the Min-Max Mark I, were advanced by finger pressure instead of a handle.

The Grundy Tutor, had a screen and a row of buttons displayed on the front of the machine. Each alternative was ascribed to one of the buttons. When the question was displayed on the screen, the correct botton had to be pressed by the student.

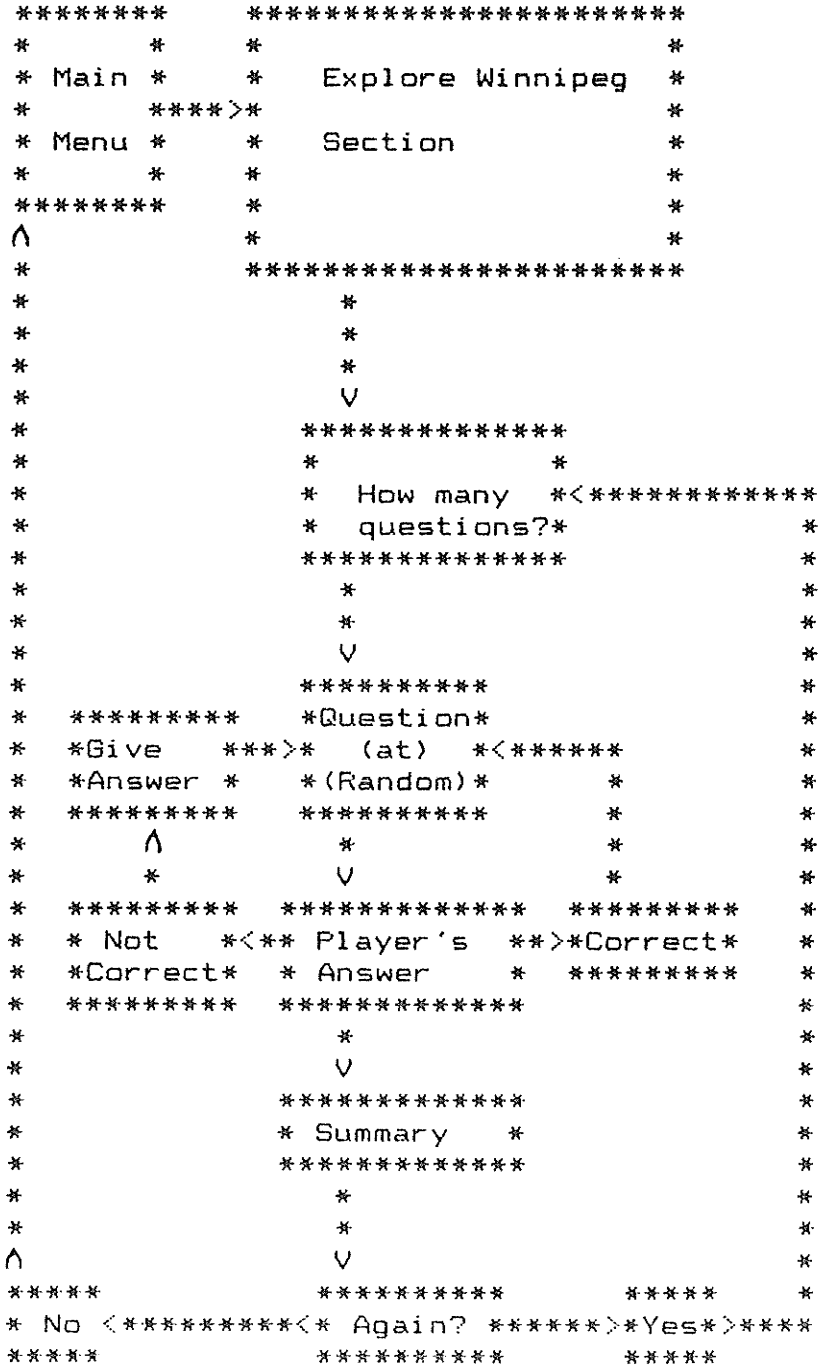
APPENDIX B

MAIN MENU FLOW CHART



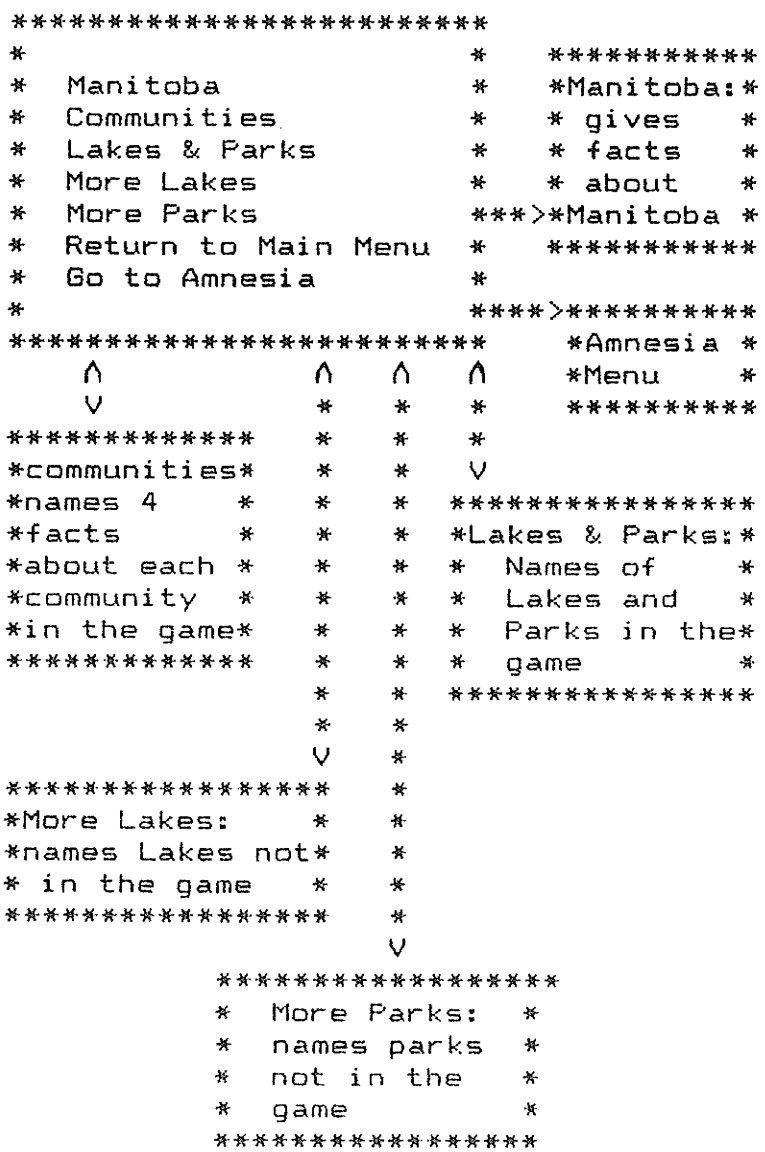
APPENDIX C

FLOW CHART FOR EXPLORING WINNIPEG



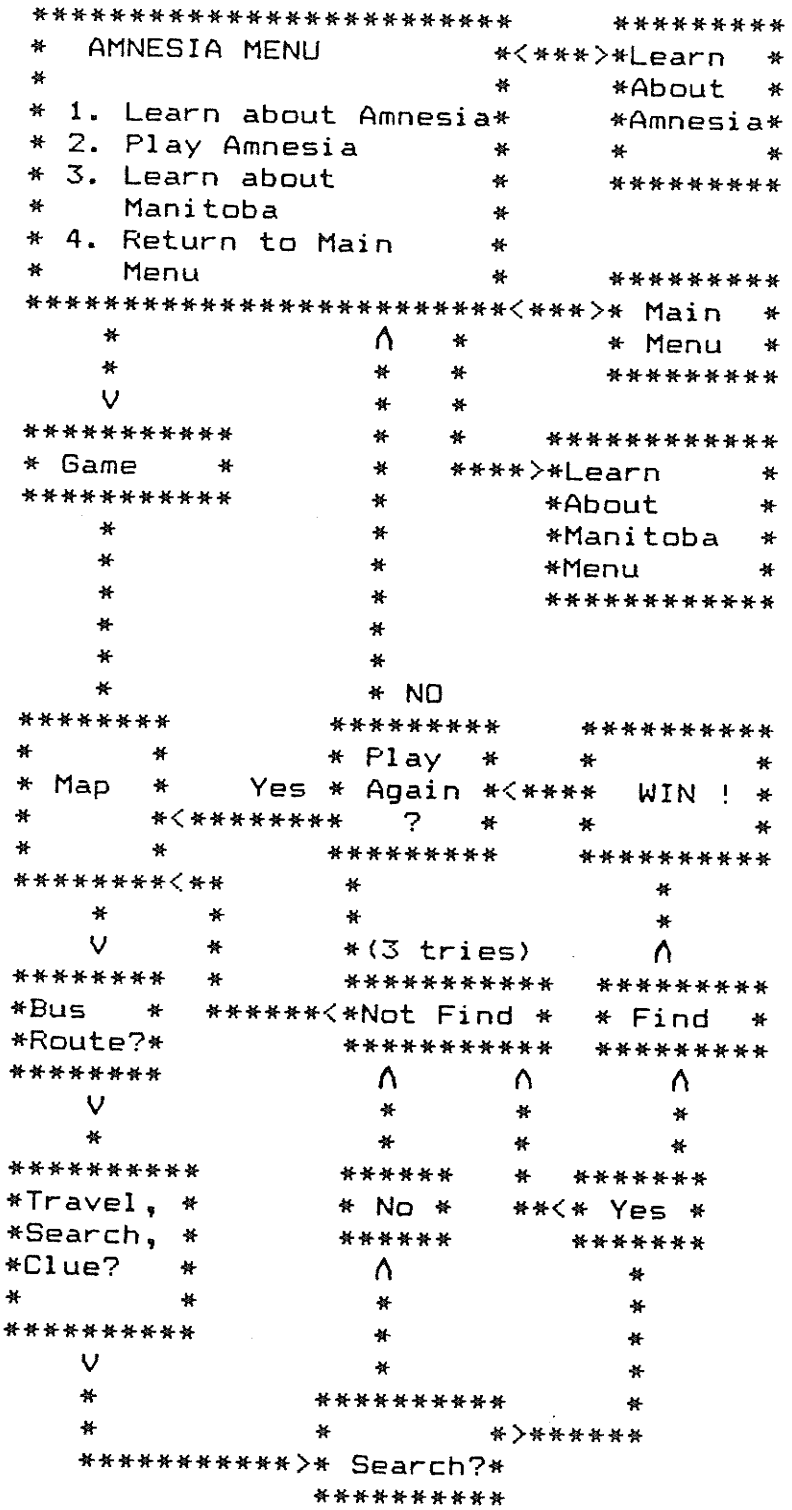
APPENDIX D

FLOW CHART FOR MANITOBA



APPENDIX E

FLOW CHART FOR AMNESIA



APPENDIX F

SUMMARY OF THE SIMULATION "AMNESIA"

"Amnesia", is a microcomputer simulation designed for the Apple IIe computer.

Jennifer has amnesia. She has travelled to a town in Manitoba. No one knows where she is. Al, her boyfriend, is trying to find her.

A map of southern Manitoba, south of the 51st parallel to the 49th parallel, is displayed on the screen. Major lakes, parks and 20 communities are included on the map.

The student begins the search in Winnipeg and must choose one of four bus routes: (1) north, (2) southeast, (3) west or (4) southwest.

A clue presents information about one of the communities. The student must find the correct location, (the place where Jennifer is) with the information provided in the clues. Four randomly generated clues are provided for each community.

Once the correct town is discovered, the student wins. The student, has the option of playing the game again. Each game is different because the "hiding place" is randomly generated each time.

APPENDIX G

DATA FOR THE COMPUTER PROGRAM

AMNESIA

```
1  Which two rivers meet at Winnipeg?
2  Red and Assiniboine
3  Red and Manitoba
4  Red and Winnipeg
5  How many airlines have regular flights
6  through Winnipeg International Airport
7  with connecting flights to other places?
8  3
9  6
10  9
11  Who lives at Government House which is
12  located on the southeast corner of the
13  grounds of the Legislative Buliding?
14  The Premier of Manitoba
15  The Lieutenant Governor of Manitoba
16  The Mayor of Winnipeg
17  Upper Fort Garry replaced which fort
18  built by La Verendrye?
19  Fort Red River
20  Fort La Verendrye
21  Fort Rouge
22  The Winnipeg Convention Centre
23  exhibition has 10 metre high ceilings.
24  What is the floor area of the centre?
25  9800 square metres
26  7800 square metres
27  6800 square metres
28  The Legislative Building is in the form
29  of what letter?
30  I
31  H
32  O
33  Approximately 2500 railway cars are
34  handled each day at one of the most
35  modern railway yards on the continent.
36  What is the name of this yard?
37  C.P.R
38  Red River Railway Yard
39  Symington Yard
40  The Golden Boy sculptured by Charles
41  Gardet of Paris weighs how many kgm?
42  11 000 kgm
43   6 600 kgm
44   2 200 kgm
45  The Witch's Hut from the story of Hansel
46  and Gretel is found in which park?
47  Kildonan Park
48  Assiniboine Park
49  St. Vital Park
50  The number of animals exhibited in
```

```
51  Assiniboine Park Zoo is 200.
52  True
53  False
54  The Prairie Dog Central station is close
55  to which shopping centre?
56  Garden City shopping centre
57  Polo Park
58  St. Vital shopping centre
59  Rainbow Stage is located in which park?
60  Assiniboine Park
61  Kildonan Park
62  Birds Hill Park
63  The M. S. River Rouge can carry 200
64  passengers on its Red River cruises.
65  True
66  False
67  Seven Oaks House built by John Inkster
68  in 1851 is the oldest habitable home in
69  Manitoba.
70  True
71  False
72  Lombard Place is located in Winnipeg's
73  first underground concourse at Portage
74  and Main.
75  True
76  False
77  The Legislative Building is built of
78  Tyndall stone.
79  True
80  False
81  The City Hall Administrative and Council
82  buildings are linked by tunnels to the
83  Centennial Centre.
84  True
85  False
86  All coins for Canada are minted at the
87  Royal Canadian Mint in Winnipeg.
88  True
89  False
90  The Pan-American Swimming Pool built in
91  1967 for the Pan-American Games is one
92  of the largest indoor pools in Canada.
93  True
94  False
95  Upper Fort Garry located on the west
96  side of Main St. South was built as the
97  centre of the Red River Settlement in?
98  1835
99  1940
100  1945
```

Beausejour is the home of one of Manitoba's famous premiers. He was also the Governor General of Canada. His initials are E.S. Do you know his name? Beausejour's Winter Farewell Festival is held in February. People celebrate with a parade, sculptures, and many games and activities. Beausejour has a museum called the Broken- Beau Historical Society Museum. It has a railway station a log pioneer home and a school. Beausejour is 46 km east of Winnipeg.

Turtle Mountain Provincial Park is located near Boissevain. The park contains 400 lakes and provides an ideal habitat for the Western Painted Turtle. The Canadian Turtle Derby is held here in mid- July. People come from all over to compete in the turtle race. Nearby, is the International Peace Garden, located between Canada and North Dakota. The garden commemorates the longest unfortified border in the world. See if you can find it on a map. Boissevain is 251 km southwest of Winnipeg.

The Agriculture Research Station is situated in Brandon, conducting research on many crops and weed control. Brandon's university, built in 1899, is one of Manitoba's first universities. Brandon University is famous for its School of Music established in 1906. The Film Festival is held here in mid- March. The Manitoba Amateur Rodeo Championship is held at the end of October. Brandon is 197 km west of Winnipeg.

The first jail in Manitoba was built in Emerson in 1870. Emerson was named after the poet Ralph Waldo Emerson. If you travel to Fargo, North Dakota from Winnipeg you could pass through customs at Emerson. The Red and Pembina Rivers meet at Emerson. The Hudson Bay Company, the North West Company and the X.Y. Company all had fur trading posts at Emerson. Emerson is 96 km south of Winnipeg.

Commercial fishing is a major industry in Gimli. Gimli is the site of the first Icelandic settlement in Canada.

The Icelandic Festival of Manitoba held in August draws crowds who enjoy the displays, food and contests.
Gimli is 82 km north of Winnipeg.
Grand Beach has a 12 km trail that shows how the glaciers formed the beach.
Grand Beach is one of the finest beaches in North America. A castle- building contest is held in July. Grand Beach is 87 km north of Winnipeg on Highway 59.

Manitoba's first hydro- electric dam was built in Lac du Bonnet. Now, Winnipeg's hydro-electric power comes from Seven Sisters Falls which was completed in 1951. Lac du Bonnet is a popular fishing spot. It is 98 km northeast of Winnipeg.
The town of Lundar has a giant statue of a Canada goose in the town. Lundar is situated near the nesting sites of these geese. People come to Lundar to take part in the All- Canada Goose Shoot held in October. Hunters compete for trophies and prizes. They only get 10 bullets to shot as many geese as possible.
Lundar is 99 km north of Winnipeg.
Melita has a museum called the Antler River Historical Society Museum. Many different kinds of military equipment is displayed at this museum in Melita.
Melita has a Lion's Harvest Wind- up in late September. A fiddler's contest, tractor pull and barbecue are some of the events held at that time.
Melita is 319 km southwest of Winnipeg.
La Verendrye was the first French explorer to reach southern Manitoba. He is honoured in Morden with a plaque.
The Corn and Apple Festival is held in Morden in the last weekend of August. People celebrate by eating corn and drinking apple cider. There are many displays, farmer's markets and even a queen.
Morden is 104 km south of Winnipeg.

The town was named after the Honourable Alexander ------, Lieutenant-Governor of Manitoba from 1872 to 1877. The site was the location of two rival fur trading posts, the North West Company and the X.Y. Company. Five days of professional rodeo, and chuckwagon and chariot racing draw people from all over Canada and the U.S. Morris is 52 km south of Winnipeg. The Beautiful Plains Museum is located in Neepawa. Here, many pioneer items and a log cabin can be seen. The Manitoba Holiday Festival of the Arts is held in Neepawa. Then artists and others can study art for two weeks. The festival is held in July. A major route from the Red River Settlement to Fort Edmonton passes through Neepawa. It is called the Saskatchewan trail. Fur traders and settlers travelled this route. Neepawa is 175 km west of Winnipeg. This town is located in the Whiteshell. Many people go to this area for boating, fishing and camping. Wilderness training is very useful if you go to this area. The Whiteshell Nuclear Research Station is located in Pinawa. Pinawa is 95 km northeast of Winnipeg. The Abitibi- Price paper mill is located at Pine Falls. The Sakeeng Museum has Indian handicrafts and art, and a model of Fort Alexander. The Paper, Power, Pickerel and Pea Festival is held here in early September. There are displays, a parade and a fishing derby. Pine Falls is 119 km north of Winnipeg.

La Verendrye built Fort la Reine here in 1739. The site is marked with a plaque. The Right Honourable Arthur Meighen, one of the youngest prime ministers of Canada came from here. The Strawberry Festival is held here in June. Portage la Prairie is 70 km west of Winnipeg. The Festival on the Red is held in Selkirk in early February. The Marine Museum of Manitoba is located here. It shows the nautical history of Manitoba and has on display old restored ships. Visitors to the museum are also shown an animated program bringing the fur trade era to life.

Selkirk is 21 km north of Winnipeg.
The Royal Canadian Artillery Museum is located at Shilo. It features artillery from 1790 and has 1500 books on weapons. Historical documents concerning Louis Riel and Queen Victoria are displayed also. Other countries, such as Germany use the military base at Shilo to train their troops.
Shilo is 177 km west of Winnipeg.
Sometimes Steinbach is called the 'Automobile City' of Manitoba because there are many car dealers located here. Steinbach was started by Mennonite settlers from Russia. Pioneer Days is held here the first weekend in August. You can see an authentic windmill that is powered by wind, grind grain in the Mennonite Village Museum.
Steinbach is 48 km east of Winnipeg.
Manitoba's main oil field is located in Virden. The crude oil is brought up from underground resevoirs. Virden is the home of the Canadian Firefighters in September. Then, firefighters from Canada and the U.S. compete in ladder races, water soccer and the bucket brigade. Virden has a stone schoolhouse which was built in 1896.
Virden is 277 km west of Winnipeg.
Winnipeg Beach was the northern boundary of Manitoba when Manitoba was called the Postage Stamp province.
Many people enjoy going to Winnipeg Beach for fun and sun at the beach. Boardwalk Days is held in July. Food, swimming events and entertainment are all part of the fun. Winnipeg Beach also has a winter festival which includes a curling bonspiel and tournaments.
Winnipeg Beach is 66 km north of Winnipeg.
Winnipeg is located at the junction of the Red and Assiniboine Rivers. It is the sixth largest city in Canada with a population of over 600 000.
Assiniboine Park Zoo has more than 1000 animals. A model of the Witch's Hut from the story of Hansel and Gretel stands on the banks of Lord Selkirk Creek in Kildonan Park.

All of Canada's gold and silver coins are minted in Winnipeg at the Royal Canadian Mint. A totem pole donated to Manitoba by British Columbia stands behind the Legislative Building on the banks of the Assiniboine River.
Here are some more Manitoba lakes; Clear Lake, West Hawk Lake, Falcon Lake, Whitemouth Lake and Lake Winnipegosis. Try to find these lakes on a map of Manitoba. Which direction are they from Winnipeg? Can you find other lakes?
Here are some more parks of Manitoba; Agassiz Provincial Forest, Clearwater Lake Provincial Park, Duck Mountain Provincial Park and Hecla Provincial Park.
Did you know that Manitoba had so many parks? Try to find them on a map of Manitoba. See if there are any others.
Birds Hill Provincial Park is 24 km north of Winnipeg on highway 59. It has cross- country ski, snowshoe and cycle trails. You can go horseback riding too. White- tail deer live in the park.
Grand Beach Provincial Park is 92 km north of Winnipeg on highway 59. It has one of the finest beaches in North America. A sand castle- building contest is held there in July.
Riding Mountain National Park is 251 km northwest of Winnipeg. Camping, tennis, and horseback riding are available here. You can fish for pike, rainbow trout, walleye and lake trout in its lakes.
Spruce Woods Provincial Park is 200 km southeast of Winnipeg. Quicksand, a desert, and Manitoba's only lizard, the northern prairie skink, can be found here. The Assiniboine River is nearby.
Turtle Mountain Provincial Park is 277 km west of Winnipeg. Rolling forested hills are part of this park. It includes Lake Max which is stocked with pickerel. Lake William is stocked with rainbow and brown trout.

Whiteshell Provincial Park is 145 km east of Winnipeg. You can reach it by highways 1, 11 or 44. It is Manitoba's first and largest park. It is very popular with visitors who can hunt, fish canoe, and hike there. Falcon, White and West Hawk are some of the lakes in it. The Indians called Lake Manitoba 'Manito Bau' which means 'narrows of the Great Spirit' in Cree. Lake Manitoba was named 'Lac des Prairies' by La Verendrye in 1738.

Both Grand Beach and Winnipeg Beach are on Lake Winnipeg. Can you find Lake Winnipeg and these beaches on a map? Manitoba takes its name from the Cree 'Manito Bau' which means 'narrows of the Great Spirit'. Thomas Spence tried to form a new republic outside the district of Assiniboia in 1868. He called it Manitobah.

Spence joined Louis Riel's council at Fort Garry. His suggestion was used to name the province 'Manitobah' in 1870. The letter 'h' was dropped.

Before confederation in 1870, Manitoba was known as the Postage Stamp province. Its boundaries were in the shape of a square. The northern boundary was at Winnipeg Beach and the eastern at Piney.

The beautiful mauve prairie crocus was chosen as Manitoba's floral emblem by school children in 1906. They voted first for the crocus, second for the prairie lily and third for the prairie wild rose. Manitoba was the first province to adopt a floral emblem.

The coat of arms was approved by King Edward VII on May 10, 1905. It has a buffalo standing on a rock with a green background. Above the buffalo is the Cross of St. George.

This town houses the Beckoning Hills Museum which displays rural household and field relics.
The Canadian Turtle Derby attracts people from many places to race their turtles here in mid- July.
The International Peace Garden is located close to this town.

It is 251 km southwest of Winnipeg.

The Agriculture Canada Research Station is situated here. It conducts research on many crops and weed control.
The university built here in 1899 was one of the first in Manitoba. It is famous for its School of Music.
The film festival in mid- March is held in this town. The Manitoba Amateur Rodeo Championship is held here in October.
It is 197 km west of Winnipeg.

Commercial fishing is a major industry in this town.

It is the first permanent Icelandic settlement in Canada.

The Icelandic Festival of Manitoba is held in August.

This town is 82 km north of Winnipeg.

The town was named after the Honourable Alexander ------, Lieutenant-Governor of Manitoba from 1872 to 1877.
The site was the location of two rival fur trading posts, the North West Company and the X. Y. Company.
Five days of professional rodeo, and chuckwagon and chariot racing draw people from all over Canada and the U.S.
It is the home of the Manitoba Stampede.
It is 52 km south of Winnipeg.

Many people go to this area for camping, fishing and boating.

Wilderness training is very useful if you are near this town.

The Whiteshell Nuclear Research Station is located in this town.

It is 95 km northeast of Winnipeg.

Sometimes this town is called the 'Automobile City' of Manitoba. There are many car dealers located in this town. Pioneer Days is held on the first weekend in August. The town was started by Mennonite settlers from Russia. You can see an authentic windmill, which is powered by the wind, in the Mennonite Village Museum.
It is 48 km east of Winnipeg.

An accident has left Jennifer with a loss of memory. She has amnesia. She wandered away from a Winnipeg hospital around 1 PM. She was spotted on a bus that was heading out of Winnipeg. The bus travels to towns in Manitoba. You will have to depend on your knowledge of Manitoba to find Jennifer. The bus driver might be able to help by giving you a clue about her location. As you travel around Manitoba looking for Jennifer, remember these rules. When you search in a town, you are checking if Jennifer is there. You are allowed only 3 unsuccessful searches in the game.
Sometimes the bus driver will give a clue, sometimes he won't.
There are four bus routes starting and ending in Winnipeg. They are; West, Southwest, North, East. You pick the one that you wish to travel on.
Good luck. May you find Jennifer soon. She needs her medicine.
This town is the home of one of Manitoba's famous premiers, Ed Schreyer.

The Winter Farewell Festival is held in this town in February.

This town has the Broken-Beau Historical Society Museum.

The town is 46 km east of Winnipeg.

The first jail in Manitoba was built in this town in 1870.

The town was named after the famous poet, Ralph ----------.

The Red and Pembina Rivers meet in this town.

The town is 96 km south of Winnipeg.

In the town is a long trail that shows how glaciers formed the beach.

This town has one of the finest beaches in North America.

A castle-building contest is held here in July.

It is 87 km north of Winnipeg.

Manitoba's first hydro-electric dam was built in this town.

This town is near Seven Sisters Falls.

This town is a popular fishing spot.

The town is 98 km northeast of Winnipeg.

The town has a giant Canada Goose statue.

People come here to participate in the all-Canada Goose Shoot in October.

Goose hunters get only 10 bullets and have to shoot as many geese as possible with the bullets.
The town is 99 km north of Winnipeg.

The town has a museum called the Antler River Historical Society.

People celebrate with a fiddle contest, a tractor competition, and a barbeque in this town.
The Lions Harvest Wind-Up is held here in September.

The town is 319 km west of Winnipeg.

La Verendrye was the first explorer to reach this town in southern Manitoba.

The Corn and Apple Festival is held in this town in August.

People celebrate by eating corn, drinking apple cider, and having many displays.
The town is 104 km south of Winnipeg.

The Beautiful Plains Museum is located here, showing pioneer items and a log cabin.
The Manitoba Holiday Festival of the Arts is held here in July.

The Saskatchewan Trail, a major route from the Red River settlement to Fort Edmonton, passed through this town.
The town is 175 km west of Winnipeg.

The Abitibi-Price Inc. paper mill is in this town.

The Sagkeeng Museum in this town displays native handicrafts, art and a model of Fort Alexander.
The Paper, Power, Pickerel and Pea Festival is held here in September.

It is 119 km north of Winnipeg.

La Verendrye built Fort la Reine here in 1739.

Right Honourable Arthur Meighen, one of the youngest prime ministers of Canada came from this place.

The Strawberry Festival is held here in June.

The town is 70 km west of Winnipeg.

In early February, the Festival on the Red is held here.

The Marine Museum of Manitoba here shows the history of Manitoba waterways.
In the museum of this town, people can see an animated program of life during the fur trade.
The town is 21 km north of Winnipeg.

The Royal Canadian Artillery Museum in this town shows artillery from 1790.
Historical documents about Louis Riel and Queen Victoria are displayed here.

Germany uses this town to train their troops.

The town is 177 km west of Winnipeg.

Manitoba's main oil field is located in this town.

This town is the home of the Canadian Firefighters Rodeo in September.

The town has a stone schoolhouse which was built in 1896.

This town is 277 km west of Winnipeg.

This town marked the northern boundary of the 'Postage Stamp Province'.

Boardwalk Days are held in July.

In winter, curling bonspiels attract many people to this town.

The town is 66 km north of Winnipeg.

APPENDIX H

STUDENTS WORKBOOK

FOR AMNESIA

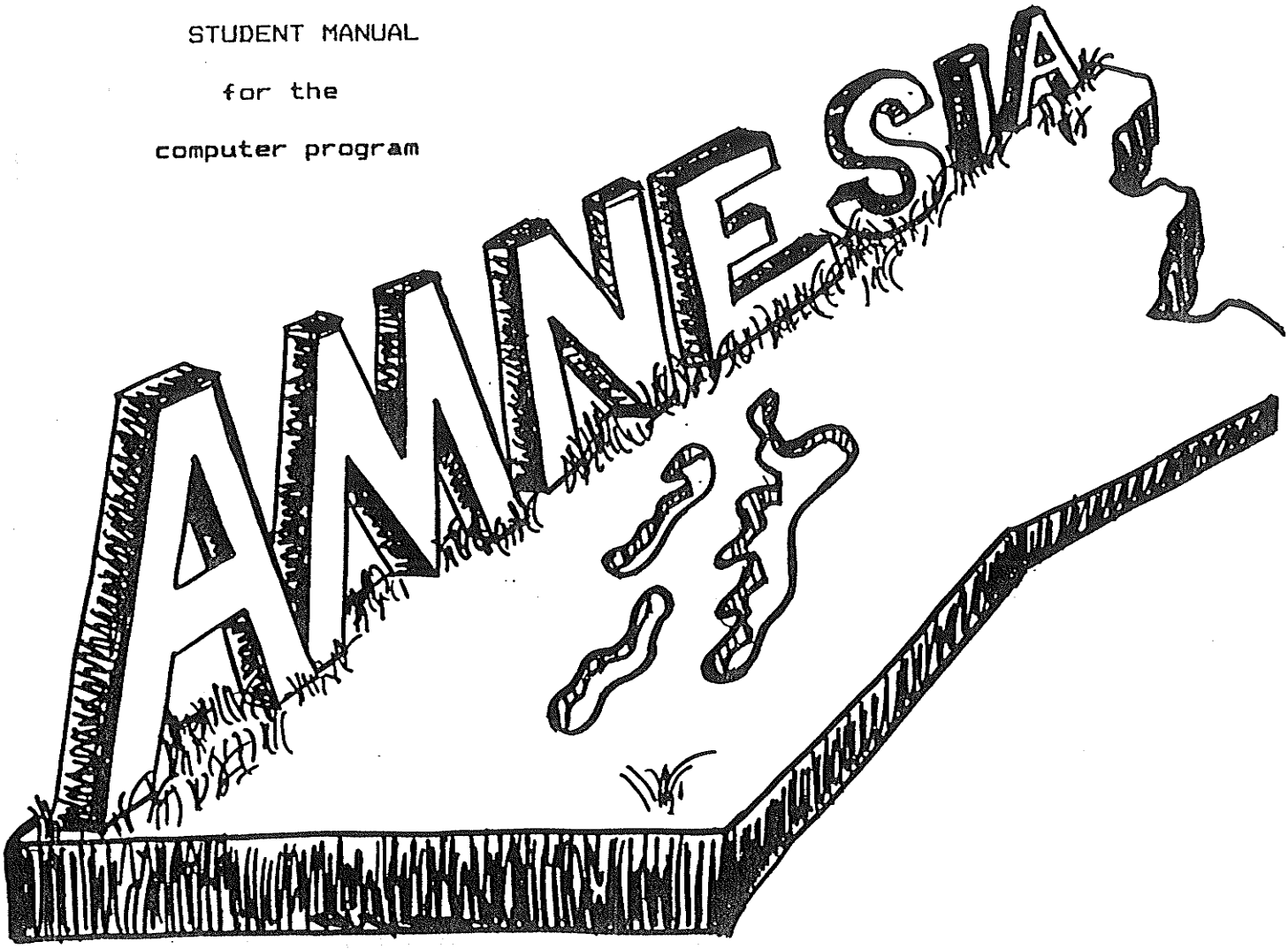
Name:.....Female....Male....

School:.....Grade....

STUDENT MANUAL

for the

computer program



designed by I. Penn

for

Grade Five Social Studies

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Helpful Hints

1. What do the square brackets mean?
   When you see a word in square brackets, you must PRESS THE KEY named within the brackets.

2. What is the cursor and how has it been changed?
   The cursor appears as a small flashing square on the screen when you turn on the monitor.
   In this program the cursor was altered to enable it to high-light long words.

3. What does the computer do?
   The computer calculates your instructions and presents a new screen-page.

4. What is a "menu" and what do I do with it?
   A menu lists the program content. It is something like the table of contents in a book.

5. What does the main menu of "Amnesia" contain?
   The main menu of "Amnesia" contains the following:

   Main Menu

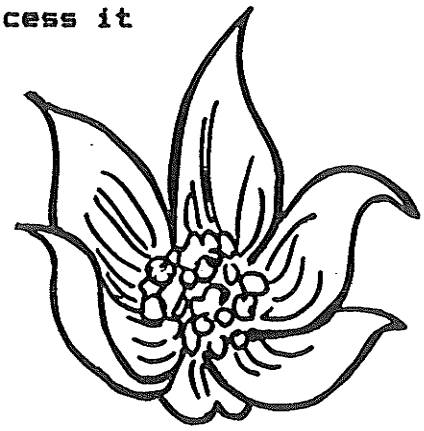
   Amnesia
   Explore Winnipeg
   Explore Manitoba
   Quit

6. How do you access your choice?
   For Example: If you want to get "Explore Winnipeg" do the following:
   a) Load the program menu.
   b) Press the space bar to high-light "Explore Winnipeg".
   c) Then Press the return key.
   d) New information will be presented.

7. Take time to load the program, and access it correctly.

Well, that wasn't too hard, was it?

*****



Floral Emblem

Learn about Amnesia

1. Choose "Amnesia" from the "Main Menu", or from the "Exploring Manitoba" menu.

2. The "Amnesia Menu" appears.

3. Use the menu in the following order:
   1. Learn About Amnesia
   2. Play Amnesia

4. The section "Learn About Amnesia" gives you the background story. You are an expert authority of Manitoba. Your assignment is to solve the problem (find Jennifer).

5. Once you have read "Learn About Amnesia", return to the "Amnesia Menu" and select "Play Amnesia".

Take Care!

*****

Using The Map

1. Select "Playing Amnesia" from the "Amnesia" menu.

2. When you see the map, the very first thing you have to do is attach the ascetate map, containing the names of the towns, to the monitor.

3. Make sure the screen is clean and free of dust. If it is dusty, wipe it with a kleenex before you turn on the power switch.

4. Carefully, hold the map against the screen map. Find Winnipeg on the overlay. Winnipeg on the screen must be direcly below it.

5. Gently place the map against the screen. It should "stick" to the monitor. If it does not stay in place, use a little masking tape.

6. Check points: The ascetate overlay should match:
   a) The north-direction arrow
   b) Winnipeg

Now you are READY
to play the game !

******

Official Tartan

The Game

1. Select "Playing Amnesia" from the "Amnesia Menu".

2. Attach the map with the town names to the monitor.

3. Read the first clue.

4. Decide which bus route to take, of the four:
   West, North, South or Southwest

5. Press the "Space Bar" to choose; then the "Return" key .

6. The first town of the chosen route will flash.
   Then the town will be named. (The flashing stops
   as soon as you make another choice.)

7. Decide what you want to do in this town.
   Your choices are: Travel, Search or Clue
   a) Choose "Travel", to continue to the next town.
   b) Choose "Search", to see if it is the correct town.
      If it is correct, you win!
      If it is not, you loose one "search".
   d) Choose "Clue", to see another clue.
      (Sometimes you will not get a clue).

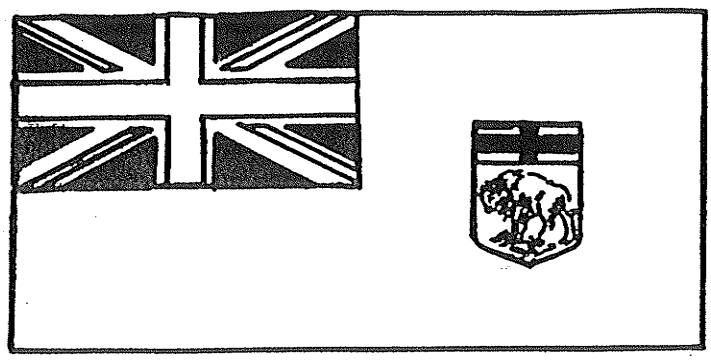
8. Your partner may help in decision-making. Use the
   Amnesia Fact Sheet to keep track of things.

9. After you have played the game two or three times,
   try it without the ascetate overlay map. See if you
   can name the town before it is given on the screen.

10. During every game note:
    a) which direction the town is from Winnipeg.
    b) which highway is being used.
    c) how far the town is from Winnipeg.

Make Your Move!

*****



Official Flag

Three Official Boundaries of Manitoba

1. In 1870, Manitoba was known as "the postage-stamp province" because its boundary was in the shape of a square, resembling a postage stamp.

   (a) The northern boundary was near Winnipeg Beach.
   (b) The southern boundary was at the 49th parallel.
   (c) The western boundary was just west of Crystal City.
   (d) The eastern boundary was near Piney.

2. In 1881 the boundaries changed to:

   (a) The northern border moved a little north.
   (b) The southern border remained at the 49th parallel
   (c) The western boundary was extended to its present location.
   (d) The eastern boundary was set at the northwest Angle of Lake of the Woods (Ontario).

3. In 1912, Manitoba's boundaries were changed to the following:

   (a) north: 60 parallel

   (b) south: 49th parallel

   (c) west: extended to the 60th parallel

   (d) east: extended to Hudson Bay

   These are the boundaries Manitoba has today.

*****

Emblems of Manitoba

1. Manitoba's Coat-of-Arms was declaired by King Edward VII on May 10, 1905. It is a buffalo standing on a rock against a green background. Above the buffalo, on a silver background, is the cross of St. George.

2. The prairie crocus became the floral emblem of Manitoba on May 16, 1906. The flower was chosen by the school children of Manitoba. Other nominated flowers were the prairie rose and the prairie lily.

3. The Red Ensign, with the Union Jack in the upper quarter, on the "staff" half of the flag, and the Coat-of-Arms centered, in the "fly" half of the flag, is the official flag of Manitoba. Her Majesty Queen Elizabeth II, gave royal approval of the flag in October 1965. The flag was offically proclaimed May 12, 1966.

4. Each color of the design of Manitoba's official tartan has a special meaning.
   dark red squares - Red River Settlement
   green squares - natural resources
   golden lines - agriculture
   azure blue lines - Lord Selkirk
   dark green lines - the many races of Manitoba

5. A provincial Order-in-Council, dated December 1, 1903, provided that the seal be gold-colored, two and three quarters inches in diameter, with the words, "The Great Seal of the Province of Manitoba" encircling the Coat-of-Arms.

6. In 1985, the Great Grey Owl was named Manitoba's official bird. This bird is found throughout southern Manitoba. The "Great Bird Search" drew hundreds of entries. Some other nominated birds were the western meadowlark, the American robin, the common loon, the Canada goose and the red-winged blackbird.

*****

Page 13

Time Sheet

Name:.....................................Male.....Female.....

School:...................................Grade...............

Date: Month/ Day/87	Time Computer Lesson Started	Time Computer Lesson Ended	Total Length of lesson in minutes
For example:			
Apr. 2	9:30	10:00	30
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______

Exploring Winnipeg

Recording Sheet

Name:.....Male....Female.....

School:.....Grade.....

Date: Month/ Day/1987	# of questions chosen	# of questions correct	Percent correct
For example:			
Mar.16	16	8	50

Amnesia Fact Sheet

Keep track while you play

Name:.....Male... Female...

School:.....Grade.....

Name of Town	Clue 1	Clue 2	Clue 3	Clue 4
For example: ?	research	197 km west of Wpg.	film festival	amature rodeo
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

****

I found Jennifer in the following town.

Name of town:

1..... 6.....

2..... 7.....

3..... 8.....

4..... 9.....

5..... 10.....

APPENDIX I

TEACHER'S MANUAL

TEACHER'S MANUAL

Table of Contents

I. Kit Contents
II. Lesson Routine
III. Movement through the Student Workbook
IV. Instructional uses in the Classroom
V. What the student should know.
VI. The Teacher Should
VII. Before and After Activities.
VIII. Goals and Behavioral Objectives
IX. General Objectives
X. Behavioral Objectives
XI. Affective Objectives

I. Kit Contents:

This kit contains:
1. Computer disk with "Amnesia" for the Apple IIe
2. Teacher's Guide
3. Student Workbook
4. Transparent Map
5. Disk care rules
6. Map of Manitoba
7. Teacher's Evaluation
8. Student's Evaluation

II. Lesson Routine:

1. Hand out students workbooks
2. Read or review in workbooks
3. Students Use computers
4. Hand out disks, ascetate maps (Students should not need the ascetate screen over-lay maps after 2 or 3 lessons)
5. Record progress on recording sheets in student's workbook
6. Collect disks and ascetate maps
7. Collect student workbooks

III. Movement through the Student Workbook

Approximate time to cover everything is 4 1/2 hours.

A. Begin:

1. Hand out student workbooks.
   Books must be handed out at the beginning of each social studies class and returned to the teacher at the end of the class.

2. Students work in small groups of two.
   Make a list of partners and place on the bulletin board.

3. Refresh student memories by reviewing the Maps on the inside cover - provinces and capitals, prairie provinces and some towns and lakes.

4. Review the table of contents, so they know what the contents of the program is about.

5. Explain how to keep track of their daily lesson time on page 13. Record when the class starts and when it ends, each time.

B. Getting Started:

1. Explain how to load the program.

2. Have the students take turns reading "Booting the Apple".

3. Ask if there are any questions.

4. Some students may have a C-64, where the disk drive, monitor and keyboard are turned on before the the disk is inserted into the drive.
   So it's important for them to understand that the Apple is different.

5. Read Turning off the Apple. Students may take turns reading this.

6. Leave the disk drive door in the open position, to relax the mechanisim.

C. Disk Care:

1. Students should be made aware how fragile the disks are and that extra special care must be taken with them.

2. If disks are not in the disk drive, then they should be in the protective jacket. Even the particles in the air (dust, smoke, etc.) can damage the disks.

3. Disks should never be removed from the drive when the light is on. The red light means that the drive is loading something. Taking disks out at that time may damage the disks.

4. See if the students can name any other rules for disk care.
   One student may write these on the board, or students may take turns writing them on the board.

5. Students may write these rules on the bottom of page 11 in their student manuals.

D. Helpful Hints:

1. Have students take turns reading Helpful Hints.

2. Explain what "amnesia" is.

3. Explain that the computer program is user friendly, and easy to use.

4. The "SPACEBAR" is tapped until the selection wanted is high-lighted. Then the "RETURN" key is pressed.

5. Then the student waits for the new page to appear.

6. The red light will go on if the program is being loaded.

7. Use the ESCAPE key to go back a page.fp

E. Exploring Winnipeg

1. Have students take turns reading "Exploring Winnipeg".

2. Explain how to keep track of their scores when using "Explore Winnipeg" page 14.

3. Then they are to access "Explore Winnipeg" and each try 5 questions.

4. Then record the results in their books on page 14.

5. Then try 10 questions each, and record the results. Then try 15 each, etc.

F. Learn about Amnesia:

1. Explainthat there will be quite a bit of reading today on the monitor.

2. Ask them to take turns reading to eachother.

3. Tell them that they should read carefully, and that the clues that they are reading today will be very helpful when they play the game.

G. Using the Map:

1. Take turns reading "Using the Map". Show them a map.

2. Explain that, if the map does not stick to the monitor, rather than rubbing it which will cause static, and students may get schocks from the computer, use masking tape.

H. The Game:

1. Take turns reading "The Game".

2. Explain how they should keep track of whatever they do in the game, on page 15 and 16.

I. Three Offical Boundaries of Manitoba:

1. Read about the three official boundaries of Manitoba.

2. Explain that the three boundaries are shown in the computer program, and that they should look at it today, under Explore Manitoba.

J. Emblems of Manitoba:

1. Read Emblems of Manitoba.

2. Explain the bus routes in the game Amnesia.

3. Complete one bus route together.

4. Go to computer room.

K. Review:

1. Review everything in the Student Workbook.

2. Keeping their books closed -
Have students fill in the names of as many communities as they know on a map of southern Manitoba where the communites are marked, but not named.

3. If they missed any, then use the map in their book to fill in the rest.

4. Play the game as many times as the teacher instructs the students to do so.

5. Remind them to keep track of scores etc.

IV. Instructional Uses in the Classroom

The educational program "Amnesia" was designed to help the teacher integrate the teaching of general information about communities in Manitoba in the social studies curriculum.

"Amnesia" was designed to be used as an adjunct to teaching the grade 5 classroom and fits directly into the grade 5 social studies curriculum in Unit II.

Exploring Winnipeg provides reinforcement and immediate feedback, thus enabling the student to self-pace the instruction.

Interaction, required by simulations, help students participate and motivate them. Students learn from each other when allowed to do so. Small groups is an excellent means of helpful learning.

Class discussions following the use of the simulation would reinforce and build on the content of the social studies program.

Students often do not appreciate their own country and province, and know very little about it, since there is so much information about the United States and other countries; the students' own country often gets over-shadowed by other information.

Using modern technology to present the information about the student's own province will make it more interesting for the student.

This instructional computer package "Amnesia" acts as a laboratory, allowing for the application of skills, requiring full participation of the student while being effective in teaching at various skill levels of Bloom's Taxonomy.

V. What the Student should know?

As a prerequisite to using "Amnesia" the following suggestions could be included.

1. The student should have had some previous map reading ability. At minimum, the student should have studied a map of Manitoba.

2. Previous instruction with directions and highways routes would be beneficial.

VI. The Teacher Should:

1. Look at the material in the kit.

2. Read the teacher guide.

3. Become familiar with all the information on communities, Winnipeg and the game Amnesia.

4. Explain the use of maps and how to read them.

5. Explain how to draw a map.

6. Discuss the results of the assignment

7. Assign a project to students who are not working on the computers, while some may be working on the computer

8. Explain and do an off computer activity before the computer program

VII. Before and After activities:

A. BEFORE:

1. For a full description, see page 18 of the social studies curriculum guide.

2. Plan an imaginary flight across the southern part of Manitoba from east to west. Marrate the trip. Mention places, special land marks, geographical characteristics, vegetation, etc.

- Remind students of the historical events associated with particular locations. Discuss what they say when the journey is completed.

- Are ther places they would like to visit?

-Where many names new to them?

-Some unfamiliar areas or places can become the focus for special research topics.

-Have students write down their impressions about Manitoba.

B. AFTER

1. See social studies curriculum guide page 25 for a full description.

Assign students to role play a conversation between the family and the students in which the class tries to explain what life will be like on the prairies in the future.

Have the students describe the changes that the last 80 years have brought.

Have students record their experiences on paper.

Discuss what the students have learned.

2. Ask students to travel back in time to the turn of the century in the "Last Best West", to meet a prairie farm family.

What would they see? What would farm life be like? What is the family's background? Are they experienced farmers?

Have students record their experiences on paper.

VIII. Goals

1. To provide the opportunity for the student to become familiar with the towns, cities in southern Manitoba

2. To provide the opportunity for the student to use the computer in an educational learning experience. The technological age demands that modern machines be used in the classrooms.

3. To provide enrichment for students at the elementary level.

4. To provide the opportunity for meaningful independent study.

5. To provide the opportunity to judge which solutions are best. The student makes many decisions which can affect the outcome of the game.

6. To provide students with the opportunity of using problem-solving skills and exhibit their decision-making skills.

IX. General Objectives:

The software program "Amnesia" will provide the student with:

- a positive attitude toward social studies and the computer
- a positive attitude about social studies and Manitoba
- the opportunity to use the computer in an educational setting in the social studies classroom
- the opportunity to learn about communities in southern Manitoba
- the opportunity to become familiar with Winnipeg
- the opportunity for independent meaningful study in social studies
- the opportunity to use problem solving skills and exhibit decision-making skills

X. Behavioral Objectives

After using the game the students will be able to:

1. Use the computer to play the game.

2. Name 8 major highways leaving Winnipeg.

3. Identify the major highways in southern Manitoba

4. Name 20 towns in southern Manitoba.

5. Write down information about 20 towns in Southern Manitoba.

6. Judge the result of making a decision in the game.

7. Evaluate the final outcome of the game.

XI.Affective Objectives

The student will

1. Have a positive attitude toward social studies in particular Manitoba.

2. Feel free from teacher judgement.

3. Acknowledge that s/he has mastered a computer program (Amnesia).

4. Feel confident about using a computer.

APPENDIX J

MEMBERSHIP OF THE EDUCATIONAL SOFTWARE EVALUATION CONSORTIUM (1985 membership)

1. Alberta: Department of Education
2. Arizona: Arizona State University Microcomputer Research Clinic
3. British Columbia: Ministry of Education
4. California: TECC Software Library
5. Clearinghouse California Educational Computing Consortium
6. California: Library Media Consortium
7. California: Computer-Using Educators
8. Department of Defense Dependents Schools
9. EPIE Institute
10. Florida: Department of Education
11. International Council for Computers in Education
12. Illinois: Micro-Ideas
13. Indiana: Clearinghouse for Computer Education
14. Iowa: Micro Libraries
15. Lousiana: Department of Education
16. Maryland: Montgomery County School
17. Michigan Association for Computer Ussers in Learning
18. Michigan: Oakland Schools
19. MICROSIFT
20. Minnesota: Department of Education
21. New York: Department of Education
22. New York: New York City Schools
23. North Carolina: Department of Education
24. Oklahoma: Oklahoma State University
25. Oregon: Center for Advanced Technology in Education
26. South Dakota: Department of Education
27. Texas: Education Computer Cooperative
28. Wyoming Department of Education

APPENDIX K

STUDENTS SOFTWARE EVALUATION

AND

STUDENTS COMMENTS

Student Software Evaluation

PART I: Circle "YES" or "NO"

Circle the answer that best describes how you feel about the computer program "Amnesia".

1. The program was fun.....YES NO
2. I liked the program.....YES NO
3. I learned something NEW about Manitoba by using the program.....YES NO
4. The program made me think.....YES NO
5. The computer program was easy to use.....YES NO
6. The instructions (rules) were easy to follow.....YES NO
7. I would like to visit the towns named in Manitoba I was studying.....YES NO
8. I would use the program again.....YES NO
9. I would want my friend to use the program..YES NO
10. (a) I have a computer at home.....YES NO

    (b) If you answered "YES", write down the kind of computer you have.....

PART II: Short Answers

11. (a) WHAT did you LIKE MOST about the program?

    .....

    .....

    (b) WHY did you like that the most?

    .....

12. (a) WHAT did you NOT LIKE about the program?

.....

.....

(b) WHY did you not like that?

.....

.....

13. (a) Have you ever used computer programs in any other class?.....YES NO

(b) If you answered "YES", write down in which classes.
(For example: science, maths, spelling)

.....

.....

14. (a) Should any changes be made to the program?
YES NO

(b) If you answered "YES", how would you change the program.

.....

.....

15. How many times did you use the program?....times.

16. How many minutes or hours did you spend using the program?

.....hours .....minutes

17. How many times did you find the correct town in the program?

.....

18. Do you have anything more to say about the program?
Write your answer at the back of the page.

THANK YOU

Students Answers and Comments

Student Software Evaluation

PART I: Circle "YES" or "NO"

Circle the answer that best describes how you feel about the computer program "Amnesia".

		YES	NO
1.	The program was fun.....		
	Group A.....	18	4
	Group B.....	18	1
2.	I liked the program.....	YES	NO
	Group A.....	17	5
	Group B.....	18	1
3.	I learned something NEW about Manitoba by using the program.....	YES	NO
	Group A.....	20	2
	Group B.....	18	1
4.	The program made me think.....	YES	NO
	Group A.....	18	4
	Group B.....	18	1
5.	The computer program was easy to use.....	YES	NO
	Group A.....	20	2
	Group B.....	14	4
6.	The instructions (rules) were easy to follow.....	YES	NO
	Group A.....	17	5
	Group B.....	18	1
7.	I would like to visit the towns named in Manitoba I was studying.....	YES	NO
	Group A.....	18	4
	Group B.....	16	3
8.	I would use the program again.....	YES	NO
	Group A.....	17	5
	Group B.....	14	5

9. I would want my friend to use the program..YES NO

Group A	18	4
Group B	15	4

10. (a) I have a computer at home.....YES NO

Group A	8	14
Group B	11	8

(b) If you answered "YES", write down the kind of computer you have.....
Group A: Vic 20, Adam
Group B: Vic 20, Apple, Commodore 64

PART II: Short Answers

11. (a) WHAT did you LIKE MOST about the program?
(b) WHY did you like that the most?

Answers provided by Group A:

a) I liked Amnesia.
b) because you have to travel
a) I liked playing Amnesia
b) It was fun and interesting game
a) I liked when we could guess by the clues where Jennifer is.
a) The questions are the best part
b) It has much more strategy.
a) I liked the game Amnesia the most because it was easy to understand and it was fun.
b) You learn things just from the game. You have lots of fun.
a) I liked travelling to the towns.
b) because it was fun.
a) Trying to find Jennifer.
b) I liked it the most because if you couldn't find her with the clues you got and the other people did, later on it means you learned something.
a) I did not like it.
a) I liked to learn about towns.
b) because I learned things.

Answers provided by Group B:
a) I liked the game the best
b) because it was fun and I like playing games.
a) I liked doing the twenty questions, and finding Jennifer.
b) I liked that the most because it was educational.
a) When we found Jen.
b) because we got complemented.
a) Playing Amnesia
b) because it was fun
a) Finding Jennifer.
b) It was fun looking for Jennifer in the towns, cities and lakes.
a) I liked the part when you have to find Jennifer because I have a cousin with that name.
b) I liked that part the most because it was worthwhile and interesting.
a) Everything.
a) It taught me.
b) because now I know more about Manitoba.
a) What I like most was finding Jennifer.
b) Why? Well the computer gives you clues.
a) I like answering the multiple choice questions.
b) I like that the most because it was fun.
a) I liked the part of the Exploring Winnipeg.
b) because you can answer easy questions.

12. (a) What did you NOT LIKE about the program?
(b) WHY did you not like that?

Answers provided by Group A:
a) I didn't like having to memorize the map.
b) because there are so many different towns.
a) the part about reading the instructions.
a) There is nothing that I didn't like, I liked everything.
a) I can't think of anything I didn't like.
a) Remembering
a) I liked everything.
a) It was too easy.
b) I always like a challenge.
a) I didn't like the test.
b) it was to long.
a) studying the towns and reading about them
b) it wasn't exciting.
a) I like the game and I learnt things I didn't know about Manitoba.

b) because the game was a fun way to learn.
a) the writing part
b) because I liked playing the game more.
a) I didn't like when they said how many km the town was.
b) I didn't like it because it was easy when they said that.

Answers provided by Group B:
a) I didn't like the test.
b) because it was to hard.
a) I did not like reading the information.
a) learning about Manitoba and lakes and parks
a) I did not like learning about Amnesia.
a) Nothing.
a) The test.
b) because it was hard.
a) I liked everything.
a) going through all the places
b) I took much time and I want to play the game.
a) I didn't like when the bus driver said sorry, I can't help you.
a) Not really anything.

13. a) Have you ever used computer programs in any other class?.....YES NO

Group A:.....22 Ø
Group B.....10 9

(b) If you answered "YES", write down in which classes.
(For example: science, maths, spelling)
Group A: Maths, Science, Spelling, LA
Group B: Friend's house-4 , computer class-1, Spelling-1, Reading-1, Maths-4, my house-1

14. (a) Should any changes be made to the program?

	YES	NO
Group A	6	16
Group B	3	16

(b) If you answered "YES", how would you change the program.

Group A: Make it harder.
Use all of Manitoba.
Write the test shorter.
Make it more funnier.
Don't put so many clues.
The bus driver should give a few more clues.

Group B: I would love more questions.
Make it harder.
I would put in the game Anmesia in the program that you can walk through the town as well as taking a bus.

15. How many times did you use the program.
Group A: 10(22)
Group B: 8(2), 9(4), 10(5), 11(8)

16. How many minutes or hours did you spend using the program?

17. How many times did you find Jennifer.
Group A:about 15 (22)
Group B:10(4), 11(2), 12(4) 15(2), 20(4), 22(1) ,24(2)

18. Do you have anything more to say about the program?
Group A:
Thanks for letting our class use this program, it was alot of fun.
I thought that it is a very good program. How did you make it? Was it hard?
I would do the exact same thing, but do it also in the northern part of Manitoba. Maybe even other provinces.
You could put what the town looks like when you travel there like this (drew a picture) a view out the window.

Group B:
I liked the program very much and I would like to do it again.
It was great fun.

APPENDIX L

TEACHER SOFTWARE EVALUATION

TEACHER SOFTWARE EVALUATION

Please Complete the Evaluation using the rating scale below.

Rating Scale:
1) Poor 2) Fair 3) Good 4) Very Good 5) Excellent

PART I: Student/Teacher Needs

1. The program reaches the target population..... 1 2 3 4 5
2. The program motivates the student to learn.....1 2 3 4 5
3. The content is relevant to the instructional needs of the student.....1 2 3 4 5
4. The material is effective with individual learning styles.....1 2 3 4 5
5. The format appeals to the student.....1 2 3 4 5
6. The informaton is well organized.....1 2 3 4 5

PART II: Instructional Integrity

1. The program states behavioral objectives.....1 2 3 4 5
2. The content is presented clearly.....1 2 3 4 5
3. The content accurate.....1 2 3 4 5
4. The material is self-sufficient.....1 2 3 4 5
5. The required reading is presented at the student's level.....1 2 3 4 5
6. The content has educational value.....1 2 3 4 5

7. The program allows the student adequate time to complete the learning segments.....1 2 3 4 5

8. The program is free of racial, sexual or political bias.....1 2 3 4 5

PART III: Technical Adequacy

1. The teacher's instructions are well organized, useful, and easy to understand.....1 2 3 4 5

2. The material is of high quality.....1 2 3 4 5

3. The program is easy to operate.1 2 3 4 5

4. The student can use the program without supervision....1 2 3 4 5

PART IV: Content

1. The program engages students in analyzing and in attempting to solve the problem.....1 2 3 4 5

2. The program focuses on useful information.....1 2 3 4 5

3. Students are given practice in naming, identifying and testing hypotheses..... .....1 2 3 4 5

4. The program fosters the development of thinking skills.1 2 3 4 5

5. The program provides opportunities for success.....1 2 3 4 5

6. The program instigates communication skills.....1 2 3 4 5

7. The program provides useful feedback.....1 2 3 4 5

8. The program relates to the social studies curriculum?.....1 2 3 4 5

PART V: Short Answer

1. (a) Have you used computer programs in any of your classes before this?...YES NO

   (b) If YES - state how the computer was used.

   .....

   .....

2. Do you have a computer at home?.....YES NO

   If "YES", state what kind.

   .....

3. Do you have access to a computer in the school? (Under what circumstances, how many, when etc.)

   .....

   .....

4. (a) Would you change the social studies computer program in any way?.....YES NO

   (b) If you answered "YES", state how you would change it.

   .....

   .....

5. Have you attended any classes or workshops with emphasis on computers in education?.....YES NO

   If you answered "YES", under what circumstances? (e.g. school workshop, division workshop)

   .....

6. After this, would you use a computer in your classes again?.....YES NO

7. Do you have any further comments to make? You may use the back of the sheet for additional comments.

THANK YOU

APPENDIX M

LETTER OF PERMISSION

Dear Parents:

In order to learn more about the social development of adolescents, it is sometimes necessary to conduct investigations into their social relationships and behaviour. With each investigation, we gain a little more knowledge concerning the experiences which are most beneficial to their social development.

The purpose of this letter is to inform you that such a study is being conducted and to request your permission to allow your son or daughter to participate in this research in the near future.

The research to be conducted is to determine whether students can learn a social studies lesson successfully when a computer is added to the lesson. Some students will be working with the computer and others will have classes as usual. All students will receive the same social studies curriculum-fit lesson. The study will begin .....and end ..... .

Students will be completing questions before and after each lesson. Examples of the questions are: (a) Name two lakes in Manitoba, (b) Name two rivers that meet at Winnipeg, and (c) Name the direction you would have to travel to reach Brandon if you started driving from Winnipeg. The students working with computers will be asked how they felt about the program. Examples of questions are: (a) Did you learn something new about Manitoba by using the program. (b) What did you like most about the program? and (c) What did you not like about the program?

The results of this study will not affect the student's school marks in any way and will be available to any parent who wishes to have them after the completion of the study. The information gathered in this study will be treated as confidential. Students take part in this study on a voluntary basis and can withdraw at anytime.

Please indicate whether or not you wish your son or daughter to participate by completing the permission slip on the next page and returning it to the school.

Yours sincerely,

.....

DATE: _____

PERMISSION FORM:

Title: Social Studies Study

Name of Student_____

check one:

_____ I do consent to let my son or daughter participate.

_____ I do not consent to let my son or daughter participate.

Parent's signature:

_____

.....

APPENDIX N

POSTTEST

Name:.....

Grade.....Female.....Male.....School.....

Part I: True and False

1. Read each of the following statements.
   If the statement is true circle the "T".
   If the statement is false, circle the "F".

(a) T F Beausejour is east of Winnipeg.

(b) T F Brandon is west of Winnipeg.

(c) T F Emerson is south of Winnipeg.

(d) T F Pinawa is east of Winnipeg.

(e) T F Portage la Prairie is east of Winnipeg

(f) T F Shilo is east of Winnipeg.

Part II: Matching

1. Manitoba is a province of many historic and cultural festivals. Column I lists the towns.
   Column II lists the festivals. Match the festival with the town in which it is held.

   ON THE LINE to the left of each town in Column I, WRITE the LETTER you see in front of the correct festival, in Column II.

Column I (towns)	Column II (festivals)
.....a) Boissevain	A. Pioneer Days
.....b) Gimli	B. Turtle Derby
.....c) Lundar	C. Strawberry Festival
.....d) Morris	D. Icelandic Festival
.....e) Steinbach	E. All-Canada Goose shoot
	F. Manitoba Stampede

2. Many different cultural groups settled in Manitoba. Column I lists the towns. Column II lists the ethnic groups. Match the town with its correct ethnic group.

ON THE LINE to the left of each town in Column I, WRITE the LETTER you see in front of the correct festival, in Column II.

Column I (towns)	Column II (ethnic groups)
.....a) Brandon	A. English
.....b) Gimli	B. French
.....c) Steinbach	C. Icelandic
	D. Mennonite/German

Part III: Short Answers

1. Name TWO LAKES found in Manitoba that you learned about in the computer program.

1.....

2.....

2. To which town named in the game "Amnesia" would you travel to see the Turtle Derby? WRITE down the name of the town.

.....

3. You are travelling in a town in Manitoba. You see a real windmill. You also know that the town is sometimes called the "Automobile City". WRITE down the name of the town.

.....

4. You have studied about The International Peace Garden in the game "Amnesia". WRITE down the NAME of the provincial park next to the International Peace Garden?

.....

.....

5. In your own words, write down what the International Peace Garden represents.

.....

.....

.....

6. In the computer program, you learned that the boundary between the United States and Canada is at the 49th parallel.

WRITE down TWO reasons why you think most people in Manitoba live near the border between Canada and the United States.

1.....

.....

2.....

.....

PART IV: Multiple Choice - CIRCLE the LETTER in front of the correct answer.

1. Who lives at Government House located on the southeast corner of the Legislative Building grounds in Winnipeg?

(a) The Lieutenant Governor of Manitoba

(b) The Governor General

(c) The Mayor of Winnipeg

(d) The Premier of Manitoba

2. Upper Fort Garry is located on the west side of Main Street, south of Broadway and was built at the centre of the Red River Settlement. In which year was Upper Fort Garry built?

(a) 1825

(b) 1830

(c) 1835

(d) 1840

3. Which of the flowers named below is the floral emblem of Manitoba.

(a) Prairie Carnation

(b) Prairie Crocus

(c) Prairie Lily

(d) Prairie Wild Rose

4. Who named the floral emblem of Manitoba?

(a) Louis Riel

(b) King Edward VII

(c) The school children of Manitoba

(d) Queen Victoria

5. What was the Province of Manitoba often called in 1870?

(a) The Postage Stamp Province

(b) The Red River Settlement

(c) The Manito Bau Province

(d) Lac des Prairies

6. Which town named in the list below, has the main oil field in Manitoba?

(a) Virden

(b) Shilo

(c) Pine Falls

(d) Melita

7. Which area listed below, applies best to the part of the province of Manitoba, you learned about in the game "Amnesia".

(a) An area of few roads

(b) An area of many roads

(c) An area of no roads

(d) An area of only gravel roads

8. Which of the regions listed below, applies best to the region of Manitoba you studied about in the game "Amnesia".

(a) Eastern region of Manitoba

(b) Western region of Manitoba

(c) Northern region of Manitoba

(d) Southern region of Manitoba

PART V: Map Work

1. FIND the shape belonging to MANITOBA on the correct map provided. Be careful, the map shapes are jumbled and north is not always at the top of the page.

(A). PRINT the name MANITOBA on the correct shape.

(B). DRAW the correct BOUNDARIES Manitoba had in 1870, on the same shape of Manitoba.

2. On the correct map provided:

(A) PLACE AN "X" on the map at the correct location for each town named below.

(B) PRINT the NAME of the town next to the "X" on the map.

(a) Gimli (b) Shilo

(c) Pine Falls (d) Morris

3. You are an aeroplane pilot flying over Manitoba. You look down and see a town below. You remember that the town marked the NORTHERN BOUNDARY of Manitoba in 1870.

You also know from the game "Amnesia" that Boardwalk Days is celebrated in July of each year. People come to the town from all over, to take part in the swimming events.

(A) PLACE AN "X" on the map at the correct location of the town described above.

(B) PRINT the NAME of the town next to the "X" on the map.

NOTE: COMPLETE question #4 OR #5.
--

DO NOT answer both questions.
------

4. You are in a town in Manitoba. You learn that the Film Festival is held in this town. You also discover that the town has an Agriculture Research Station conducting research on crop and weed control.

(A) PLACE AN "X" on the map at the correct location of the town described above.

(B) PRINT the NAME of the town next to the "X" on the map.

(C) DRAW a SOLID LINE on the map FROM Winnipeg TO the town, using the highway(s) on the map, to show the route you would travel by car from Winnipeg to the town.

(D) WRITE the correct HIGHWAY NUMBER(S), on the highway(s) on the map, that you used to travel from Winnipeg to the town.

(E) CIRCLE the highway number(s) on the map.

OR
--

5. You have a pet turtle. You want to enter the Turtle Derby held in a town in Manitoba. In the game "Amnesia" you learned that the town is near Turtle Mountain Provencial Park. The park has 400 lakes and is the home of the western painted turtle.

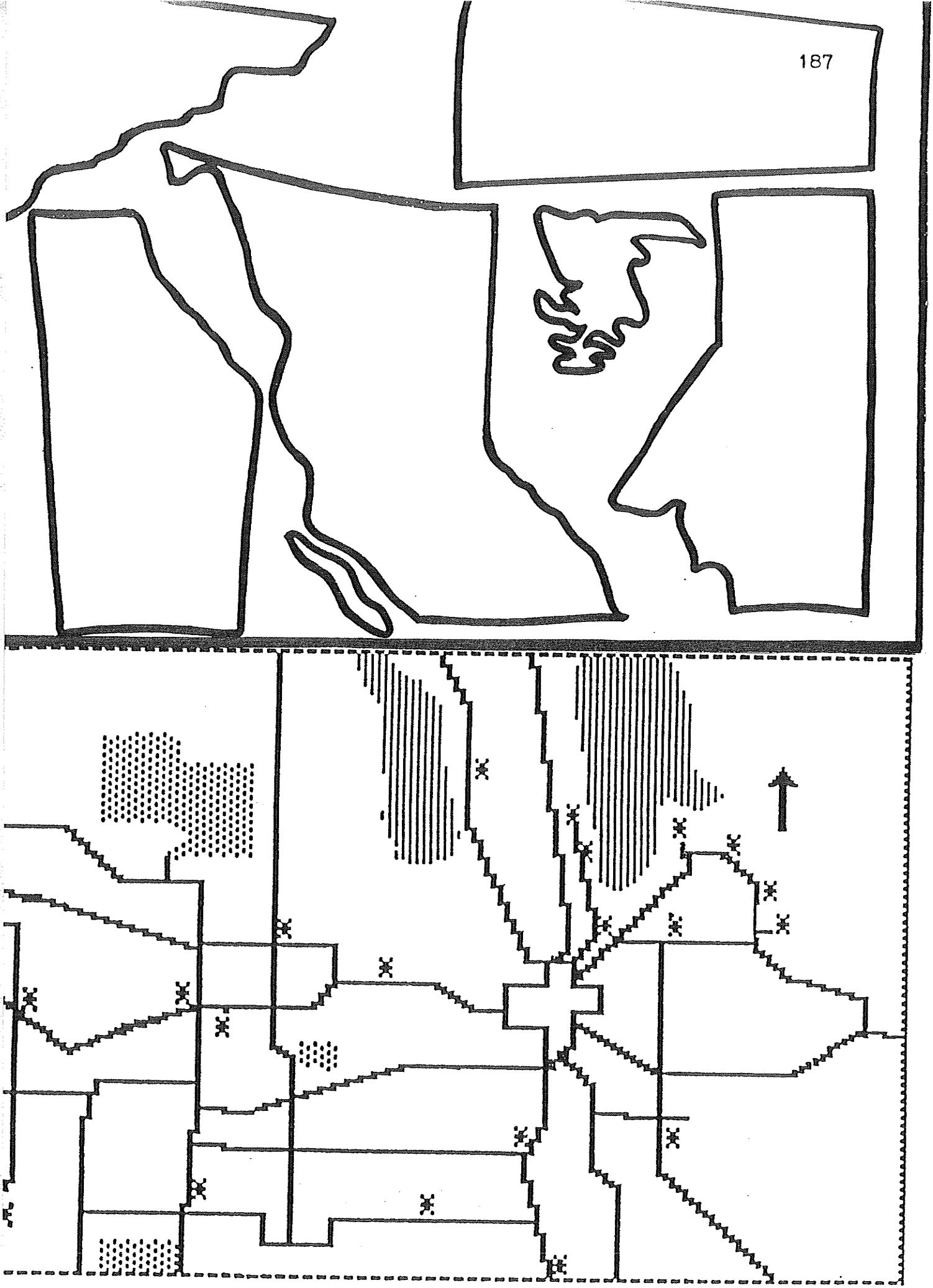
(A) PLACE an "X" on the map at the correct location of the town described above.

(B) PRINT the NAME of the town next to the "X" on the map.

(C) DRAW a SOLID LINE on the map FROM Winnipeg TO the town using the highway(s) on the map, to show the route you would travel by car from Winnipeg to the town.

(D) WRITE the correct HIGHWAY NUMBER(S), on the highway(s) on the map, that you used to travel from Winnipeg to the town.

(E) CIRCLE the highway number(s) on the map.



APPENDIX O

RAW SCORES

APPENDIX O

Raw Scores

Subject Number	Gender F=1 M=2	Age	Score	Treatment	Test Time
1	1	12	10	1	1
2	1	11	28	1	1
3	1	11	36	1	1
4	1	10	31	1	1
5	1	11	25	1	1
6	1	11	21	1	1
7	1	10	12	1	1
8	1	10	25	1	1
9	2	10	24	1	1
10	2	11	13	1	1
11	2	11	32	1	1
12	2	11	15	1	1
13	2	11	38	1	1
14	2	10	26	1	1
15	2	11	13	1	1
16	2	10	18	1	1
17	2	10	33	1	1
18	2	11	37	1	1
19	2	12	12	1	1
20	2	11	23	1	1
21	2	10	29	1	1
22	2	10	30	1	1
23	1	12	8	1	2
24	1	11	32	1	2
25	1	11	30	1	2
26	1	10	33	1	2
27	1	11	37	1	2
28	1	11	36	1	2
29	1	10	21	1	2
30	1	10	34	1	2
31	2	10	30	1	2
32	2	11	16	1	2
33	2	11	39	1	2
34	2	11	28	1	2
35	2	11	40	1	2
36	2	10	34	1	2
37	2	11	28	1	2
38	2	10	37	1	2
39	2	10	38	1	2
40	2	11	32	1	2
41	2	12	30	1	2
42	2	11	24	1	2
43	2	10	27	1	2
44	2	10	28	1	2

Appendix O continued

Raw Scores

45	1	10	27	2	1
46	1	10	17	2	1
47	1	11	20	2	1
48	1	10	23	2	1
49	1	10	21	2	1
50	1	11	23	2	1
51	1	11	28	2	1
52	1	10	27	2	1
53	1	10	21	2	1
54	1	11	29	2	1
55	2	11	15	2	1
56	2	11	20	2	1
57	2	11	22	2	1
58	2	10	17	2	1
59	2	10	30	2	1
60	2	10	24	2	1
61	2	11	21	2	1
62	2	11	27	2	1
63	2	11	25	2	1
64	1	10	26	2	2
65	1	10	25	2	2
66	1	11	24	2	2
67	1	10	20	2	2
68	1	10	24	2	2
69	1	11	27	2	2
70	1	11	28	2	2
71	1	10	20	2	2
72	1	10	23	2	2
73	1	11	31	2	2
74	2	11	23	2	2
75	2	11	21	2	2
76	2	11	15	2	2
77	2	10	23	2	2
78	2	10	25	2	2
79	2	10	23	2	2
80	2	11	25	2	2
81	2	11	25	2	2
82	2	11	20	2	2

Appendix D continued

Summary of Group A
One Computer for the Class

Subject Number	Gender	Age	First Score	Second Score
1	F	12	10	8
2	F	11	28	32
3	F	11	36	30
4	F	10	31	33
5	F	11	25	37
6	F	11	21	36
7	F	10	12	21
8	F	10	25	34
9	M	10	24	30
10	M	11	13	16
11	M	11	32	39
12	M	11	15	28
13	M	11	38	40
14	M	10	26	34
15	M	11	13	28
16	M	10	18	37
17	M	10	33	38
18	M	11	37	32
19	M	12	12	30
20	M	11	23	24
21	M	10	29	27
22	M	10	30	28
Totals			531	662
Class Means			24.13	30.09
Means for:				
Females			23.34	28.87
Males			24.5	30.78

Females	8
Males	14
Total Age	235
Average Age	10.6

Appendix O continued

Summary of Group B
Two students per Computer

Subject	Gender	Age	First Score	Second Score
1	F	10	27	26
2	F	10	17	25
3	F	11	20	24
4	F	10	23	20
5	F	10	21	24
6	F	11	23	27
7	F	11	28	28
8	F	10	27	20
9	F	10	21	23
10	F	11	29	31
11	M	11	15	23
12	M	11	20	21
13	M	11	22	15
14	M	10	17	23
15	M	10	30	25
16	M	10	24	23
17	M	11	21	25
18	M	11	27	25
19	M	11	25	20
Totals			437	448
Class Mean			23.00	23.57
Mean for:				
Females			23.6	24.8
Males			22.3	22.22

Females	10	
Males	9	
Total Age	200	
Average Age	10.5	

APPENDIX P

ITEM DIFFICULTY INDEX

DATA

GROUP A TEST TIME 1

NO.	TOT	ITEM NUMBER ON TEST 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	10	1	0	0	1	0	1	0	0	1	0	0	1	1	0	1	1	0	0	0	0
2	28	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	0	1	1	0	1
3	36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	31	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	0	1
5	25	0	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	0	1	0	1
6	21	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	0	0	1	1	1
7	12	1	0	1	1	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1
8	25	0	1	1	1	1	0	1	1	1	0	1	0	0	1	1	1	1	1	0	1
9	24	1	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	0	1	0	1
10	13	1	1	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1
11	32	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1
12	15	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
13	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	26	1	0	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	0	1
15	13	1	1	1	1	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0
16	18	0	1	1	1	1	0	0	0	1	0	1	0	0	1	1	1	0	1	0	1
17	33	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	37	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	12	1	1	0	0	0	1	1	0	0	1	1	0	0	0	1	0	1	1	0	0
20	23	0	1	1	0	0	1	1	0	0	1	1	1	0	1	1	0	1	1	0	0
21	29	1	1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	0	1
22	30	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	0	1
TOTAL	531	17	18	20	17	18	16	13	9	13	13	14	13	12	15	18	14	12	20	6	18

NO.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2	1	1	0	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0
3	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0
4	1	1	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0	0
5	0	0	0	1	1	1	1	1	0	1	1	0	0	1	1	1	0	1	0	0
6	0	0	1	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0
7	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0
9	0	0	0	0	1	1	1	1	1	0	1	0	0	1	1	1	1	0	0	0
10	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0
11	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0
12	0	0	0	0	1	1	1	0	0	0	1	1	1	0	1	1	1	0	0	0
13	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
14	1	0	0	0	1	1	1	0	1	0	1	0	1	1	0	1	1	1	0	0
15	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
16	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0
17	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	0
18	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
19	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
20	1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0
21	1	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0
22	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	10	7	10	5	20	18	19	13	13	13	15	8	12	14	15	16	10	11	5	1

GROUP B TEST TIME 1

		ITEM NUMBER ON TEST																			
NO.	TOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	27	1	1	1	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1
2	17	1	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0
3	20	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1
4	23	1	0	1	1	0	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1
5	21	1	1	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	1	1	0
6	23	0	1	1	1	1	1	0	0	1	0	1	0	0	1	1	1	0	1	0	1
7	28	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	0	1	1	1
8	27	1	0	1	0	1	1	1	0	0	0	1	0	0	0	1	1	0	1	1	1
9	21	1	1	0	1	0	1	0	0	0	0	0	0	0	1	1	1	0	1	1	1
10	29	1	1	1	0	1	1	0	1	0	0	1	0	0	0	1	1	0	1	0	1
11	15	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	1	1	1
12	20	1	0	1	1	0	1	0	1	0	1	1	0	0	0	1	1	0	1	0	0
13	22	1	1	0	1	0	0	1	1	1	0	1	0	0	1	1	1	1	1	0	0
14	17	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1
15	30	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1
16	24	0	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	1	1	1
17	21	1	1	1	0	1	1	0	0	0	0	1	1	0	0	1	1	0	1	1	1
18	27	1	1	1	0	1	1	0	1	0	0	1	0	1	1	1	1	0	1	0	1
19	25	0	1	1	0	1	1	1	1	0	0	0	1	1	0	1	1	1	1	0	0
TOTAL	437	16	15	15	10	13	16	5	10	5	2	12	5	5	10	18	17	7	18	11	14

NO.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TO
1	1	0	1	0	1	1	1	0	1	1	1	1	0	1	0	1	0	0	0	0	27
2	0	0	1	1	1	1	0	1	1	0	1	1	1	0	0	1	0	0	0	0	17
3	1	0	1	0	1	0	0	1	1	0	1	1	1	0	1	0	1	0	0	0	20
4	1	1	0	0	0	1	1	0	0	1	1	1	0	0	1	0	0	0	0	0	23
5	0	0	1	1	1	1	1	0	1	0	1	1	1	0	1	0	1	0	1	0	21
6	0	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	23
7	0	0	1	0	1	1	1	1	0	0	1	1	1	0	1	1	1	0	0	0	28
8	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	1	1	1	27
9	0	1	1	1	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	0	21
10	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	29
11	0	0	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	0	0	15
12	0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0	20
13	0	1	1	0	0	0	1	1	0	1	1	1	1	1	1	0	0	0	0	0	22
14	0	1	1	1	0	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	17
15	1	0	1	1	1	1	1	0	1	0	1	1	0	1	0	1	0	1	1	0	30
16	0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0	24
17	1	1	1	0	1	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0	21
18	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	27
19	0	0	1	0	1	0	1	0	0	1	1	1	1	1	1	1	0	1	1	1	25
	8	7	17	8	16	13	16	7	9	11	19	19	14	10	14	8	5	4	5		3437

GROUP A TEST TIME 2

NO.	TOT	ITEM NUMBER ON TEST 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	8	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0
2	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
3	30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	37	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
6	36	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
7	21	0	1	0	1	1	1	1	0	0	0	0	0	1	0	1	1	1	1	0	0
8	34	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
9	30	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
10	16	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0
11	39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0
12	28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
14	34	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15	28	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16	37	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
17	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	32	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	30	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	0	1
20	24	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0
21	27	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	1	1	1	0	1
22	28	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0
TOTAL	662	15	21	20	18	20	22	20	18	17	18	19	16	21	19	18	16	22	21	9	14

NO.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2	1	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
3	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0
4	1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
5	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	0
6	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	0	0	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	1
8	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0
9	0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0
10	0	0	1	0	0	1	1	1	0	0	1	1	0	0	1	1	0	0	0	0
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
12	1	0	0	0	1	1	1	0	1	0	1	1	1	0	1	0	0	0	0	0
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	1	1	0	1	1	1	1	1	1	0	1	1	0	1	0	1	1	1	1	1
15	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
16	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
18	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
19	0	0	1	1	1	0	1	1	1	1	0	0	1	1	0	1	0	1	1	0
20	0	0	1	0	1	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0
21	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	0
22	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1
	10	9	18	13	21	21	21	18	20	16	19	17	14	14	16	16	10	11	8	6

GROUP B TEST TIME 2

		ITEM NUMBER ON TEST																			
NO.	TOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	26	1	1	1	1	1	0	1	1	1	0	1	1	0	0	1	1	1	1	0	1
2	25	1	1	1	1	0	0	1	1	1	0	0	1	1	1	1	1	0	1	0	1
3	24	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	0	1	0	1
4	20	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1
5	24	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	0	0
6	27	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	0	1
7	28	1	1	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	1
8	20	1	1	1	0	1	1	0	1	0	0	0	0	0	1	1	1	0	1	0	0
9	23	1	1	0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	1	0	1
10	31	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1
11	23	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	1	1	0	1	0
12	21	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	0
13	15	1	0	1	1	1	0	0	1	0	1	0	0	0	0	1	1	1	1	1	0
14	23	0	1	1	1	1	1	1	1	1	0	1	0	1	1	0	0	1	1	0	0
15	25	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	1	0	0
16	23	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1
17	25	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	0	1
18	25	0	1	1	0	1	1	0	1	1	0	1	0	1	1	1	1	0	1	0	1
19	20	0	1	1	0	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	1
TOT	448	15	18	18	14	18	16	14	12	8	3	10	7	9	14	17	17	13	18	4	12

NO.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	0	1	0	1	1	1	1	1	0	1	0	0	1	1	0	0	1	1	0
2	0	0	1	1	1	1	0	1	1	0	1	0	1	0	1	1	0	0	1	0
3	0	0	1	0	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	0
4	0	0	1	1	0	1	1	0	1	0	1	1	1	0	1	1	0	0	0	0
5	0	0	1	1	1	1	1	0	1	0	1	1	0	1	1	1	0	0	0	0
6	0	0	1	0	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0
7	0	0	0	1	1	1	1	0	1	1	1	1	0	1	0	1	0	1	1	1
8	1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
9	0	0	1	1	1	1	1	0	1	0	0	1	1	0	0	0	1	1	1	0
10	1	0	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	1	0
11	0	0	1	1	0	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0
12	0	0	0	1	1	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0
13	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
14	0	0	0	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	1	0
15	1	0	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	1	1	0
16	0	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	0	0	0	0
17	1	0	1	0	1	1	1	0	1	0	1	1	1	1	1	1	0	0	0	0
18	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	1	0	0	0
19	0	0	1	1	1	0	1	0	0	1	0	0	1	1	1	1	0	0	0	0
	5	1	14	12	17	16	16	8	15	9	14	11	10	9	10	8	2	6	7	1

ITEM DIFFICULTY INDEX

(P) VALUES

ITEM NO.	GROUP A TIME 1	P=/22	GROUP B TIME 1	P=/19	GROUP A TIME 2	P=/22	GROUP B TIME 2	P=/19
1	17.00	.77	16.00	.84	15.00	.68	15.00	.78
2	18.00	.81	15.00	.78	21.00	.95	18.00	.94
3	20.00	.90	15.00	.78	20.00	.90	18.00	.94
4	17.00	.77	10.00	.52	18.00	.81	14.00	.73
5	18.00	.81	13.00	.68	20.00	.90	18.00	.94
6	16.00	.72	16.00	.84	22.00	1.00	16.00	.84
7	13.00	.59	5.00	.26	20.00	.90	14.00	.73
8	9.00	.40	10.00	.52	18.00	.81	12.00	.63
9	13.00	.59	5.00	.26	17.00	.77	8.00	.42
10	13.00	.59	2.00	.10	18.00	.81	3.00	.15
11	14.00	.63	12.00	.63	19.00	.86	10.00	.52
12	13.00	.59	5.00	.26	16.00	.72	7.00	.36
13	12.00	.54	5.00	.26	21.00	.95	9.00	.47
14	15.00	.68	10.00	.52	19.00	.86	14.00	.73
15	18.00	.81	18.00	.94	18.00	.81	17.00	.89
16	14.00	.63	17.00	.89	16.00	.72	17.00	.89
17	12.00	.54	7.00	.36	22.00	1.00	13.00	.68
18	20.00	.90	18.00	.94	21.00	.95	18.00	.94
19	6.00	.27	11.00	.57	9.00	.40	4.00	.21
20	18.00	.81	14.00	.73	14.00	.63	12.00	.63
21	10.00	.45	8.00	.42	10.00	.45	5.00	.26
22	7.00	.31	7.00	.36	9.00	.40	1.00	.05
23	10.00	.45	17.00	.89	18.00	.81	14.00	.73
24	5.00	.22	8.00	.42	13.00	.59	12.00	.63
25	20.00	.90	16.00	.84	21.00	.95	17.00	.89
26	18.00	.81	13.00	.68	21.00	.95	16.00	.84
27	19.00	.86	16.00	.84	21.00	.95	16.00	.84
28	13.00	.59	7.00	.36	18.00	.81	8.00	.42
29	13.00	.59	9.00	.47	20.00	.90	15.00	.78
30	13.00	.59	11.00	.57	16.00	.72	9.00	.47
31	15.00	.68	19.00	1.00	19.00	.86	14.00	.73
32	8.00	.36	19.00	1.00	17.00	.77	11.00	.57
33	12.00	.54	14.00	.73	14.00	.63	10.00	.52
34	14.00	.63	10.00	.52	14.00	.63	9.00	.47
35	15.00	.68	14.00	.73	16.00	.72	10.00	.52
36	16.00	.72	8.00	.42	16.00	.72	8.00	.42
37	10.00	.45	5.00	.26	10.00	.45	2.00	.10
38	11.00	.50	4.00	.21	11.00	.50	6.00	.31
39	5.00	.22	5.00	.26	8.00	.36	7.00	.36
40	1.00	.04	3.00	.15	6.00	.27	1.00	.05
TOTAL	531.00	24.13	437.00	23.00	662.00	30.09	448.00	23.57

P < 0.25= DIFFICULT ITEMS
P > 0.80= EASY ITEMS

APPENDIX Q

ITEM DISCRIMINATION INDEX

DATA

UPPER LOWER FOR GROUP A TEST TIME 1 TEST ITEM NUMBER

A1	TOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
13	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	37	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	33	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	32	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1
4	31	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	0	1
22	30	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	0	1
21	29	1	1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	0	1
2	28	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	0	1	1	0	1
14	26	1	0	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	0	1
5	25	0	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	0	1	0	1
NO.RT.		9	10	11	9	11	9	10	6	9	9	8	7	9	10	10	9	9	11	5	11
8	25	0	1	1	1	1	0	1	1	1	0	1	0	0	1	1	1	1	1	0	1
9	24	1	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	0	1	0	1
20	23	0	1	1	0	0	1	1	0	0	1	1	1	0	1	1	0	1	1	0	1
6	21	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	0	0	1	1	1
16	18	0	1	1	1	1	0	0	0	1	0	1	0	0	1	1	1	0	1	0	1
12	15	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
10	13	1	1	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0	1
15	13	1	1	1	1	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0
19	12	1	1	0	0	0	1	1	0	0	1	1	0	0	0	1	0	1	1	0	0
7	12	1	0	1	1	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1
1	10	1	0	0	1	0	1	0	0	1	0	0	1	1	0	1	1	0	0	0	0
NO.RT.		8	8	9	8	7	7	3	3	4	4	6	6	3	5	8	5	3	9	1	7

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0
1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	0
1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0
1	1	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0	0
1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0
1	1	0	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	0	1	0	1	0	1	1	0	1	1	1	0	0
0	0	0	1	1	1	1	1	0	1	1	0	0	1	1	1	0	1	0	0
9	7	7	2	11	10	11	9	7	9	11	6	10	11	10	11	7	9	5	1
0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0
0	0	0	0	1	1	1	1	1	0	1	0	0	1	1	1	1	0	0	0
1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0
0	0	1	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0
0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	0	0	0	1	1	1	0	1	1	1	0	0	0
0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0
0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
1	0	3	3	9	8	8	4	6	4	4	2	2	3	5	5	3	2	0	0

UPPER LOWER FOR GROUP B TEST TIME 1 TEST ITEM NUMBER

B1	TOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4	23	1	0	1	1	0	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1
6	23	0	1	1	1	1	1	0	0	1	0	1	0	0	1	1	1	0	1	0	1
16	24	0	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	1	1	1
19	25	0	1	1	0	1	1	1	1	0	0	0	1	1	0	1	1	1	1	0	0
8	27	1	0	1	0	1	1	1	0	0	0	1	0	0	0	1	1	0	1	1	1
18	27	1	1	1	0	1	1	0	1	0	0	1	0	1	1	1	1	0	1	0	1
1	27	1	1	1	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1
7	28	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	0	1	1	1
10	29	1	1	1	0	1	1	0	1	0	0	1	0	0	0	1	1	0	1	0	1
15	30	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1
NO.RT.		7	8	10	5	9	10	4	7	4	1	8	4	5	7	10	10	5	10	5	9
13	22	1	1	0	1	0	0	1	1	1	0	1	0	0	1	1	1	1	1	0	0
5	21	1	1	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	1	1	0
17	21	1	1	1	0	1	1	0	0	0	0	1	1	0	0	1	1	0	1	1	1
9	21	1	1	0	1	0	1	0	0	0	0	0	0	0	1	1	1	0	1	1	1
3	20	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1
12	20	1	0	1	1	0	1	0	1	0	1	1	0	0	0	1	1	0	1	0	0
14	17	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1
2	17	1	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0
11	15	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	1	1	1
NO.RT.		9	7	5	5	4	6	1	3	1	1	4	1	0	3	8	7	2	8	6	5

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	1	0	0	0	1	1	0	0	1	1	1	0	0	1	0	0	0	0	0
0	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0
0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0
0	0	1	0	1	0	1	0	0	1	1	1	1	1	1	1	0	1	1	1
1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	1	1	1
1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0
1	0	1	0	1	1	1	0	1	1	1	1	0	1	0	1	0	0	0	0
0	0	1	0	1	1	1	1	0	0	1	1	1	0	1	1	1	0	0	0
1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
1	0	1	1	1	1	1	0	1	0	1	1	0	1	0	1	0	1	1	0
6	3	9	4	9	8	10	3	5	7	10	10	7	7	8	5	3	4	4	3
0	1	1	0	0	0	1	1	0	1	1	1	1	1	1	0	0	0	0	0
0	0	1	1	1	1	1	0	1	0	1	1	1	0	1	0	1	0	1	0
1	1	1	0	1	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0
0	1	1	1	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	0
1	0	1	0	1	0	0	1	1	0	1	1	1	0	1	0	1	0	0	0
0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0
0	1	1	1	0	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0
0	0	1	1	1	1	0	1	1	0	1	1	1	0	0	1	0	0	0	0
0	0	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	0	0
2	4	8	4	7	5	6	4	4	4	9	9	7	3	6	3	2	0	1	0

UPPER LOWER FOR GROUP A TEST TEST TIME 2 TEST ITEM NUMBER

A2	TOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
13	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	37	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
16	37	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
8	34	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
14	34	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
2	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
18	32	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	0	1
NO.RT.		9	11	11	9	10	11	11	11	11	11	11	9	11	11	10	9	11	11	7	10
9	30	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3	30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
15	28	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
12	28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
22	28	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0
21	27	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	0	1	1	0	0
20	24	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1
7	21	0	1	0	1	1	1	1	0	0	0	0	0	1	0	1	1	1	1	0	1
10	16	0	1	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0	1
1	8	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0
NO.RT.		6	10	9	9	10	11	9	7	6	7	8	7	10	8	8	7	11	10	2	4

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
1	1	0	1	1	1	1	1	1	0	1	1	0	1	0	1	1	1	1	1
1	0	1	0	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	0
1	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0
0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
9	7	9	8	11	11	11	11	11	9	11	10	8	10	10	11	9	9	7	5
0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0
0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
0	0	1	1	1	0	1	1	1	1	0	0	1	1	0	1	0	1	1	0
0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
1	0	0	0	1	1	1	0	1	0	1	1	1	0	1	0	0	0	0	0
0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1
0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	0
0	0	1	0	1	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0
0	0	1	1	1	1	1	1	1	1	0	0	1	0	1	0	0	0	0	0
0	0	1	0	0	1	1	1	0	0	1	1	0	0	1	1	0	0	0	0
0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1	2	9	5	10	10	10	7	9	7	8	7	6	4	6	5	1	2	1	1

UPPER LOWER FOR GROUP B TEST TIME 2 TEST ITEM NUMBER

B2	TOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10	31	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1
7	28	1	1	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	1
6	27	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	0	1
1	26	1	1	1	1	1	0	1	1	1	0	1	1	0	0	1	1	1	1	0	1
2	25	1	1	1	1	0	0	1	1	1	0	0	1	1	1	1	1	1	1	0	1
15	25	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	1	0	0
17	25	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	0	1
18	25	0	1	1	0	1	1	0	1	1	0	1	0	1	1	1	1	0	1	0	1
3	24	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	0	1	0	1
5	24	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	0	0
NO.RT.		9	10	10	8	9	8	8	6	4	1	6	5	5	9	10	10	7	10	1	8
11	23	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	1	1	0	1	0
14	23	0	1	1	1	1	1	1	1	1	0	1	0	1	1	0	0	1	1	0	0
9	23	1	1	0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	1	0	1
16	23	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1
12	21	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	0
4	20	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1
8	20	1	1	1	0	1	1	0	1	0	0	0	0	0	1	1	1	0	1	0	0
19	20	0	1	1	0	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	1
13	15	1	0	1	1	1	0	0	1	0	1	0	0	0	0	1	1	1	1	1	0
NO.RT.		6	8	8	6	9	8	6	6	4	2	4	2	4	5	7	7	6	8	3	4

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	1	0
0	0	0	1	1	1	1	0	1	1	1	1	0	1	0	1	0	1	1	1
0	0	1	0	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0
0	0	1	0	1	1	1	1	1	0	1	0	0	1	1	0	0	1	1	0
1	0	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	1	1	0
1	0	1	0	1	1	1	0	1	0	1	1	1	1	1	1	0	0	0	0
0	0	1	0	1	1	0	0	1	1	1	1	1	1	1	0	1	0	0	0
0	0	1	1	1	1	1	0	1	0	1	1	0	1	1	1	0	0	0	0
4	1	9	5	10	10	8	5	9	5	8	6	5	8	6	6	1	4	5	1
0	0	1	1	0	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0
0	0	0	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	1	0
0	0	1	1	1	1	1	0	1	0	0	1	1	0	0	0	1	1	1	0
0	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	0	0	0	0
0	0	0	1	1	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0
1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
0	0	1	1	1	0	1	0	0	1	0	0	1	1	1	1	0	0	0	0
1	0	5	7	7	6	8	3	6	4	6	5	5	1	4	2	1	2	2	0

ITEM DISCRIMINATION INDEX

(D) VALUES
GROUP A TIME 1

ITEM NO.	UPPER	PU/11	LOW	PL/11	PU-PL =D
1	9.00	.81	8.00	.72	.09
2	10.00	.90	8.00	.72	.18
3	11.00	1.00	9.00	.81	.18
4	9.00	.81	8.00	.72	.09
5	11.00	1.00	7.00	.63	.36
6	9.00	.81	7.00	.63	.18
7	10.00	.90	3.00	.27	.63
8	6.00	.54	3.00	.27	.27
9	9.00	.81	4.00	.36	.45
10	9.00	.81	4.00	.36	.45
11	8.00	.72	6.00	.54	.18
12	7.00	.63	6.00	.54	.09
13	9.00	.81	3.00	.27	.54
14	10.00	.90	5.00	.45	.45
15	10.00	.90	8.00	.72	.18
16	9.00	.81	5.00	.45	.36
17	9.00	.81	3.00	.27	.54
18	11.00	1.00	9.00	.81	.18
19	5.00	.45	1.00	.09	.36
20	11.00	1.00	7.00	.63	.36
21	9.00	.81	1.00	.09	.72
22	7.00	.63	0.00	0.00	.63
23	7.00	.63	3.00	.27	.36
24	2.00	.18	3.00	.27	.09
25	11.00	1.00	9.00	.81	.18
26	10.00	.90	8.00	.72	.18
27	11.00	1.00	8.00	.72	.27
28	9.00	.81	4.00	.36	.45
29	7.00	.63	6.00	.54	.09
30	9.00	.81	4.00	.36	.45
31	11.00	1.00	4.00	.36	.63
32	6.00	.54	2.00	.18	.36
33	10.00	.90	2.00	.18	.72
34	11.00	1.00	3.00	.27	.72
35	10.00	.90	5.00	.45	.45
36	11.00	1.00	5.00	.45	.54
37	7.00	.63	3.00	.27	.36
38	9.00	.81	2.00	.18	.63
39	5.00	.45	0.00	0.00	.45
40	1.00	.09	0.00	0.00	.09
TOTAL	345.00	31.36	186.00	16.90	14.63

ITEM DISCRIMINATION INDEX
(D) VALUES
GROUP B TIME 1

ITEM NO.	UPPER	PU/10	LOWER	PU/9	PU-PL = D
1	7.00	.70	9.00	1.00	.30
2	8.00	.80	7.00	.77	.02
3	10.00	1.00	5.00	.55	.44
4	5.00	.50	5.00	.55	.05
5	9.00	.90	4.00	.44	.45
6	10.00	1.00	6.00	.66	.33
7	4.00	.40	1.00	.11	.28
8	7.00	.70	3.00	.33	.36
9	4.00	.40	1.00	.11	.28
10	1.00	.10	1.00	.11	.01
11	8.00	.80	4.00	.44	.35
12	4.00	.40	1.00	.11	.28
13	5.00	.50	0.00	0.00	.50
14	7.00	.70	3.00	.33	.36
15	10.00	1.00	8.00	.88	.11
16	10.00	1.00	7.00	.77	.22
17	5.00	.50	2.00	.22	.27
18	10.00	1.00	8.00	.88	.11
19	5.00	.50	6.00	.66	.16
20	9.00	.90	5.00	.55	.34
21	6.00	.60	2.00	.22	.37
22	3.00	.30	4.00	.44	.14
23	9.00	.90	8.00	.88	.01
24	4.00	.40	4.00	.44	.04
25	9.00	.90	7.00	.77	.12
26	8.00	.80	5.00	.55	.24
27	10.00	1.00	6.00	.66	.33
28	3.00	.30	4.00	.44	.14
29	5.00	.50	4.00	.44	.05
30	7.00	.70	4.00	.44	.25
31	10.00	1.00	9.00	1.00	0.00
32	10.00	1.00	9.00	1.00	0.00
33	7.00	.70	7.00	.77	.07
34	7.00	.70	3.00	.33	.36
35	8.00	.80	6.00	.66	.13
36	5.00	.50	3.00	.33	.16
37	3.00	.30	2.00	.22	.07
38	4.00	.40	0.00	0.00	.40
39	4.00	.40	1.00	.11	.28
40	3.00	.30	0.00	0.00	.30
TOTAL	263.00	26.30	174.00	19.33	8.85

ITEM DISCRIMINATION INDEX
(D) VALUES
GROUP A TIME 2

ITEM NO.	UPPER	PU/11	LOWER	PL/11	PU-PL = D
1	9.00	.81	6.00	.54	.27
2	11.00	1.00	10.00	.90	.09
3	11.00	1.00	9.00	.81	.18
4	9.00	.81	9.00	.81	0.00
5	10.00	.90	10.00	.90	0.00
6	11.00	1.00	11.00	1.00	0.00
7	11.00	1.00	9.00	.81	.18
8	11.00	1.00	7.00	.63	.36
9	11.00	1.00	6.00	.54	.45
10	11.00	1.00	7.00	.63	.36
11	11.00	1.00	8.00	.72	.27
12	9.00	.81	7.00	.63	.18
13	11.00	1.00	10.00	.90	.09
14	11.00	1.00	8.00	.72	.27
15	10.00	.90	8.00	.72	.18
16	9.00	.81	7.00	.63	.18
17	11.00	1.00	11.00	1.00	0.00
18	11.00	1.00	10.00	.90	.09
19	7.00	.63	2.00	.18	.45
20	10.00	.90	4.00	.36	.54
21	9.00	.81	1.00	.09	.72
22	7.00	.63	2.00	.18	.45
23	9.00	.81	9.00	.81	0.00
24	8.00	.72	5.00	.45	.27
25	11.00	1.00	10.00	.90	.09
26	11.00	1.00	10.00	.90	.09
27	11.00	1.00	10.00	.90	.09
28	11.00	1.00	7.00	.63	.36
29	11.00	1.00	9.00	.81	.18
30	9.00	.81	7.00	.63	.18
31	11.00	1.00	8.00	.72	.27
32	10.00	.90	7.00	.63	.27
33	8.00	.72	6.00	.54	.18
34	10.00	.90	4.00	.36	.54
35	10.00	.90	6.00	.54	.36
36	11.00	1.00	5.00	.45	.54
37	9.00	.81	1.00	.09	.72
38	9.00	.81	2.00	.18	.63
39	7.00	.63	1.00	.09	.54
40	5.00	.45	1.00	.09	.36
TOTAL	392.00	35.63	270.00	24.54	11.09

ITEM DISCRIMINATION INDEX
(D) VALUES
GROUP B TIME 2

ITEM NO.	UPPER	PU/10	LOWER	PL/9	PU-PL = D
1	9.00	.90	6.00	.66	.23
2	10.00	1.00	8.00	.88	.11
3	10.00	1.00	8.00	.88	.11
4	8.00	.80	6.00	.66	.13
5	9.00	.90	9.00	1.00	.10
6	8.00	.80	8.00	.88	.08
7	8.00	.80	6.00	.66	.13
8	6.00	.60	6.00	.66	.06
9	4.00	.40	4.00	.44	.04
10	1.00	.10	2.00	.22	.12
11	6.00	.60	4.00	.44	.15
12	5.00	.50	2.00	.22	.27
13	5.00	.50	4.00	.44	.05
14	9.00	.90	5.00	.55	.34
15	10.00	1.00	7.00	.77	.22
16	10.00	1.00	7.00	.77	.22
17	7.00	.70	6.00	.66	.03
18	10.00	1.00	8.00	.88	.11
19	1.00	.10	3.00	.33	.23
20	8.00	.80	4.00	.44	.35
21	4.00	.40	1.00	.11	.28
22	1.00	.10	0.00	0.00	.10
23	9.00	.90	5.00	.55	.34
24	5.00	.50	7.00	.77	.27
25	10.00	1.00	7.00	.77	.22
26	10.00	1.00	6.00	.66	.33
27	8.00	.80	8.00	.88	.08
28	5.00	.50	3.00	.33	.16
29	9.00	.90	6.00	.66	.23
30	5.00	.50	4.00	.44	.05
31	8.00	.80	6.00	.66	.13
32	6.00	.60	5.00	.55	.04
33	5.00	.50	5.00	.55	.05
34	8.00	.80	1.00	.11	.68
35	6.00	.60	4.00	.44	.15
36	6.00	.60	2.00	.22	.37
37	1.00	.10	1.00	.11	.01
38	4.00	.40	2.00	.22	.17
39	5.00	.50	2.00	.22	.27
40	1.00	.10	0.00	0.00	.10
TOTAL	260.00	26.00	188.00	20.88	7.28

ITEM DISCRIMINNATION INDEX

SUMMARY OF (D) VALUES

ITEM NO.	GROUP A TIME 1	GROUP B TIME 1	GROUP A TIME 2	GROUP B TIME 2
1	.09	.30	.27	.23
2	.18	.02	.09	.11
3	.18	.44	.18	.11
4	.09	.05	0.00	.13
5	.36	.45	0.00	.10
6	.18	.33	0.00	.08
7	.63	.28	.18	.13
8	.27	.36	.36	.06
9	.45	.28	.45	.04
10	.45	.01	.36	.12
11	.18	.35	.27	.15
12	.09	.28	.18	.27
13	.54	.50	.09	.05
14	.45	.36	.27	.34
15	.18	.11	.18	.22
16	.36	.22	.18	.22
17	.54	.27	0.00	.03
18	.18	.11	.09	.11
19	.36	.16	.45	.23
20	.36	.34	.54	.35
21	.72	.37	.72	.28
22	.63	.14	.45	.10
23	.36	.01	0.00	.34
24	.09	.04	.27	.27
25	.18	.12	.09	.22
26	.18	.24	.09	.33
27	.27	.33	.09	.08
28	.45	.14	.36	.16
29	.09	.05	.18	.23
30	.45	.25	.18	.05
31	.63	.63	.27	.13
32	.36	.36	.27	.04
33	.72	.72	.18	.05
34	.72	.72	.54	.68
35	.45	.45	.36	.15
36	.54	.54	.54	.37
37	.36	.36	.72	.01
38	.63	.63	.63	.17
39	.45	.45	.54	.27
40	.09	.09	.36	.10
	14.63	8.85	11.09	7.28
MEAN	.36	.22	.27	.18