AN ASSESSMENT OF STUDENT COMPUTER LITERACY FROM THE SCORES ON THE PROGRAMMING SECTION OF A STANDARDIZED COMPUTER TEST WHERE THE LANGUAGES USED WERE HYPERTALK AND BASIC

A Dissertation

Presented in Partial Fulfillment of the Requirement for the

DEGREE OF DOCTOR OF PHILOSOPHY

with a

Major in Higher Education

in the

College of Graduate Studies

University of Idaho

by

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May, 1997

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This dissertation of Linda M. Kieffer, submitted for the degree of Doctor of Philosophy with a major in Education and titled "An Assessment of Student Computer Literacy from the Scores on the Programming Section of a Standardized Computer Test where the Languages used were HyperTalk and BASIC," has been reviewed in final form, as indicated by the signatures and dates given below. Permission is now granted to submit final copies to the College of Graduates Studies for approval.

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Abstract

This study sought to determine if there was a significant difference in selected student characteristics on the programming section of a standardized computer literacy test, when the languages used were HyperTalk and BASIC.

The subjects were 105 students in six sections of the CSCD 120 computer literacy class. Forty-nine students were in the sections using HyperTalk and fifty-six were in the sections using BASIC. The sample consisted of forty-four males and sixty-one females. Seventy-three percent were age 25 or under. Eighty percent of the students had a female instructor and twenty percent had a male instructor.

A quasi-experimental pretest/post test design was used. It involved part three of the Standardized Test of Computer Literacy, and the Computer Anxiety Index (both developed at Iowa State University).

Data was processed through an analysis of variance (ANOVA) statistical test. There was no significant difference at the 0.05 level in either achievement or attitude on a standardized computer literacy test, when the language used to teach the programming concepts was BASIC, nor when the language used was HyperTalk. There was no significant interaction at the 0.05 level between gender of the student and language used to teach the programming concepts, between the age of the student and the language used to teach the programming concepts, nor between the gender of the instructors and the language used to teach the programming

subjects. There was an interaction at the 0.044 level in achievement between the gender of the instructors and the language used to teach the programming concepts. No correlation was found between attitude and achievement.

In this study the computer language used to teach programming concepts in a computer literacy course did not have a significant difference on the achievement or attitude of the students. The trend of males doing better than females in achievement and attitude of computer literacy appears to be fading, with both genders becoming equal. The significant interaction in achievement when the students had a female instructor could have been influenced by the fact that the females had more teaching experience.

Acknowledgments

I wish to thank my committee Dr. Martha Yopp, Dr. Gary G. Delka, Dr. Paul Oman, and Dr. Lowell Jackson for their help and encouragement. They altered their schedules to meet my time constraints. I thank you very much.

My major professor Dr.Lowell Jackson generously gave of his time with guidance and encouragement. Thank you Dr. Jackson, I could never have completed this project without you.

Finally thank you to my husband, Chuck, for his patience and encouragement through out this project. Yes, Chuck I am finally done!

Table of Contents

List of Tables

List of Figures

CHAPTER ONE: THE PROBLEM

Introduction

Since the early 1970's, many have tried to define the term "computer literacy." At that time computer science was a new discipline, those involved in the study of computers were from many different disciplines, including mathematics, business and engineering. Attempts to define computer literacy, therefore, came from many different disciplines. In 1972 the Conference Board of the Mathematical Sciences defined computer literacy as an understanding of computers' capabilities, application and algorithms. Ball and Charp (1977) felt computer literacy represented only a basic awareness of terminology and uses of computers.

In 1983 the U.S. Office of Education funded a project to define "Computer Literacy and develop an instrument to measure Computer Literacy" (Moursund, 1983, p. 3). They brought together a group of expert educators to help with this task. The experts were divided between those supporting a definition on the "talk-level" and those supporting a definition on the "doing-level." The "talk-level" supporters believed computer literacy consisted of knowledge of the history of computers, computer terms, how computers are used, societal and ethical views, and some hands on experience. The "doing-level" supporters believed computer literacy consisted of all those things in the "talk-level" plus the ability to use application software and to program computers. Even the "doing-level" group was split on the issue of whether computer programming should be a part of computer literacy. This division can be explained by the fact that computers were no longer hidden away in large corporations and universities, but actually seen and used in businesses, government and schools.

Many other groups have met to define computer literacy and many definitions have resulted from these meetings, but none of the definitions have experienced general acceptance.

Many of the educators involved in these meetings have changed their minds concerning computer literacy. Moursund (1976) defined computer literacy as "non-technical and low-technical aspects of the capabilities and limitations of computers and of the social, vocational and educational implications of computers" (p. 55). Yet in 1983, Moursund states he supports and defends the "do-level" definition that includes computer programming (p. 3).

One interpretation of this dissonance was that computer technology was changing so fast, those trying to define computer literacy could not establish a definition before technology changed and they needed a new definition. VanDyke (1987) presents an explanation of the inability to define computer literacy saying we should not expect the definition to remain static since the standards of all literacy have varied throughout history. She feels that to remain culturally relevant the term computer literacy, along with other literacy terms, needs to be repeatedly redefined. In the early 1970's when mainframes were the only computers and they were located in universities and large businesses, computer literacy could be defined as an awareness. However, now that many homes, most schools, libraries and business have computers, more than an awareness is needed. The 1970 definition is no longer relevant in today's world. While changes in other literacies have taken place so slowly they are hardly recognized, the changes in computer literacy have taken place rapidly.

Equally as difficult as defining computer literacy, has been the task of defining the content of the computer literacy course. If computer programming was a part of the computer literacy course, what language would be used to teach the programming concepts? The selection to choose from was very limited in the 1970's. BASIC was the language chosen most often because of its availability, low cost, and minimal machine requirements.

Decker and Hirshfield (1990) feel computer literacy courses can be characterized by four models: (a) the beginning programming course usually in Pascal or BASIC; (b) the "How to Use" an application software package; (c) the Social Science perspective; or (d) a combination of the three models. One of these four models has served as the description for most computer literacy courses. The only differences over time have been the language used in model one, and the software packages in model two.

Background to the Problem

The Computer Literacy course at Eastern Washington University, CSCD 120: Introduction to Computers with

Programming Concepts, was created in 1983. The five credit course meets five hours per week. It fulfills the natural science general university requirement. It is a combination of the three models developed by Decker & Hirshfield (1990). It consists of three to four weeks of programming, four to five weeks of software application and the remainder of the one quarter course is spent on computer terminology, architecture and social science perspectives. The programming portion of the course presents the concepts of input/output, decision making and repetition. Since CSCD 120 began, the programming portion of the course has been taught using the BASIC programming language. BASIC has been used in many computer literacy courses because of its availability and ease of use. But questions remain as to determining if this is the best language to use in teaching computer programming concepts. Since many new languages have been developed since CSCD 120 was designed in 1983 and many changes in technology, is it time to reassess the language used to teach the programming concepts?

Many different languages have been used for teaching programming concepts. In 1986 Shaffer did a comparison of the BASIC Language and the Logo language. This study led to the replacement of BASIC with Logo in the Computer Literacy course CS 105 at Lander College. Fischer (1984) promotes the use of Logo and Pascal as the best programming languages for learning beginning programming concepts. Bailey (1987) of East Tennessee State University promotes the idea of replacing the programming portion of the literacy class with more instruction on spreadsheet and databases. He argues that the programming concepts can be learned more efficiently from the spreadsheets and databases. According to John Motil (1991) of California State University, Northridge, using a large application package that students can modify is the best way of teaching programming concepts. Motil feels that the spreadsheet is an appropriate application for use throughout a literacy course. Juan Alvarez Rubio (1992) of the University of Chile in Santiago, Chile, suggests the use of Pascal in the literacy class. Brooklyn College, City University of New York uses Pascal in their computer literacy program according to Arnow (1991). The relatively few constructs of the Pascal language explain its use at Duke University (Biermann, 1990). William J. Taffe (1991) teaches a course at Plymouth State College where they use Stella, a nonprocedual graphics-based simulation language to teach programming concepts.

One of the newest approaches suggests the fourth generation authoring language, HyperTalk, as an alternative to the BASIC programming language. Allen et al. (1990) feel the best way to begin a programming course is to begin with HyperCard and its scripting language HyperTalk. Decker and Hirshfield (1990) present an entire literacy course using HyperCard on the Macintosh computer. They feel the success of using HyperCard and HyperTalk is because HyperCard allows the beginning programmer to achieve results faster, and this keeps the interest high. The ease of use of the HyperCard and

HyperTalk allows the students to concentrate on problem solving. The language is very natural in that many of the instructions are similar to everyday language. An example is the instruction to go to the next card is simply "goto next." There are several ways to express the same instruction. The students seem to experience less anxiety. Because HyperCard and HyperTalk are object-oriented, the students are experiencing the newest in programming methodology. Decker and Hirshfield (1990) have created a large framework called an engine and the students complete assignments within this framework. This changes the pedagogical approach as well as the programming language.

What factors affect the achievement of a student in computer literacy? Smith and Necessary (1996) found gender to be a significant factor. However, this could be explained by the significant interaction between gender and computer experience. The males had more computer experience and scores higher in achievement. They also found non-traditional students scored significantly higher on the Computing Ability Scale developed by Kay (1993). This contradicted Parker's (1993) report that non-traditional students feel inadequate with regard to computers. Kay's Computing Ability Scale measures awareness of computers in society, programming skill and perceived control of computers. Kuschel (1994/1995) found significant relationships between computer attitude and computer literacy achievement. He found no relationship between age groups or gender in computer literacy achievement. What does affect achievement in computer literacy?

Statement of the Problem

The problem of this study was to determine if there was a significant difference in selected student characteristics on the programming section of a standardized computer literacy test, when the languages used were HyperTalk and BASIC.

Hypotheses

1. There is a significant difference in achievement on a standardized computer literacy test, between using HyperTalk or using BASIC, when teaching the computer programming concepts of a computer literacy course.

2. There is a significant difference in attitude on a standardized computer literacy test, between using HyperTalk or using BASIC as the programming language, when teaching the computer programming concepts of a computer literacy course.

3. There is a significant interaction in achievement scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

4. There is a significant interaction in attitude scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

5. There is a significant interaction in achievement scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

6. There is a significant interaction in attitude scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

7. There is a significant interaction in achievement scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

8. There is a significant interaction in attitude scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

9. There is a significant correlation between attitude and achievement on a standardized computer literacy test.

Significance of the Study

This study determined if there was an interaction in student achievement and attitude, when using BASIC or when using HyperTalk as the language for teaching the programming concepts. The language used in future quarters in CSCD 120 at Eastern Washington University will be determined by the outcome of this study. Other schools may benefit from the results of this study as they address the questions of what language to use in teaching programming concepts.

Limitations

The Teaching Assistants and Instructors responsible for the six sections of CSCD 120 at Eastern Washington University were hired by the Computer Science Department. They were assigned to teach this course by the department chairman with consideration to their other responsibilities. The students themselves selected the section of CSCD 120. The 9 a.m., 10 a.m., and 11 a.m. sections were most popular. The 8 a.m., 12 p.m., and 1 p.m. sections had fewer students. The students in the 8 a.m., 12 p.m., and 1 p.m. sections may have been more interested in the class, because the times were less popular.

Delimitations

The students were all enrolled in one of the six sections of CSCD 120 at Eastern Washington University. The study was delimited to programming concepts and those student characteristics of gender, age, and gender of instructor.

Definitions

Computer Literacy is, for the purpose of this study, defined as the combination model at Eastern Washington University that consists of three to four weeks of programming, four to five weeks of software application and the remainder of the quarter spent on computer terminology, architecture and social science perspectives.

Programming concepts, for the purpose of this study, are the concepts of input and output, decision making and repetition.

HyperCard is a multimedia creation program by Apple running on the Macintosh platform. HyperCard uses a card and stack metaphor on which text fields, user buttons and graphics can be placed.

HyperTalk is a scripting language for use in programming HyperCard.

Scripting is a sequence of instructions that tell an object how to respond.

Object is a data structure that models the world in a natural way. It encapsulates both functions and data and can only be accessed through an established user interface. Because an object supports inheritance, new objects can be built from current objects.

BASIC - Beginner's All-purpose Symbolic Instruction Code was developed by Kemeny and Kurtz in the mid 1960s as an educational programming language. BASIC has a simple algebraic structure and can be either interpreted or compiled.

Input/Output is the process of the computer program receiving information from the user and sending information to the user.

Decision Making is the process of determining the actions of a program by the evaluation of a condition.

Productivity Software includes word processors, spreadsheets, databases or other software, introduced in the 1970's, that runs on many different machines with minimal customization and thus increasing the productivity of the user.

Repetition is the commands that cause a set of statements to execute repeatedly based on a condition.

Service course is a course provided by a department for the students of one or more different departments.

Assumptions

The Teaching Assistants and Instructors of CSCD 120, Computer Fundamentals with Programming, have the necessary background and desire to effectively teach the class.

Chapter Summary

Computer Literacy has been defined many times since its beginnings in the 1970's. In a model which includes programming concepts, many languages have been used to teach computer literacy. Does the language affect student achievement and attitude? Chapter Two will review the history and relevant research concerning computer literacy, the languages used to teach programming concepts, and what characteristics affect achievement and attitude of students in a computer literacy course. Chapter Three will define the methodology used in this study. Chapter Four will present the findings and how this study relates to the current literature. Chapter Five will present a summary of the study, conclusions and recommendations.

CHAPTER TWO: REVIEW OF THE LITERATURE

Introduction

Since the early 1970's, when the term "computer literacy" began appearing in the literature, many definitions have been presented. This literature review was delimited to the exploration of the many definitions of computer literacy, the contents of the computer literacy course at the university level, the languages used to teach the computer programming concepts in a computer literacy course, and what factors affected the students' attitude and achievement in a computer literacy course at the university level. This chapter was divided into four sections: (1) A Definition of Computer Literacy; (2)The Computer Literacy Course; (3) Teaching of Programming Concepts; and (4) The factors that affect attitudes and achievement in computer literacy.

Materials were obtained through the University of Idaho Library and the Eastern Washington University Library. The years 1980 to present were searched. Materials published prior 1980 were obtained if referenced in the later literature. The descriptors of computer literacy, computer literacy course and computer programming, computer education, BASIC programming language and HyperCard were used. Searches were conducted using ERIC and the FirstSearch databases for Education and Sciences.

A Definition of Computer Literacy

The term computer literacy (Finkel 1991) had its origin in 1972 when Dr. Arthur Luehrmann was attending The Spring

Joint Computer Conference in Boston and took issue with a speaker who voiced the opinion that the virtue of using computers was as teaching machines. Luehrmann suggested that "students should be taught to program the computers rather than be programmed by them" (Finkel, 1991, p. 25). Since that time many definitions for computer literacy have surfaced. Ball and Charp (1977) say computer literacy is the basic awareness of terminology and uses of computers. Rawitsch (1978) states that it is a "functional facility with hardware and software as problem solving programming languages" (p. 12). Luehrmann (1980) believes that specialized programming skills are needed to be computer literate.

With the many differences of opinion, conferences were organized to try to answer the question "What is Computer Literacy?" The National Science Foundation sponsored a three day conference in 1980 entitled "National Goals for Computer Literacy in 1985." No single definition resulted from that conference. A ten-member panel of the National Center for Education Statistics (1983) gave the following definition: "Computer literacy may be defined as whatever a person needs to know and to do with computers in order to function competently in our information based society" (p. 8).

David Moursund (1983) discusses a conference he attended which was funded by the U.S. Office of Education. The task was to define computer literacy and develop an instrument to measure it. When trying to define computer literacy the group was divided between the talking level group and the doing level group. Those supporting the talking level definition believed computer literacy included history, definition of terms, knowledge about what a computer can do, social and ethical issues and a modest level of hands on skill. The doing level group felt the most important issue was making the computer do something. The doing level group was divided on what doing something meant. This division of "talking verses doing" is the foundation of many models in later literature.

Computer technology was changing at a very rapid rate. In the early 1970's computers were moving from a time when they were mysterious machines that were owned by the government, large corporations and large universities (never seen by the average person), to a time when many businesses and public schools were beginning to acquire computers. This helps to explain the wide and changing views of a definition of computer literacy.

Wolfe (1983) defines computer literacy as "a measure of competency to exploit computer technology" (p. 186). More recently it has been realized that the term computer literacy may not be a static term that can be permanently defined. Arnow (1991) states "X literacy is whatever I want those who are outside the field of X to know about the subject" (p. 79). As a result, the definition of particular technical literacies is determined by social values. VanDyke (1987) suggests that "we should not expect the definition of computer literacy to remain static, but change as the definition of literacy has changed in history" (p. 367).

Robin Kay (1992) presented a six-stage history of computer literacy, where the technology of the time is the deciding factor in each stage of defining computer literacy.

1. Stage one began in the early 1970's when mainframe computers were only available to large businesses, universities and government agencies. It was during this stage that Ball and Charp (1977) defined computer literacy as the basic awareness of computers.

2. The introduction of microcomputers was the beginning of stage two. The computer hardware and software became available in public schools. The software was very limited, but Logo and BASIC were available for programming. Many definitions of computer literacy during this time include programming concepts.

3. The third stage began in the mid 1980's when hardware costs were going down and software quality was going up. This stage was marked with the need to define computer literacy, organize computer literacy classes, and plan for the future.

4. The fourth stage began with the productivity software flooding the market. The "do something" attitude prevailed, as did the need for individuals to feel comfortable using the computer.

5. During the fifth stage it was felt that an individual no longer needed to be an expert in a number of computer applications because the software was becoming so user-friendly. The development of user-friendly software allowed

computer literacy to focus on process and not on content; i.e., why computers should be used, not how they are used.

6. The final stage, stage six, defines computer literacy as being able to use the computer to meet the individual's personal needs. There is too much computer technology for any one person to know every aspect. Individuals just need to know enough to perform the tasks they wish to accomplish.

VanDyke's (1987) and Kay's (1992) explanations of the technology of the time as the driving force behind the definition, gave some understanding of why computer literacy has had so many definitions.

The Computer Literacy Course

The discussion of whether programming concepts should be a part of a computer literacy course has many opinions both in favor and in opposition.

Schneider (1986) feels a service course should present information on what that discipline is about. Programming is what computer science is about, as well as what computer scientists do. Programming should be a part of a computer literacy course so persons in other disciplines can become educated about computer science. An analogy used by those opposed to including programming in a literacy course is that you do not need to know how an engine works to drive a car. However Cuoco (1984) counters that teaching programming is not like teaching students how an engine works; instead, it is more like teaching them how to drive. He suggests teaching students to run applications is like teaching a driver education class to ride in a taxi.

John Peterson (1987) expressed the views of the faculty of Northwestern College. They were convinced "that teaching programming in a course designed for the persons who just want to use the computer is wasting valuable time needed for other concepts" (p. 505).

Palumbo and Reed (1991) report a significant increase in problem solving skills for high school students receiving programming instruction in a computer literacy class, but not for those students who received instruction in only computer applications.

Teaching of Programming Concepts

If programming concepts are to be taught as part of a computer literacy course, how should they be taught? What programming languages should be used? Shaffer (1986) presents a comparison between Logo and BASIC as programming languages for teaching introductory programming concepts. Since most courses were designed at a time when BASIC was the only language available, the concepts lend themselves to BASIC, even though other programming languages may be better. His conclusion, based on a comparison of the characteristics of each language, was that Logo was a better choice for teaching the introductory programming concepts because of its decision and repetition structures.

Bailey (1987) believes the argument that everyone needs to know something about programming is archaic. The same concepts of input/output, decision making and repetition can be taught faster and easier with a spreadsheet and a database. These provide immediate feedback and do not overwhelm the student with complicated syntax.

At Plymouth State College, William Taffe (1991) uses a non-procedural, graphics-based simulation package called Stella to teach programming concepts. Stella allows the user to describe the system under consideration and execute a simulation. Simulations can include deer population in a region and how it is affected by predators, a library budget or environmental pollution. Taffe feels that simulating good models shows computing as a programming language for enhancing thinking. The students can have minimal knowledge of the icon-based language and still have the ability to create a simulation. More advanced features of the language can be learned as needed.

HyperCard and its scripting language HyperTalk, released in 1987 by Apple, has become a recent choice for teaching beginning programming concepts. Allen, Porter, Nanney and Abernethy (1990) of Furman University believe HyperCard and HyperTalk represent a better choice for teaching beginning programming concepts and have designed a course using them. The time saved learning machine specific details about editors, networks and system messages, is used to include additional concepts in the course. HyperCard and HyperTalk offer greater productivity for the students (Allen et al. 1990). Katz and Porter (1991), also of Furman, believe that

HyperCard and HyperTalk allow the student to develop good programming practices in an easily accessible programming environment. The beginning concepts of input/output, decision making and repetition are taught with HyperTalk.

Decker and Hirshfield (1990) have developed an entire literacy course using HyperCard and HyperTalk and have published a text for the course. They believe that students have less anxiety writing programs in HyperTalk because of the versatility of the HyperTalk language and its immediate results. They have developed a framework, referred to as an engine, where the students write their small code segments. The approach of students writing only small code segments within the engine represents a different pedagogical approach from the traditional approach of students writing individual programs. A student can accomplish in a few hours with HyperCard and HyperTalk what would take days in BASIC or Pascal.

Reed and Lui (1994) conducted a study to determine if there was a difference in problem solving, computer anxiety and performance when students were taught programming concepts using BASIC and HyperTalk. The sample (n=21) was very small and of unknown educational level. It may have been preservice and inservice teachers, but this was not stated in the literature. Reed and Lui's (1994) findings revealed a significant increase in problem solving for the groups using the BASIC programming language ($F[1,19] = 8.167$, $p = 0.01$) and no interaction between problem solving and the programming language of BASIC or HyperTalk ($F[1,19] = 2.173$ $p = 0.157$). There was a significant decrease in computer anxiety ($F[1,19] = 54.893$, $p < 0.001$) for the combined sample, but no interaction between computer anxiety and the programming language of BASIC or HyperTalk ($F[1,19] = 0.478$, $p = 0.498$). The HyperTalk groups scored significantly higher in programming ($t[19] = -2.213$, $p = 0.039$) and debugging ($t[19] = -6.612$, $p < 0.0001$). This was based on a post test only. There was no pretest in the areas of programming and debugging.

An informal 1997 survey by Dr. Robert Reid (personal communication, May 29, 1997) at Michigan State University indicated that more than twenty-four different computer languages are used to teach CS1. CS1 is a course defined by the Computer Science Accrediting Board as the first course for computer science majors in colleges and universities.

Dr. Robert Reid was contacted concerning a survey of computer languages used in computer literacy courses. He has no knowledge of such a survey. Dr. Maggie Neise (personal communication, May 29, 1997) of Oregon State University and past president of the Northwest Council for Computer Education was also contacted. She has no knowledge of such a survey.

If a course in a well defined curriculum such as CS1 can use over twenty-four different computer languages, it is easy to understand how computer literacy courses, which are less well defined, can use many different computer programming languages.

The Factors That Affect Attitudes And Achievement In Computer Literacy

What factors influence a student's attitude and achievement? Many tests have been developed to test student computer literacy achievement and attitude. Two of these tests are widely used, The Computer Ability Scale (CAS), and the Standardized Test of Computer Literacy.

Kay (1993) developed the Computer Ability Scale (CAS) that measures an individuals software ability, awareness of computers in society, programming skills, and perceived control. The CAS includes the variables of gender, age, number of years of computer experience, hours per week of computer use, overall knowledge of computers, and personal computer ownership. It is a self administered test consisting of twenty-two Likert scale items. The items test students in the areas of software ability, computer awareness, programming skills and perceived control. Kay (1993) used the CAS in a study to investigate the computer literacy of preservice teachers at six universities in the province of Ontario. Students were mailed the survey and asked to complete and return it. The overall mean was 70.1 with a standard deviation of 26.0 and possible range of 22 to 154. The internal reliability for the CAS was 0.96. Kay (1993) reports that in order to improve attitudes towards computers, more emphasis should be placed on awareness and applied skills, and less on computer programming.

Simonson, Montag, Maurer, Oviatt and Whitaker (1992) developed the Standardized Test of Computer Literacy at the Research Institute for Studies in Education at Iowa State University. It consists of three sections (1) Computer Systems; (2) Computer Applications; and (3) Computer Programming. There is a separate test for Computer Anxiety. The following is the listings of the mean, standard deviation and range for each section of the Standardized Test of Computer Literacy:

Section	Mean	Standard Deviation	Range
(1)	18.62	3.83	8-27
(2)	0.50	4.31	0-26
(3)	11.09	3.79	13-69

The following is the mean and standard deviation for the Computer Anxiety Test:

70.2	18.46

The higher the score, the more computer anxious the individual. Simonson, etc. al. found a significant negative correlation (r =-0.27) between the computer anxiety index score and the computer achievement test score. Students with high anxiety scores, scored lower on the computer achievement test.

A number of studies have investigated the relationship between gender and computer attitudes. Anderson (1987), and Nickell and Pinto (1986) report that males have a more positive attitude toward computers. Siann and Durnell (1988) found that gender differences in computer literacy diminished with increased computer experience.

Anderson (1987) reports a significant relationship between the age of the student and computer literacy attitudes.

Smith and Necessary (1996) replicated and extended Kay's (1993) work using the CAS with undergraduate college students enrolled in business courses. The subjects were 316 students. Of these students, 261 (83%) were traditional students between the ages of seventeen and twenty-two and 55 (17%) were nontraditional students. There were 144 females and 172 males in the sample. They found a significant effect of gender on achievement in computer literacy. Males have more positive attitudes towards computers (M=90.6) ($F[1,314] = 10.8$, $p = 0.001$) than females (M=81.8) (Smith and Necessary, 1996, p. 190). They found a significant difference in age, with the nontraditional students (M=93.8) ($F[1,314]=6.03$, $p= 0.01$) scoring higher than the traditional students (M=85.1). A significant interaction between gender and computer experience was found (F[3,299] 3.29, $p = 0.021$). The interaction between gender and computer experience indicates that females have less computer experience. Smith and Necessary (1996) believe that if the females had more experience, they might do better on the CAS.

Kuschel (1994/1995) attempted to describe demographic variables that may enhance or interfere with achievement in computer literacy. Using the Standardized Test of Computer

Literacy at the Research Institute for Studies in Education at Iowa State University, she found no relationship between age groups and achievement, nor between gender and achievement. However she did find a significant relationship between attitude and achievement. Gunter (1994), using Kay's (1993) CAS, examined the variables that could possibly influence attitudes toward learning and working with computers. She conducted pre and post tests on students enrolled in a college of business and a college of education. The education students had a more positive attitude, lower anxiety, more confidence, and found computers more useful than the business students. She found attitude of all the students is affected by age, access to a home computer and computer experience.

Borgo (1993/1994) also found that computer experience is a greater factor in attitude and achievement than is gender. The gender differences are often reduced with more experience. Boettner (1991) investigated the effects the completion of a computer literacy course had on computer anxiety, what factors were correlated with computer anxiety, and what relation computer anxiety had on achievement in computer literacy. The variables investigated were gender, number of semesters of prior computer experience, and number of university credits completed. The findings indicated a significant correlation between anxiety and the number of semesters of prior computer experiences, and of anxiety and achievement on a standardized computer literacy test.

Klein, Knupfer, and Crooks (1993) investigated the attitudes towards computers of re-entry students and traditional students in an undergraduate computer literacy course. The participants were 213 students consisting of 63 males and 150 females. Fifty-nine students were classified as re-entry students. A survey instrument consisting of 15 questions was developed by Klein, et al., and used to gather information. The findings indicated a significant effect of age for overall performance ($F[8,204] = 2.46$, $p < 0.05$).

Maurer and Simonson (1993-94) studied an introductory college class on computers in education where two treatments, a relaxation exercise section and a control section, were randomly assigned to the students. They found achievement was more strongly related to anxiety at the end of the course ($r = -0.33$) than anxiety at the beginning of the course ($r = -0.16$). This was significant at the 0.05 level.

Shashaani (1994) presented the idea that gender differences in computer attitudes begins before the college level and can be attributed to the father's and mother's occupation, education, sex-type attitudes and encouragement. She found a significant main effect of gender on computer interest ($F[1,1724] = 170.75$, $p <= 0.001$), computer stereotype ($F[1724] = 311.34$, $p <= 0.001$) and computer confidence ($F[91,1724]= 127.59$, $p <= 0.001$). The instrument was a 39 item computer attitude survey. The data revealed perceived parental attitudes that the computer is more appropriate for males than for females.

Hakkinen (1994-95) conducted a study to determine whether the experience received in a computer course reduced computer anxiety. The subjects were first-year students of education at the University of Joensuu. A pre-experimental design was used with the instrument being an attitude measurement questionnaire. The findings reveal a significant reduction in computer anxiety in two areas: computer equipment (F=9.7, $p < 0.01$) and the use of computers (F=80.8, $p < 0.001$).

Ayersman and Reed (1995-96) conducted a study to determine if computer programming instruction reduced computer anxiety and studied the variables of learning style and gender. The sample consisted of undergraduate education majors. The CAS was used as a pre and post test. They found a significant decrease in computer anxiety following the programming instruction ($t[26] = 1.99$, $p = 0.028$). The females significantly outperformed the males on the programming portion of the achievement test. The authors suggest that the trend may be reversing with regard to male dominance and computer achievement. No other gender differences were found. No differences were found by learning styles.

Summary

Research has indicated the rapid growth in technology that has affected attempts to define computer literacy. Today no common definition exists. The components of the computer literacy course also are not clearly defined, with discussions concerning whether programming concepts should be a component. If programming concepts are a component, what language should be used? The literature includes a wide variety of languages: BASIC, Pascal, spreadsheets, Stella, Logo and HyperCard with HyperTalk as examples of some of the languages used to teach the programming concepts.

Many factors affect the attitude and achievement of a student in a computer literacy course. The literature indicates gender, age, and prior computer experience as possible factors.

This study will investigate the use of BASIC and HyperTalk as languages used to teach programming concepts. Also the interaction of the characteristics of gender, age, and gender of instructor on student attitude and achievement in a computer literacy course is explored. The methodology is discussed in Chapter Three.

CHAPTER THREE: METHODOLOGY

Introduction

The research sample, the instruments, the design, and the procedures of this study are discussed in this chapter. This study investigated the achievement and attitudes of students in the programming concepts portion of a computer literacy course. Nine hypotheses were investigated.

Statement of the Problem

The problem of this study was to determine if there was a significant difference in selected student characteristics on the programming section of a standardized computer literacy test, when the languages used were HyperTalk and BASIC.

Hypotheses

1. There is a significant difference in achievement on a standardized computer literacy test, between using HyperTalk or using BASIC, when teaching the computer programming concepts of a computer literacy course.

2. There is a significant difference in attitude on a standardized computer literacy test, between using HyperTalk or using BASIC as the programming language, when teaching the computer programming concepts of a computer literacy course.

3. There is a significant interaction in achievement scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

4. There is a significant interaction in attitude scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

5. There is a significant interaction in achievement scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

6. There is a significant interaction in attitude scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

7. There is a significant interaction in achievement scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

8. There is a significant interaction in attitude scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

9. There is a significant correlation between attitude and achievement on a standardized computer literacy test.

Population

The subjects of this experimental study were the students in the six sections of CSCD 120 at Eastern Washington University. The students registered for CSCD 120 during the regular registration period. Each section had a maximum enrollment limit of thirty students. It was expected that the

8 a.m., 12 p.m., and 1 p.m. sections might not reach maximum enrollment because these were the less popular times.

The programming concepts portion of the course was about half way through the quarter. The number of subjects could be 180. However a more realistic estimate of the sample size was approximately 120. This was due to three of the sections not reaching maximum enrollment, students dropping the course, and those students not in class on the days of the pretest or the post test.

Eastern Washington University

Eastern Washington University, in Cheney and Spokane, Washington, was established in 1882 and has become one of three comprehensive regional universities in the state of Washington. Degree programs are offered at the baccalaureate and master's levels. The academic structure of the university consists of four colleges: Business and Public Administration; Education and Human Development; Letters, Arts, and Social Sciences; and Science, Mathematics and Technology. Eastern also has consortium relationships with the Intercollegiate Center for Nursing Education and the Spokane Intercollegiate Research and Technology Institute.

As a comprehensive university in a major urban community, serving a large traditional and non-traditional student population, Eastern Washington University provides high-quality liberal arts and professional education with co-curricular opportunities for its undergraduates. The university maintains a strong commitment to excellence in instruction, scholarship, and public service. International education and other programs of emphasis continue to be integrated into the curriculum as the university responds to the ever-changing demographics of the Inland Northwest and the nation.

There are approximately 8,000 undergraduate students and 1,000 graduate students at Eastern Washington University. They represent 52 nations and 43 states. About half of the students commute from Spokane, with the other half living on campus or in off-campus housing in Cheney.

The students represent a wide age range. While the majority of the students are young adults, professionals from the community and working adults also contribute significantly to Eastern's student body. The average age is approximately 27 years.

Variables

Independent Variables

The independent variables for this research were: (a) the Standardized Test of Computer Literacy developed at the Research Institute for Studies in Education at Iowa State University; (b) Standardized Test of Computer Anxiety developed at the Research Institute for Studies in Education at Iowa State University; (c) gender of student; (d) age of student; (e) gender of instructor; and (f) the programming language HyperTalk or BASIC.

Dependent Variables

The dependent variables were the student scores on the pre and post Standardized Test of Computer Literacy and the pre and post Standardized Test of Computer Anxiety. (See Appendix A)

Research Design

To test the hypotheses, a quasi-experimental design was chosen.

The Instruments

The Standardized Test of Computer Literacy was developed at the Research Institute for Studies in Education at Iowa State University. It consists of three sections (1) Computer Systems; (2) Computer Applications; and (3) Computer Programming. There is a separate test for Computer Anxiety. The sections can be used separately or in any combination. Section three of the Standardized Test of Computer Literacy evaluates twenty achievement competencies in computer programming. It is language independent. Section three was an instrument in both the pre and post test. The competencies evaluated by Section three of the Standardized Test of Computer Literacy matched the desired competencies in the CSCD 120 class.

The attitudes were measured by the Computer Anxiety Index test of the Standardized Test of Computer Literacy developed by Iowa State University. The test is a twenty-six item attitude survey.

Validation and Reliability of the Instruments

The development of the Standardized Test for Computer Literacy began in 1987 with 186 questions written to match competencies developed by surveying computer education specialists. The test items were then reviewed, revised and edited with information gained from a pilot testing and analysis by computer specialists. The test took the form of 80 multiple choice questions in three sections. This test was given to 152 subjects who had just completed a semester of college computer literacy, and was then evaluated by 33 computer literacy educators who rated it on a Likert scale of 1 - 5. The overall test rated a 3.64 with section III receiving a rating of 3.74. Section III has a KR-20 reliability estimate of 0.69 and the entire test has a KR-20 reliability estimate of 0.86. Permission was granted by Dr. Michael R. Simonson of the Research Institute for studies in Education at Iowa State University to make copies and use the test (See Appendix A for permission to copy).

The Computer Anxiety Index began with a large number of questions concerning attitudes toward computers. A pilot test was used to determine which items discriminated best. Further revisions were made until a twenty-six item test using a 6-point Likert scale was developed. Test-retest reliability was determined by administering the Computer Anxiety Test to college students in a teacher education course. They were given the Computer Anxiety Index test twice, with a three-week interval between testing sessions. The test-retest reliability was 0.90. Internal consistency reliability is 0.94. Permission was granted by Dr. Michael R. Simonson of the Research Institute for Studies in Education at Iowa State University to make copies and use the test (See Appendix A for permission to copy).

The Assignments

The student assignments were chosen from a Pascal programming text book. They were from respective chapters on input/output, decision making and repetition (See Appendix B for assignments).

Procedure

The experiment consisted of a pretest, the teaching of the programming concepts using either the BASIC programming language or HyperTalk and a post test. The pretest that consisted of section three of the Standardized Test of Computer Literacy, and the Computer Anxiety Index of the Standardized Test of Computer Literacy, both developed at Iowa State University, were administered to the students at the beginning of the programming concepts instruction. The programming concepts instruction was given and the same tests were used as the post tests.

An analysis of variance (ANOVA) using the statistical computer software SPSS 7.0 for Windows 95 was used to determine if any differences in sample means were statistically significant at the 0.05 level by comparing them to the variation within sample. The 0.05 level of significance was chosen because of its general acceptance in educational research, and because it was a comfortable level for this study.

The subjects for this study were the students enrolled in the six sections of CSCD 120. The students themselves selected the section in which they enrolled by the normal registration process and had no knowledge of this study. The six sections of CSCD 120 were taught by two teaching assistants and two instructors. Each instructor taught two sections and the teaching assistants one section each.

The sections were assigned to the teaching assistants and instructors, none of which had prior knowledge of the study. The instructors and teaching assistants were assigned the programming language they would use. The instructors used the same programming language in each of the sections they taught. The assignment of the programming languages was necessary because books had to be assigned to sections, but the selection of the teaching personnel was not final until just prior to the start of the quarter. The instructors and teaching assistants knew a new approach was being tried, but had no knowledge of the study.

The instructors had all previously taught this course using the BASIC language. The HyperTalk language was new and required more preparation time for the instructors. The instructors were eager and excited to try a new language. There were three sections using HyperTalk and three using BASIC. The potential number of students was 180. Students who dropped the course after it began were not included in the study. Only those students in class on the days of the pre and post tests were included in the study. The instructors and teaching assistants administered the pre and post tests to their classes. Each was given written instructions for administering the tests. This was to assure that the test was administered in accordance with set guidelines to all students (Appendix A). The pre and post tests were evaluated according to the instructions provided by Iowa State University.

All students completed the same assignments (Appendix B). These assignments were chosen by the research from respective chapters of input/output, decision making and repetition of a Pascal programming text book.

The assignments were reviewed by five experts from the Eastern Washington University Computer Science Department in the area of teaching programming concepts. The areas of expertise of the five experts included the Pascal, Ada, C, C++, and Occam programming languages. They knew a new approach was being tried, but had no knowledge of the study. They were told it was important that the assignments be language independent. Since they were experts in the area of teaching programming concepts, they were asked to review the assignments. They were given the assignments and asked if the assignments emphasized the programming concepts of input/output, decision making and repetition. If any of the experts did not feel the assignments emphasized the programming concepts, a new assignment would be suggested. They all agreed that the assignments were language independent and emphasized the programming concepts of input/output, decision making and repetition.

After the instruction was completed, post tests were administered to test achievement and attitudes. The post tests were the same as the pretest.

Analyses of the Data

In order to ensure that the HyperTalk section and the BASIC section met the criteria for using the Analysis of Variance (ANOVA), statistical tests were performed. The ANOVA requires independence, normality and equal variance. A two-sample independent t-Test was used to determine independence, the Shapiro-Wilks test was used to test for normality, and the Levene test was used to determine if the assumption of equal variance could be accepted. If any of these could not be assumed, a nonparametric test would be used to analyze the data. The Kendall's tau_b statistic and the Spearman's rho statistics were used to test Hypothesis nine.

Summary

A quasi-experimental study was conducted to determine if there was a significant difference in selected student characteristics on a standardized test of computer literacy when the programming language used to teach programming concepts was HyperTalk and BASIC. The subjects were enrolled in a computer literacy course. Six sections of this course were tested. Three sections used the HyperTalk programming language and three used the BASIC programming language. The pre and post testing instruments were the standardized test of

Computer Literacy developed at the Research Institute for Studies in Education at Iowa State University. Statistical tests were conducted to determine if there was a significant difference between the mean scores of the sections using HyperTalk and the sections using the BASIC programming language. Statistical tests also were conducted to determine if the characteristics of gender, age, and gender of instructor affected these outcomes.

CHAPTER FOUR: RESEARCH FINDINGS

Introduction

This research investigated the achievement and attitude of students in the programming concepts portion of a computer literacy course. Nine hypotheses were proposed in Chapter One. The statistical analysis of the data was conducted with SPSS Statistical Software version 7.0 for Windows 95.

Homogeneity of the Samples

Of the estimated 180 students potentially participating in the study, only 105 were included in the analysis. The 8 a.m., 12 p.m., and 1 p.m. sections did not achieve maximum enrollment. Prior to the pretest, several students dropped the course. Those students not present in class on the days of either the pretest or post test were not included.

The individual class sections were reviewed (Table 4.1, Figure 4.1). Since the data was to be evaluated by programming language (HyperTalk or BASIC), the data was regrouped according to the programming language used to teach the programming concepts. The programming language groups were reviewed based on the pretest scores of achievement and the pretest scores of attitude (Table 4.2).

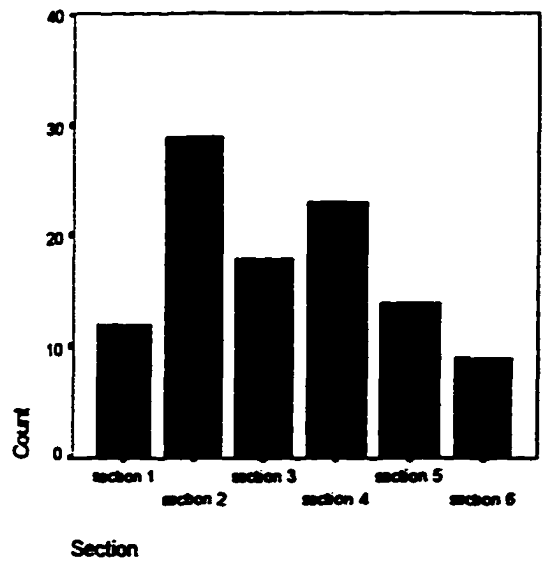
An ANOVA requires three assumptions to be true: (a) independent random samples; (b) normal populations and; (c) equal variances. Tests were conducted for each of the three assumptions for both achievement and attitude. An Independent Samples t-test was conducted to determine whether the samples were independent. A Shapiro-Wilks test was conducted to test the hypothesis that the groups were normal. A Levene test was conducted to test the hypothesis that the variances of the groups were equal.

Table 4.1: Students per Section

Section

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	section 1	12	11.4	11.4	11.4
	section 2	29	27.6	27.6	39.0
	section 3	18	17.1	17.1	56.2
	section 4	23	21.9	21.9	78.1
	section 5	14	13.3	13.3	91.4
	section 6	9	8.6	8.6	100.0
	Total	105	100.0	100.0	
Total		105	100.0		

Figure 4.1: Students per Section



Achievement Data

The calculated *t* value of 0.687 does not exceed the critical value of 1.99 (see Table 4.3). Therefore, it can be concluded that the data fails to disprove the assumption of two independent samples.

The Levene *F* statistic of 0.227 does not exceed the critical value of 3.93 (see Table 4.4). Therefore, it can be concluded that the data fails to disprove the assumption of equal variances.

Table 4.2: Descriptive Achievement Statistics by Group

Report

Pretest Score Computer Literacy

Hypercard	Mean	7.88
	N	49
	Std. Deviation	2.91
	Variance	8.443
BASIC	Mean	7.45
	N	56
	Std. Deviation	3.22
	Variance	10.362
Total	Mean	7.66
	N	105
	Std. Deviation	3.07
	Variance	9.420

The findings of the Kolmogorov-Smirnov and the Shapiro-Wilk tests indicate that the groups are not normal distributions (See Table 4.5). The ANOVA is not heavily dependent on the normality assumption, as long as the data is not extremely non-normal it is acceptable to proceed.

Table 4.3: Independent Two Sample t-Test for Achievement Data

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Mean	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pretest Score Computer Literacy	Equal variances assumed	.227	.634	.687	103	.494	.41	.60	-.78	1.61
	Equal variances not assumed			.691	102.892	.491	.41	.60	-.77	1.60

Table 4.4: Test of Homogeneity of Variance for Achievement Data

Test of Homogeneity of Variance

	Levene Statistic	df1	df2	Sig.
Pretest Score Computer Literacy	.227	1	103	.634

Attitude Data

The calculated *t* value of -0.227 does not exceed the critical value of plus or minus 1.99 (see Table 4.6). Therefore, it can be concluded that the data fails to disprove the assumption of independent samples.

Table 4.5: Normality of Achievement Data

Tests of Normality

	Hypercard or Basic	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Pretest Score Computer Literacy	Hypercard	.116	49	.098	.961	49	.224
	BASIC	.147	56	.004			

a. Lilliefors Significance Correction

The Levene *F* statistic of 0.978 does not exceed the critical value of 3.93 (See Table 4.7). Therefore, the data fails to disprove the assumption of equal variance.

Table 4.6: Attitude Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances F	Sig.	t-test for Equality of Means t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Mean Lower	Upper
Pretest Opinion	Equal variances assumed	.978	.325	-.227	103	.821	-.66	2.91	-6.43	5.11
	Equal variances not assumed			-.225	94.119	.823	-.66	2.94	-6.50	5.18

Table 4.7: Attitude Test of Homogeneity of Variance

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Pretest Opinion	.978	1	103	.325

Table 4.8: Attitude Tests for Normality

Tests of Normality

	Hypercard or Basic	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest Opinion	Hypercard	.117	49	.091	.950	49	.067
	BASIC	.108	56	.157			

a. Lilliefors Significance Correction

The findings of the Kolmogorov-Smirnov and the Shapiro-Wilk test indicate that the groups are not normal distributions (See Table 4.8). The ANOVA is not heavily dependent on the normality assumption, as long as the data is not extremely non-normal it is acceptable to proceed.

Further review of the data

The different group makeup is very similar with respect to gender. Each group contained 53% to 63% females and 36% to 46% males (See Table 4.9), which corresponds to the total sample makeup of 58.1% females and 41.9% males.

The makeup of the groups was similar in regard to age with both the HyperTalk group and the BASIC group having over

70% of the participants under the age of 25. Those over 30 years of age represented at least 10% (See Table 4.10).

The group makeup is similar with respect to the gender of the instructor. Both the HyperTalk and BASIC groups had approximately 80% of the participants with a female instructor. The two instructors, who taught two sections each, were female, and the two teaching assistants, who taught one section each, were male (See Table 4.11).

Table 4.9: Gender of Students in HyperTalk and BASIC Groups

Gender of student * Hypercard or Basic Crosstabulation

			Hypercard or Basic		Total
			Hypercard	BASIC	
Gender of student	Male	Count	18	26	44
		% of Hypercard or Basic	36.7%	46.4%	41.9%
	Female	Count	31	30	61
		% of Hypercard or Basic	63.3%	53.6%	58.1%
Total		Count	49	56	105
		% of Hypercard or Basic	100.0%	100.0%	100.0%

Table 4.10: Age by Categories in HyperTalk and BASIC Groups

agecat * Hypercard or Basic Crosstabulation

			Hypercard or Basic		Total
			Hypercard	BASIC	
agecat	less than 20	Count	22	20	42
		% of Hypercard or Basic	46.8%	35.7%	40.8%
	21-25	Count	13	21	34
		% of Hypercard or Basic	27.7%	37.5%	33.0%
	26-30	Count	6	5	11
		% of Hypercard or Basic	12.8%	8.9%	10.7%
	31-35	Count	1	2	3
		% of Hypercard or Basic	2.1%	3.6%	2.9%
	over 35	Count	5	8	13
		% of Hypercard or Basic	10.6%	14.3%	12.6%
Total		Count	47	56	103
		% of Hypercard or Basic	100.0%	100.0%	100.0%

Table 4.11: Gender of Instructor by HyperTalk or BASIC Groups

sexinst * Hypercard or Basic Crosstabulation

			Hypercard or Basic		
			Hypercard	BASIC	Total
sexinst	Male	Count	12	9	21
		% of Hypercard or Basic	24.5%	16.1%	20.0%
	Female	Count	37	47	84
		% of Hypercard or Basic	75.5%	83.9%	80.0%
Total		Count	49	56	105
		% of Hypercard or Basic	100.0%	100.0%	100.0%

Table 4.12: Descriptive Statistics for Post Test Achievement and Attitude.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
PostTest Score Computer Literacy	105	15	5	20	10.83	3.14	9.855
Post Test Score Opinion	105	69	61	130	105.40	15.90	252.762
Valid N (listwise)	105						

Overview of the Analysis of Data

Four dependent variables were considered in this study: the pre and post test achievement scores and the pre and post test attitude scores. Independent variables were the gender of the students, age of the students, and gender of the instructors.

The pretest data for achievement and attitude was analyzed to determine if the Analysis of Variance statistical test could be used for analysis. It was determined the Analysis of Variance could be used for both the achievement data and the attitude data.

The data concerning gender of student, age of student, and gender of instructors was reviewed and it was determined to be homogeneous.

Results of the Hypotheses

Nine Hypotheses were presented in Chapter One and were addressed by the data.

Hypothesis One

There is a significant difference in achievement on a standardized computer literacy test, between using HyperTalk or using BASIC, when teaching the computer programming concepts of a computer literacy course.

An ANOVA was conducted to test Hypothesis One (See Table 4.13). Since the calculated F scores of 0.262 did not exceed the critical value of 3.94, the data rejected the hypothesis. There was no significant difference in achievement on a standardized computer literacy test, between using HyperTalk or using BASIC, when teaching the computer programming concepts of a computer literacy course.

Table 4.13: Analysis of Variance of Achievement by HyperTalk or BASIC.

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
LITDIF	Main Effects	Hypercard or Basic	2.830	1	2.830	.262	.610
	Model		2.830	1	2.830	.262	.610
	Residual		1112.084	103	10.797		
	Total		1114.914	104	10.720		

a. LITDIF by Hypercard or Basic

Hypothesis Two

There is a significant difference in attitude on a standardized computer literacy test between using HyperTalk or using BASIC as the programming language when teaching the computer programming concepts of a computer literacy course.

Table 4.14: Analysis of Variance of Attitude by HyperTalk or BASIC.

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
OPDIF	Main Effects	Hypercard or Basic	11285.258	1	11285.258	1.198	.276
	Model		11285.258	1	11285.258	1.198	.276
	Residual		970154.990	103	9418.980		
	Total		981440.248	104	9436.925		

a. OPDIF by Hypercard or Basic

An ANOVA was conducted to test Hypothesis Two (See Table 4.14). Since the calculated *F* scores of 1.198 did not exceed the critical value of 3.94, the data rejected the hypothesis.

There was no significant difference in attitude on a standardized computer literacy test, between using HyperTalk or using BASIC as the programming language when teaching the computer programming concepts of a computer literacy course.

Hypothesis Three

There is a significant interaction in achievement scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

Table 4.15: Analysis of Variance of Achievement by HyperTalk or BASIC by Gender of Student

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
LITDIF	Main Effects	(Combined)	18.174	2	9.087	.844	.433
		Hypercard or Basic	1.665	1	1.665	.155	.695
		Gender of student	15.344	1	15.344	1.425	.235
	2-Way Interactions	Hypercard or Basic * Gender of student	9.269	1	9.269	.861	.356
	Model		27.443	3	9.148	.850	.470
	Residual		1087.471	101	10.767		
	Total		1114.914	104	10.720		

a. LITDIF by Hypercard or Basic, Gender of student

The ANOVA used to test Hypothesis Three calculated an *F* value of 0.861 for the two-way interaction between the programming language of HyperTalk of BASIC and the gender of the student (See Table 4.15). This did not exceed the critical value of 3.94, therefore the data rejected the hypothesis. There was no significant interaction in achievement scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

Hypothesis Four

There is a significant interaction in attitude scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

The ANOVA used to test Hypothesis Four calculated an *F* value of 1.213 for the two-way interaction between the programming language of HyperTalk of BASIC and the gender of the student (See Table 4.16). This did not exceed the critical value of 3.94, therefore the data rejected the hypothesis. There was no significant interaction in attitude scores between gender and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

Table 4.16: Analysis of Variance of Attitude of HyperTalk and Basic and Gender of Student Interaction

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
OPDIF	Main Effects	(Combined)	19408.227	2	9704.114	1.031	.360
		Hypercard or Basic	9387.013	1	9387.013	.997	.320
		Gender of student	8122.969	1	8122.969	.863	.355
	2-Way Interactions	Hypercard or Basic * Gender of student	11414.547	1	11414.547	1.213	.273
	Model		30822.774	3	10274.258	1.092	.356
	Residual		950617.473	101	9412.054		
	Total		981440.248	104	9436.925		

a. OPDIF by Hypercard or Basic, Gender of student

Hypothesis Five

There is a significant interaction in achievement scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

The ANOVA used to test Hypothesis Five calculated an *F* value of 4.150 for the two-way interaction between the programming language of HyperTalk of BASIC and the gender of the instructors (See Table 4.17). This exceeds the critical value of 3.94, therefore the data failed to reject the hypothesis. There was a significant interaction in achievement scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

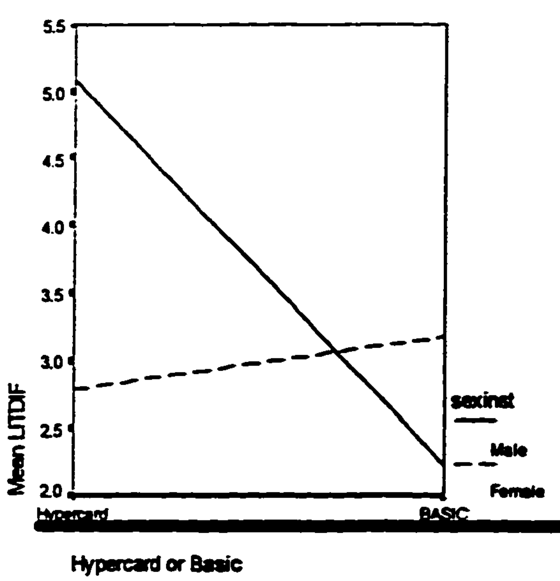
Table 4.17: Analysis of Variance of Achievement of HyperTalk and Basic and Gender of Instructor Interaction

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
LITDIF	Main Effects	(Combined)	14.087	2	7.044	.673	.513
		Hypercard or Basic	1.744	1	1.744	.167	.684
		sexinst	11.257	1	11.257	1.075	.302
	2-Way Interactions	Hypercard or Basic * sexinst	43.446	1	43.446	4.150	.044
	Model		57.533	3	19.178	1.832	.146
	Residual		1057.381	101	10.469		
	Total		1114.914	104	10.720		

a. LITDIF by Hypercard or Basic, sexinst

Figure 4.2: Interaction of Achievement in Programming language (HyperTalk of BASIC) and Gender of the Instructor



As shown in Figure 4.2 the lines indicating gender of the instructors and the programming language of HyperTalk or BASIC intersect, indicating an interaction between the gender of the instructors and the programming language of BASIC and

HyperTalk. The students with female instructors did better using the BASIC language and those students with male instructors did better when using HyperTalk.

Figure 4.3: Achievement by Gender of Instructor

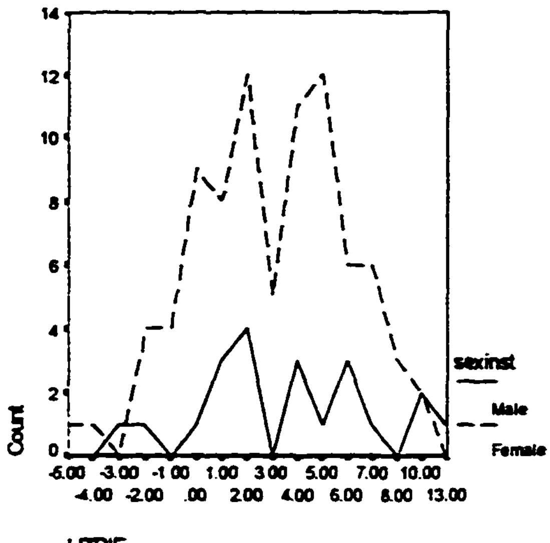


Figure 4.3 indicates that the students with male instructors actually scored higher on the achievement test. The students with the female instructors have more scores in the mid ranges. This difference was not significant.

Hypothesis Six

There is a significant interaction in attitude scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

Table 4.18: Analysis of Variance of Attitude of HyperTalk and Basic and Gender of Instructors Interaction

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
OPDIF	Main Effects	(Combined)	12809.100	2	6404.550	.669	.514
		sexinst	1523.842	1	1523.842	.159	.691
		Hypercard or Basic	12043.650	1	12043.650	1.258	.265
	2-Way Interactions	sexinst * Hypercard or Basic	1719.395	1	1719.395	.180	.673
	Model		14528.495	3	4842.832	.506	.679
	Residual		966911.752	101	9573.384		
	Total		981440.248	104	9436.925		

a. OPDIF by sexinst, Hypercard or Basic

The ANOVA used to test Hypothesis Six calculated an *F* value of 0.180 for the two-way interaction between the programming language of HyperTalk of BASIC and the gender of the instructors (See Table 4.18). This did not exceed the critical value of 3.94, therefore the data rejected the hypothesis. There was no significant interaction in attitude scores between the gender of the instructors and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

<u>**Hypothesis Seven**</u>

There is a significant interaction in achievement scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

The ANOVA used to test Hypothesis Seven calculated an *F* value of 0.670 for the two-way interaction between the programming language of HyperTalk or BASIC and the age of the student (See Table 4.19). This did not exceed the critical value of 2.47, therefore the data rejected the hypothesis. There was no significant interaction in achievement scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

Table 4.19: Analysis of Variance of Achievement Interactions Between Programming Language (HyperTalk of Basic) and Age by Category

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
LITDIF	Main Effects	(Combined)	32.045	5	6.409	.569	.724
		Hypercard or Basic	6.700	1	6.700	.595	.443
		agecat	28.230	4	7.057	.626	.645
	2-Way Interactions	Hypercard or Basic * agecat	30.205	4	7.551	.670	.614
	Model		62.250	9	6.917	.614	.782
	Residual		1047.867	93	11.267		
	Total		1110.117	102	10.883		

a. LITDIF by Hypercard or Basic, agecat

Hypothesis Eight

There is a significant interaction in attitude scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test.

The ANOVA used to test Hypothesis Eight calculated an *F* value of 0.876 for the two-way interaction between the programming language of HyperTalk of BASIC and the age of the student (See Table 4.20). This did not exceed the critical value of 2.47, therefore the data rejected the hypothesis. There was no significant interaction in attitude scores between age of the student and the use of the programming language of HyperTalk or BASIC on a standardized computer literacy test

Table 4.20: Analysis of Variance of Attitude Interactions Between Programming Language (HyperTalk of Basic) and Age by Category

ANOVA[a]

			Experimental Method				
			Sum of Squares	df	Mean Square	F	Sig.
OPDIF	Main Effects	(Combined)	39359.851	5	7871.970	.807	.548
		Hypercard or Basic	16209.209	1	16209.209	1.661	.201
		agecat	27461.637	4	6865.409	.704	.591
	2-Way Interactions	Hypercard or Basic * agecat	34207.430	4	8551.857	.876	.481
	Model		73567.281	9	8174.142	.838	.583
	Residual		907488.777	93	9757.944		
	Total		981056.058	102	9618.197		

a. OPDIF by Hypercard or Basic, agecat

Hypothesis Nine

There is a significant correlation between attitude and achievement on a standardized computer literacy test.

The Kendall's tau_b statistic accounts for 2.7% of the variability. The Spearman's rho accounts for 3.8% of the variability (See Table 4.21). Both values were too low to indicate a significant correlation between attitude and achievement on a standardized computer literacy test.

Discussion of Findings

The mean score for section three of the Standardized Test of Computer Literacy developed at the Research Institute for Studies in Education at Iowa State University was 11.09 (Table 4.12). The mean score of this study was 10.53. The standard deviation of section three of the standardized test was 3.79 (Table 4.12). The standard deviation for this study was 3.14. The range of scores was 0-20 on the standardized test (Table 4.12). The range for this study was 5-20.

Table 4.21: Correlation of Post test Achievement and Post Test Attitude

Correlations

			PostTest Score Computer Literacy	Post Test Score Opinion
Kendall's tau_b	Correlation Coefficient	PostTest Score Computer Literacy	1.000	.027
		Post Test Score Opinion	.027	1.000
	Sig. (2-tailed)	PostTest Score Computer Literacy	.	.698
		Post Test Score Opinion	.698	.
	N	PostTest Score Computer Literacy	105	105
		Post Test Score Opinion	105	105
Spearman's rho	Correlation Coefficient	PostTest Score Computer Literacy	1.000	.038
		Post Test Score Opinion	.038	1.000
	Sig. (2-tailed)	PostTest Score Computer Literacy	.	.703
		Post Test Score Opinion	.703	.
	N	PostTest Score Computer Literacy	105	105
		Post Test Score Opinion	105	105

The data in this study had a slightly lower mean score and less variability. A 95% confidence interval on the study data indicates a 95% confidence that the data mean was between 10.44 and 11.22. Since the mean of the standardized test was 11.09, it can be concluded that the mean of this study was within the 95% confidence interval.

The mean score for the Computer Anxiety Index of the Standardized Test of Computer Literacy was 70.2 (Table 4.12). The mean score was 105.4 for this study. The standard deviation for the standardized test was 18.46 with a range of 26 to 131 (Table 4.12). The standard deviation was 15.90 for this study with a range of 61-130. The mean score of the data for this study was higher and there was less variability. The higher the score, the higher the computer anxiety.

The data in this study was more closely grouped about the mean than the data used to standardize the test. A 95% confidence interval indicates the mean was between 102.32 and 108.48. The mean score for the standardized test was 70.2 and was only expected less than 5% of the time.

Hypotheses One and Two

Only one study (Reed & Lui 1994) investigating the programming languages of BASIC and HyperTalk and their effect on achievement and attitude was found in the literature. This study was very small (n=21), and the educational level was not stated in the literature. Reed and Lui (1994) found those using HyperTalk scored significantly better in programming and debugging. Because of the sample size, the findings of the

Reed and Lui study may not be significant. Many authors presented opinions and detailed analysis of the characteristics of programming languages (Shaffer, 1986; Bailey, 1987; Taffe, 1991; Allen et al., 1990; Katz & Porter, 1991; Decker & Hirshfield, 1990). From the findings of this small study (n = 105), language was not an important factor in the achievement or attitude of computer literacy students.

Informal discussions with the students indicated both the HyperTalk group and the BASIC group felt they had the more difficult programming language, and the other group had the easier language. Any problems the students may have had in achievement, were attributed to the programming language. This may have had an affect on the attitude scores.

The instructors using BASIC had taught the course before using BASIC. The instructors using HyperCard with HyperTalk were using the language for the first time. The lack of experience using the new language may have had an affect on the achievement and attitude scores.

In order to learn HyperTalk, one must learn HyperCard. HyperCard consists of five objects, each with its own attributes. A paint program is incorporated into HyperCard. BASIC requires only learning the BASIC editor. Hence, the HyperCard environment may be interfering with the learning of the programming concepts within HyperTalk.

Hypotheses Three and Four

A large number of studies have investigated the effects of gender on student achievement and attitude in a computer literacy course. Studies (Anderson, 1987; Nickell & Pinto, 1986; Smith & Necessary, 1996) report that males had a more positive attitude toward computers and that gender had a significant effect on achievement in computer literacy. Ayersman and Reed (1995-96) suggested the trend of male dominance with regard to student achievement and attitude in the area of computer literacy is beginning to reverse. They found that females significantly outperformed the males on the programming portion of the achievement test. This study supported the findings of a trend reversal of male dominance in achievement and attitude of computer literacy students. One possible explanation for this reversal was found by Borgo (1993/1994) who concluded that gender differences in achievement were often reduced with more computer experience. Prior computer experience was not investigated in this study. However, one has to ask if the advances in technology have made computers more accessible to students and begun to close the gap of experience.

The current societal attitudes towards the opportunities available to females may have had an affect on the attitudes of the females concerning computers. Are females becoming more confident? Shashaani (1994) found that perceived parental attitudes affect females and their achievement and attitude concerning computers. This suggests that the more current attitudes towards opportunities available to females is beginning to affect parental and student attitudes concerning achievement and attitude in computer literacy.

Hypotheses Five and Six

No research was found investigating the gender of instructors and its affect on the achievement and attitude of students in a computer literacy course. However, it should be noted that the female instructors had more teaching experience. It is not known if this higher score is due to the gender of the instructor or the teaching experience of the instructor. No data was collected regarding the teaching experience of the instructors.

Other instructor characteristics could also have contributed to the findings of this study. No data was collected regarding the teaching style or personality of the instructors.

The size of the sample may be too small be generalized. Only two female instructors and two male teaching assistants were investigated.

Hypotheses Seven and Eight

Age of the student was not found to be a significant factor in achievement and attitude. The literature is contradictory and indicates no clear trends regarding age and achievement or attitude of the computer literacy student. The possibility of the current societal attitudes towards the opportunities available to all, and the availability of computers, may effect the achievement and attitudes of all students.

Hypothesis Nine

The literature (Kuschel, 1994/1995; Boettner, 1991; Reed & Lui, 1994) found a significant correlation between attitude and achievement in a computer literacy class. This study does not support the literature findings. There was no correlation found between attitude and achievement.

Summary

There was no significant difference in either achievement or attitude on a standardized computer literacy test when the language used in teaching the programming concepts was BASIC, nor when the language used was HyperTalk. There was no significant interaction between gender of the student and language used to teach programming concepts, the age of the student and the language used to teach programming concepts, and no significant interaction was found in attitude between gender of the instructors and the language used to teach programming concepts. There was a significant interaction in achievement between the gender of the instructors and the language used to teach programming concepts. No correlation was found between attitude and achievement.

CHAPTER FIVE: SUMMARY OF STUDY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

This was a quasi-experimental study conducted to determine if a student performs better on an achievement test or attitude test, when the student was taught using HyperCard with its scripting language of HyperTalk, or when a student was taught using the BASIC programming language. The characteristics of gender, age, and gender of instructors were investigated to determine if there was any interaction with the programming language of BASIC or HyperTalk. The subjects were enrolled in six sections of a computer literacy course. Three sections used HyperTalk and three used BASIC. The pre and post testing instruments were section three of the Standardized Test of Computer Literacy, developed at the Research Institute for Studies in Education at Iowa State University, and the Computer Anxiety Index test of the Standardized Test of Computer Literacy, also developed at Iowa State University. An independent samples t-test was conducted to test if the samples were independent. A Shapiro-Wilks test was conducted to test the hypothesis that the groups were normal. A Levene test was conducted to test the hypothesis that the variances of the groups were equal.

An ANOVA was conducted to determine if there was a significant difference in achievement and attitude for the groups using HyperTalk or BASIC. No significant difference was found in achievement nor in attitude.

An ANOVA was conducted to determine if there was a significant interaction in achievement or attitude between any of three factors (gender of the student, age of the student, or gender of the instructors), and the programming language of HyperTalk or BASIC. No significant interaction was found in achievement or attitude between gender of the student and the programming language of HyperTalk or BASIC. No significant interaction was found in achievement or attitude between age of the student and the programming language of HyperTalk or BASIC. A significant interaction was found in achievement between gender of the instructors and the programming language of HyperTalk or BASIC. No significant interaction was found in attitude between gender of the instructors and the programming language of HyperTalk or BASIC.

Conclusions

Conclusion One

No significant difference in achievement or attitude was found in the groups using BASIC and the groups using HyperTalk. From this small study it can be concluded that either language would produce similar results.

However, the attitudes of the students may have been affected by the fact that the majority of the students from both the HyperTalk and the BASIC groups thought they were using the more difficult language.

Also, the HyperCard environment has more components than the BASIC environment. The more complex environment may be affecting those students using HyperTalk.

Conclusion Two

There was a significant interaction between the gender of the instructors and the programming languages of BASIC and HyperTalk on the achievement of the students. The teaching experience of the instructors was not equal. The teaching experience, teaching styles and personalities of the instructors may have had an effect on the achievement and attitude of the computer literacy students. No data was collected on these characteristics. The sample size was small. Therefore, the finding indicating a significant interaction between gender of the instructors and the programming language of BASIC and HyperTalk can not be generalized.

Conclusion Three

Recent societal attitudes have affected the way females perceive themselves and how parents perceive their female children. This is having an affect on how females are performing in areas that were previously male dominated. The research (Anderson, 1987; Nickell & Pinto, 1986) in the late 1980's found differences in achievement and attitude with respect to computers between males and females. The females appeared to be more anxious and did not do as well in achievement. Ayersman and Reed (1995-96) indicated the beginning of a reversal of the male dominance in computer attitude and achievement. Research also indicated that more exposure to computers reduced computer anxiety (Siann & Durnell, 1988). Due to a combination of societal changes and more exposure to computers for students, the male dominance in the areas of computer achievement and attitude is weakening. This study found no significant interaction between gender of the student and achievement or attitude, and supports the reversing of the male dominance trend in the areas of computer achievement and attitude.

Conclusion Four

The literature is contradictory regarding age and achievement and attitude in computer literacy. The findings of this study indicate that there is no interaction between age and the programming languages of BASIC and HyperTalk.

Recommendations

Recommendation One

More research is needed to determine if there is a difference in achievement and attitude between those using the program languages of HyperTalk and BASIC. The following adjustments to the study are suggested:

(a) This study was conducted the first quarter that the language of HyperTalk was introduced into the curriculum. The instructors had no time to develop teaching techniques and materials for the new language. Further study should allow the instructor to teach the course using HyperTalk at least twice before a formal study is conducted.

(b) The HyperCard environment is more complex than the BASIC environment. Those students using HyperTalk should have instruction in HyperCard before beginning the programming concepts.

(c) More data should be collected regarding the background, teaching style and personality of the instructors.

(d) More data should be collected regarding the prior computer experience of the students.

(e) A larger sample would help to determine if the gender of the instructors is really a significant factor in achievement and attitude of a computer literacy student.

Recommendation Two

The literature and this study suggest a reversal of the male dominance trend in the areas of computer achievement and attitude. Additional studies need to be conducted to provide confirmation that this trend is indeed reversing.

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Appendix A

Where to Obtain, Permission to Copy and Instructions for Use of the Standard Test of Computer Literacy and Computer Anxiety Index

The Standard Test of Computer Literacy and the Computer Anxiety Index are copyrighted instruments. For information regarding their use, contact:

Dr. Michael R. Simonson
Research Institute for Studies in Education
College of Education
Lagomarcino Hall
Iowa State University
Ames, IA 50011

Permission to use the Standard Test of Computer Literacy and the Computer Anxiety Index.

EASTERN
EASTERN WASHINGTON UNIVERSITY
CHENEY • SPOKANE

October 6, 1992

Michael R Simonson
Instructional Resources Center
N031 Lagemarcino
Iowa State University
Ames Iowa 50011

Dear Dr Simonson:

I am requesting use of the Standard Test of Computer Literacy and the Computer Anxiety Index. I am a graduate student at the University of Idaho working on my Ph.D. with emphasis on Computer Education. My research involves an empirical study testing if there is a significant difference in achievement if a student is taught the concepts of input/output, decision making and repetition using HyperCard and its scripting language HyperTalk than when the student is taught the same concepts using the Basic programming language. Is there a difference in the students attitude when HyperCard is the teaching tool rather than the Basic programming language. The Standard Test of Computer Literacy section III and the Computer Anxiety Index would provide the pre and post test to measure the achievement and the computer anxiety of the students.

Enclosed is a check in the agreed upon amount of $50.00. I agree to made copies of the exam and give the exams in compliance with the directions in the test administrator's manual. The samples will consists of approximately 200 students in CSCD 120 Computer Fundamentals with Programming Concepts at Eastern Washington University. I am requesting the necessary instruction for scoring the exams. The results will be forwarded to you after completion of the study.

Thank you for your help.

Sincerely

Linda M Kieffer
Assistant Professor

You have permission to copy per this letter
M Simonson
- Scoring key enclosed

COMPUTER SCIENCE
202 Computer Science Building • Mail Stop 86 • Cheney, Washington 99004-2495
(509) [illegible]
EOE

Directions for Administering the Standard Test for Computer Literacy Section III and Computer Attitude Survey

Computer Attitude Survey

Students should follow directions on the front of the test booklet before beginning the test. (name, sex, etc.).

Students have ten (10) minutes to complete this section.

All questions must be answered.

When the 10 minutes are up collect answer sheets and pass out Computer Literacy Test.

Computer Literacy Test Section III

Students have thirty (30) minutes to complete this section.

Students should follow directions on the front of the test booklet before beginning the test (name, sex, etc.)

Assure students that we do not expect them to know all the answers on the test, but please do the best that they can.

If a student finishes early, they are to sit quietly until the 30 minutes are up. Do not allow them to work on other work.

At the end of the 30 minutes, collect answer sheets.

DO NOT ANSWER QUESTIONS ABOUT TEST QUESTIONS FOR THE STUDENTS. TELL THEM TO DO THE BEST THEY CAN.

Appendix B

The Assignments

Programming Assignments

Assignment 1
Write a program that prompts the user for a number of inches. The program will convert the inches to feet and yards and print these results on the screen. Be sure the prompts are clear and your results are formatted.

Turn in a copy of your code and a copy of three different runs of your program.

Assignment 2
Write a program that prompts the user for an employee number, hours worked and hourly pay rate and then calculate the wages. All hours over 40 are paid at 1.5 times the regular hourly pay rate. Execute the program with the following values.

Employee Number	Hours Worked	Hourly Pay Rate
123	38	7.50
175	39.5	7.85
223	40	9.25
375	44.5	8.35

Turn in a copy of your code and copies of the above runs.

Assignment 3
Random Number Guessing Game
Write a program to simulate the random number guessing game. The computer generates a random number between 1 and 100 inclusive. The user gets 10 tries to guess the number. After each guess the user is told if they have guessed the number. If they have not guessed the number they are told if they are too high or too low. If the user has not guessed the number in 10 tries, the number is revealed to the user.

Turn in a copy of your code, and copies of runs showing the number being guessed and another with the number not guessed in the 10 tries.