To the Graduate Council:

I am submitting herewith a dissertation written by Jenia D. Alfonzo entitled "Feasibility of Using HyperStudio™ Generated Applications to Accelerate Learning". I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment for the requirements for the degree Doctor of Philosophy, with a major in Curriculum and Instruction.

Dr. Lonnie McIntyre, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor
And Dean of the Graduate School

THE FEASIBILITY OF USING HYPERSTUDIO GENERATED APPLICATIONS TO ACCELERATE LEARNING

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Jenia D. Alfonzo
August, 1999

DEDICATION

**This study is dedicated to
my husband Jose, my support
and to my son Gabriel, my inspiration,
for their love and patience.**

ACKNOWLEDGEMENTS

I wish to greatfully acknowledge the contributions of many individuals who provided guidance, assistance, encouragement and support for this study.

First of all, I want to thank God, my strength comes from him.

I want to thank the Universidad Centroccidental "Lisandro Alvarado" in Barquisimeto, Venezuela for its sponsorship.

Great appreciation is extended to my advisor, Dr. Lonnie McIntyre, for his expert assistance and guidance during this project and throughout my years in the doctorate program at the College of Education. I am also appreciative of the interest, assistance and support of the other members of my committee Dr. Everett Myer and Dr. Priscilla Blanton, and specially Dr. Russel French for taking his time to read my papers to make my dissertation better.

I would also like to thank the teachers and students who participated in this study. Their help and support will always be remembered.

A special word of appreciation is extended to my friends at home and in Sutherland Apartments, their help and encouragement throughout the study are greatly appreciated.

Heart felt gratitude is also expressed to my husband, Jose. Thank you for having faith in me, for being supportive, for always being there when I need you. No words can adequately express how much you mean to me.

Finally, I want to thank my son, Gabriel, my source of encouragement and inspiration.

I hope that I can repay their support by helping others, as they have helped me.

ABSTRACT

The purposes of this study were to assess the feasibility of using Hyperstudio™ generated applications to help students with specific needs to overcome their weaknesses, and to determine the perceptions of students about the experience.

Hyperstudio™ is an authoring tool that can be used to create multimedia applications. Sounds graphics and color can be combined in the design of the stack, a series of cards connected by buttons.

The data was collected at an inner city elementary school in East Tennessee. Participants were ten 4th grade students aged 9 to 10. Pretest, posttest and retention tests were administered to determine gains in knowledge. The three tests were the same test and they were ten point tests. A questionnaire was prepared to assess participants' perceptions on the experience.

The first and second research questions regarding students' gain in knowledge and retention of knowledge were analyzed quantitatively. Gains from pretest to posttest were computed by group and individually. Retention of knowledge was measured by comparison of posttest and retention tests scores.

Students' perceptions of this experience were assessed using a questionnaire. Responses to each question were summed. The basic data treatment was limited to arithmetic computation, and results were reported in "number of total responses" format.

Results of the analysis of data answered the research questions. Findings from this study point to several conclusions related to the research questions. The following are conclusions from this study:

(1) The value of Hyperstudio™ applications as remedial instruction for some students in some content areas is still open to questions. Some gains are not considered substantial for remedial students who are being instructed in the same content for a second time.

(2) No patterns were found in relation to students' gains. Students gained from 1 to 7 points in different contents and applications.

(3) The students who interacted with the applications seemed to enjoy them.

(4) Retention was limited to short-term memory. Accuracy of measurement is questionable since a few students demonstrated gains between posttest and retention test without additional instruction.

Suggestion for further investigation where research can be productive are given.

TABLE OF CONTENTS

Chapter		Page
I.	**INTRODUCTION**	1
	Background of the Problem	3
	Purpose of the Study	6
	Methodology	7
	Significance of the Study	9
	Assumptions of the Study	9
	Limitations of the Study	10
	Delimitations of the Study	11
	Definitions of terms	11
	Organization of the Study	13
II	**REVIEW OF THE LITERATURE**	
	Introduction	15
	Remedial Learning	15
	Retention of Knowledge	22
	Computer–Assisted Instruction	24
	Attitude and Performance	27
	Educational Software Development	28
	HyperStudio™	30

Chapter		Page
III	**RESEARCH DESIGN AND METHODOLOGY**	
	Introduction	36
	Description of the Population and Setting	36
	Voluntary Subject Review	37
	Design of the Study	35
	Research Questions	38
	Design of Hyperstudio™ Applications	39
	Test and Computer Usage	47
	Data Collection	49
	Pretest/Posttest/Retention Test	49
	Questionnaire	50
	Data Analysis	51
	Summary	52
IV	**ANALYSIS OF THE DATA**	
	Introduction	53
	Presentation of the Data Collected	54
	Research Question # 1	54
	Research Question # 2	74
	Research Question # 3	89
	Summary	93

Chapter		Page
V	**CONCLUSIONS AND RECOMMENDATIONS**	
	Summary	94
	Discussion	96
	Conclusions	97
	Recommendations for Further Research	100
	LIST OF REFERENCES	103
	APPENDIXES	109
	Appendix A: Consent Form	110
	Appendix B: Human Subjects Form	113
	Appendix C: Hyperstudio™ Applications	115
	D-1 Adverbs	116
	D-2 Measurement	133
	D-3 Division	149
	D-4 Nouns	161
	D-5 Verbs	173
	D-6 Graphs	185

Appendix D: Data Collection Sheets 196

C-1 Computer time/Attendance 197

C-1 Test Results 198

Appendix E: Tests 199

E-1 Adverbs 200

E-2 Measurement 201

E-3 Division 202

E-4 Nouns 204

E-5 Verbs 405

E-6 Graphs 206

Appendix F: Sample of Questionnaire 208

"Perceptions of a Hyperstudio™ Experience"

VITA 211

LIST OF TABLES

Table		Page
2-1	The Constructivist Approach	31
4-1	Adverbs: Gains	55
4-2	Measurement: Gains	56
4-3	Division: Gains	57
4-4	Nouns: Gains	58
4-5	Verbs: Gains	59
4-6	Graphs: Gains	60
4-7	Average Gains	72
4-8	Adverbs: Retention	75
4-9	Measurements: Retention	76
4-10	Division: Retention	77
4-11	Questionnaire Responses	90

LIST OF FIGURES

Figure		Page
2-1	Annual Assessment Model	18
2-2	Group Remediation Model	19
2-3	Immediate Remediation Model	20
3-1	Distribution of Pretests, Posttests and Computer time	47
4-1	Student A: Gains	62
4-2	Student B: Gains	63
4-3	Student C: Gains	64
4-4	Student D: Gains	65
4-5	Student E: Gains	66
4-6	Student F: Gains	67
4-7	Student G: Gains	68
4-8	Student H: Gains	69
4-9	Student I: Gains	70
4-10	Student J: Gains	71
4-11	Student A: Retention	79
4-12	Student B: Retention	80
4-13	Student C: Retention	81
4-14	Student D: Retention	82
4-15	Student E: Retention	83

Figure		Page
4-16	Student F: Retention	84
4-17	Student H: Retention	86
4-18	Student I: Retention	87
4-19	Student J: Retention	88

CHAPTER I

Introduction

Many educators agree that the primary goal of the educational system is to maximize the learning potential of the students. The appearance of computers in educational settings was heralded as revolutionary, in much the same way as instructional films and television had been. That these latter two technologies have fallen far short of revolutionizing education is now widely accepted (Cuban, 1986). This may be a premature judgement in the case of computers, however.

Computers maintain a presence in the curriculum in many ways. Since the computer was first introduced into schools, it has been considered an object of study. Academic courses presented the computer as subject matter and addressed computer literacy, programming skills, and the role of the computer in society.

The computer is also an instructional medium. Students can interact with software designed to address specific instructional content or use a computer as a tool for completing an assortment of educationally related tasks. Learning enrichment is the major instructional purpose particularly at the elementary level.

The use of personal computers increased during the 1980s and its popularity experienced remarkable growth, particularly in education. The U.S. Congress, Office of Technology and Assessment (1988) reported that between 1981 and 1987, the percentage of American schools with one or more computers intended for instruction grew from about 18 percent to 95 percent. By 1989 the typical high school had between 40 and 50 computers and the median number for elementary schools was nearly 20 (Becker, 1990).

Between 1986 and 1991 computers were used primarily for the instructional purpose of enrichment and occasionally for remediation, but they were still not used in a major way for developing thinking skills or understanding about a subject (Becker, 1990).

While computers have been in the classroom since the 1960s, instructional software has failed to assume predominant roles. Much of the educational software developed for the classroom seeks to implement conventional teaching practices on a computer. This was true of the first generation of classroom applications, which did not go beyond electronic workbooks or computer-based multiple choice tests (Carbonell, 1970a). Later systems attempted to leverage more advanced techniques of artificial intelligence to monitor students' progress through a sequence of tasks (Carbonell, 1970b). But even successfully piloted research efforts represent only pieces of the puzzle, as opposed to offering a comprehensive solution to how educational software should be designed.

The development of multimedia personal computers in the 1990s has captured the attention of many educators. Object –oriented authoring systems such as HyperCard, HyperStudio and Authorware are growing in popularity in schools. Most United States classrooms now have at least one PC available for instructional delivery, but not all teachers have access for instructional preparation. There is a growing trend toward incorporating the Internet, especially the World Wide Web and educational software, such as CD-ROMs, into the lesson (Johnson et al., 1996).

The vision for the future is that every student and teacher will have access to computers and will be connected to Internet.

Computer software companies have now developed thousands of educational programs for children of all ages. There are math, reading, science, history, geography, and many more; all of which can be used in the classroom for learning, but some students experience specific needs that might not be addressed by commercially produced software.

The Background of the Problem

Regardless of their promise, the value of computers in instruction is dependent on their use; technology inappropriately or little used is bound to have little positive impact. With proper implementation, the computer can transform the

classroom and create a superior learning environment (Stram & Torell, 1998). A computer is a very useful, motivating tool when used thoughtfully and purposefully. However, students' attitudes toward computers have been found to be one of the major factors relating to their success in learning about and using them (Francis & Evans, 1995; Freedman & Liu, 1996; Liu & Johnson, 1998).

On another front, many studies have been conducted to measure the effectiveness of computers in the classroom. The results are promising. Educational computer software studies have also shown an improvement in learning. For example, Kulik and Kulik (1991) conducted research on the effectiveness of software in self-paced instruction. Their results showed 20% improvement in learning, mostly in mathematics and grammar. However, there is still relatively little known about the impact of different software applications on learning.

The growing use of various technologies to prepare students is prominent in today's society. As society changes schools must adapt to the changing nature and needs of students. To meet this challenge schools need to provide a more visually stimulating learning environment. One way in which the needs of visual learners may be met is through hypermedia stacks which can be viewed and heard by both students and teachers alike (Heidenreich,1992). Communicating ideas in visual form is becoming increasingly important (Hyperstudio Website, 1999). The determination to increasingly computerize schools is energized by the instructional

opportunities afforded by this technology and its potential benefits. However, research into computer applications and real benefits is needed.

Another aspect of computer-based instruction that needs more investigation is the viability of different software applications for instruction of remedial learners. Some individuals, for one reason or another, cannot master an objective after the first initial presentation. Secondary instruction should be provided. Previous instruction should not be repeated; the topic should be approached from a different angle (Soulier, 1988).

Historically, educational software has emerged from computer science laboratories, which has resulted in a gap between those who construct such systems and the needs of the users. In order to maximize the effects of software on students with specific needs, the development of software meeting those needs is imperative. It would be desirable but unlikely for one to find commercially produced hypermedia applications that exclusively meet specific needs of specific students.

Software designed for specific needs should help remedial students overcome their weaknesses. Can remediation be accomplished using a technology that provides more involvement in terms of how students learn? The potential benefits for remedial students are particularly interesting because the use of software for remediation may be less threatening to a student who has experienced many failures in traditional classroom situations. Stratham and Torell (1998) state

that some of the highest gains in achievement consistently come when at-risk students are afforded the opportunity to access computer technology. Software applications allow for children to learn at their personal level.

The use of hypermedia stacks can help students build on normal required tasks, allowing them to work at their own pace while offering a non-traditional approach to learning and relearning. Therefore, research specifically focused on hypermedia applications in remedial learning and instruction is much needed.

Purposes of the Study

The primary purposes of this study are:

(1) Assess the feasibility of using Hyperstudio™, a multimedia program that allows the creation of interactive applications to help students with specific needs overcome their weaknesses.

(2) Determine the perceptions of participants using Hyperstudio™ generated applications regarding their experiences.

Methodology

Participants in this research were ten fourth graders, an entire 4th grade class, attending an inner city school in East Tennessee. The average student at this school comes from a middle-low income family.

There are different authoring tools that can be used to create hypermedia applications based on the needs of specific students. Hyperstudio™ was used in this study because of its capabilities and ease of use. Hyperstudio™ is analogous to a stack of three-by-five inch cards that are connected. Hyperstudio™ is an authoring tool that lets you develop an electronic stack of cards that contains buttons, graphics, and text (Sharp, 1997).

Six Hyperstudio™ applications were generated for the study. Topics for these applications were identified by the teacher based on class performance and test results. The applications developed were in the areas of Math and Language Arts. Topics were Division, Measurement and Graphs in Math; Adverbs, Verbs and Nouns in Language Arts.

Pretest and posttest scores were compared in order to determine gains in knowledge. The same test was administered a third time two weeks later to measure retention of knowledge. Retention was measured only on the first three applications --adverbs, division and measurement-- because the school year ended before students could take the test in the three remaining areas. Retention tests in

each area were administered two weeks after the posttest, and three weeks after the pretest.

The analysis performed to find gains in knowledge included computation of pretest and posttest scores. These scores were then compared to see if differences existed. Retention was measured by readministering the posttest two weeks later.

A questionnaire was prepared and administered to participants to assess their attitude toward the use of Hyperstudio™ generated applications. Responses were analyzed. The occurrence of a response served as the basis for its analysis. Percentages were used for their interpretation.

This research study was quantitative in design. The following research questions guided the study:

1. Do remedial students experience gains in knowledge as a result of using Hyperstudio™ generated applications?

2. Do students who have used Hyperstudio™ applications as a means of remedial instruction domonstrate retention of knowledge gained?

3. Do students have positive perceptions toward their experience using Hyperstudio™ applications?

Significance of the Study

This study is significant for the following reasons:

1. Educators are becoming increasingly aware that both high and low achievers in the educational system need attention. Research on both extremes is needed.This study is an experience in reteaching low achievers using Hyperstudio™ stacks, a way to deliver instruction different from the traditional methods.

2. This study will help to validate Hyperstudio™ as a tool that can be used for creating hypermedia applications based on the needs of remedial students.

3. This study will provide data in relation to the use of Hyperstudio™ applications with remedial students.

4. This study will provide data related to the perceptions of students using Hyperstudio™ applications.

Assumptions of the Study

The following assumptions were made in this study:

(1) Hyperstudio™ is an authoring program that offers capabilities and ease of use even for non-experienced users.

(2) Hyperstudio™ is an appropriate authoring program for use in this study.

(3) Students performed to the best of their ability on all tests administered.

(4) Fourth graders were capable of evaluating their educational experience with Hyperstudio™.

(5) The selection of a fourth grade population for this study will provide sufficient data to assess the potential of Hyperstudio™ for use with other student groups.

Limitations of the Study

There are a number of limitations to this study.

(1) The use of the same testing instrument two or three times might have affected the results the second or third time it was administered. Student responses might be a result of recall of the test items as stated by Spitzer (1939).

(2) The number of participants in this study was small; only 10 students participated in this study.

(3) Participants were not chosen randomly. The selection was based on parent or guardian's authorization to participate in the study.

(4) Research was conducted with a group of students, same grade, same age range, possibly similar interests and same level of maturation. This affects the degree to which results can be generalized, including estimates of validity of findings.

(5) As in many other research studies, data analysis and conclusions are limited to the interpretations of the research data by the researcher.

(6) Not only students with specific needs participated in the study. All students worked with all the applications because of classroom time management.

Despite the limitations, this study offers data and results that will be of value to educators who have questions about the effects of using Hyperstudio™ applications in classrooms.

Delimitations

The study was delimited by the following qualifications:

(1) This study only minimally investigated the instructional uses of Hyperstudio™ in relation to specific subject areas.

(2) The study did not consider classroom management or administrative uses of computers.

(3) The assessment of validity of results will essentially be restricted to:

a. verifying the degree to which Hyperstudio™ generated applications helped this group of students overcome their weaknesses.
b. assessing students' perceptions of the experience.

Definition of Terms

Achievement: measurement of performance.

Authoring Tool: a computer program used to design and create your own computer applications.

Average Gain: a number that is equal to the mean of all gains.

Branching Stack: an application in which one card connects to other cards throughout the stack, for example a table of contents.

Computer Experience: training, work experience, or self-help techniques with computers apart from an accredited computer course.

Gain: a positive difference obtained when pretest and posttest scores and posttest and retention scores are compared.

Hyperstudio: a multimedia authoring tool that allows one to deliver ideas on a diskette, CD-ROM or over the Internet.

Interactivity: the sensory dialog that occurs between human beings and a computer program.

Linear Stack: a computer application developed sequencially, cards follow the numerical order.

Loss: when the difference between a pretest and a posttest or a posttest and a retention test is negative.

Motivation: a willingness to attempt to do something.

Multimedia: term that generally describes a computer based program that integrates several forms of media that may include video, sound, animation, graphics and text.

Percentage Gained: percentage of the posttest that is the actual gain.

Percentage of Retention: percentage of the posttest that was actually retained.

Remedial Learning: The section of the instruction to which students are routed if their performance in the main body of instruction is unsatisfactory.

Retention: the capacity to recall, comprehend, or apply previously learned facts and concepts.

Retention Interval: time period between the initial exposure to facts and concepts and the second exposure.

Skill: an ability to perform an action or group of actions.

Specific needs student: all students who, for a variety of possible reasons, may be considered problematical in terms of teaching and learning in specific areas.

Software: generic programs designed to carry out useful tasks required by the discipline.

Stack: a metaphor for a pile of cards.

Storyboard: feature that lets you preview the entire stack of cards, rearrange the order of the stack, or delete cards from the stack.

Remedial Learning: The section of the instruction to which students are routed if their performance in the main body of instruction is unsatisfactory.

Retention Interval: time period between posttest and retention test. For this study it was two weeks.

Retention Test: test administered after a given period with the purpose of determining how much of the instruction is remembered. It is also known as a second posttest.

Transition: special effects that transport the user from one card to the next.

Organization of the Study

This study is presented in five chapters.

Chapter I has been an introductory chapter. It consisted of background of the problem, statement of the problem, purposes of the study, the need for the study, its methodology, its limitations and delimitations, and its organization. It also includes definition of terms and assumptions made for the study.

Chapter II consists of a comprehensive review of the related research and literature which serve as a background for this study.

Chapter III provides the research design and methodology. It presents the methods and techniques for data collection and data analysis.

Chapter IV presents and summarizes all data collected. The findings of this study as they relate to the research questions are reported. These findings are presented in tables and summaries where appropriate.

Chapter V provides a synopsis of the study, conclusions, discussion, and recommendations for further research.

These five chapters are followed by a reference section consisting of a complete bibliography and appendices. The appendices contain letter to parents and consent forms (Appendix A), human subject form (Appendix B), Hyperstudio™ applications (Appendix C), data collection sheets (Appendix D), test samples (Appendix E), and a sample of the questionnaire (Appendix F).

CHAPTER II

Review of the Literature

Introduction

In conducting the present study, the investigator conducted a review of the literature in the following areas: (1) Remedial Learning, (2) Retention of Knowledge, (3) Computer-assisted Instruction, (4) Attitude and Performance, (5) Educational Software Development, and (6) Hyperstudio.

Remedial Learning

The review of the literature on this topic shows that remedial education and remedial students are identified in a variety of ways. Remedial education is referred to in the literature using terms like 'special education', 'compensatory education', 'remedial loops' and 'support work'. In the same way, those on the receiving end have been variously identified as 'backward', 'slow learners', 'low

attainers', 'underachievers', 'special needs learners', and 'special education students to name a few descriptors.

Special educational needs refer to the needs of the students, which constrain them from having full access to the curriculum and extra-curricular activities of a school or institution that are enjoyed by their contemporaries. Thus defined, it is impossible to identify needs by simple measures and it is conceivable that almost all students will, at some point, experience a learning difficulty, which impedes normal progress. Thus conceived, special educational needs are not peripheral to mainstream activity but part of the general curriculum delivery to all students. (Hinson, 1991).

Remedial education is that part of education which is concerned with the prevention, investigation and treatment of learning difficulties from whatsoever source they may emanate and which hinder the normal educational development of the students (National Association for Remedial Education, NARE Guidelines No1 Report on In-service Training, 1977. Cited in Hinson, 1991). This definition is intended to be as broad as possible, and to encompass the whole range of difficulties caused by cognitive, emotional or physical factors.

Steinberg (1984) refers to this kind of instruction as remedial loops. She defines a remedial loop as the section of instruction to which students are routed if their performance in the main body of instruction is unsatisfactory. After students complete this remedial loop, they are routed back to the point from which they

came. This definition conforms to the sense in which the term is used in this investigation.

There is agreement in the literature in relation to how remedial instruction should be delivered, and what its content should be. In this sense, Steinberg (1984) considers that remediation may consist of different explanations of the subject matter, more detailed explanation of examples, new example applications or any instruction that helps student overcome their misunderstandings or their lack of understanding. Soulier (1988) affirms that previous instruction should not be repeated; the topic should be approached from a different angle, with a unique set of examples. Mere repetition of the original instruction is unlikely to be effective. If it did not work the first time, there is no strong reason to suggest that it will work, if repeated.

A stable instructional system must attend at the design stage to both aptitude extremes, the faster and the slow learners. The traditional process for addressing underachievement (see Figure 2-1) prevalent until recently in North America was repetition of the year's work in one or more areas (Pratt, 1980). As The reader can see, this practice wastes the underachiever's time. The student repeats the whole year (often an ineffective form of remediation) although failure may have been only in part. If the failure occurred early and had been remediated then, the whole year might have been saved.

Pratt (1980) presents different approaches for remedial education, but identifying the underachievers seems to be the logical starting point. When and how remediation occurs is then the teacher's decision.

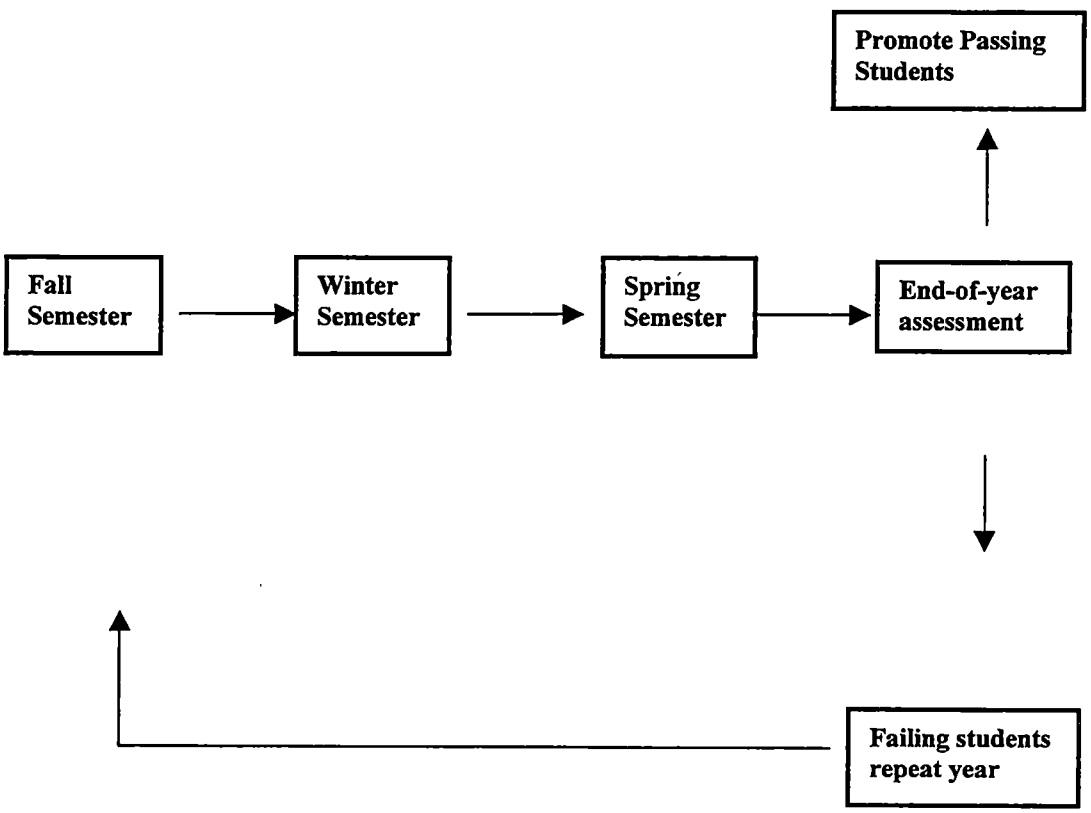


Figure 2-1: Annual Assessment Model. Taken from Pratt (1980).

The group remediation model (see figure 2-2) considers that deficiencies in the class may be remediated by devoting a lesson or two to remediation with the whole class. While this approach may be effective, it wastes the time of the successful students, who have to sit through remediation they do not need.

Group Remediation Model

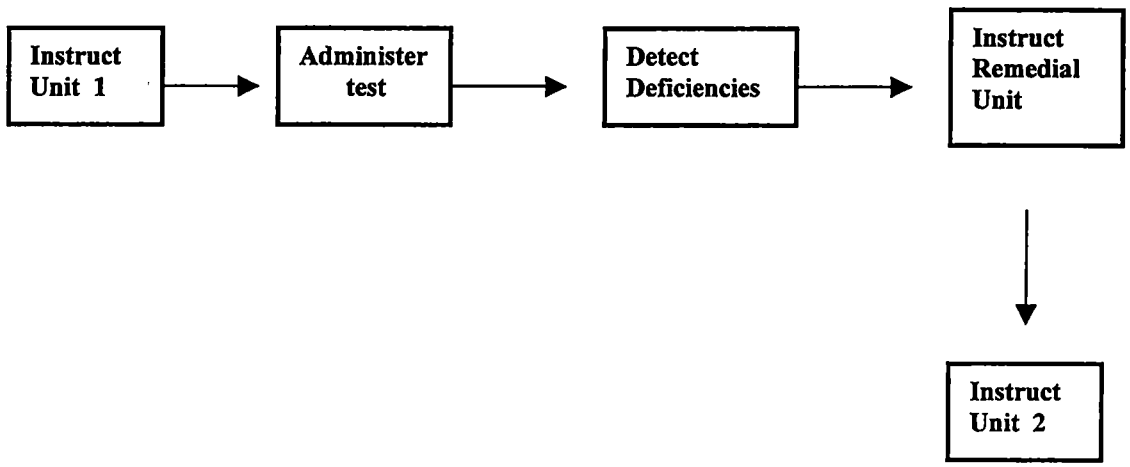


Figure 2-2: Group Remediation Model (Pratt, 1980)

Remediation can be included in the instructional process, as demonstrated in Pratt's Immediate Remediation Model (see figure 2-3) avoiding the shortcomings of the previous approach. In this model, units are relatively short; underachievers are given immediate remediation so that they can catch up with the rest of the group before it completes the next unit. Passing students are advanced even while underachievers are being remediated.

Immediate Remediation Model

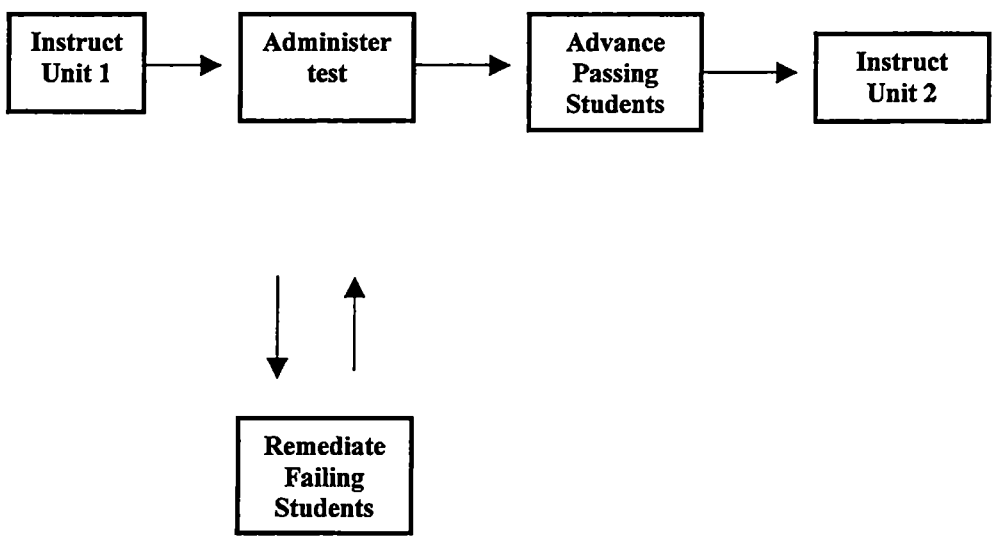


Figure 2-3: Immediate Remediation (Pratt, 1980).

Pratt states that if the designer wants to develop a stable curriculum system –one in which individual students do not fall seriously behind their peers- then remediation must follow swiftly on the heels of identification of learning difficulty. In practice this usually means that remediation must be (1) predesigned, (2) unexacting for the teacher, and (3) relatively painless for the learner. It is advisable to have a number of remedial packages ready, based on prediction or prior experience of the main areas of underachievement.

Several studies on remediation have been conducted using computers, an approach that can be fitted to Pratt's Immediate Remediation Model. Giordano (1993) focused on children who are failing to learn mathematics following typical classroom programs using routine instruction and material. Results show that students' performance improved by using different strategies and resources.

In this review of the literature on remedial learning, it was found that many studies refer to disadvantaged and disabled students as students in need which is a focus different from the one of this study. The literature is plentiful in this respect. In this research, a remedial student is a student who did not learn the first time instructed without implying any physical impediment to learn. Remedial learning, as focused in this study is barely found in the literature. It has not been a fully developed topic; research is lacking. Most authors dedicate a paragraph, if any, to refer to remedial teaching/learning or reteaching.

Retention of Knowledge

Retaking the end-of-course test or a parallel test at the end of a given period of time following the training will indicate how much of what the student originally learned he/she now remembers. Obviously, if the student has had the opportunity to put the knowledge gained into practice, use will have consolidated learning, and retention will be better. There are some factors related to knowledge decay. They are the ability characteristics of the student, and the retention interval --transit time between tests- (Tucker, 1997).

It is difficult to compare knowledge retention because, during the period between the immediate posttest and the retention test because each individual will be exposed to different experiences in their day-to-day activities and these experiences will affect the retention of knowledge.

Keeley (1999) cites a study that compares the percentage of material retained after different intervals of time. The results showed that 54 percent was retained after the first day, 35 percent was retained after seven days, 21 percent was retained after 14 days, 18 percent was retained after 21 days, 19 percent was retained after 28 days and 17 percent was retained after 63 days. Keeley does not explain if these percentages were considered high, normal or low in average.

A study that focused on knowledge decay during the interval of graduation from a basic electricity school and entry into a construction electrician. The sample of 307 graduates was retested using identical tests over different periods of

time. This research showed that the amount of decay increases as the time between tests increases and as student ability decreases.

Tucker (1997) reports studies performed in the United States and in the United Kingdom. This studies have proved conclusively that persons learn more and retain that knowledge for longer periods when using technology-based training as a learning tool. One study, in the United Kingdom, was carried out to ascertain whether there was any difference in knowledge retention between students using computer-based technology and the students using expert systems. Two groups of ten subjects were trained on the job for ten weeks, one of them using computer-based technology. They then took identical tests at the same points in time. Both groups did well in the immediate posttest, but those in the computer-based training retained more. Although the sample was not large enough for results to be of statistical significance, these results do appear to confirm that persons learn more when using technology-based training.

.Human memory works on two different levels: short-term memory and long-term memory Keeley (1999) affirmed that to learn information so that it can be retained and recalled, it must be transferred from short-term memory to long-term memory. Short-term memory includes what the student focuses on in the moment, what holds his/her attention. Long-term memory includes all the information that the student knows and recalls, it becomes a part of her/him and he/she has access to it for a long time.

Research has shown that students retain 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear, and do (Geisman, 1988). These findings lend support to the use of computer applications, particularly applications using software that combines the auditory, visual and touch modes. Hypermedia applications meet these criteria. By doing constructivist hypermedia projects students' achievement on tests and retention of information may likely improve.

Computer-Assisted Instruction

The potential for computer-assisted instruction (CAI) has been with us for more than 30 years. Over 30 million children attend elementary school in the United States (GAO, 1995). Seventy percent of children in American schools have access to computers, and the number of computers in schools is growing by at least 10 percent per year (Becker, 1992). An Educational Technology Survey of 1,000 educators across the United States found that 85 percent of teachers reported that students used computers in their classrooms for instructional purposes (Heller, 1995).

As a rule, instructors have used technology primarily to enhance the traditional teaching paradigm, not significantly altering the way they teach. Woodlief (1996), and Keyuravong (1997) agree that today's technology is friendlier, with software programs increasingly easier to master. Academic

computing has become more faculty friendly, and high tech staffed instructional centers are sometimes available for faculty to develop presentations and projects. This development makes this technology more popular, and some educators are eager to take advantage of its benefits. Those benefits include assisting teachers in teaching the class. Computers can introduce materials that lead to class discussion and other activities. Computers can also direct teaching, for example, students can use computer courseware to learn by themselves in the computer laboratory while teachers are available in class to help them when problems arise.

The advent of computers in education is changing the method and content of the curriculum. Teaching methods should consider the wide applicability of computer-assisted learning. Lally and Mcleod (1982) found that computer work doubles the attention span of children as compared with paper and pencil work on the same topic. Woodhouse and McDougall (1986) reported that computers also have proven to be useful for remedial teaching/learning for several reasons: minimal extraneous distractions while the child is concentrating on the computer, the computer's undivided attention to the student, unlimited patience and rapid reactions to answers or requests, the great variety of exercise formats, and the absolute privacy for making mistakes.

Steinberg (1991) also suggests that computers can assist instruction in many ways. They can actually present instruction, interacting with students in tutor-like fashion, individually or in small groups. Computer-presented instruction

embraces a wide range of techniques and can vary in complexity from simple drills to decision-making tasks.

Some definitions of CAI encompass all of these applications of computers to instruction; while some include only computer-presented applications. One of the most frequently reported advantages of computers is their potential to be interactive. Apart from humans; the computer is the only educational medium which possesses such capability. With the appropriate software, the computer can analyze student responses and make instant decisions concerning accuracy, style of response, nature of errors and can react according to the needs of individual students. Provision of such sophisticated educational software requires equally sophisticated models of how learning occurs, the nature of the subject matter, and the interactions between the two. (Sewell, 1990)

Venezky and Orsin (1990) state that computers deliver information, but they also possess a property shared by few other media: they are information processing machines. A strong difference exists between media that presents information to humans and, media with which humans interact. Computers belong to the second class, and what gives computer-assisted instruction its distinguished status when compared with other methods of instruction is precisely its capacity for interaction.

In this study, the form of computer-assisted instruction used was computer-presented instruction that was individualized, interactive, and directed. The

methodology was interactive in that there was two-way communication between the learner and the Hyperstudio™ application. The multimedia application posed questions, the learner responded, and the computer presented feedback.

Attitude and Performance

Generally, the term motivation can be defined as a willingness to attempt to do something (Kellemberg, 1996). Existing theories and models of motivation are attempts at explaining future behavior (Keller, 1983) and assume a relationship between motivation and performance: the higher the motivation, the better the performance (Benswanger, 1991; Gollwitzer, Heckhausen, & Ratajczak, 1990).

The measurement of performance, in general, is achievement. In education, the measurements of students' performance in their learning are their learning achievement scores. Theoretically, motivation influences performance and, hence, influences achievement.

Numerous studies have determined that motivation contributes significantly to variance in achievement (Parkinson, Lomax, Schiller, & Walberg, 1984; Mean, Jonassen, & Dwyer, 1997).

The attitude of students toward computers and toward the use of computers as well as the evaluation of computer effectiveness for enhancing learning are addressed in many studies (Francis & Evans, 1995; Freedman & liu, 1996; Liu &

Johnson, 1998). Most of these studies report that students have positive attitudes or that the use of computers resulted in an increase in favorable attitudes. None of the studies reviewed investigated if this attitude can be attributed to the way instruction is delivered. In his meta-analyses of studies across all grade levels Kulik (1985) found out that most computer-based education students developed positive attitudes toward computers. Bangert-Drowns et al. (1985) reported strong effects at the elementary and secondary levels. In a more recent meta-analysis Roblyer et al (1989) concluded that students did not seem to have a preference for computers over other instructional media.

Based on the findings of these studies, motivation, in general, influences achievement. However, most motivation related studies have not examined the relationship between computer motivation and computer achievement

Educational Software Development.

Quality is a central issue for developers and users of educational software. Moreover, the main purpose of developing quality software is to enhance the quality of teaching and learning. The development of quality software is a complex process as there is a range of issues which occur and need to be considered during the process. The Organization for Economic Co-operation and

Development (OECD) (1989), states that to develop quality software is a difficult task as there is an interplay of a wide range of factors including choice of content, learning theory, curriculum and technology, as well as understanding the role of the teacher and the learner engaged in the use of the software.

OECD states that the lack of quality software not only hinders the growth in use of the computer across the curriculum, it can also distort it. Too often curriculum is fitted to available software rather than fitting the software to the curriculum need. OECD (1989) offers guidelines for the development of educational software, which suggest that quality software should be logically organized, uncluttered, pleasant to look and use. Headings, options and instructions should be in straightforward, unequivocal language. Aesthetic values such as symmetry, balance, composition, unity and proportion should be kept.

Watson (1982) points out that no unit in the computers curriculum project is developed before key questions are asked, including "What are the teaching objectives?; What background curriculum material has to be understood before the program can be used adequately?; What learning framework can the unit provide and how may it be organized?; and What understanding do you expect from the students after using the unit?".

Gare (1982) has produced a comprehensive checklist of the educational design criteria for software production. It includes identification of curriculum area and audience, analysis of task (objective, prerequisites), determination of the

instructional strategy (program type, type of use) and determination of the mode and style of interaction (student input, computer output).

Doll (1978) refers to student pace control and mobility as the important features of educational software. As the student works with a software program, he or she answers questions, fills in the blanks, makes a choice from items presented, or responds in some other way. The program reacts to the user input. The program should be written so that the student derives maximum benefit from the interaction between user and software. The student should have control over the pacing of the program. This allows for at least some student control and individualization. The user also needs to direct movement with the program, i.e., movement to specific locations or avoidance of specific sections of the program. There are different ways for the students to interact with software, and these responses differ from program to program.

HyperStudio™

As defined on its Web site HyperStudio™ is a multimedia authoring tool that allows to easily and effectively communicate and deliver ideas on diskette, CD-ROM or over the Internet. It is designed to bring together text, sound, graphics and video as well as what is considered as its innovative features: ability to access data on the Internet, ability to create and edit Quick Time and AVI movies, ability to capture images with AV Macs and/or digital cameras, and compatibility to

Mac-Windows-Web projects and the widest range of file type compatibility for graphics and sound.

Hyperstudio™ is the equivalent of an electronic stack of index cards that can be furnished with buttons that have a variety of actions (Ludwig & Green, 1998). Hyperstudio™ uses non-technical language and a minimalist design. Most programs work through an abstract or symbolic layer between user and work only approachable by experts or advanced users (Hyperstudio Website, 1999).

Its philosophy is user-centered with a constructivist approach, because people learn best when they create meaning using multimedia tools. Squires and McDougall (1994) developed an assessment heuristic to highlight the main characteristics of the constructivist approach and its implications for software development (see figure 2-5).

Table 2-1: The Constructivist Approach.

Learner Control	Significant levels of control with learners regarded as active, purposeful participants.
Complexity	Material which is typically complex, allowing a variety of content to be considered and a range of processes to be exercised.
Challenge	Intrinsic rewards gained by the successful completion of Complex tasks.

Taken from Squires and McDougall (1994).

Piña (1998) points out that the steep learning curve and programming/ scripting that is required by most programs intimidate many potential users. Based on the philosophy "use the easiest tool that will get the job done", Piña (1998) lists the reasons for adopting Hyperstudio™ as an authoring tool, they are:

(1) The card/stack metaphor used by Hyperstudio™ is easy for novices to to understand and is familiar to users of other authoring tools, such as HyperCard & Toolbook.

(2) In place of programming languages or scripting, Hyperstudio™ uses a friendly and intuitive interface that prompts users to make decisions about how their stack looks and operates.

(3) Multimedia objects, such as sound, animation, and video, are very easy to import and use.

(4) Hyperstudio™ stacks can be authored to run on both PC and Macintosh platforms.

(5) Hyperstudio™ stacks can be posted and run in their entirety on the World Wide Web.

(6) Web URLs and other software programs can be accessed from within Hyperstudio™.

(7) Training users to author in Hyperstudio™ takes significantly less than it does to train them in "higher end" authoring tools.

In agreement with the literature reviewed, Piña (1998) said that although Hyperstudio™ is very easy to use, it is an authoring tool, not an instructional design guide. How "painless" the development of C.A.I. actually is will depend on the amount of "front end" design that takes place before Hyperstudio™ is run.

Assuming that needs have been assessed, audiences and tasks have been analyzed, objectives have been specified, and content has been selected, Hyperstudio™ affords a simple, yet effective way to put it all together.

Hyperstudio™ is used in education for a variety of purposes by both students and educators. It is used to create multimedia projects, to make presentations, to integrate lessons with a new learning experience, etc. Research studies using Hyperstudio™ are diverse in relation to their focus and to the activities involved.

Cornelio (1994) developed Hyperstudio™ software to teach library skills to grades five through eight. Students received instruction in relation to how to accomplish some library basic tasks and were then tested. The results show that students acquired library skills in an enjoyable way.

Another study conducted by Thorp (1995) used Hyperstudio™ software to create history adventure games. Thorp referred that history came alive while students learned efficient writing skills, learned to understand and manipulate cause, effect choice and consequence, and learned to incorporate succint locational, climatic, and historical detail.

Ludwig and Green (1998) developed a software package on word definition for third graders using Hyperstudio™. The software includes word recognition and recall activities. Students who were designated by their teacher as Within-Word

Pattern (a program used by the students) spellers actually moved beyond that level as a result of working with the software.

Heindenreich (1992) investigated the effects of Hyperstudio™ on the achievement of seventh grade social studies students. Using a pretest/posttest control group experimental design, the study concluded that the Hyperstudio™ instruction method was not effective in raising the achievement level of the participant students as compared with the control group. However, students in the experimental group were found to have a more positive attitude toward learning.

Students in eight classes, pre-kindergarten to sixth grade, were challenged to demonstrate through the use of student-created computer presentations their knowledge of science topics. Students worked in small groups to plan, complete and share Hyperstudio™ stacks. All teachers in the study identified areas in which their previous assessment had been either incomplete or erroneous. Findings suggest that such alternative method may be a valuable strategy (Allen, 1998).

The literature suggests that Hyperstudio™ has been used in nearly all subject areas with success. Although the literature brings up the benefits that computers offer to remedial learners, nothing was found about the impact of Hyperstudio™ applications with remedial learners.

Summary

The majority of research to date has shown that computer applications can help students improve their academic performance. Remedial students may benefit from a less threatened environment that allows learning at their own personal pace while having more control.

Hyperstudio applications can be developed based on objectives previously identified by the teacher. Sound, text and graphics are combined to make learning a pleasant process while allowing the student to participate actively in his/her learning process.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Introduction

This chapter contains five sections. In the first section, the setting and participants chosen for this investigation are discussed. In the second section, the type and description of the instrumentation used for data collection and description of the actual data collection are discussed. In the third section, the questions being investigated are presented. The fourth section deals with data analysis and the final section summarizes the chapter.

Description of the Population and Setting

Participants for this study were ten (n = 10) fourth grade students attending an inner city school in East Tennessee, 3 males and seven females between 9 and

10 years old. The name of the school and those of the participants have been withheld to protect the anonymity of the participants. The school is always referred as "a school in East Tennessee." Students are not addressed individually by names; instead, letters are used.

Students were selected based on parent or guardian's authorization. The class selected as the study population was composed of 11 students, but only 10 obtained the written consent necessary to participate in the study. A copy of the consent form and the letter to parents are contained in Appendix A.

The school in which the study was conducted was an inner city school with an enrollment of approximately 250 for the school year 1998-1999. Most students came from middle to low income families.

Voluntary Subject Review

Voluntary consent is necessary for compliance to the ethical code regarding human subjects in research. This code provides specific guidance for the conduct of ethical research with the following rights granted to the subjects: capacity to consent, freedom from coercion, comprehension of the risks and benefits involved, minimization of risk and harm, a favorable risk/benefit ratio, qualified investigators using appropriate research designs, and freedom for the subject to withdraw at anytime (Medical School Institutional Review Board, 1996).

Permission to conduct this study was granted by the County School Board and by the Research Compliance Section of the Office of Research at the University of Tennessee, Knoxville. In the study, human subjects final approval was obtained by submitting a Form B application to the Research Compliances Section of the Office of Research at the University of Tennessee, Knoxville (see Appendix B). As this study involves a vulnerable population, children, several concerns arise during the review: methods to use in the identification and recruiting of potential child-participants, assent of the child and permission of the parent(s), or guardian(s), risk and benefit assessment, use of educational records (Special Considerations for the Protection of Children, Office of Research UTK, 1998).

Design of the Study

Research Questions

The following questions were developed to guide this study.

(1) Do remedial students experience gains in knowledge as a result of using Hyperstudio™ generated applications?

(2) Do students who have used Hyperstudio™ applications as a means of remedial instruction demonstrate retention of knowledge gained?

(3) Do students have positive perceptions toward their experience using Hyperstudio™ applications?

Design of the Hyperstudio™ Applications

From a systems design standpoint, a balance is needed between the effort invested in reaching a very precise and detailed diagnosis, and the instructional support that we can provide once the diagnostic process is completed (Venezky & Osin, 1990). The purpose of diagnosis in this study was to identify the content for remediation. The specific needs of the participants determined the design and production of software applications for this study. The teacher identified these needs based on students' performance in class and test scores. An analysis of the areas in which students' answers were incorrect gave grounds to identify specific problematic contents. Needs were identified in the following content areas: adverbs, measurement, division, nouns, verbs and graphs.

Meetings with the teacher were scheduled prior to the design of each Hyperstudio™ application in order to discuss the content of each application and the test to be used. During these meetings, the following areas of concern were discussed: problematic area of content, strategies used the first time it was delivered, prerequisite knowledge, tests, and practice. The teacher decided the most convenient time for each activity, so a timeline reflecting tests and computer time was developed to avoid conflicts. Meetings were also scheduled to run the applications before students work with them, so the teacher could make suggestions.

After needs were identified, analysis of the course content was conducted. Materials researched included different fourth grade textbooks where the topic was presented. Resources, exercises, examples, and handouts previously used by the teacher to deliver instruction, and prerequisites necessary to master that knowledge were also researched.

Hyperstudio™ was selected as the medium for instruction because of its comprehensiveness and its ease of use. Applications using Hyperstudio™ were drafted in a "storyboard" format; graphics and sounds were added to each card to complete them.

Hyperstudio applications are created by designing cards. The cards can be created all at once and then buttons, sound, and transitions can be connected to them, these features can be added each time a new card is created. The creation of a card might include the following steps:

(1) Choose a background color using the "Edit Menu".

(2) Create a border (color and size of line) using the "Options Menu".

(3) Add a text object. It could be scrollable and resizeable.

Font, style, size and color of text can be selected.

(4) Add a graphic object.

Graphic objects can be dragged and resized with the mouse.

(5) Add button

A visible or an invisible button can be created with a sound (using Hyperstudio™ sound library) and a special effect that transports the user from one card to the next; this is referred as a transition (from the transition dialog box).

Card stacks can be linear, such as a book (see appendix C:Adverbs). Other projects can use the branching method where one card such as a table of contents connects to cards throughout the stack (see appendix C: Nouns).

Some of the most frequently used design tools utilizing Hyperstudio™ are the browse tool to navigate through the cards, and the arrow tool used to edit, move, resize or delete objects. Hyperstudio™ also provides files including ready-made cards, backgrounds, sound, transitions, graphic objects and buttons that are added easily to the application.

Hyperstudio™ applications can be designed so that navigation through the cards may be accomplished by clicking buttons on the mouse. The first card of the stack usually refers to the title; a button connects to the second card. The second card can refer to objectives, instructions, or a brief description of the purposes and content. The following cards develop the content and practice. The last card indicates the end of the application and is connected to the first card by a button,

in case the user wants to go over the application again. It is also convenient to have an exit button to end the activity.

Drill and practice activities may be designed with invisible buttons, if desired. Students are instructed to click on the correct answer; if the student clicks on the correct answer, he/she will be linked or connected to a correct answer card stating "Good Job", "Great Answer","Very Good", etc. However, clicking on an incorrect answer will connect the student to a wrong answer card that encourages him/her to try again. The wrong answer card may be linked to a hint card to remind students of important content related to the question (see Appendix C).

The following cards develop the content and practice. The last card indicates the end of the application and is connected to the first card by a button, in case the user wants to go over the application again.
It is also convenient to have an exit button to end the activity.

Hyperstudio™ applications were developed following the teacher's guidelines in relation to content. These guidelines included objectives, specific content to use and practice. After the applications were ready, the teacher went through them to make suggestions. As a whole, it took around two weeks to have an application ready for students to use although the time spent with the computer designing the application was only four hours on average.

Six Hyperstudio™ applications were developed. All applications contain a first card with the title, a second card with the objectives, a third card with the

instructions, a number of cards to develop content and practice, and the final card to indicate the end of the application. Practice was designed so students receive immediate feedback. The design of the application allowed the student to go back to the exercise and check the answer.

Colors were also used to provide feedback. The "wrong card" was always red and the "right card" was always green. Sound and transition were also selected so they could relate to the type of response; for example, a "right card" sound was applause with top/bottom transition. In contrast, a "wrong card" was connected using a glassbreak sound and a block transition. Transitions and sounds were used in relation to the activity throughout the application.

The following applications were developed:

Application # 1: Adverbs

Objectives

Recognition of adverbs in sentences.

Differentiation of adverbs and adjectives.

(see appendix C)

This linear application contained 32 cards. Seven cards developed content, and 20 were for practice. Multiple choice exercises were designed for this topic.

Sounds were added to show movement between cards. Special effects (transitions) as well as a sound were used to identify a correct or an incorrect response. For example a bad response connects to a "Sorry, try again card" using a block transition and a sound of a glass breaking.

Application # 2: Measurement

Objectives

Comparison of length using inch, foot, yard and mile.

Comparison of metric system units: meter, kilometer, centimeter.

Conversion from smaller to larger customary units and vice versa.

Conversion from smaller to larger standard units and vice versa.

This application was composed of 32 cards. It was designed using the linear method. The practice in this application consisted of comparison of measurement. Students were asked to choose from between two different items the one that was larger or smaller. A correct response led to a "correct" card, an incorrect response led to an "incorrect" card. The incorrect card had two buttons, one directed the student back to the exercise; the other was a hint button to direct the student to a card where he could read the information necessary to answer the question correctly (see Appendix C). Cards were connected using a click sound and a dissolve transition.

Application # 3: Division

Objectives

Definition of division.

Exploration of the patterns of division.

(see Appendix C)

This 22 card application was designed using the linear method. Five cards developed content, and 13 were dedicated to practice. "Wrong card" and "right card" were connected using distinctive sounds and transitions. The roar of a lion was used to identify the "right answer" and the sound of a monkey to identify the "wrong answer". Connections between the other cards were made using a diagonal right transition and a click sound.

Application # 4: Nouns

Objectives

Definition and identification of common and proper nouns in sentences.

Definition and recognition of abstract nouns in sentences.

Definition and identification of compound nouns in sentences.

(see appendix C)

This application contained 25 cards designed using the branching method. A table of contents directed the student to click on the different parts of the topic: Nouns, Common and Proper Nouns, Abstract Nouns, Compound Nouns and exercises. Buttons were designed so the student could navigate through the topics by clicking. Sounds and transitions were used to connect cards.

Application # 5: Verbs

Objectives

Identification of verbs in sentences.

Function of verbs in sentences.

Function of linking verbs in sentences.

Function of action verbs in sentences.

Recognition of linking verbs in sentences.

Identification of action verbs in sentences.

This was a 22 card linear application with seven content cards and eleven exercise cards. Green and red were used to identify the "right card" and the "wrong card" respectively. Sound and transitions were used to transport the student from one card to the next (see appendix C).

Application # 6: Graphs

Objectives

Identification of the different types of graphs.

Description of data in graphs.

(see appendix C)

This application consisted of 30 cards. Fifteen cards referred to content and eleven cards contained practice. Different background were used in the presentation of content in order to make the application pleasant to look at. Transitions and sounds were used to indicate movement between cards.

Tests and Computer Usage

Tests were objective, mostly multiple choice and completion. All tests were 10 point tests. Tests were designed so that participants could answer them in approximately 15 minutes (see appendix D). Tests contained between ten and fifteen items each. The tests were administered in the students' regular classroom.

A pretest/posttest was created for each application (see Appendix E). The pretest was administered before using each application, and the posttest was administered after using the application. Table 3-1 describes how pretest, computer time, and posttest were distributed during the time of the study.

Distribution of Pretests, Posttests and Computer Time

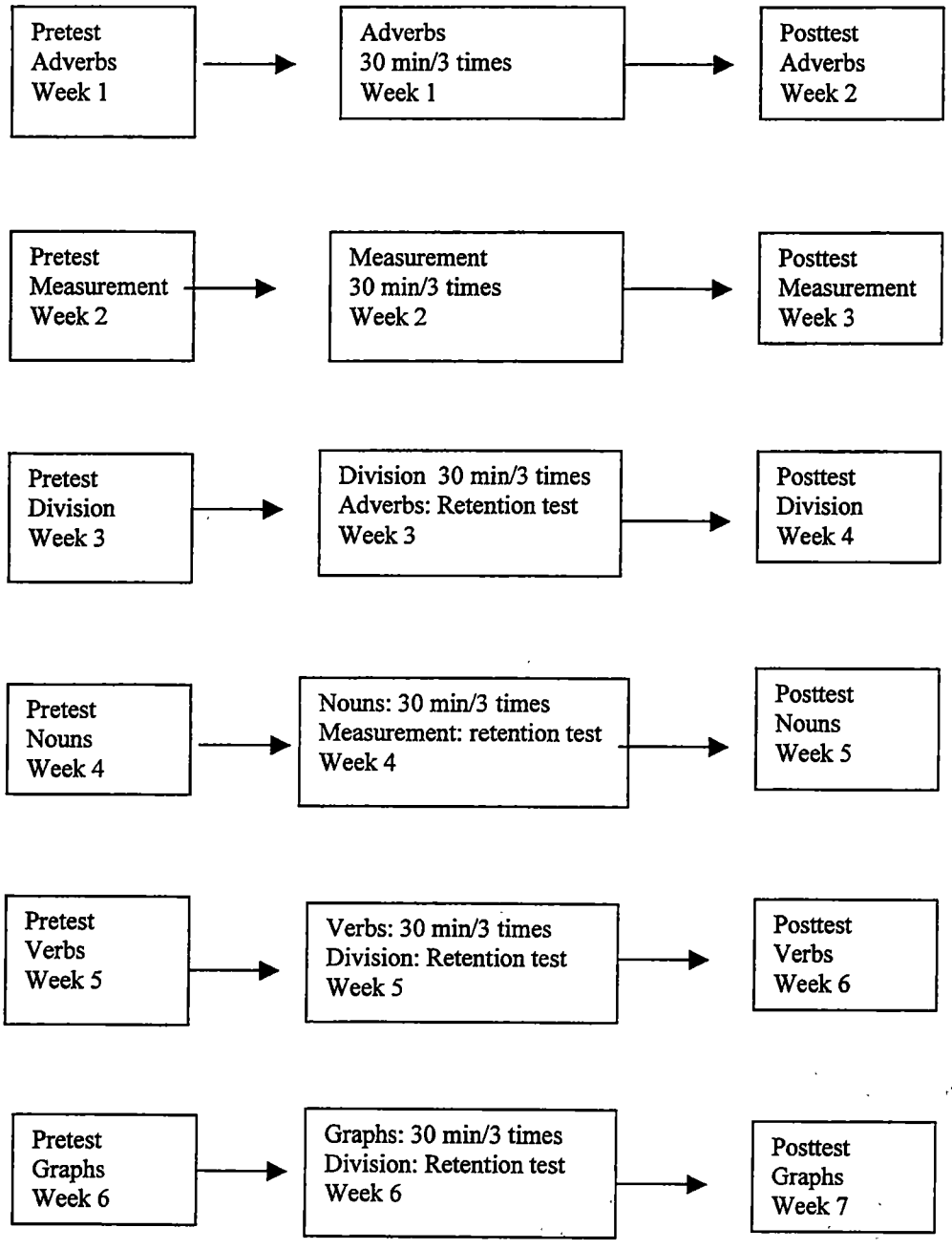


Figure 3-1: Distribution of Pretest/Posttest and Computer Usage

The same test was administered as posttest and retention test. A chart was designed to keep students' pretest and posttest scores.

Computer time refers to the time each student sat on the computer to work with the Hyperstudio™ applications. It consisted of three thirty-minute periods for each application. The computers used in this study were in another teacher's classroom. This was not a problem because computer time was planned to take place when the students were having activities like music, physical education, etc., which are not taught in their regular classroom. Five Macintosh computers were available for the study, so groups of five students used the computers at the same time, usually one group in the morning and one group in the afternoon.

Hyperstdio™ applications were installed in the computer as well as the Hyperstudio™ player. The Hyperstudio™ player can be downloaded from the Hyperstudio™ website, and it allows sharing the applications without having the program installed in each computer or requesting any authorization from the publisher.

Data Collection

Pretest/Posttest/Retention Tests

The purposes of this study were to determine the gains in knowledge and retention as a result of using Hyperstudio™ applications based on the specific

needs of the students. Gains in knowledge were determined by comparing test results (same test) of the learner at two separate points in time. The difference between the scores on the final test (posttest) and the score at the initial test (pretest) determines the gain or progress. (Venezky & Orsin, 1990). The score difference was computed for a single student, thus providing that student's individual gain. In addition, the test developed for each application was administered a third time in order to measure knowledge retention. Retention tests were administered two weeks after the posttest. Retention was measured only for the first three applications (Adverbs, Measurement and Division) because of the end of the school year. Pretest, posttest, and retention tests were the same test.

Questionnaire

A questionnaire entitled "Perceptions of a HyperStudio™ Experience" was developed in order to determine students' perceptions of their experience using Hyperstudio™ generated applications (see appendix F). This questionnaire was prepared by the researcher following the evaluation checklist presented by Doll (1987). This checklist includes several aspects of software evaluation like hardware specifications, presentation of content, educational quality, documentation and support, user interaction with the program, operating instruction, etc. The items selected from the checklist were rephrased in order to collect the necessary data for this investigation.

Students were asked to assess their opinion about their work with computers and specifically with Hyperstudio™. The survey was administered in their classroom. Students were not identified by name, the survey was completely anonymous. The questionnaire was completed in the classroom. No open questions were used in the questionnaire (see Appendix F).

An oral explanation was given to students before answering the questionnaire. This explanation included the purpose of the survey and a brief discussion of each question to ensure that they understood the terminology and sense of each question.

The survey consisted of 15 questions. The first five questions provided demographic data on the participants. The last ten questions asked for information about their experience using Hyperstudio generated applications. Results were then counted and analyzed.

Data Analysis

The first and second research questions regarding students' gain in knowledge were analyzed quantitatively. Gains from pretest and posttest were computed for each student individually. Retention of knowledge was measured by comparison of posttest and retention scores.

Students' perceptions of this experience were assessed using the previously described questionnaire. Responses to each question were calculated. The basic data treatment was limited to arithmetic computations reflecting the nature of the items in the questionnaire. Results are reported typically in a "number of total responses" format.

Summary

This chapter has described the procedures that were used to collect the data to answer the research questions. Identical pretests/posttests/retention tests and a questionnaire were administered to the students. Topics covered in this chapter included a description of the population and setting, data collection procedures, research questions, and statistics.

The following chapter will discuss the data that was collected and will examine these data in relation to the research questions.

CHAPTER IV

ANALYSIS OF DATA

Introduction

Data collected during this investigation were used to determine the usefulness of using Hyperstudio™ generated applications with remedial students to accelerate their learning, and to assess their perception of the experience. The analysis of the data gathered through the administering of pretests, posttests, retention tests and a questionnaire produced the findings in this study.

The data collected using pretests dealt with all students that participated in the study (n=10). Pretest scores served as the basis for selecting the remedial students, the focus of this study. A student who scored 5.0 or fewer points (out of 10) in the pretest was considered a remedial student.

Data collected for this study are presented in this chapter and their analysis aims to answer the questions that guided this study. The first research question is

answered by comparing pretest and posttest scores. The second research question is answered by comparing posttest scores and retention scores.

A questionnaire was used to assess participants' perceptions of their experience working with Hyperstudio™. Data gathered through the questionnaire describe students' perception of the experience. These data provide information to answer the third research question.

Presentation of the Data Collected

In this section of the chapter, the data collected are presented by research question and discussed. The research questions are then answered with the support of the data.

Research Question # 1

Do remedial students experience gains in knowledge as a result of using Hyperstudio™ generated applications?

Two means of presenting data pertinent to this research question are employed. First, pretest scores, posttest scores, number of points gained and percentage of gain for all students are presented for each content area (Tables 4-1

to 4-6). Then, a profile of each student's scores and gains in each content area in which he/she received remedial instruction is presented.

Pretests and Posttests

In this presentation of the data, students are identified by letters to protect their anonymity. The same letter corresponds to the same student in all six applications. Data are presented in tables by application. An asterisk next to the pretest score signifies that this specific student is not considered a remedial student for this content area. Each table lists students, pretest scores, posttest scores, gains (the difference between posttest and pretest scores), and percentage gain (percentage of the posttest score that is the actual gain).

Application #1: Adverbs

Table 4-1 shows pretest, posttest and gains for each student participating in the adverb application. The pretest and the posttest were 10 point tests.

In this application, eight students needed remedial instruction because their pretest scores were 5 points or fewer. The use of the Hyperstudio™ applications resulted in an increase in the posttest scores as compared to pretest scores. Individual gains were of 2 to 6 points (20 to 60 %).

Table 4-1. Adverbs: Gains

Student	Pretest Scores	Posttest Scores	Gain	Percentage gained
A	3.0	6.0	3.0	30%
B	2.0	8.0	6.0	60%
C	4.0	8.0	4.0	40%
D	5.0	7.0	2.0	20%
E	5.0	9.0	4.0	40%
F	2.0	7.0	5.0	50%
G	7.0 *	NA	NA	NA
H	3.0	8.0	5.0	50%
I	7.0 *	NA	NA	NA
J	6.0	NA	NA	NA

NA = do not apply * = no need of remedial instruction

Application # 2: Measurement

According to pretest scores, eight students needed remedial instruction in this content. After using the Hyperstudio™ applications, individual gains were 1 to 7 points which correspond to10% to 70% increase in posttest scores as compared to pretest scores. Table 4-2 shows pretest scores, posttest scores and gains for students using the Measurement application. Pretest and posttest were 10 point tests.

Table 4-2. Measurement: Gains

Student	Pretest Scores	Posttest Scores	Gain	Percentage gained
A	1.0	4.0	3.0	30%
B	5.0	9.0	4.0	40%
C	3.0	7.0	4.0	40%
D	4.0	5.0	1.0	10%
E	3.0	10.0	7.0	70%
F	7.0*	NA	NA	NA
G	7.0 *	NA	NA	NA
H	4.0	7.0	3.0	30%
I	2.0	7.0	5.0	50%
J	5.0	8.0	3.0	30%

NA = do not apply

* = no need of remedial instruction

Application # 3: Division

Nine remedial students worked with application # 3. Data show that all nine students demonstrated gains in knowledge from pretest to posttest (see table 4-3). These were 10 point tests. Individual gains in this application ranged from of 3 to 7 points which represent increases of 30% to 70%.

Table 4-3. Division: Gains

Student	Pretest Scores	Posttest Scores	Gain	Percentage gained
A	0.0	3.0	3.0	30%
B	3.0	9.0	6.0	60%
C	2.0	8.0	6.0	60%
D	0.0	4.0	4.0	40%
E	3.0	8.0	5.0	50%
F	2.0	9.0	7.0	70%
G	10.0 *	NA	NA	NA
H	4.0	8.0	4.0	40%
I	5.0	8.0	3.0	30%
J	5.0	10.0	5.0	50%

NA = do not apply

* = no need of remedial instruction

Application # 4: Nouns

Eight remedial students used this application (see table 4-4). The pretest and posttest were 10 point tests. All students experienced an increase in their posttest scores when compared to pretest scores. Gains in this application range from 3 to 6 points, that is, 30% to 60%.

Table 4-4. Nouns: Gains

Student	Pretest Scores	Posttest Scores	Gain	Percentage Gained
A	4.0	9.0	5.0	50%
B	4.0	8.0	4.0	40%
C	5.0	8.0	3.0	30%
D	1.0	7.0	6.0	60%
E	5.0	10.0	5.0	50%
F	9.0*	NA	NA	NA
G	2.0	8.0	6.0	60%
H	4.0	10.0	6.0	60%
I	5.0	9.0	4.0	40%
J	10.0*	NA	NA	NA

NA = do not apply

* = no need of remedial instruction

Application # 5: Verbs

The eight remedial students that worked with this application experienced gains of 1 to 6 points from pretest to posttest (see table 4-5). These were 10 point tests. Students' performance improved 1 to 6 points (gains of 10% to 60%).

Table 4-5. Verbs: Gains

Student	Pretest Scores	Posttest Scores	Gain	Percentage Gained
A	5.0	7.0	2.0	20%
B	4.0	9.0	5.0	50%
C	3.0	9.0	6.0	60%
D	3.0	8.0	5.0	50%
E	3.0	9.0	6.0	60%
F	7.0*	NA	NA	NA
G	7.0 *	NA	NA	NA
H	4.0	5.0	1.0	10%
I	5.0	8.0	3.0	30%
J	5.0	9.0	4.0	40%

NA = do not apply

* = no need of remedial instruction

Application # 6: Graphs

Nine remedial students used this application. These students gained from 2 to 5 points from pretest to posttest (see figure 4-6). These were 10 point tests. After instruction using Hyperstudio™ application # 6, student posttest scores were 20% to 50% higher than pretest scores.

Table 4-6. Graphs: Gains

Student	Pretest Scores	Posttest Scores	Gains	Percentage Gained
A	3.0	7.0	4.0	40%
B	4.0	9.0	5.0	50%
C	3.0	6.0	3.0	30%
D	1.0	3.0	2.0	20%
E	4.0	9.0	5.0	50%
F	8.0*	NA	NA	NA
G	5.0	9.0	4.0	40%
H	5.0	7.0	2.0	20%
I	5.0	8.0	3.0	30%
J	4.0	8.0	4.0	40%

GILBERT
100% COTTON

In order to answer research question #1, individual gains are also presented. In this analysis, each student's pretest and posttest scores are represented on a bar graph in which the vertical axis represents the scores, and the horizontal axis represents the Hyperstudio™ applications. The two sections of the bar (pretest and posttest scores) are clearly differentiated by colors.

The comparison of pretests and posttests for each student (represented by letters A to J) is presented next. Each student's individual gain is discussed and graphically presented.

Student A

The analysis of pretest scores for student A determined that this student needed remedial instruction in all six contents areas selected for this study. Figure 4-1 shows individual gains for student A in all content areas.

Student A shows an increase in posttest scores for all the applications. The highest gains are in Nouns (application #4) and Verbs (application #5). The pretest score for Division (application #3) was zero, while posttest score was 3 three. This student still needs remediation in this content area.

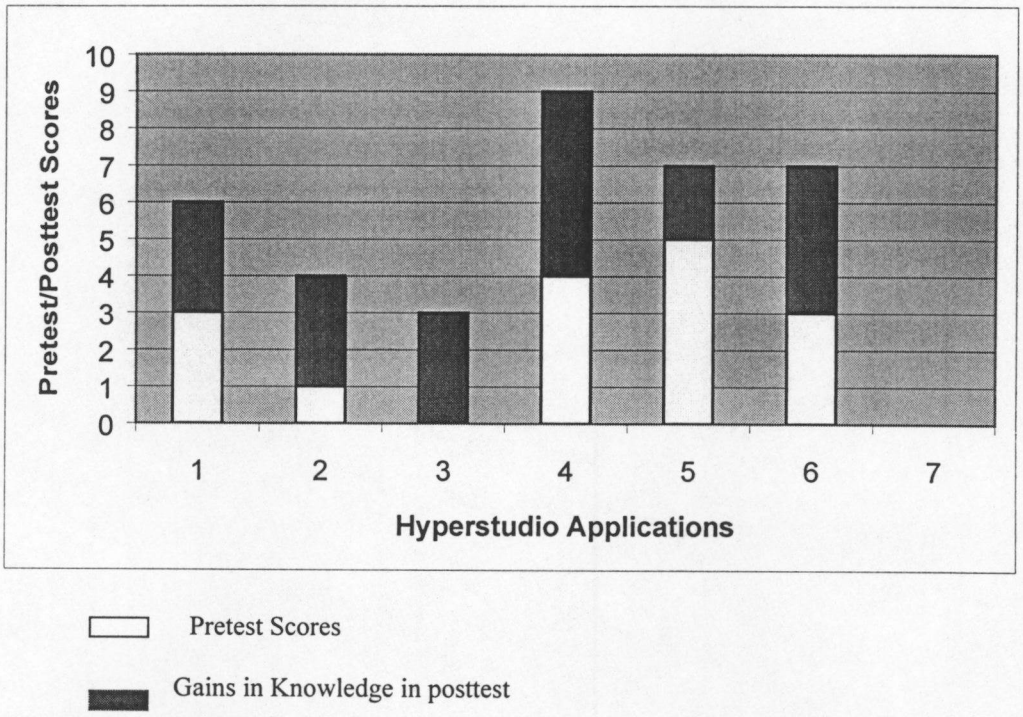


Figure 4-1: Student A/Gains

Student B

Student B's pretest scores indicated that remediation was necessary in all six content areas. Figure 4-2 shows pretest and posttest results for student B. Student B experienced gains in all application. The greatest gains were in Adverbs (application #1) and Division (application #3).

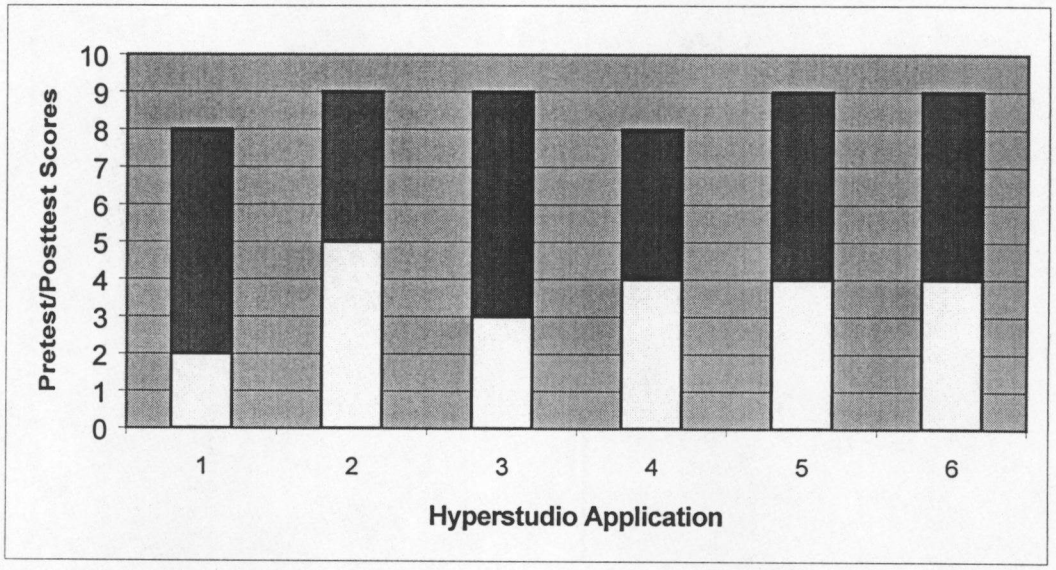


Figure 4-2: Student B/Gains

Student C

Pretests for student C indicated that remediation was needed in all six areas of content selected for the study. Figure 4-3 represents pretest and posttest scores for student C. Posttest scores were higher than pretest scores in all six areas. Greatest gains achieved by this student were in Division (application # 3) and Verbs (application #5).

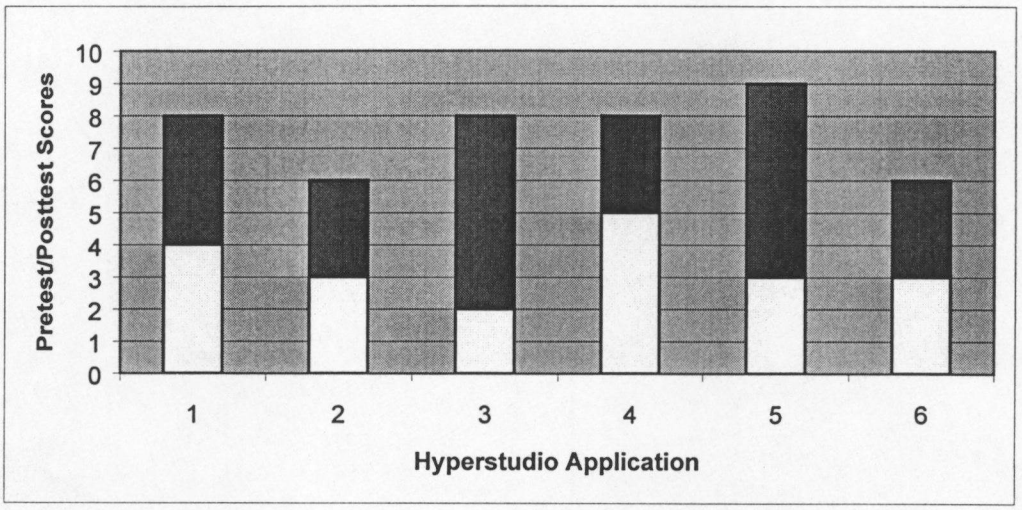


Figure 4-3: Student C/Gains

Student D

Student D was a remedial student in all six content areas. Figure 4-4 depicts the pretest scores, posttest scores and gains for student D. This student experienced gains on all posttest scores as compared to pretest scores. However, gains in Adverbs (application #1) and Graphs (application #6) were two points, and in Measurement (application #3) there was only a point gain. This student made greatest gains using hypermedia applications related to Nouns (application

#4) and Verbs (application #5). This student still needs remediation in Division (application #3) and Graphs (application #6) where posttest scores were below 5 points.

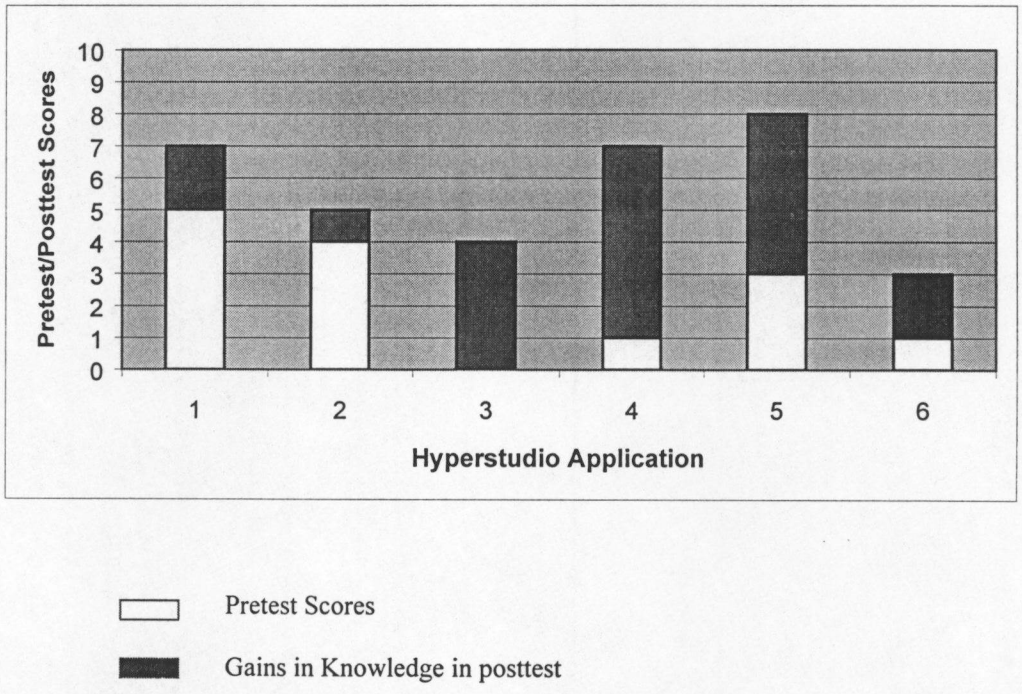


Figure 4-4: Student D/Gains

Student E

Student E needed remediation in all the six areas selected for this study. After using Hyperstudio™ applications, this student's posttest results show gains of 4 to 7 points. This student's greatest gains were in Measurement (application #2) and Verbs (application #5). Figure 4-5 shows pretest, posttest scores and gains for student E.

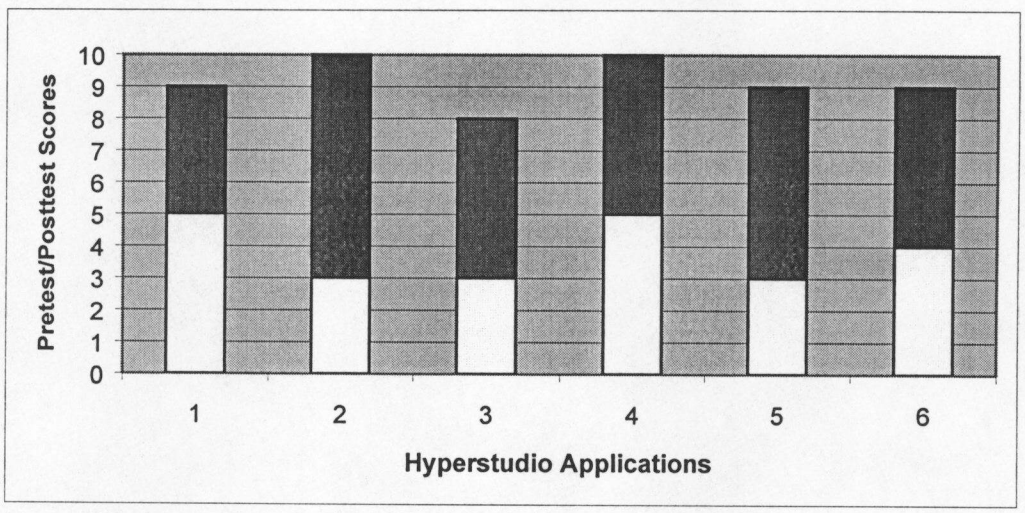


Figure 4-5: Student E/Gains

Student F

Pretest scores for student F showed that this student needed remediation only in two areas: Adverbs (application #1)and Division (application #3). Pretest scores for the other four content areas were 7 or higher. After working with Hyperstudio™ applications # 1 and # 3, posttest scores increased substantially (5 points and 7 points) with respect to pretest scores. Figure 4-6 represents pretest, posttest and gains for student F.

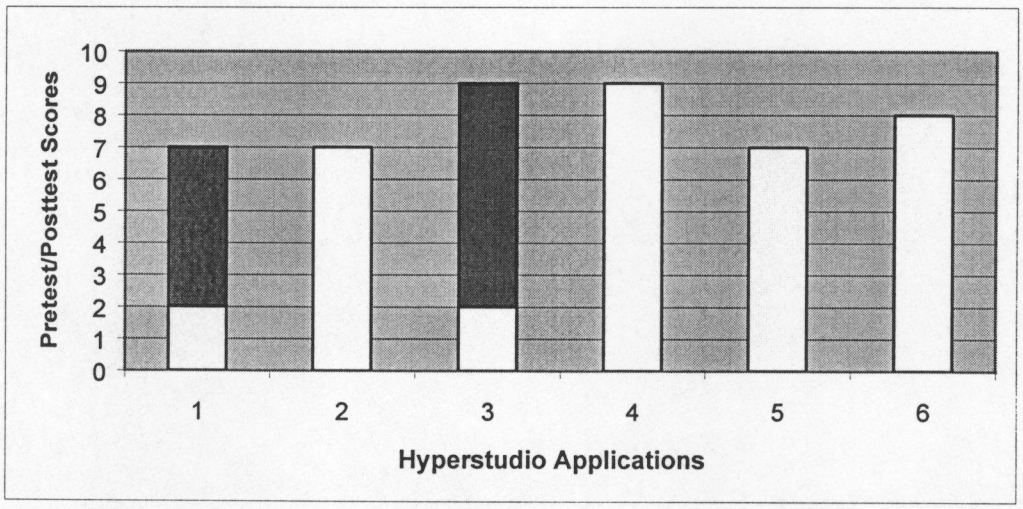


Figure 4-6: Student F/ Gains

Student G

Student G needed remediation in two areas : Nouns (application# 4) and Graphs (application # 6). Pretest scores in the other content areas were 7 or higher. Student G's posttest scores were higher than pretest scores by 4 and 6 points. Figure 4-7 shows pretest, posttest, and gains for this student.

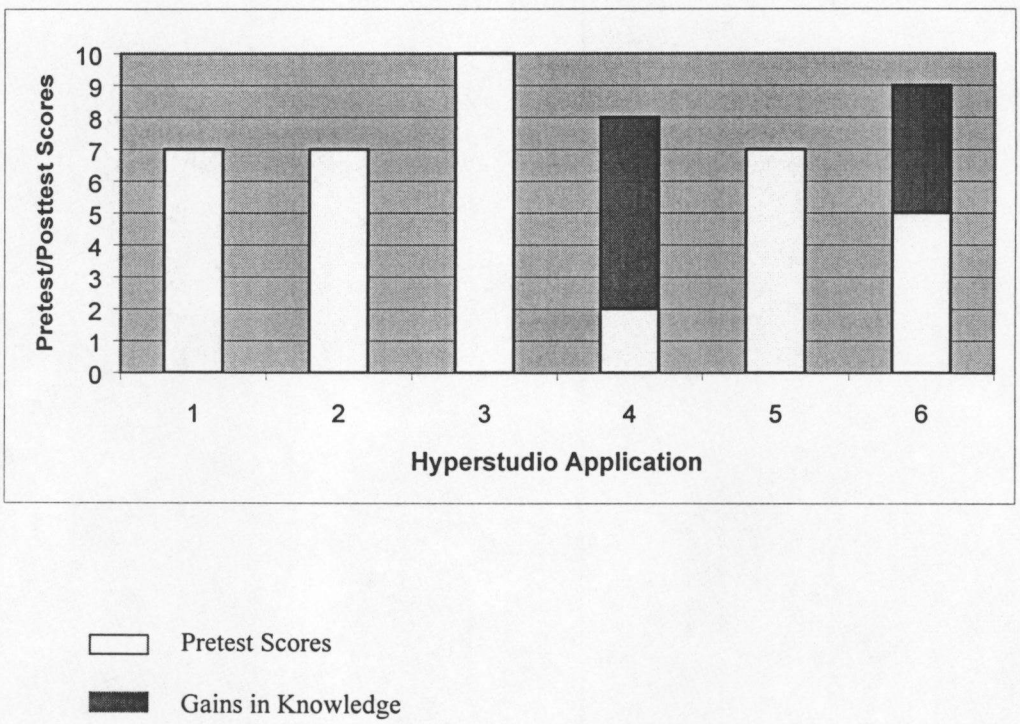


Figure 4-7: Student G/ Gains

Student H

Student H was a remedial student in all six content areas. The comparison of pretest and posttest scores for this student shows an increase in all posttest scores. Greatest gains in knowledge were in Adverbs (5 points) and Nouns (6 points). Table 4-8 shows pretest, posttest and gains for this student.

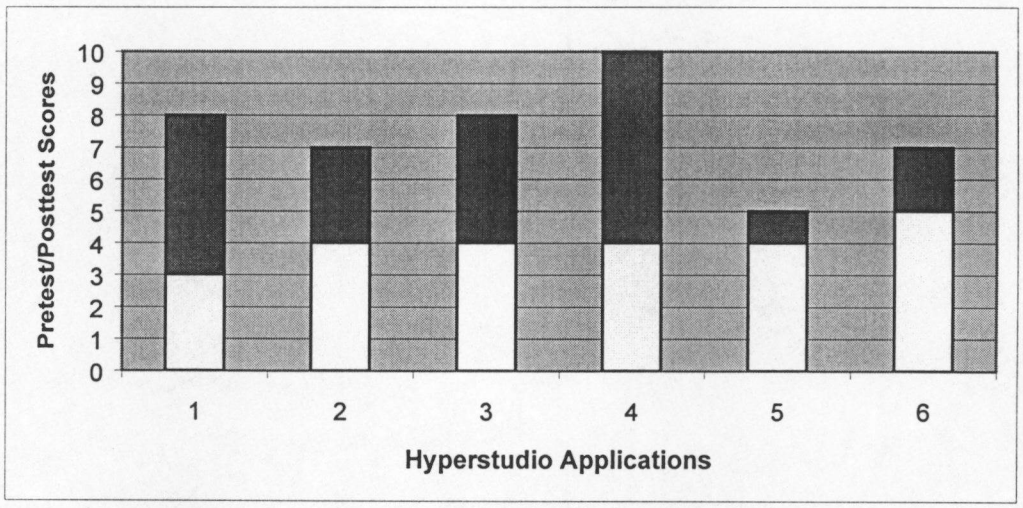


Figure 4-8: Student H/ Gains

Student I

Student I needed remediation in five of the six areas of the study. Pretest score in Adverbs was seven so remediation in this area was not needed. The comparison of pretest and posttest scores of the remaining five applications shows an increase in the posttest scores. There was a gain in knowledge as a result of using Hyperstudio™ applications. Greatest gains were in Measurement, application #2 (5 points) and in Nouns, application #4 (4 points). Figure 4-9 illustrates pretest scores, posttest scores and gains for student I.

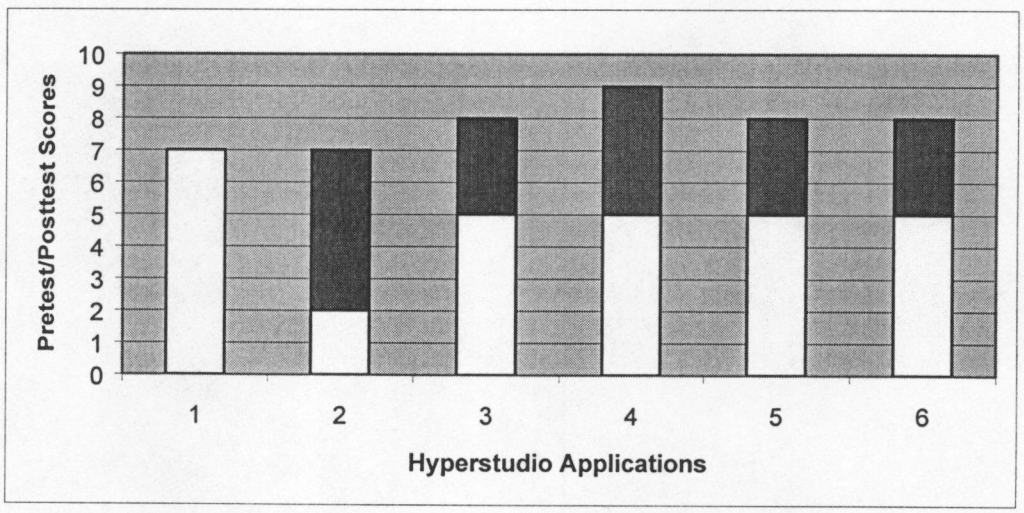


Figure 4-9: Student I / Gains

Student J

Student J needed remedial instruction in four of the six areas. Scores in Adverbs (application #1) and in Nouns (application #4) were 6 and 10 so remediation in those areas was not needed. Posttest scores in the other four content areas were higher when compared to pretest scores. Greatest gain was in Division (application #3). Figure 4-10 shows pretest, posttest, and gains for each Hyperstudio™ application.

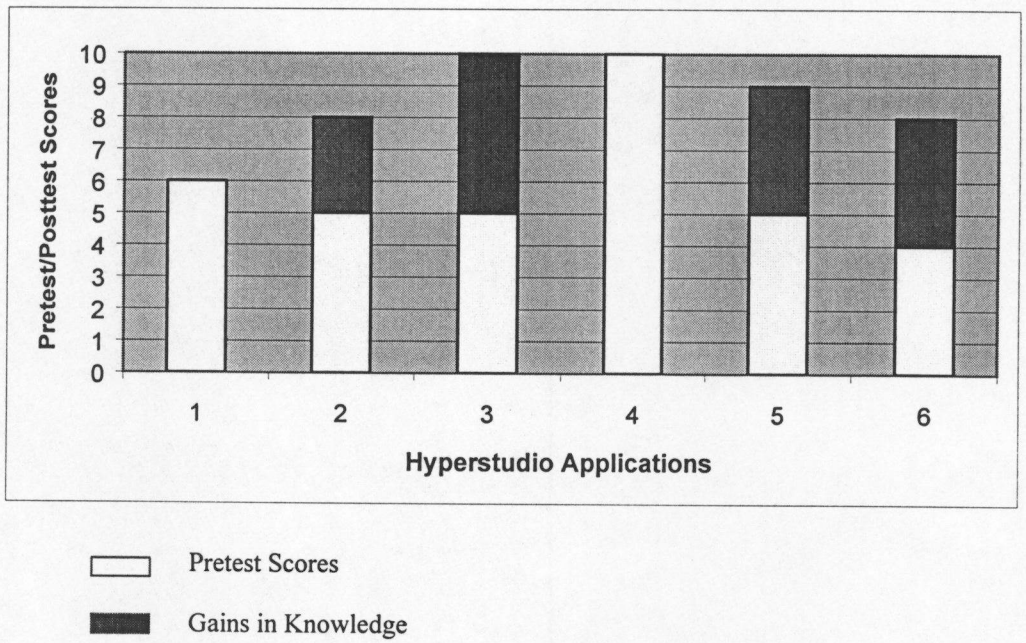


Figure 4-10: Student J/ Gains

Summary

Students' individual gains show that the use of Hyperstudio™ generated applications based on the needs of the students helped them overcome some weaknesses. Gains varied by student and by content area. There were substantial gains of 6 points or more in 20.8% of score comparisons. There was a moderate gain of 3 to 5 points in 66.6 % of score comparisons, and only 10.41% of the scores compared represented a one or two points gain.

The analysis of the average gains (average number of points gained) for each application (see table 4-10) indicated that improvement for the group as a whole was moderate in all content areas.

Table 4-7: Average Gains

CONTENT	AVERAGE GAIN(points)
#1: Adverbs	**4.1**
#2: Measurement	**3.5**
#3: Division	**4.7**
#4: Nouns	**4.8**
#5: Verbs	**4.0**
#6: Graphs	**3.5**

Three of the applications used for this study were in mathematics (measurement, division, graphs) and three in language arts (adverbs, nouns and verbs). Mean gains in the three language arts areas were 4.0 or above. The group's mean gain in division was 4.7, but both of the other mathematics applications generated mean gains of 3.5.

The answer to question # 1 is a qualified "yes"; however, gains varied by application and by student, and individual gains ranged from 1 to 7 points. Mean gains in two of three areas of mathematics were somewhat lower than mean gains in the other four areas of content (one math and three language arts). Two students (A, D) did not demonstrate achievement above the remedial level even after using the Hyperstudio™ applications in some areas.

Research Question # 2

Do students who have used Hyperstudio™ applications as a means of Remedial instruction demonstrate retention of knowledge gained?

The data to support the answer to research question #2 are presented in two ways. First, posttest scores, retention scores, amount of actual gain or loss and percentage of knowledge retention for all students are presented for each content area (Tables 4-7 to 4-9). Then, a profile of each student's posttest and retention

scores in each content area in which he/she received instruction using Hyperstudio applications is presented.

Retention in only three content areas (adverbs, measurement and division) was measured because the school year ended before tests could be re-administered in the other three areas.

Retention of Knowledge

Retention was determined by comparing posttest and retention scores for each student. The retention tests were administered two weeks after the posttests; therefore, retention measured was short-term. The retention tests and the posttests were identical. Few students experienced gains in retention. A plus sign in front of the number identifies each gain. Most students experienced a loss. A minus sign in front of the number identifies this loss.

Application # 1: Adverbs

Table 4-7 presents posttest scores, retention scores, amount of actual gain or loss and percentage of retention for each student who received remediation in adverbs. Three students (B, C, and E) achieved the same score on the retention test as on the posttest. Students A, D, and H demonstrated 10 to 20% loss of knowledge, and one student (F) showed 10% gain (1 point) between these two tests.

Table 4-8: Adverbs: Retention

Student	Posttest Score	Retention Score	Gain/Loss	Percentage of Retention
A	6.0	5.0	-1.0	90%
B	8.0	8.0	0	100%
C	8.0	8.0	0	100%
D	7.0	5.0	-2.0	80%
E	9.0	9.0	0	100%
F	7.0	8.0	+1.0	⊕ 110%
G	NA	NA	NA	NA
H	8.0	6.0	-2.0	80%
I	NA	NA	NA	NA
J	NA	NA	NA	NA

NA = do not apply

⊕ = student showed gain in retention test

Application # 2: Measurement

Table 4-8 shows posttest scores, retention scores, amount of actual gain/loss and percentage of retention for students using Measurement (application # 2). Results in the Measurement area showed that students B, C, E and J demonstrated a 10% loss of knowledge, while two students (D and H) showed a

20% loss. One student (A) showed a 10% gain between posttest and retention test. One student (I) scored the same in both tests.

Table 4-9: Measurement: Retention

Student	Posttest Score	Retention Score	Gain/Loss	Percentage of Retention
A	4.0	5.0	+1.0	⊕ 110%
B	9.0	8.0	-1.0	90%
C	7.0	6.0	-1.0	90%
D	5.0	3.0	-2.0	80%
E	10.0	9.0	-1.0	90%
F	NA	NA	NA	NA
G	NA	NA	NA	NA
H	7.0	5.0	-2.0	80%
I	7.0	7.0	0	100%
J	8.0	7.0	-1.0	90%

NA = do not apply

⊕ = student showed gain in retention test

Application # 3: Division

Table 4-9 shows posttest scores, retention scores and amount of loss/gain for application # 3. This application showed that four students (A, B, D, and I) demonstrated a loss of knowledge of 20%, and two students (H and J)

demonstrated a loss of 30%. The remaining three students scored the same in both tests.

Table 4-10: Retention in Division

Student	Posttest Score	Retention Score	Gain/Loss	Percentage of Retention
A	3.0	1.0	-2.0	80%
B	9.0	7.0	-2.0	80%
C	8.0	8.0	0	100%
D	4.0	2.0	-2.0	80%
E	8.0	8.0	0	100%
F	9.0	9.0	0	100%
G	NA	NA	NA	NA
H	8.0	5.0	-3.0	70%
I	8.0	6.0	-2.0	80%
J	10.0	7.0	-3.0	70%

NA = do not apply

In order to answer research question #2, individual score profiles are also presented. In this analysis, each student's posttest score and retention scores are represented in a vertical bar graph in which the vertical axis represents the scores and the horizontal axis represents the Hyperstudio™ application used.

Student A

Figure 4-11 illustrates posttest and retention scores for student A.

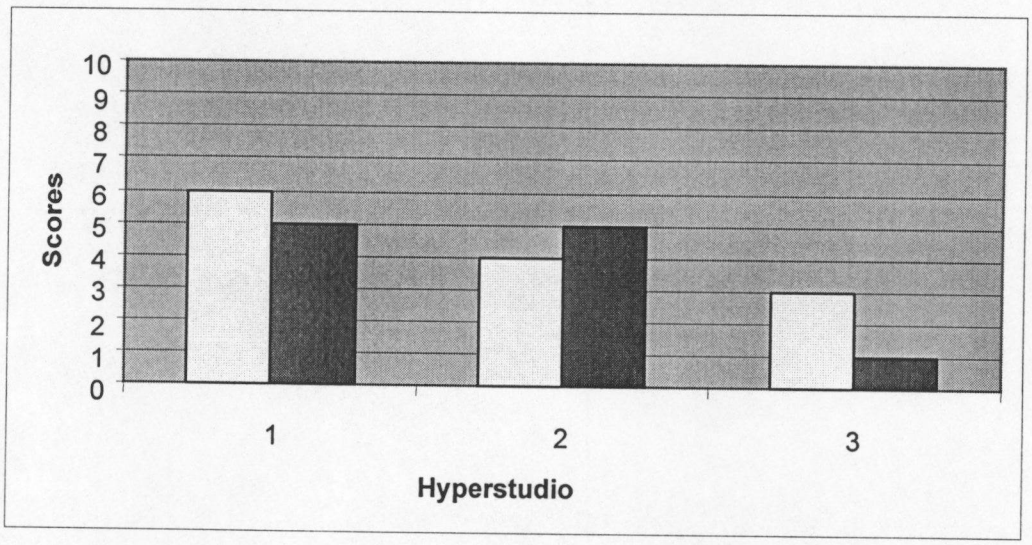


Figure 4-11: Student A/ Retention of Knowledge

There are differences between posttest and retention scores on the three applications. In the areas of Adverbs (#1) and Division (#3), this student demonstrated a loss in knowledge, however, he/she shows a gain in Measurement (#2). It is interesting to note that this student did not achieve beyond the remedial level (pretest and posttest) in Division (application #3) through the use of the Hyperstudio™ application.

Student B

Figure 4-12 represents posttest and retention scores for student B.

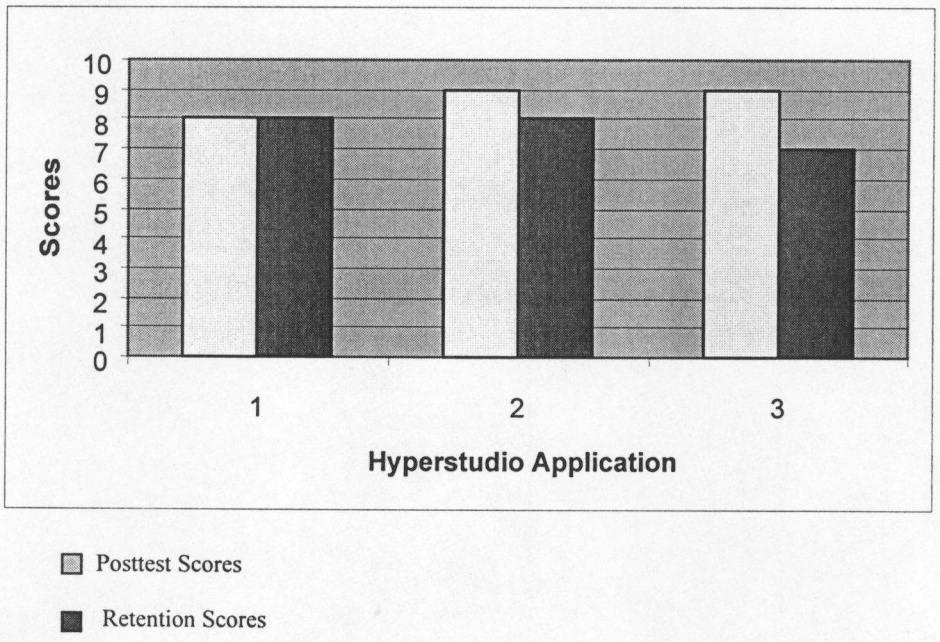


Figure 4-12: Student B/ Retention of Knowledge

Student B experienced a difference between posttest and retention scores in Measurement(application #2) and Division (application #3) in which he/she experienced a loss of knowledge. There was no difference in adverbs (application #1) in which posttest and retention scores were the same.

Student C

Figure 4-13 illustrates posttest and retention scores for student C.

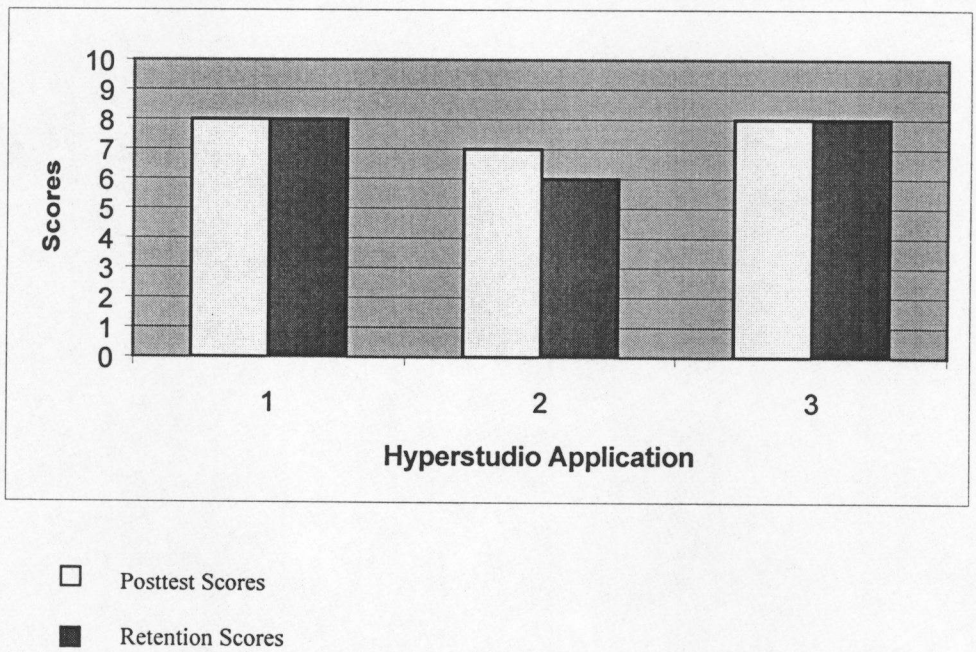


Figure 4-13: Student C/ Retention of knowledge

Student C scored 8 points in posttests and retention tests for Adverbs (application #1) and Division (application #3). However, a negative difference or loss is shown in Measurement (application #2).

Student D

. Figure 4-14 shows posttest and retention scores obtained by student D.

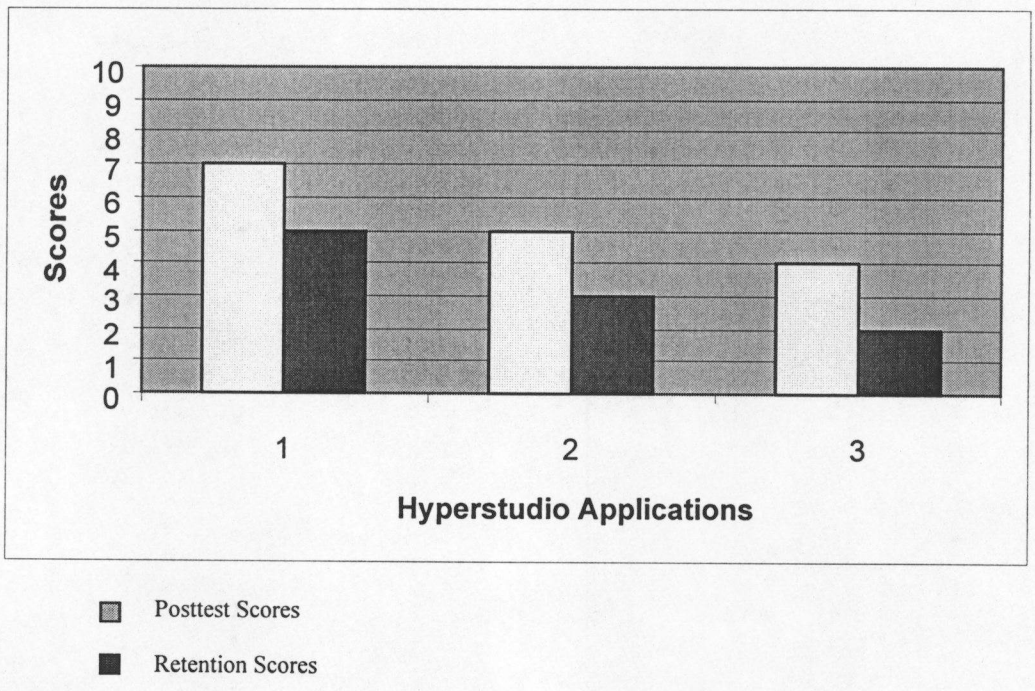


Figure 4-14: Student D/ Retention of Knowledge

This student showed negative differences between posttest and retention scores in the three areas where retention was measured (Adverbs, Measurement and Division). It is also notable that this student did not achieve beyond the remedial level in Division (application #3) after using the Hyperstudio™ application created for this content area. Figure 4-14 shows posttest and retention scores obtained by student D.

Student E

Figure 4-15 represents posttest and retention scores for student E.

Student E: Retention of Knowledge

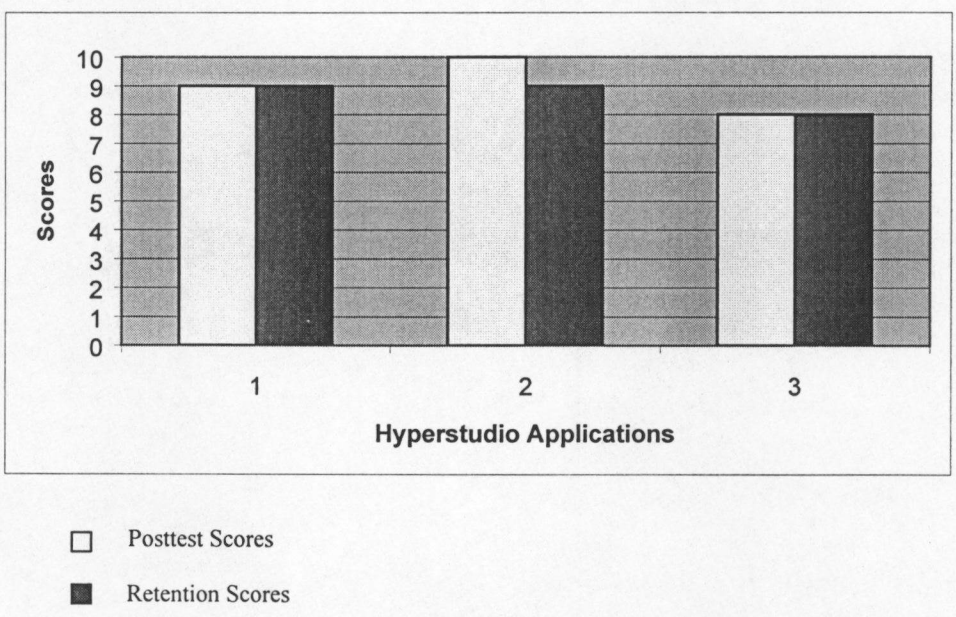


Figure 4-15: Student E/Retention of Knowledge

There is a difference between posttest and retention scores in Measurement (application #2). The student demonstrated a loss of knowledge in this content area. However, no difference was found between posttest and retention scores in Adverbs (application #1) and Division (application #3).

Student F

Figure 4-16 presents posttest and retention scores for student F.

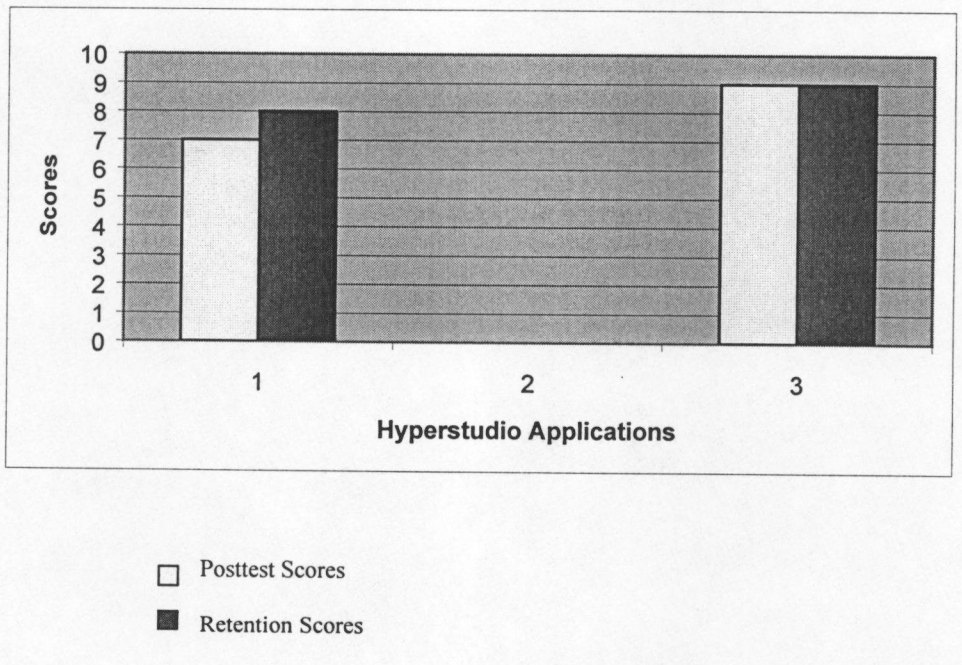


Figure 4-16: Student F/Retention of Knowledge

Student F shows a positive difference (gain) between posttest and retention scores for Adverbs (application #1). No difference is shown in Division (application #3). No data are presented for application #2 because student F was not a remedial student in this application.

Student G

Student G did not need remediation in the first three applications where remediation was measured, so no data are presented for this student.

Student H

Figure 4-17 illustrates the differences in posttest and retention scores for student H. The comparison of posttest and retention score for student H indicates a negative difference for the three applications. Student H demonstrated a loss of knowledge in Adverbs (application #1), Measurement (application #2) and in Division (application #3). Figure 4-17 shows posttest and retention scores for student H in the three applications where retention was measured.

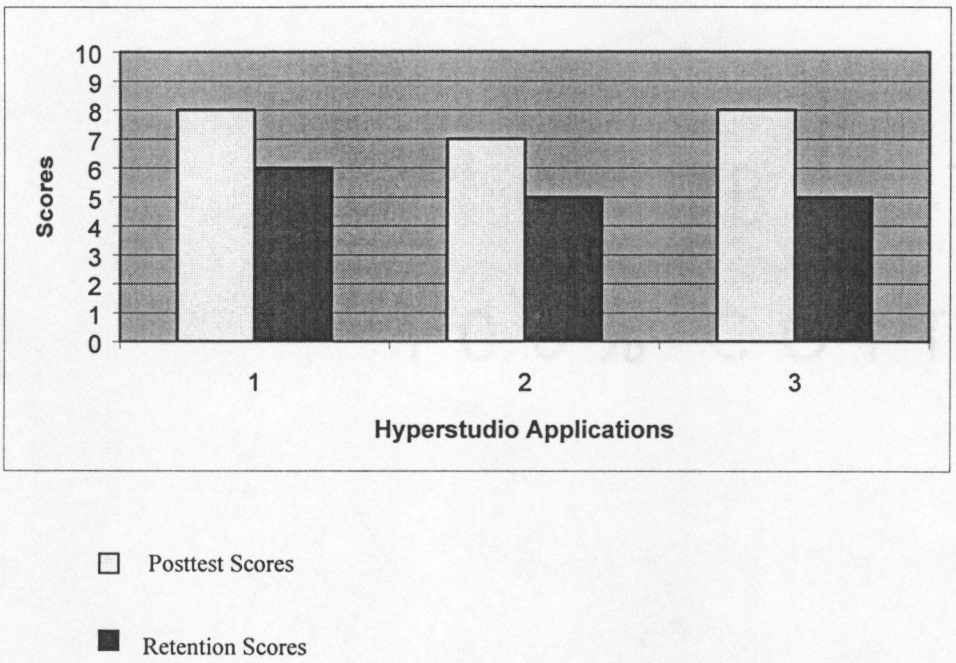


Figure 4-17: Student H/ Retention of Knowledge

Student I

Figure 4-18 represents posttest and retention scores for student I. No data are shown for student I in Adverbs (application #1) because this student did not need remediation in this content. A comparison of pretest and retention scores for Measurement (application #2) shows no difference between posttest and retention score. A negative difference is resulted in Division (application #3) where a loss was experienced.

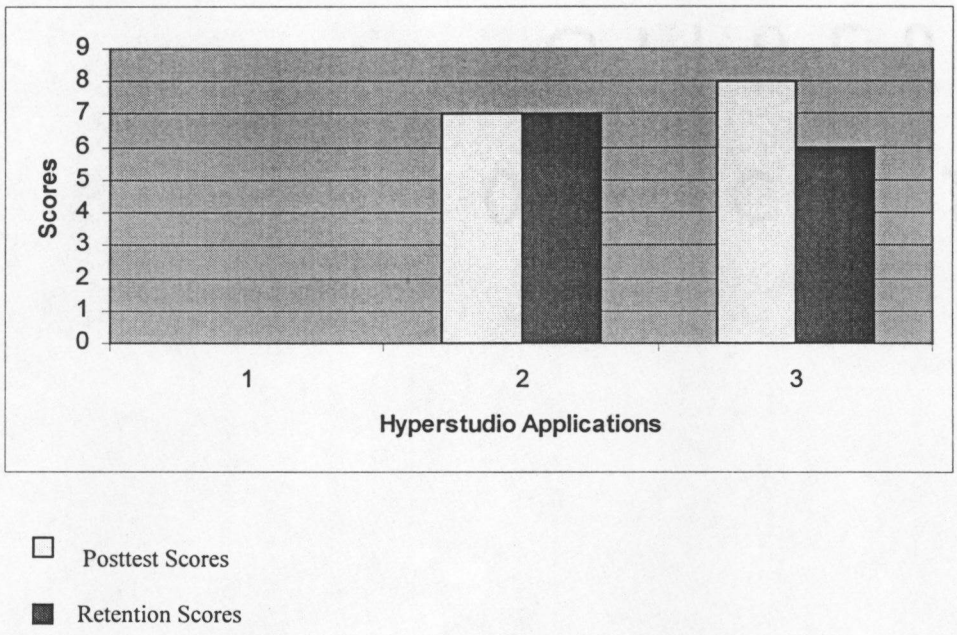


Figure 4-18: Student I/ Retention of Knowledge

Student J

Figure 4-19 illustrates posttest and retention scores for student J. Retention scores for student J indicate a negative difference in Measurement (applications #2) and Division (application#3) as compared to posttest scores. Student J was not a remedial student in application #1, so no data are presented.

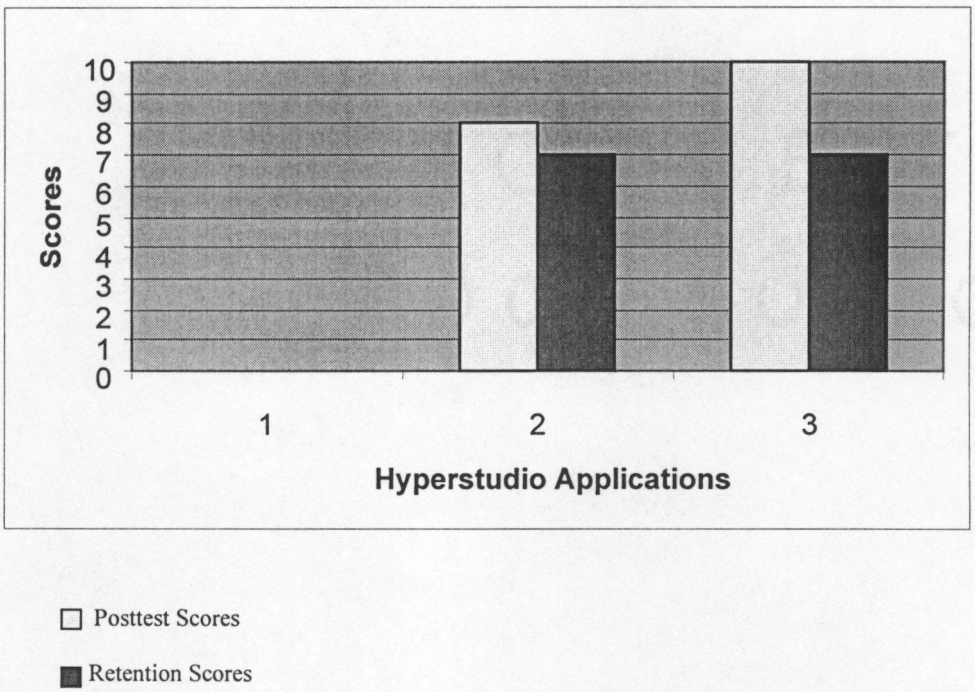


Figure 4-19: Student J/ Retention of Knowledge

Summary

In analyzing the percentages of retention, it was found that these percentages are 70% or more for all students in all content areas where retention was measured. Retention in knowledge gained through Hyperstudio™ applications was relatively high after two weeks.

Research question #2 asked if students using Hyperstudio™ applications for remediation demonstrated retention of knowledge gained. The answer is a qualified "yes", but it must be remembered that only short-term retention (two weeks) was measured, and the measurement was conducted in only three of the six content areas under investigation.

Research Question #3

Do students have positive perceptions of their experience using Hyperstudio™ applications?

Questionnaire Responses

Table 4-11 summarizes the responses reported in the questionnaire administered to assess the perceptions of the students that used Hyperstudio™ applications for remedial instruction. Answers to the questionnaire and cannot be compared with actual performance because questionnaires were anonymous and no way of identifying student respondents was devised.

Table 4-11: Questionnaire Responses

QUESTIONS	YES	NO	NOT SURE
(1) I like working with computers	8	1	1
(2) I have enough computer skills to use Hyperstudio™ applications.	8	2	0
(3) I enjoyed the time spent using Hyperstudio™ applications	8	2	0
(4) I like Hyperstudio™ Applications because they have color	3	7	0
(5) I like Hyperstudio™ Applications because they have sound	4	6	0
(6) I like Hyperstudio™ Applications because they have graphics	5	4	0
(7) I learned about the topics presented using Hyperstudio™ applications.	10	0	0
(8) Hyperstudio™ applications presented the information in a way I could understand it.	9	1	0
(9) Instructions in Hyperstudio™ applications were clear and easy to follow.	8	1	1
(10)In the future, I would like to use Hyperstudio™ applications again.	7	2	1

For the purpose of answering research question #3, items from the questionnaire are discussed individually.

Question #1

Eight (out of ten) students reported that they liked working with computers. This is important to knowing that responses to Hyperstudio™ were not related to fear of or reluctance about computers for most participants in the study.

Question #2

Eight (out of 10) reported having enough computer skills to use Hyperstudio™ applications. Again, most of the participants felt comfortable with what they were doing, in this case the software being used. In two cases, perhaps the same two students who responded negatively to question one (we really do not know) lack of perceived skills may have influenced the use of computer applications and scores.

Question # 3

Eight of ten students reported to have enjoyed the time using Hyperstudio™ applications while only two answered negatively.

Question # 4, 5, and 6

The purpose of these three items was to relate three Hyperstudio™ features (color, graphics, sound) to how students perceived the experience. Results show that they were not perceived as relevant to many students' enjoyment of their experience.

Question # 7

All ten students reported that they learned using Hyperstudio applications in areas where they needed remediation. Their perceptions were confirmed by the

test data, although average gains were moderate in several content areas, and in some content areas were minimal.

Questions # 8 and 9

These two items deal with elements of design of the applications. The presentation of the information in an appropriate way and clear instructions provide students with the necessary tools for a successful navigation through the application. Nine of ten students reported that the information was presented in a way that could be understood. Eight reported that instructions were clear and were easy to follow.

Question # 10

Seven of ten students reported that they would like to work with Hyperstudio™ applications in the future.

In addition to the ten questions presented above, the questionnaire also included an item asking the students about the appropriateness of the amount of time spent using the applications. Six answered that it was appropriate, three reported it as too short and one said it was too long.

Summary

Research question #3 asked if students' perceptions of their Hyperstudio™ experience were positive. The answer to that question is that the majority of the students rated most aspects of their experience positively. However, their positiveness was not necessarily related to the color, sound and graphics that were used in the applications.

Summary

This chapter has answered the three research questions that guided this study. These questions were answered with the support of the data collected during this study. All answers were affirmative, but there were qualifications that should be considered.

The following chapter will presents conclusions, implications and recommendations that derived from this investigation.

CHAPTER V

SUMMARY

CONCLUSIONS

DISCUSSION AND

RECOMMENDATIONS

Summary

The purposes of this study were to assess the feasibility of using Hyperstudio™ generated applications to help students with specific needs to overcome their weaknesses and to determine the perception these students have of the experience. Hyperstudio™ is an authoring tool that facilitatess the creation of multimedia applications.

The students for this study were 10 fourth graders attending a school in East Tennessee with an enrollment of approximately 250 students for the school

year 1998-1999. Seven students were females and three males between nine and ten years of age.

Students were selected based on parent or guardian's authorization. The class selected as the study population was composed of eleven students, but only ten obtained the written consent necessary to participate in the study.

Meetings with the classroom teacher, and research conducted on previous instruction, resources used and students' performance helped identify the areas of content that needed attention. The classroom teacher made suggestions for all content and materials (Hyperstudio™ applications and tests) used in this study.

Pretests were prepared and administered to identify the remedial students (5 points or fewer out of ten were considered a remedial student). After using each application, a posttest was administered. The differences between these two tests determine gains in knowledge.

Short-term retention was measured for three of the six applications. The same test was administered a third time two weeks after the posttest. Retention was defined as the percentage of knowledge overlap between the two tests. The conclusions drawn from this part of the study are all related to short-term retention.

The results of a questionnaire, prepared to assess students' perceptions of their experiences using Hyperstudio™ applications, indicated that most students'

overall perceptions were positive and that they seemed to have enjoyed the experience. A few students responded negatively.

This study provides useful information about the use of Hyperstudio™ applications to help remedial students overcome their weaknesses. Remediation is the reteaching of low achievers using a strategy different from the traditional strategy used in the classroom.

CONCLUSIONS

Results of the analyses of data answered the three research questions. Findings from this study point to several conclusions related to the research questions.

(1) This study indicates that there was a relationship between using Hyperstudio™ applications and improvement in posttest scores as compared to pretest scores for most students. An improvement in posttest scores with respect to pretest scores was experienced by all students in all six applications, although some gains were minimal. Incorporating Hyperstudio™ applications into teaching seems to help remedial students improve their academic performance. This conclusion is consistent with

Lillie's statement that students who do not learn a topic using the traditional method of instruction may benefit with computer-based instruction (Lillie et al, 1989).

(2) The value of Hyperstudio™ applications as remedial instruction for some students in some content areas is still open to questions. Gains of 1 to 2 points are not considered substantial for remedial students who are being retaught. Some students still did not performed above remedial level (6 or more points) with the use of some of the Hyperstudio applications.

(3) In general, it can be said that no consistent patterns were found in relation to students' gains. Some students gained more in one content area, and others in another. Gains were of 1 to 7 points. Average gains were similar in all content areas (between 3.5 and 4.8 points); Even though there were slightly higher gains overall in language arts content than in mathematics content, the differences are not substantial enough to support a conclusion relative to content applicability to Hyperstudio™

(4) The students who interacted with the program seemed to enjoy it. This confirms further theory that it is possible to have a favorable learning experience using computer software while enhancing the understanding of

particular content areas.

(5) Short-term retention was measured two weeks after the posttest. Accuracy of measurement is questionable since a few student demonstrated gains between posttest and retention test with no additional instruction.

There are several factors that limit the generalizability of results obtained from this study. There were a limited number of students who were selected based on the authorization of parents or legal guardian. There was not a random assignment. Homogeneity of the participants is also a limiting factor, students were in the same grade, same age range and same school.

Discussion

No major, unforseen events interfered with this study. Students' attendance was excellent throughout the duration of this study. Some students' pretest scores indicated no need for extra help. They used the application due to classroom management; however they were excluded from the analysis..

Some strengths in the current Hyperstudio™ design (version 3.1) were informally identified as the investigator watched students use the applications. It

gave the learner independence and a sense of control. An important feature of the Hyperstudio™ stacks was that they could be shared and run without having the parent program installed on the computer and without the hassle of getting authorization from the publisher. The applications were executable with a player that could be downloaded from the Hyperstudio™ Website. Hyperstudio™ applications were very easy to run; no student experienced difficulty is navigating through the applications. Skill using the mouse was the only requirement needed to run Hyperstudio™ applications successfully.

It was also informally observed that students were eager to work with the applications, were likely to act as peer tutors when necessary, and took more initiative in the learning process. As a classroom management tool, Hyperstudio applications were efficient in motivating students to work as well as in keeping them on task.

The design of the applications provided opportunity to revise each answer until it was satisfactory. Risk taking was promoted since no penalty was involved. This study did not seek to sort or rank students, rather to determine what students had learned from using Hyperstudio™ applications, and to help them improve their knowledge.

A noticable constraint involved with Hyperstudio™ applications was the developer desire and time to complete each application for use when needed. It takes time, energy, knowledge, and resources to develop the application. A regular

teacher, having the computer skills needed, may find difficult to fit into his/her schedule the time needed to produce Hyperstudio™ applications based on the needs of his/her students. The ideal would be that the teacher identifies the students's needs and the school provides staff and resources to generate the computer applications.

Another restriction that was experienced in the design of the card stacks was the need to be able to fit the entire stack onto a floppy disk. Storage of sound and graphics takes a lot of space, and the computers at the school did not have zip drives to allow the use of large capacity disks.

Recommendations for Further Study

Based on the findings of this investigation, there are additional areas where further related research may be productive.

(1) This research should be replicated with larger number of participants, and should include students from different age groups, and grades. The small number of participants in this research may have obscured some true relationships as well as limiting the degree to which results can be generalized. Results are sufficiently promising to support this recommendation .

(2) It would be beneficial to study the relationship between the use of Hyperstudio™ applications based on the needs of the students and their perceptions of the experience. The anonymity of the questionnaire in this study did not allow investigation of this respect.

(3) A study that focuses on teachers' attitudes about developing and using Hyperstudio™ applications based on the needs of the students must be conducted. As previously mentioned, it takes time and energy as well as computer and software development skills to build Hyperstudio applications. How willing are teachers with skills to do this?, What support do they need?. We do not know.

(4) The relationship between retention and the use of Hyperstudio™ generated applications must be much better assessed. This investigator attempted to study short-term retention but the limited nature of the investigation and some of the findings suggest that there is much more to be learned. Investigation of retention at different time intervals, with more students, and better measurements is needed.

Despite the limitations, this study offers data and results that are of value to educators who have questions about the effects of using Hyperstudio™ applications to remediate learning in their classrooms. This investigator strongly believe that computer software are integral to learning for the new millenium

REFERENCES

REFERENCES

Allen, N. (1998). **Not in our state: authentic assessment for native American students using digital photography.** Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, San Diego, CA.ERIC Document Reproductive Service # ED 418851.

Bangert-Drowns R. L., Kulik J. A. & Kulik C.C. (1985). Effectiveness of Computer-based education in secondary schools. **Journal of Computer-Based Instruction,** 12(3), 59-68.

Becker, H. J. (1990). **When powerful tools meet conventional beliefs and institutional constraints: national survey findings on computer use by American teachers (Report # 49).** Baltimore: The John Hopkins University Center for Research on Elementary and Middle Schools. ERIC Document Reproductive Service # ED337142.

Becker H. J. (1992). **Top-down versus grass roots decision making about computer acquisition and use in American schools.** Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA. ERIC Document Reproductive Service # ED356769.

Benswanger, H. (1991). Volition as cognitive self-regulation. **Organizational Behavior and Human Decision Processes**, 50(1), 154-178.

Carbonell, J. (1970a). **AI in CAI: an artificial intelligence approach to computer-assisted-instruction.** IEEE Transactions on Man-Machine Systems, 11, 190-292.

Carbonell, J. (1970b). **Mix-initiative man-computer instructional dialogues,** Ph.D. Dissertation, Massachusets Institute of Technology.

Click Art version 1.0 for Mascintosh. (1996). T/Maker Company. Mountain View, CA.

Cornelio A. (1994). **A multimedia approach to teaching library research skills.** ERIC Document reproductive Service # EJ 477977.

Cuban, L. (1986). **Teachers and machines: the classroom use of technology since** 1920. Teachers College Press: New York.

Doll, C. (1987). Evaluating educational software. American Library Association: Chicago, Il.

Francis L. & Evans, T. (1995). The reliability and validity of the Bath county computer attitude scale. **Journal of Educational Computing Research**, 12(2), 135-146.

Freedman K. & Liu M. (1996). The importance of computer experience, learning processes, and communication patterns in multicultural networking. **Educational Technology Research and Development**, 44(1), 43-59.

Giordano G. (1993). **Diagnostic and remedial mathematics in special education.** ERIC Document Reproductive Service # ED 392599.

GAO (1995). **School facilities: condition of America's school. United States General Accounting Office Report to Congressional Requesters**, GAO/ HEHS- 95-61. Cited in Oates, Evans & Hedge. .(1998). An anthropometric and postural risk assessment of children's school computer work environment. **Computers in Schools**, 14(3-4), 55-63.

Gare, R. (1982). **Educational software development: a guide to the design and development of computer-based learning materials.** Curriculum Branch, Department of Education, Queensland. Cited in Woodhouse, D. & Macdougall, A. (1986). **Promise and challenge in education.** Blackwell Scientific Publications: Palo Alto, CA.

Geisman, J. (1988). Beyond CBT: interactive video. **Computers and Personal**, 35-38.

Gollwitzer P., Heckhausen, H.& Ratajezak, S. (1990). From weighing to willing: Approaching a change decision through prior or postdecisional mentation. **Organizational Behavior and Human Decision Processes**, 45(1), 41-46.

Heidenreich, B. (1992). **The effects of Hyperstudio in the achievement of seventh grade social studies students.** ERIC Document Reproductive Service # ED 412895.

Heller (1995). Heller report on educational technology markets, 7(2). Highland Park, Il: Educational Technology Survey, Inc. Cited in Oats et al.(1998). An anthropometric and postural risk assessment of children's school Computer work environment. **Computers in Schools**, 14(3-4), 55-63.

Hinson M. (1991). **Teachers and special education needs.** Longman. Essex, England.

HyperStudio Web Site. http://www.hyperstudio.com/ . [Online]. 1999.

Johnson, Dupuis, Musial, Hall & Gollnick (1996). **Introduction to the foundations of american education.** tenth edition. Allyn and Bacon.

Keeley M. (1999). Memory and the importance of review. [Online]. http:www.bucks.edu/~specpop/memory.html

Kellenberg, D. W. (1996). Preservice teachers' perceived computer self-efficacy based on achievement and value beliefs within a motivational framework. **Journal of Research on Computing in Education,** 29(2), 124-140.

Keller, J. M. (1983). **Motivational design of instruction.** In C.M. Reigeluth (Ed.). Instructional design theories and models: an overview of their current status (p.p. 384-434).Lawrence Erlbaum, Hillside, NJ.

Keyuravong S. (1997). The use of computers in English language teaching in Japan. **Thai TESOL Bulletin**. [Online]. www.paubuc.th/~elcdrn/ttesol...ications/bulletin1002/100208.html/

Kulik, J.A. (1985). **Consistencies in findings on computer-based education.** Paper presented at the Annual Meeting of the American Educational Research Association. Chicago, Il, 31 Mar – 4 April. ERIC Document Reproductive Service # ED263880.

Kulik J. & Kulik C. (1991). **Effectiveness of computer-based instruction: an updated analysis.** Computers in Human Behavior, 7, 12.

Lally M. & Macleod I. (1982). Development of skills through computers: achieving an effective, enjoyable learning environment. **Impact of Science on Society**, 32, 449-460.

Lillie D., Hannun W. & Stuck G. (1989). **Computers and effective instruction – using computers and software in the classroom.** Longman, New York.

Ludwig J. & Green L. (1998). **Jungle quest: adventures in creating a hyperstudio word study program.** Paper presented at the Annual Meeting of the National Reading Conference, Scottsdale AZ. ERIC Document Reproductive Service # ED419521.

Liu, L & Johnson L. (1998). **Different computer attitudes between American and Chinese students**. Paper presented at the SITE Ninth International Conference, Washington, D.C.

Medical School Institutional Review Board. (1996). IRBMED. Available [Online]: http//:www.med.unimich.edu/irbmed.

OECD/CERI. (1989). **Problems and issues on educational software development.**[Online]. Available: http://gauge.ugakugei.ac.jp/apeid/apeid95/chap18.html

Piña, A.. (1998). **(Relatively) Painless computer-assisted instruction with Hyperstudio**. Paper presented at the Annual Conference of the Association for Educational Communications and Technology, St. Louis, MO. ERIC Document Reproductive Service # ED 416833.

Pratt D. (1980). **Curriculum Design and Development.** Hartcourt Brace Jovanovich, New York, NY.

Roblyer M., Castine W.B. & King F.J.. (1989). Assessing the impact of computer-based instruction: a review of recent research. **Computers in the Schools**, 5(3-4), 1-149.

Sewell G. (1996). **Special needs provision: assessment, concern and action.** Cassel: London.

Sharp V. (1997). **Hyperstudio 3.1 in one hour.** International Society for Technology in Education. Oregon.

Soulier, S. (1988). **The design and development of computer based instruction.** Allyn And Bacon, Inc.: Boston, MA.

Steinberg, E. (1984). **Teaching computers to teach.** Lawrence Erlbaum Associates, Inc., Hilldale, NJ.

Steinberg, E. (1991). **A synthesis of theory, practice and technology**. Lawrence Erlbaum Associates, Inc., Hilldale, NJ.

Spitzer H. (1939). **Studies in retention.** Journal of Educational Psychology, 30 (9), 641-656.

Thorp C. (1995). **Choices and consequences.** ERIC Document Reproductive Service # EJ 518651.

Tucker, B. (1997). **Handbook of technology-based training. A forum for technology in training.** Gower Publishing Limited, England.

University of Tennessee, Knoxville. Office of Research. (1998). **Special considerations for the protection of children.**

Venezky R. & Orsin L. (1990). **The intelligent design of computer-assisted instruction.** Longman: New York.

Wagner, R. (1995). **Hyperstudio** (version 3.0.4) [Computer Software]. El Cajon, California: Robert Wagner Publishing.

Watson D. (1982). **Some implications of micros on curriculum development**, in R. Lewis & E.D. Tagg (eds). Involving micros in education, pp. 197-206, North Holland.

Woodhouse, D. & Macdougall, A. (1986). **Promise and challenge in education.** Blackwell Scientific Publications: Palo Alto, CA.

Woodlief A. (1996). **Teaching with computers.** [Online]. Available: http://mason2.gmu.edu/~epiphany/docs/teaching.html.

APPENDIXES

APPENDIX A:

Consent Form

Letter to Parents

PARTICIPANTS' LEGALLY AUTHORIZED REPRESENTATIVE CONSENT FORM

I understand that the purpose of this study is to use HyperStudio, a computer program used to enhance learning based on the needs of the participants, I further understand that my child will be using these computer applications in the school setting during the school year 98-99, as well as completing a pretest and a posttest for each application.

I understand that all data will be held in confidence, without identification of participants, the school or the school system by name. Identification numbers will be used instead of participants' names.

I understand that my child's participation in this study is entirely voluntary and that I may withdraw him/her from participation at any time without incurring in any penalty. No grade is involved.

I understand that I may contact the investigator, Jenia D.Alfonzo, or her academic advisor, Dr. Lonnie McIntyre, at any time if I have further questions about the project or my child participation in it.

I read and understood the attached letter in which the purpose of the study was stated.

I authorize my child _____
to participate in the project *Using HyperStudio Generated Applications to accelerate Learning.*

_____
Name of Parent or Legal Guardian

_____
Signature

_____
Date



USING HYPERSTUDIO GENERATED APPLICATIONS TO ACCELERATE LEARNING

Dear Parents,

I am a doctoral student at the University of Tennessee, Knoxville. One of the requirements for graduation is to conduct research in the area(s) of concentration, in my case, Education and Computer Application in Education.

I am going to conduct a study that involves using HyperStudio, a computer program that students can use to overcome weaknesses in specific areas. Students will use these programs at school without interfering with regular class activities. Each student will work with the computer a maximum of 30 minutes, 3 times a week during 10 weeks; the teacher will decide the most convenient time. I will be collecting performance scores at different points in time –before and after using the program a number of times- using an objective pretest and posttest in order to determine gains in knowledge. No grades are involved. The results of this project may benefit its participants by helping them master class content. Dr. Lonnie McIntyre, my academic advisor, will be supervising all the activities.

The purpose of this letter is to have your consent for your child to participate in the study. Involvement in this study signifies no risk to the participants. Participation is voluntary, and you may withdraw him/her from participation at any time. I appreciate your help.

Please feel free to contact me or my advisor if you have any questions or concerns.

Jenia D. Alfonzo
jalfonzo@utk.edu
415 Claxton Addition
UTK, College of Education
(423) 974 4207

Dr. Lonnie McIntyre
mcintyre@utk.edu
415 Claxton Addition
UTK, College of Education
(423) 974 4207

APPENDIX B:

Human Subject Form

THE UNIVERSITY OF TENNESSEE
KNOXVILLE

04/09/99

IRB # : 5683 B

Title : Feasibility of using HyperStudio Generated Applications to Accelerate Learning

Alfonzo, Jenia
EdSMRT
3500 Sutherland Ave., Apt.
Knoxville, TN 37919

McIntyre, Dr. Lonnie
EdSMRT
415 Claxton Addn.
Campus

Your project listed above was reviewed. It qualified for expedited review and has been approved.

This approval is for a period ending one year from the date of this letter. Please make timely submission of renewal or prompt notification of project termination (see item #3 below).

Responsibilities of the investigator during the conduct of this project include the following:

1. To obtain prior approval from the Committee before instituting any changes in the project.
2. To retain signed consent forms from subjects for at least three years following completion of the project.
3. To submit a Form D to report changes in the project or to report termination at 12-month or less intervals.

The Committee wishes you every success in your research endeavor. This office will send you a renewal notice (Form R) on the anniversary of your approval date.

Sincerely,

Brenda Lawson

Brenda Lawson
Compliances

cc: M. Everett Myer

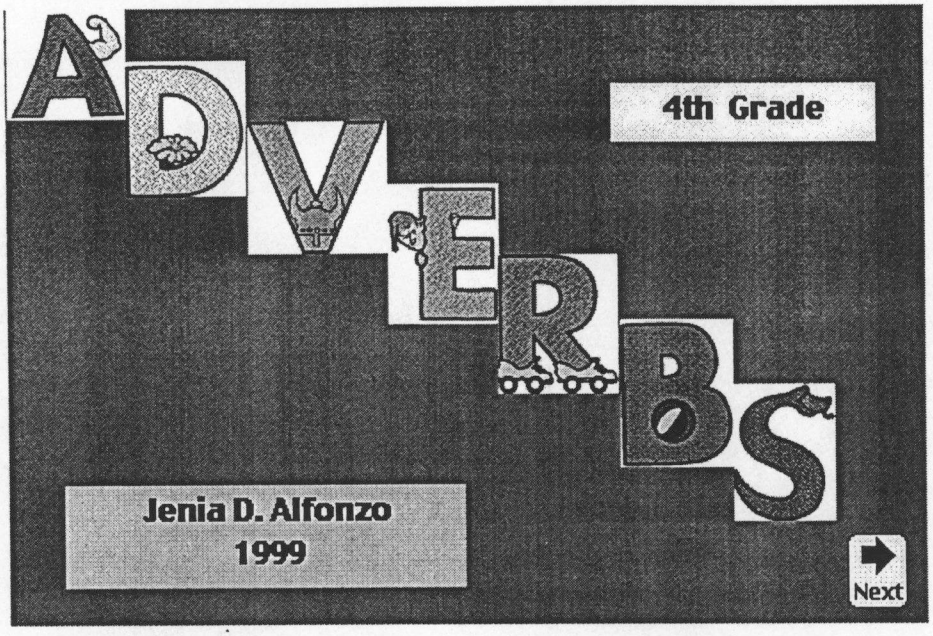
APPENDIX C:

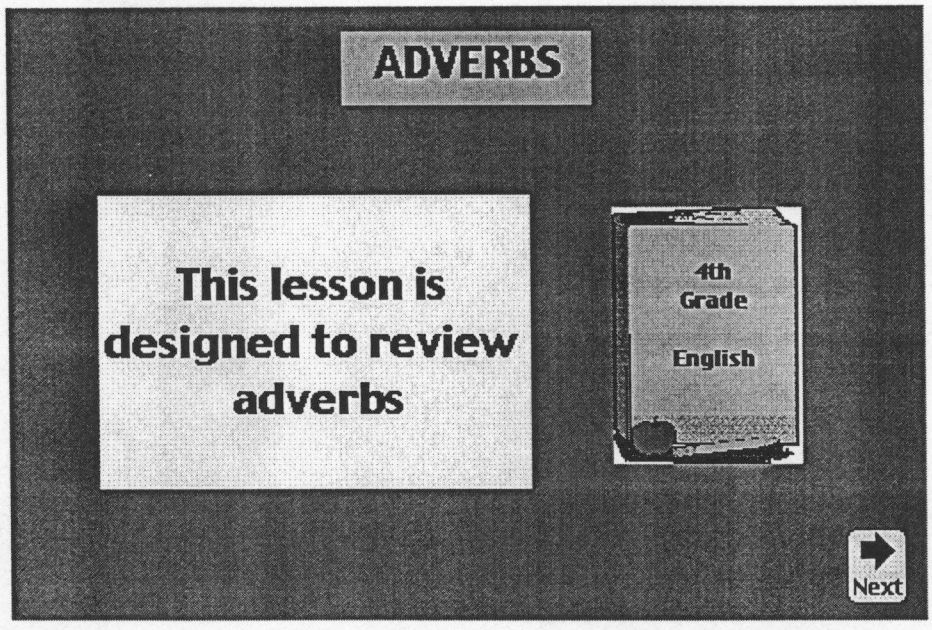
Hyperstudio™

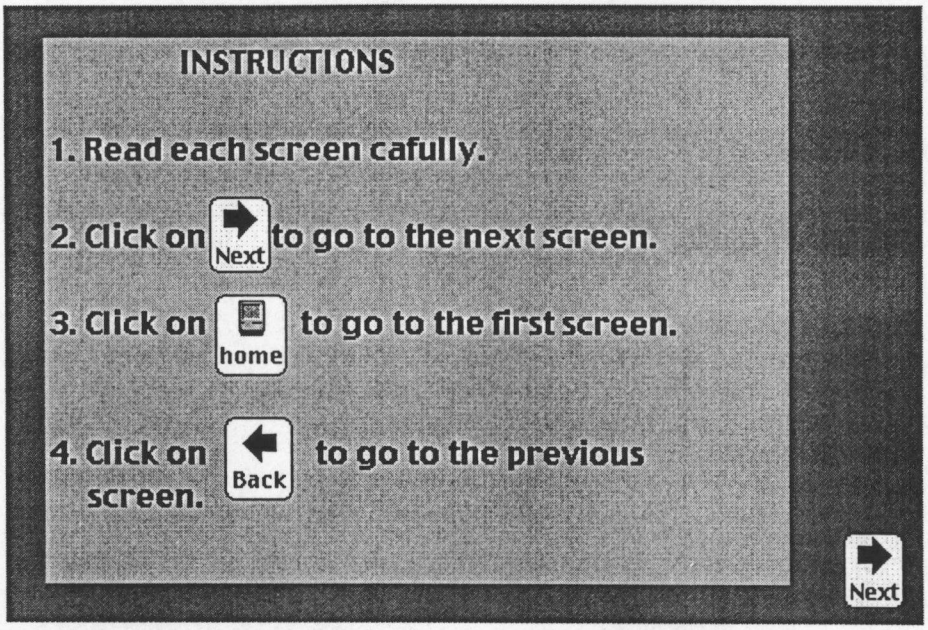
Applications

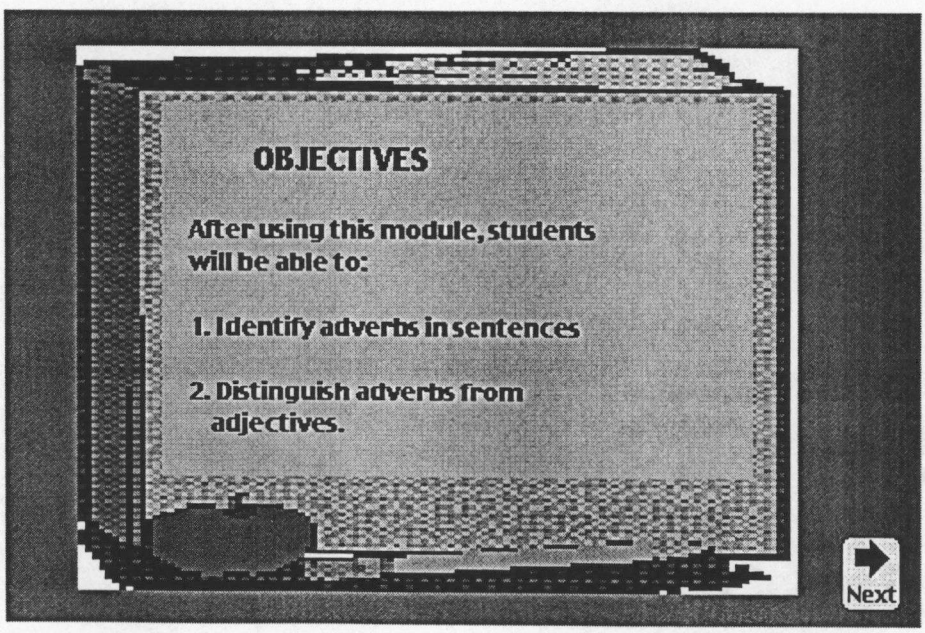
APPLICATION # 1:

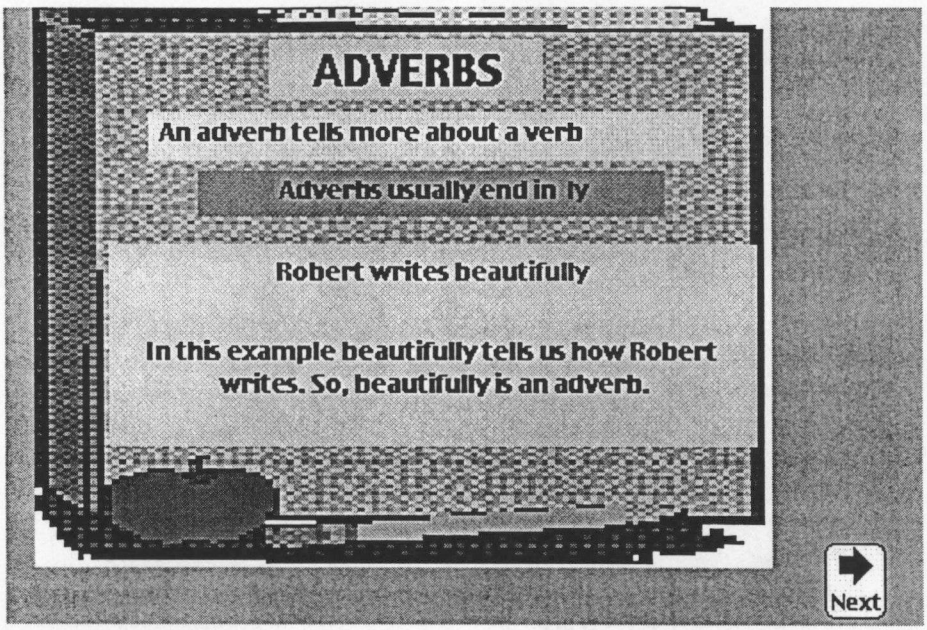
ADVERBS

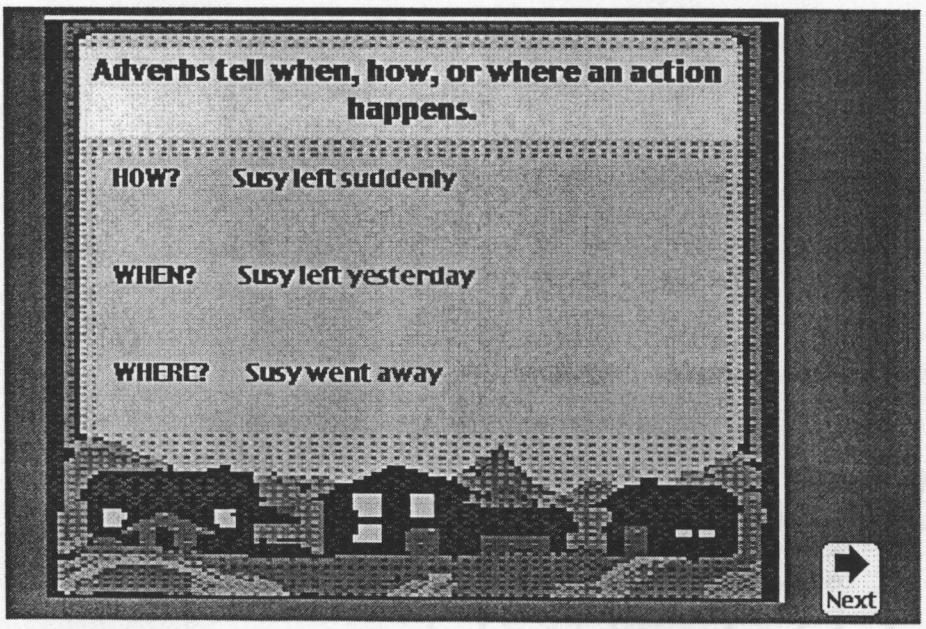

ADVERBS
4th Grade
Jenia D. Alfonzo
1999
Next

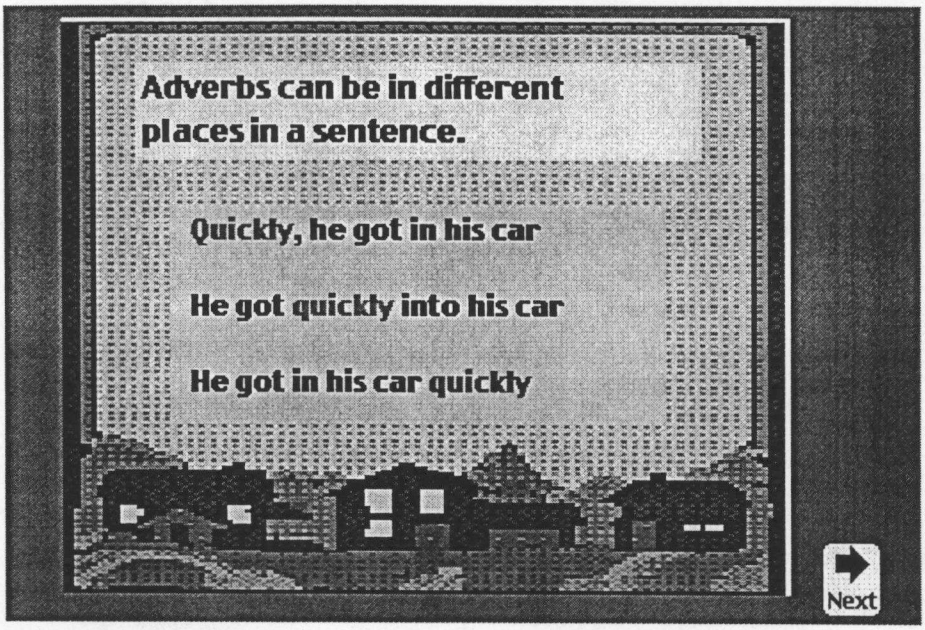

ADVERBS
This lesson is designed to review adverbs
4th Grade English
Next

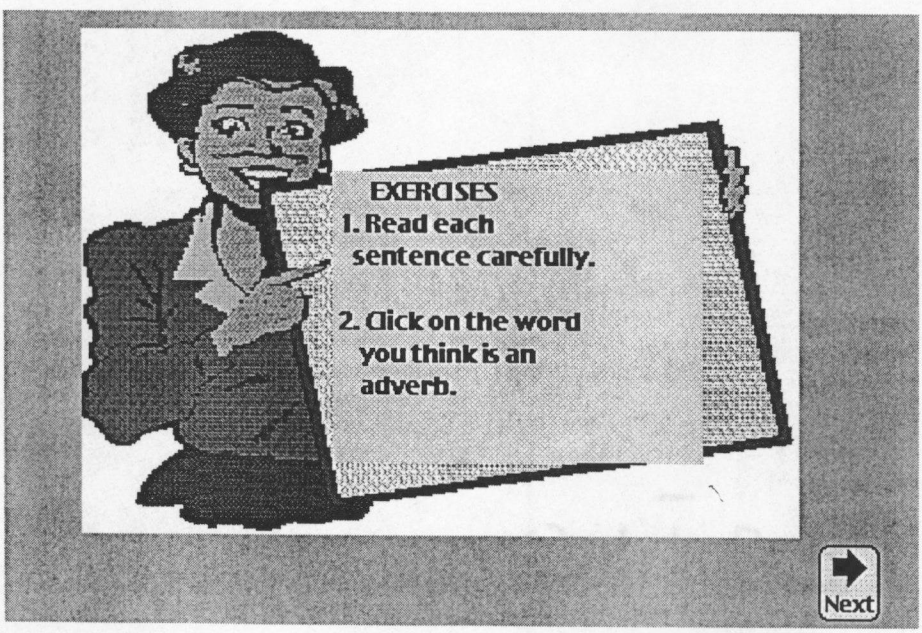

INSTRUCTIONS
1. Read each screen cafully.
2. Click on Next to go to the next screen.
3. Click on home to go to the first screen.
4. Click on Back to go to the previous screen.
Next

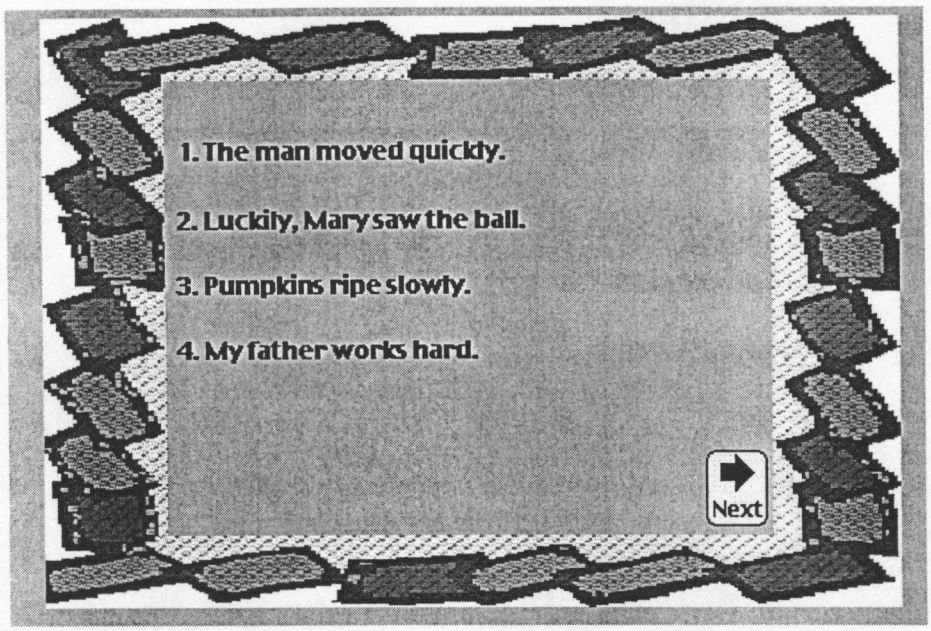

OBJECTIVES
After using this module, students will be able to:
1. Identify adverbs in sentences
2. Distinguish adverbs from adjectives.
Next

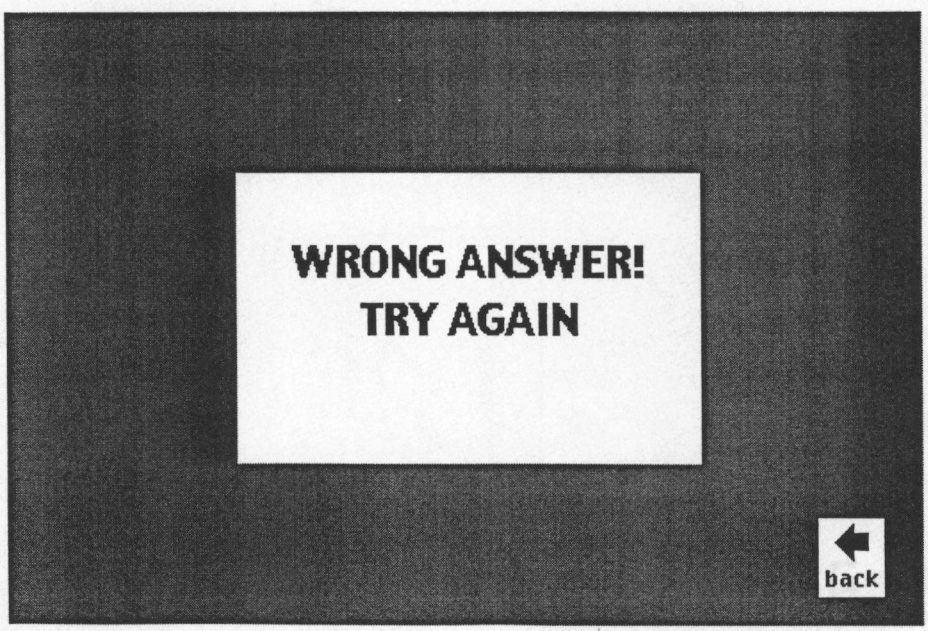

ADVERBS
An adverb tells more about a verb
Adverbs usually end in ly
Robert writes beautifully
In this example beautifully tells us how Robert writes. So, beautifully is an adverb.
Next


Adverbs tell when, how, or where an action happens.
HOW? Susy left suddenly
WHEN? Susy left yesterday
WHERE? Susy went away
Next

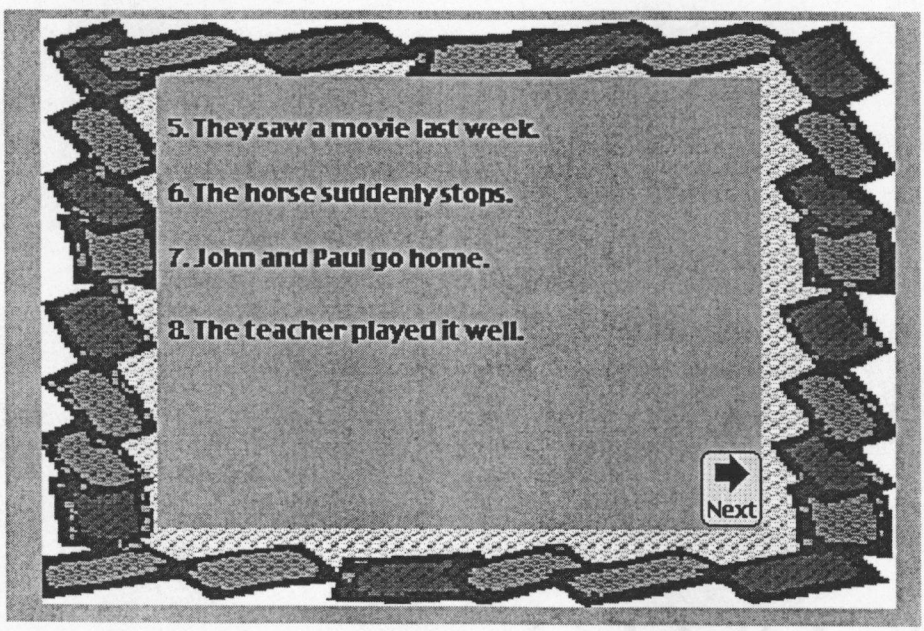

Adverbs can be in different places in a sentence.
Quickly, he got in his car
He got quickly into his car
He got in his car quickly
Next

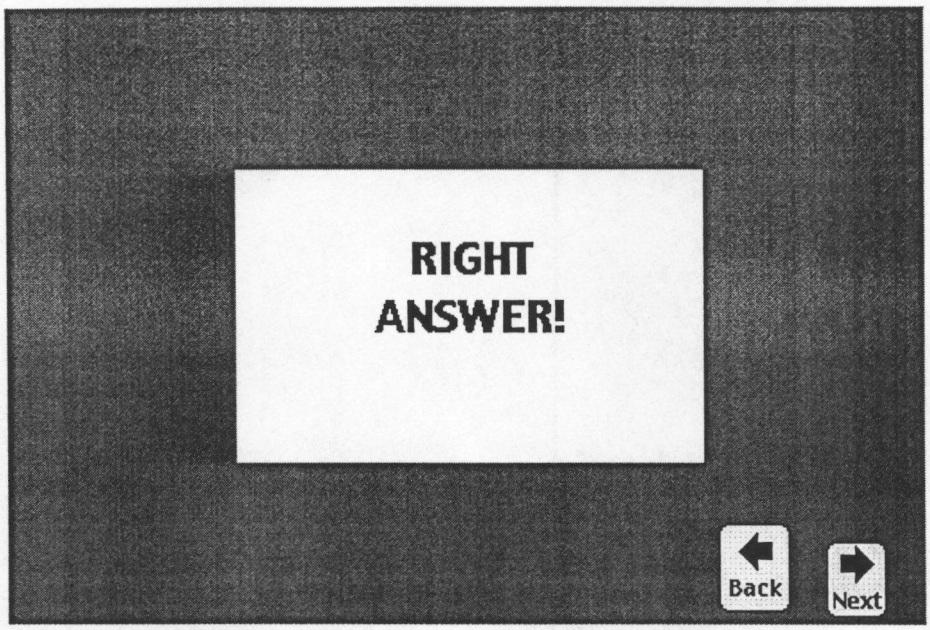

EXERCISES
1. Read each sentence carefully.
2. Click on the word you think is an adverb.
Next

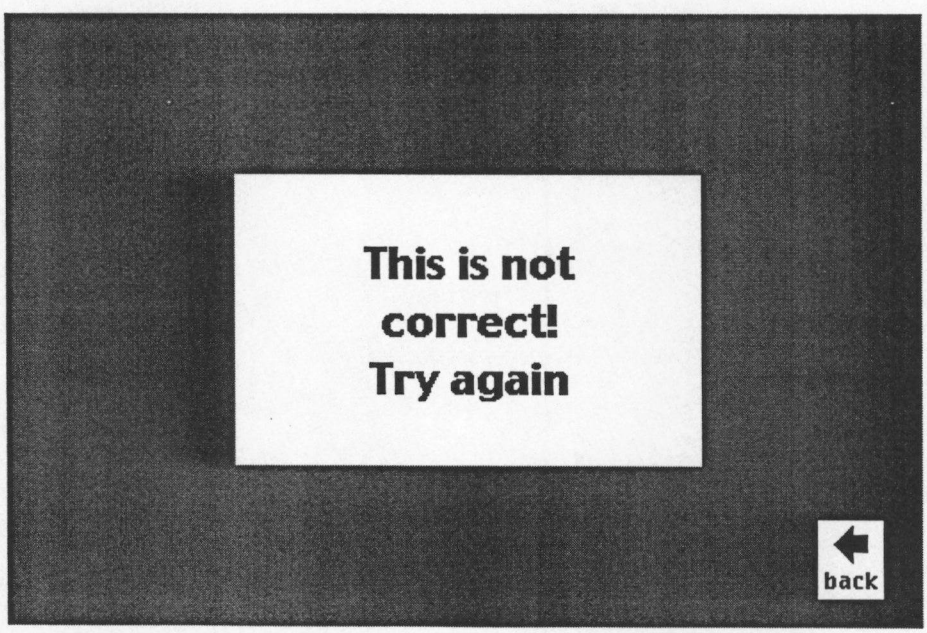

1. The man moved quickly.
2. Luckily, Mary saw the ball.
3. Pumpkins ripe slowly.
4. My father works hard.
Next

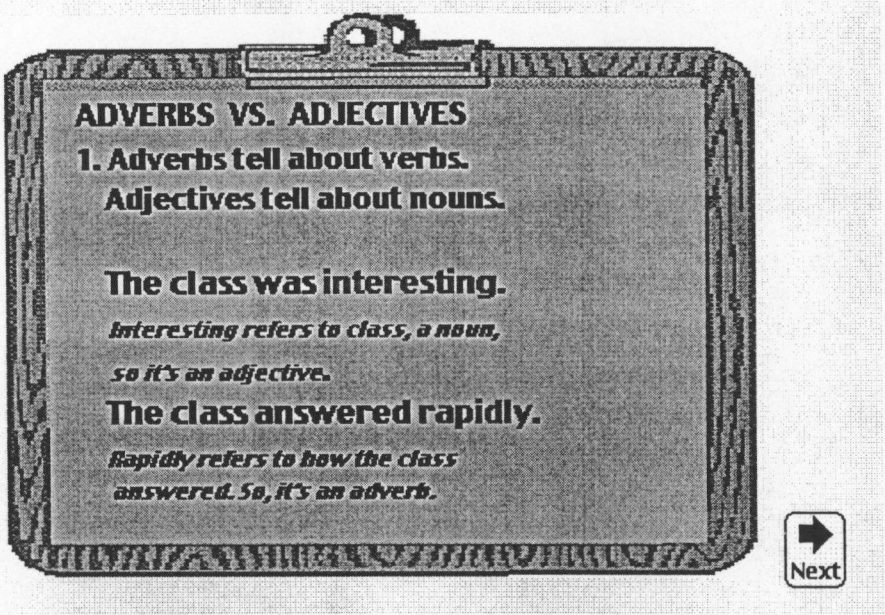

WRONG ANSWER!
TRY AGAIN
back


GREAT
RESPONSE!
Back
Next

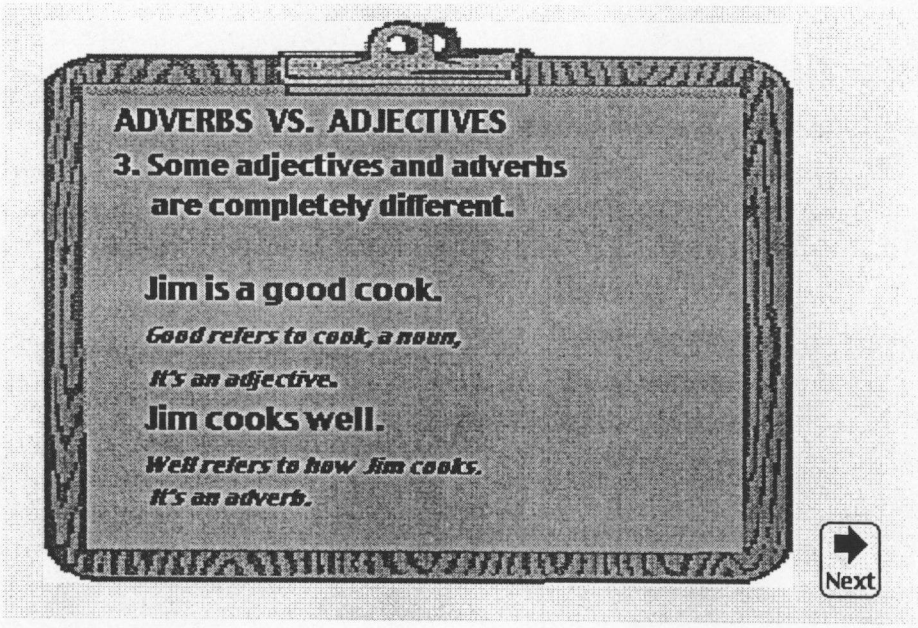

5. They saw a movie last week.
6. The horse suddenly stops.
7. John and Paul go home.
8. The teacher played it well.
Next


RIGHT
ANSWER!
Back
Next

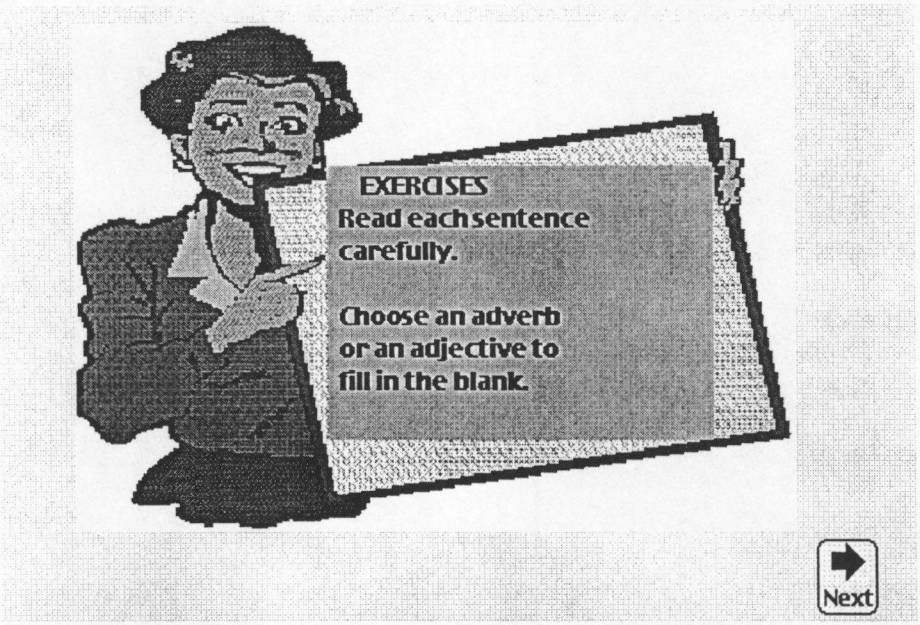

This is not
correct!
Try again
back

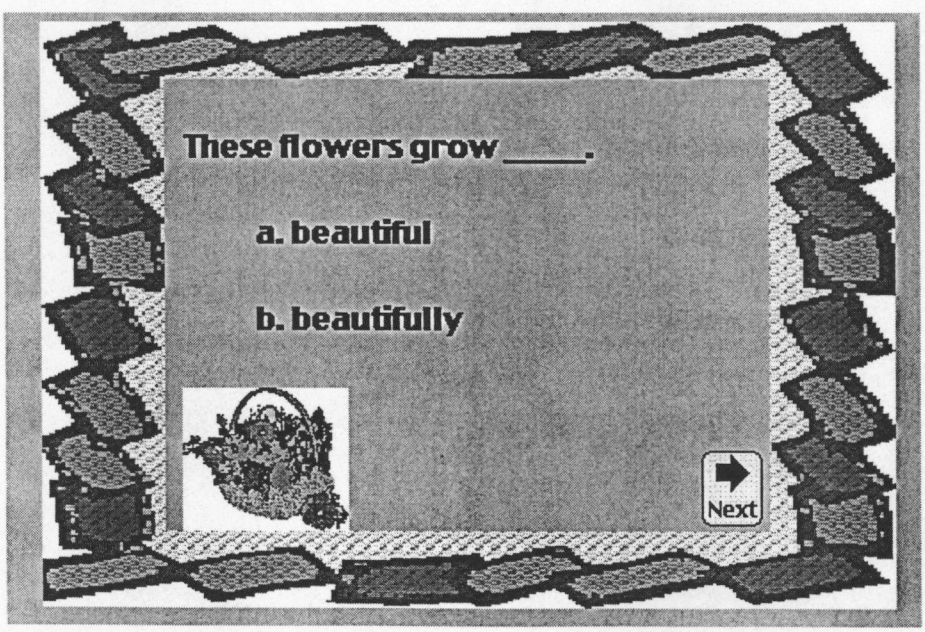

ADVERBS VS. ADJECTIVES
1. Adverbs tell about verbs.
Adjectives tell about nouns.
The class was interesting.
Interesting refers to class, a noun,
so it's an adjective.
The class answered rapidly.
Rapidly refers to how the class
answered. So, it's an adverb.
Next


ADVERBS VS. ADJECTIVES
2. Some adverbs and adjectives
have the same form.
My sister is a fast runner.
fast refers to runner, a noun,
it's an adjective.
My sister runs fast.
Fast refers to how my sister runs,
it's an adverb.
Next


ADVERBS VS. ADJECTIVES
3. Some adjectives and adverbs are completely different.
Jim is a good cook.
Good refers to cook, a noun, it's an adjective.
Jim cooks well.
Well refers to how Jim cooks, it's an adverb.
Next

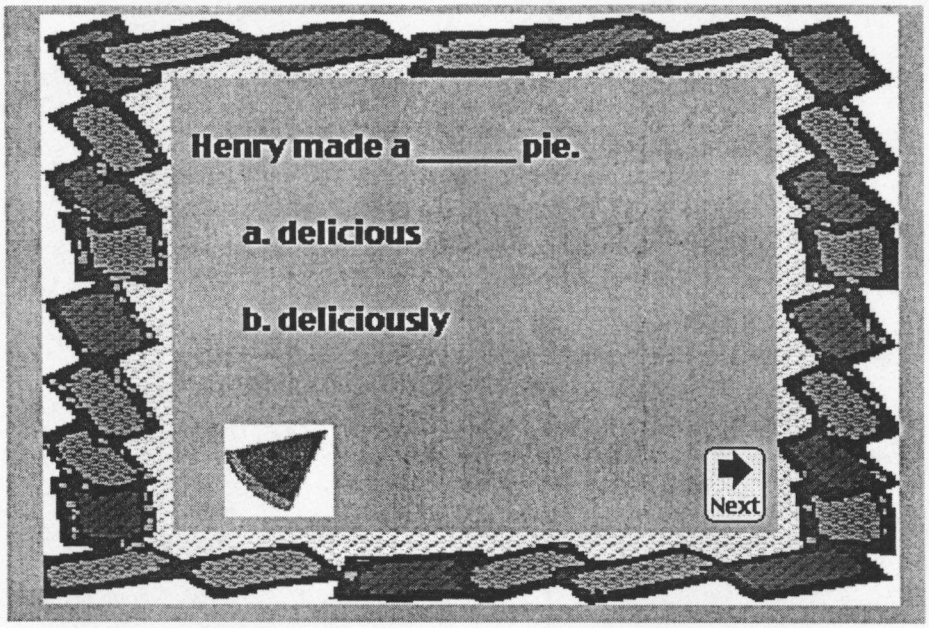

ADVERBS VS. ADJECTIVES
4. Add –ly to most adjectives to make an adverb.
Jane is proud of it
Proud is an adjective, it refers to Jane.
Jane did it proudly.
Proudly is an adverb, it refers to how Jane did it.
Next

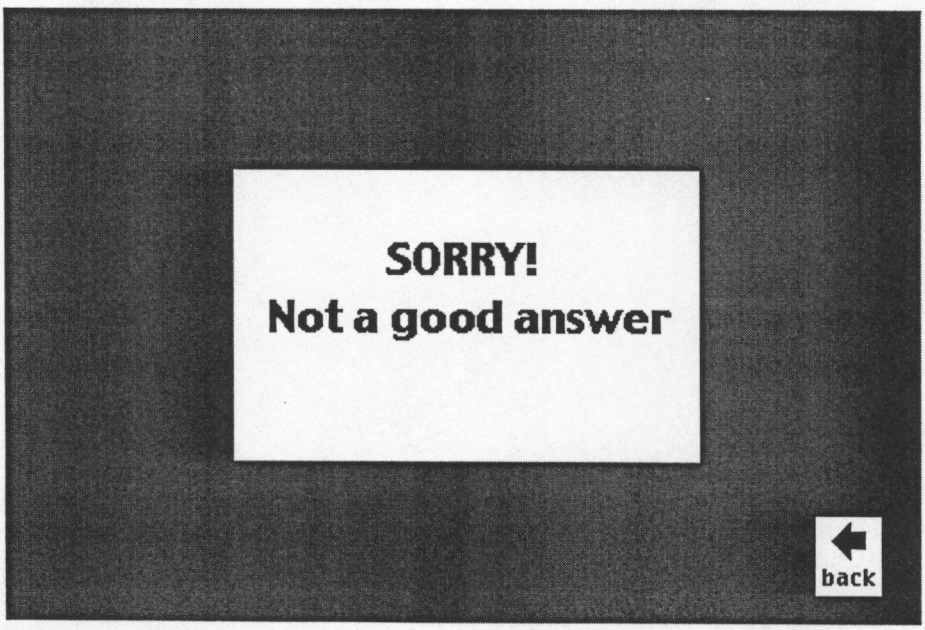

EXERCISES
Read each sentence carefully.
Choose an adverb or an adjective to fill in the blank.
Next

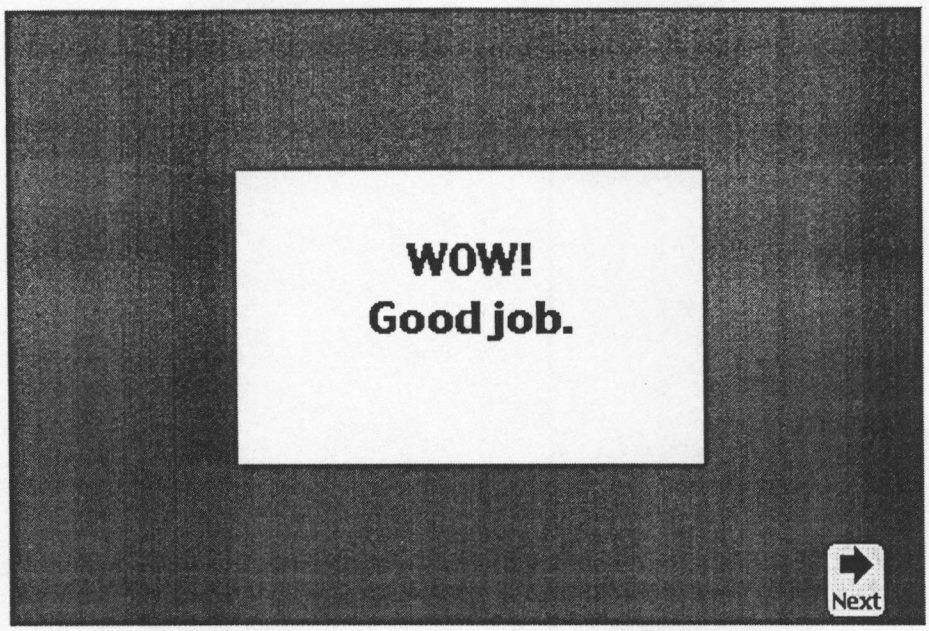

These flowers grow _____.
a. beautiful
b. beautifully
Next

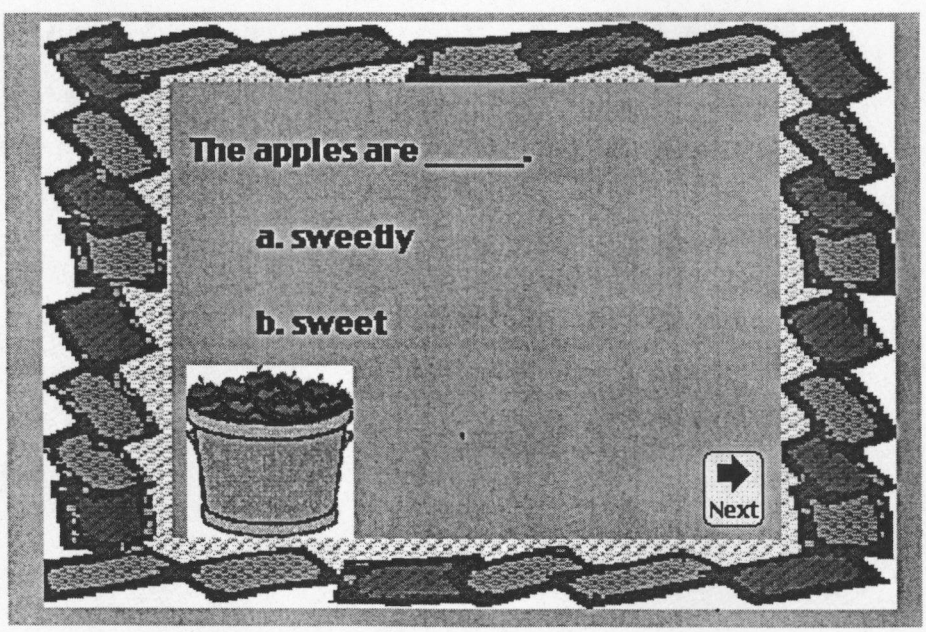

GO BACK
AND
TRY AGAIN!
back


GOOD
JOB!
Next


Henry made a _____ pie.
a. delicious
b. deliciously
Next

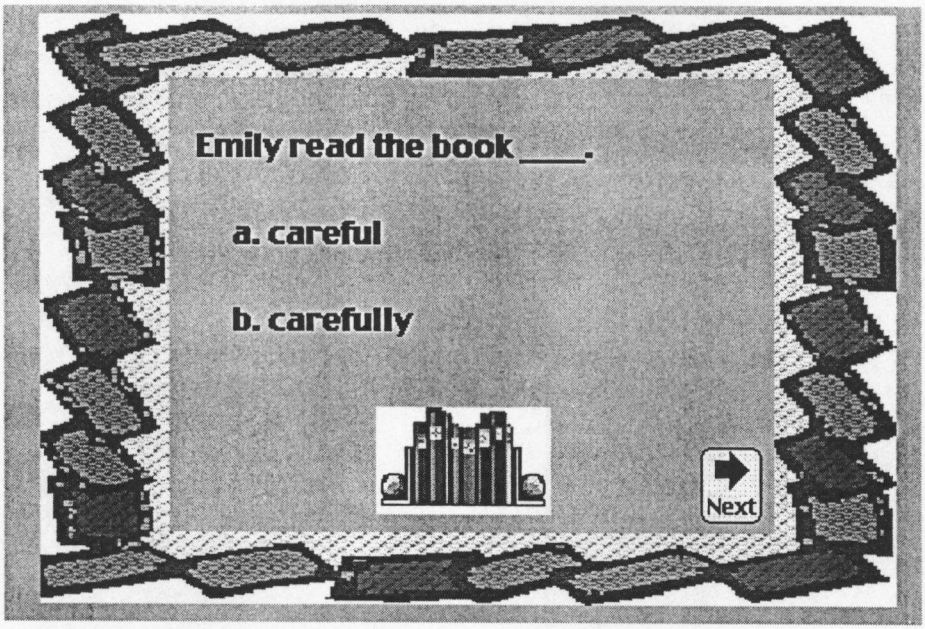

SORRY!
Not a good answer
back


WOW!
Good job.
Next


The apples are _____.
a. sweetly
b. sweet
Next

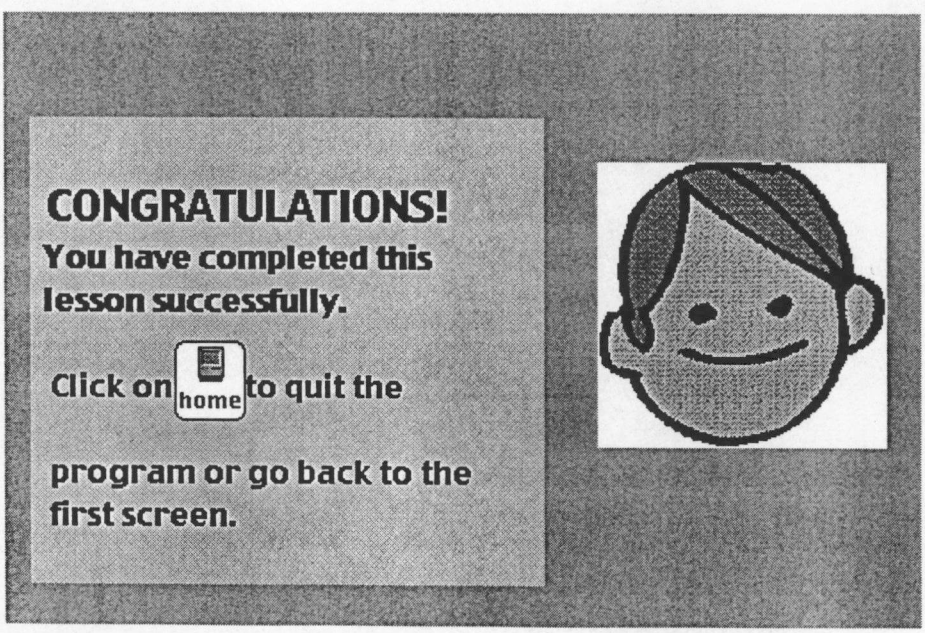

WRONG,
TRY AGAIN!
back


WONDERFUL!
Next


Emily read the book ____.
a. careful
b. carefully
Next

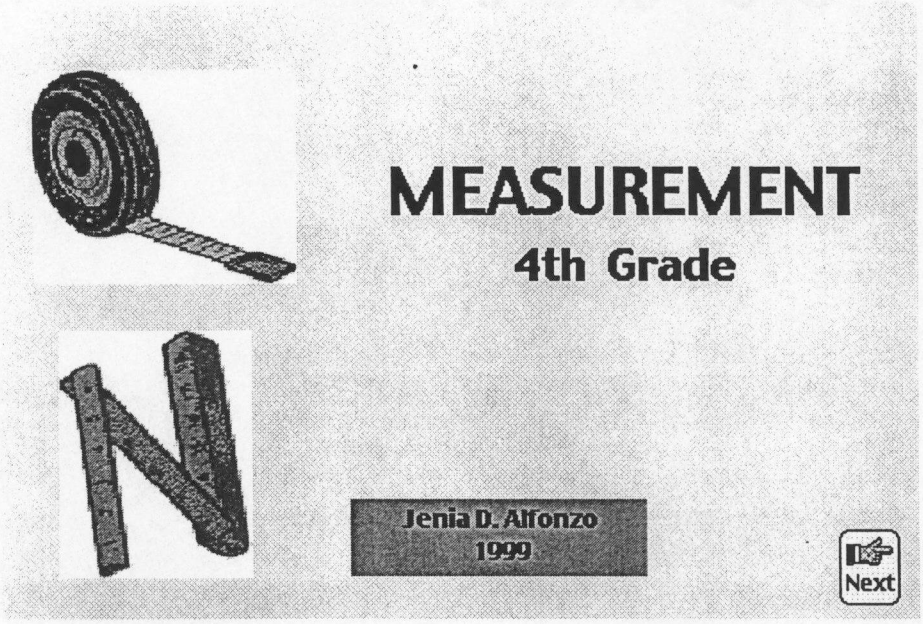

WRONG,
TRY AGAIN!
back

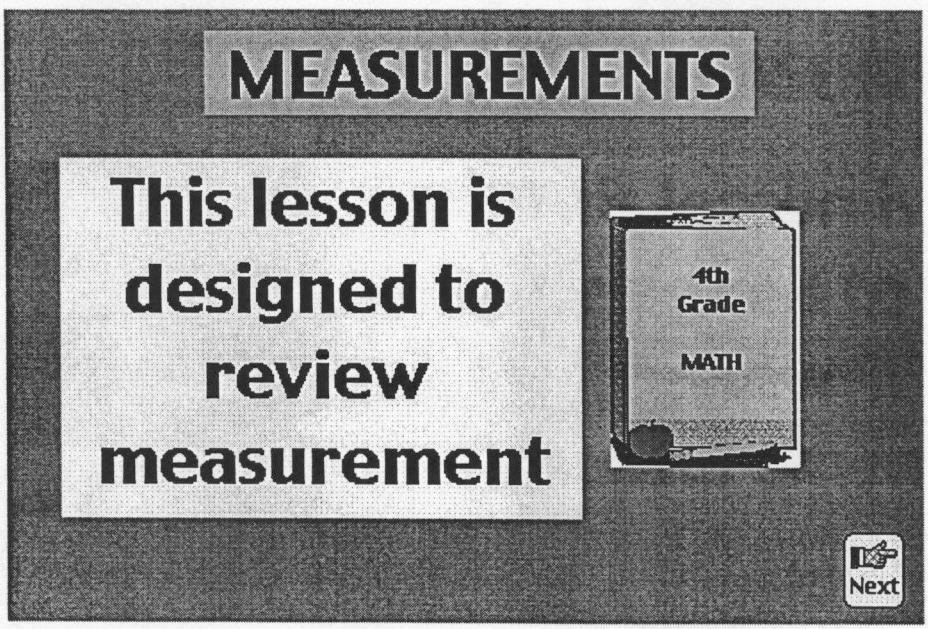

WONDERFUL!
Next

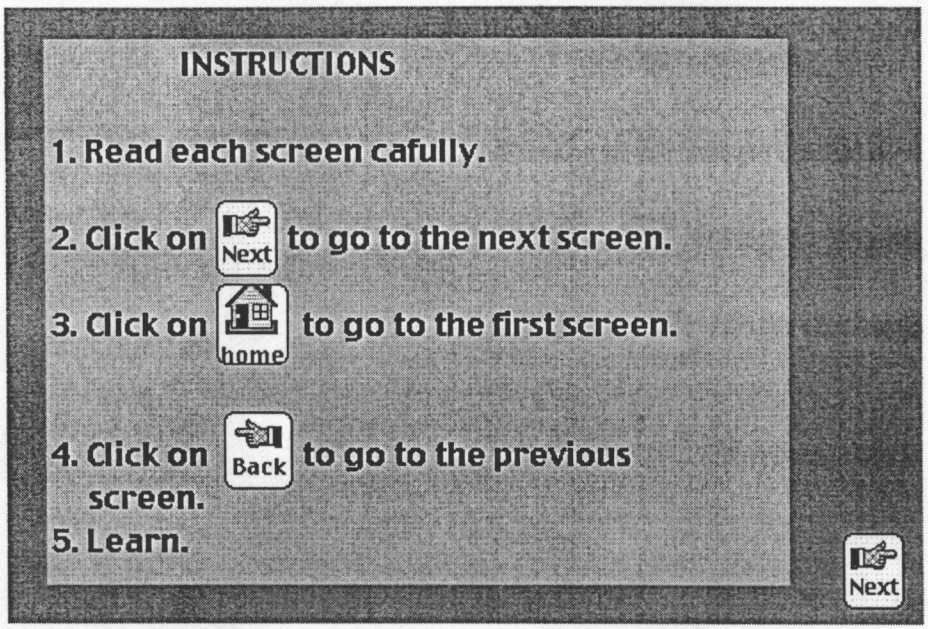

CONGRATULATIONS!
You have completed this lesson successfully.
Click on home to quit the
program or go back to the first screen.

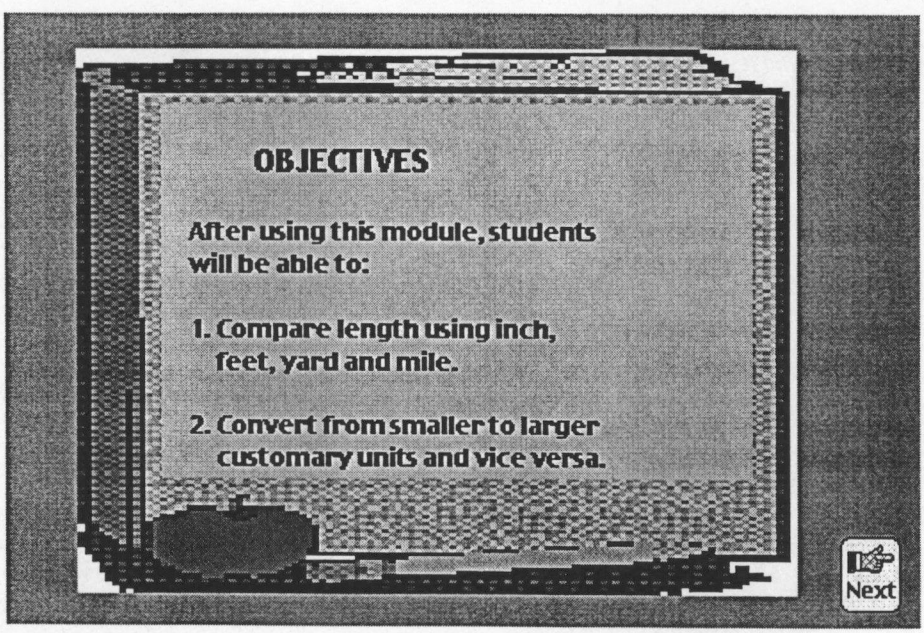
APPLICATION # 2:

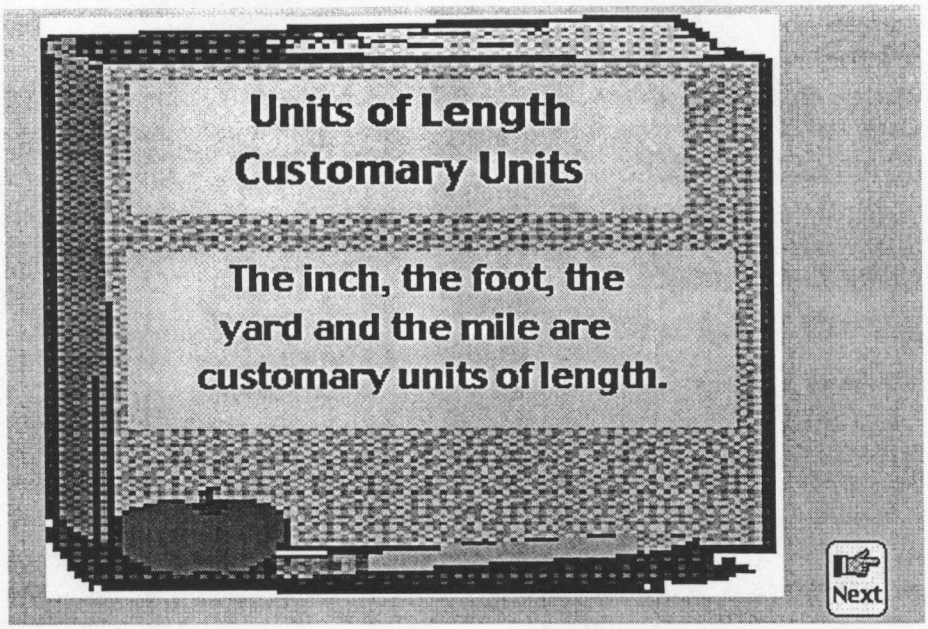
MEASUREMENT

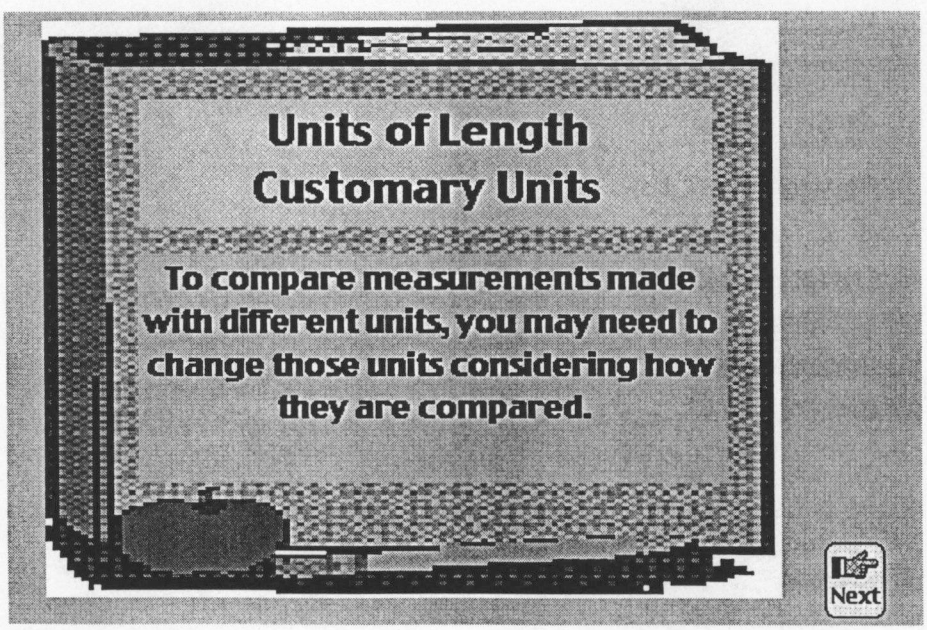

MEASUREMENT
4th Grade
Jenia D. Alfonzo
1999
Next

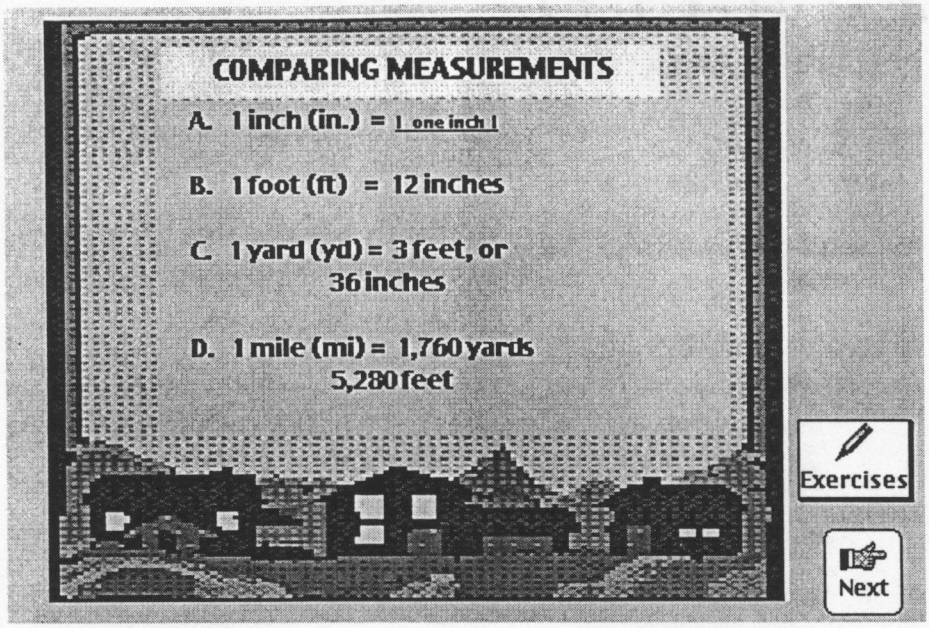

MEASUREMENTS
This lesson is designed to review measurement
4th Grade
MATH
Next

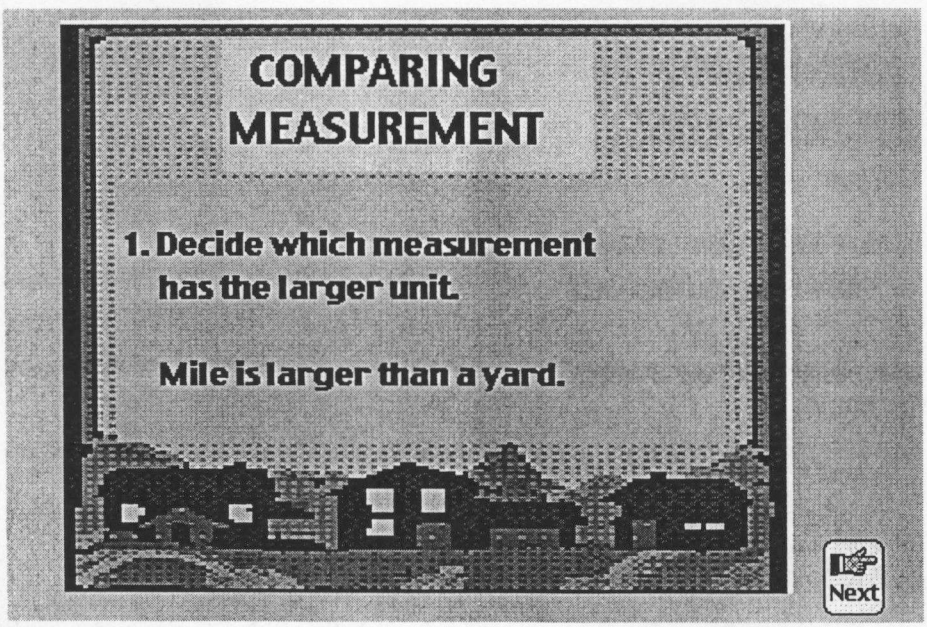

INSTRUCTIONS
1. Read each screen cafully.
2. Click on Next to go to the next screen.
3. Click on home to go to the first screen.
4. Click on Back to go to the previous screen.
5. Learn.
Next

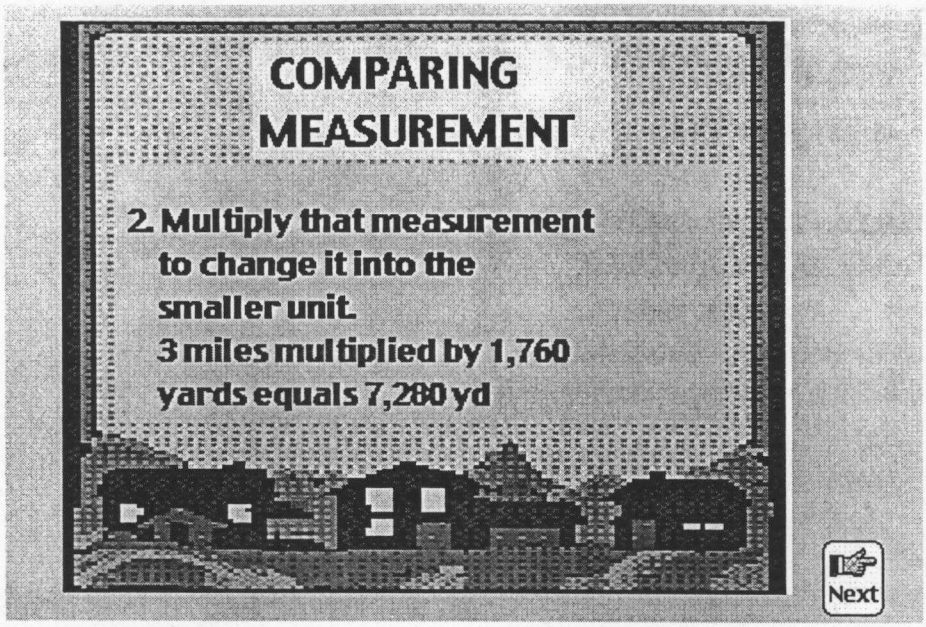

OBJECTIVES
After using this module, students will be able to:
1. Compare length using inch, feet, yard and mile.
2. Convert from smaller to larger customary units and vice versa.
Next

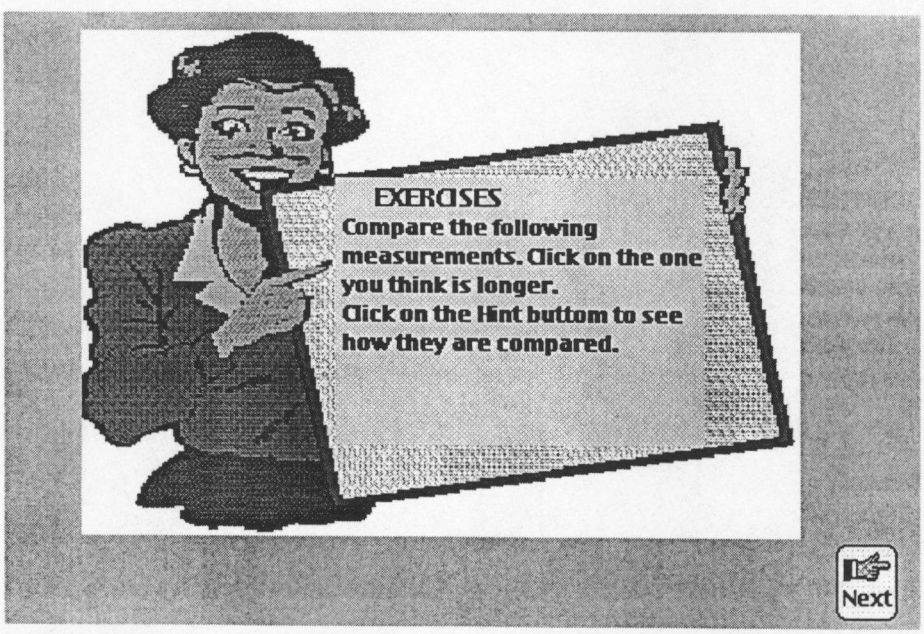

Units of Length
Customary Units
The inch, the foot, the yard and the mile are customary units of length.
Next

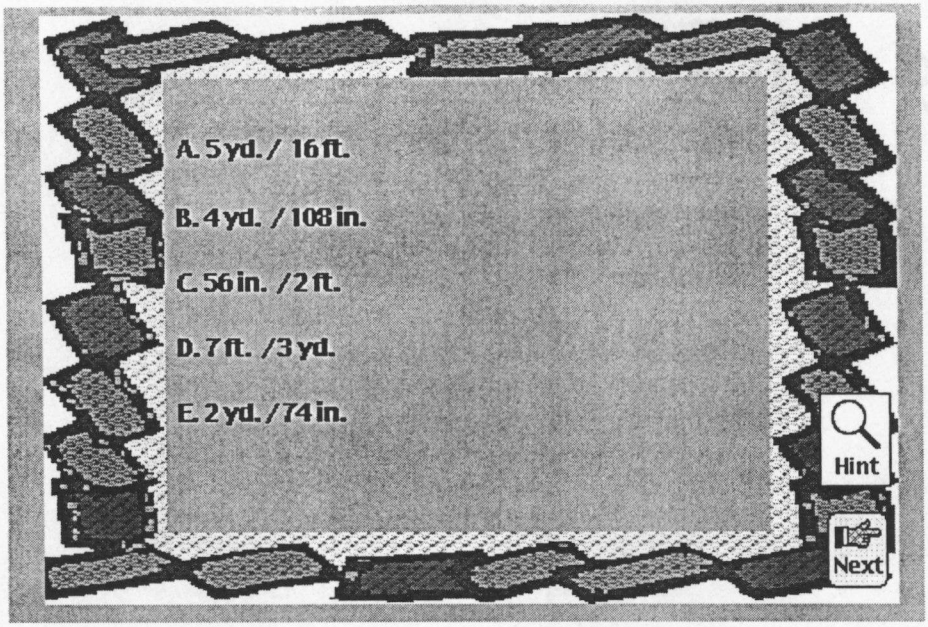

Units of Length
Customary Units
To compare measurements made with different units, you may need to change those units considering how they are compared.
Next

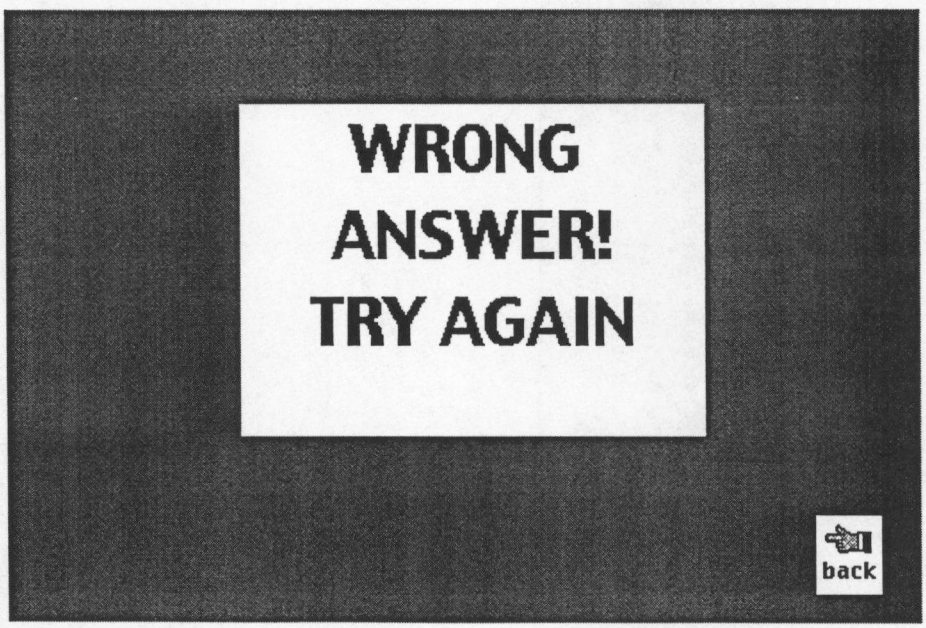

COMPARING MEASUREMENTS
A. 1 inch (in.) = [one inch]
B. 1 foot (ft) = 12 inches
C. 1 yard (yd) = 3 feet, or
36 inches
D. 1 mile (mi) = 1,760 yards
5,280 feet
Exercises
Next


COMPARING
MEASUREMENT
1. Decide which measurement
has the larger unit.
Mile is larger than a yard.
Next

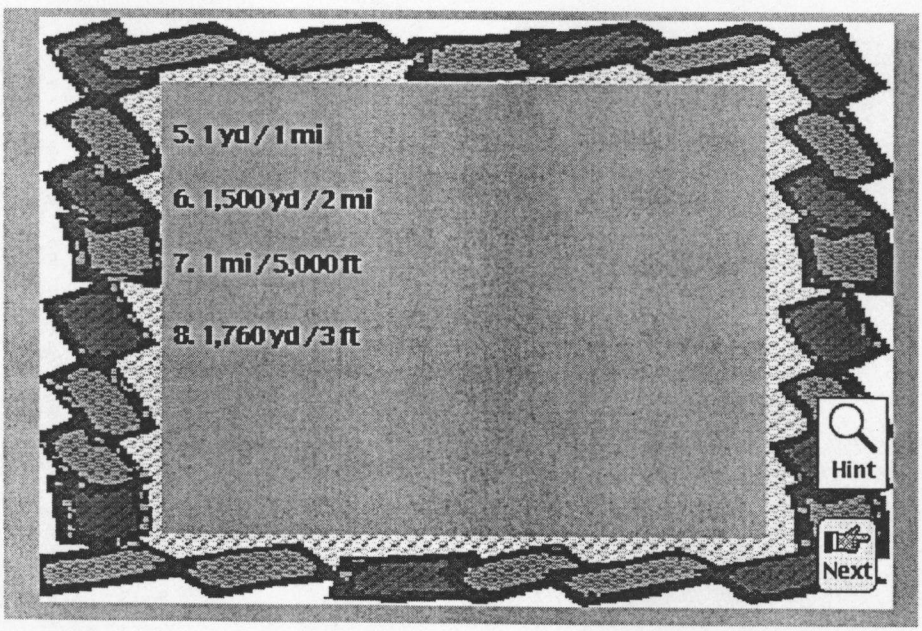

COMPARING
MEASUREMENT
2. Multiply that measurement
to change it into the
smaller unit.
3 miles multiplied by 1,760
yards equals 7,280 yd
Next

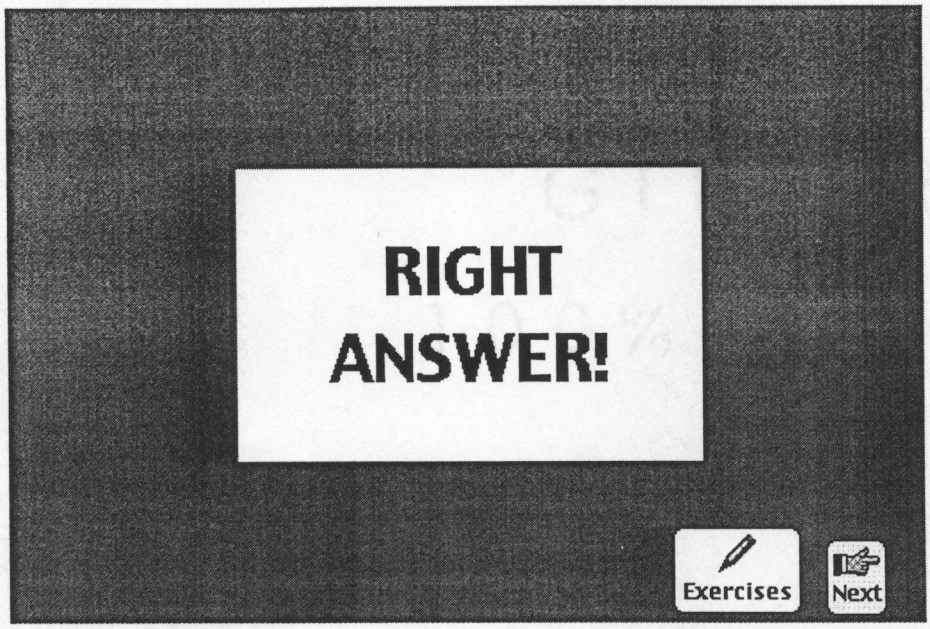

EXERCISES
Compare the following
measurements. Click on the one
you think is longer.
Click on the Hint buttom to see
how they are compared.
Next

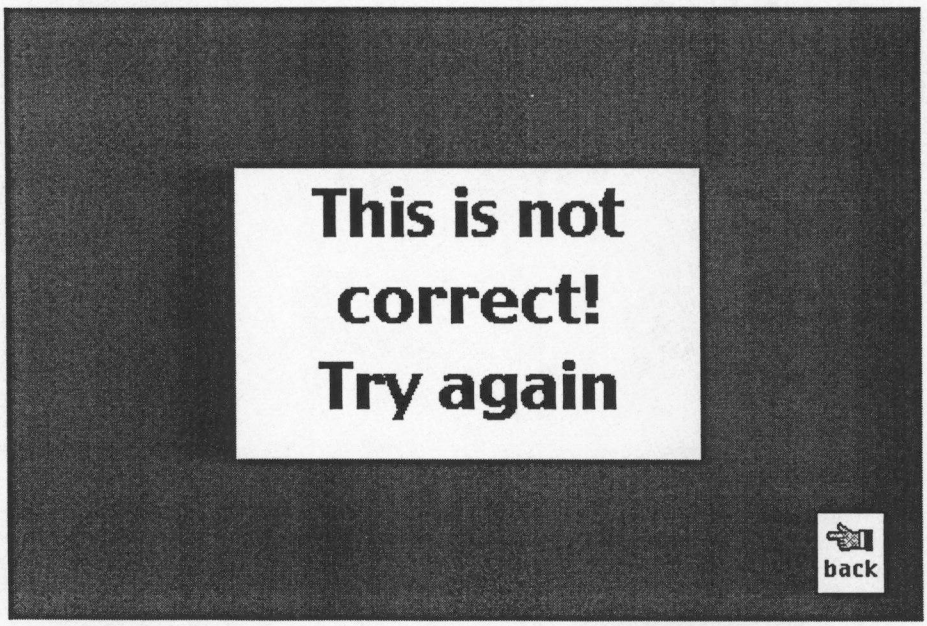

A. 5 yd. / 16 ft.
B. 4 yd. / 108 in.
C. 56 in. / 2 ft.
D. 7 ft. / 3 yd.
E. 2 yd. / 74 in.
Hint
Next

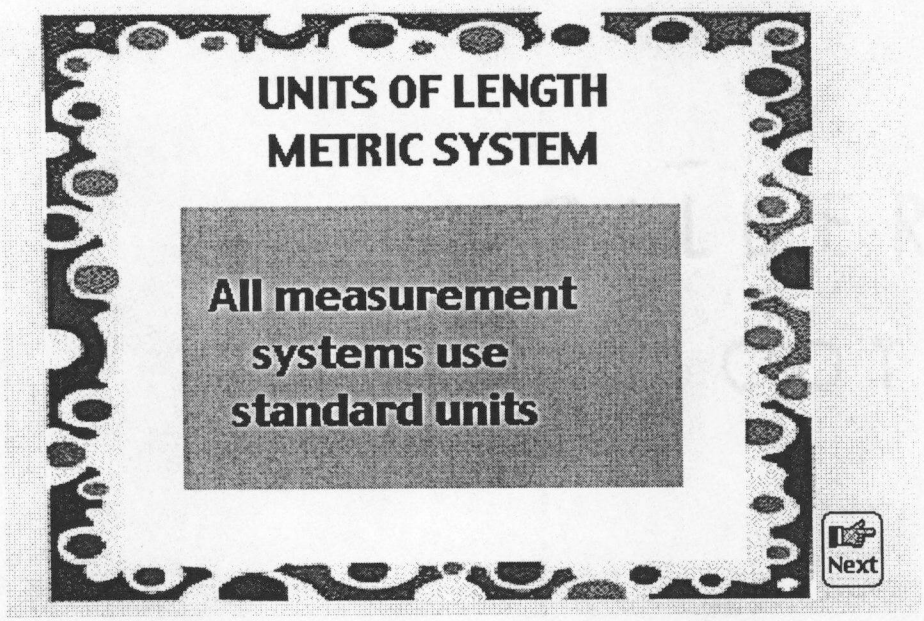

WRONG
ANSWER!
TRY AGAIN
back

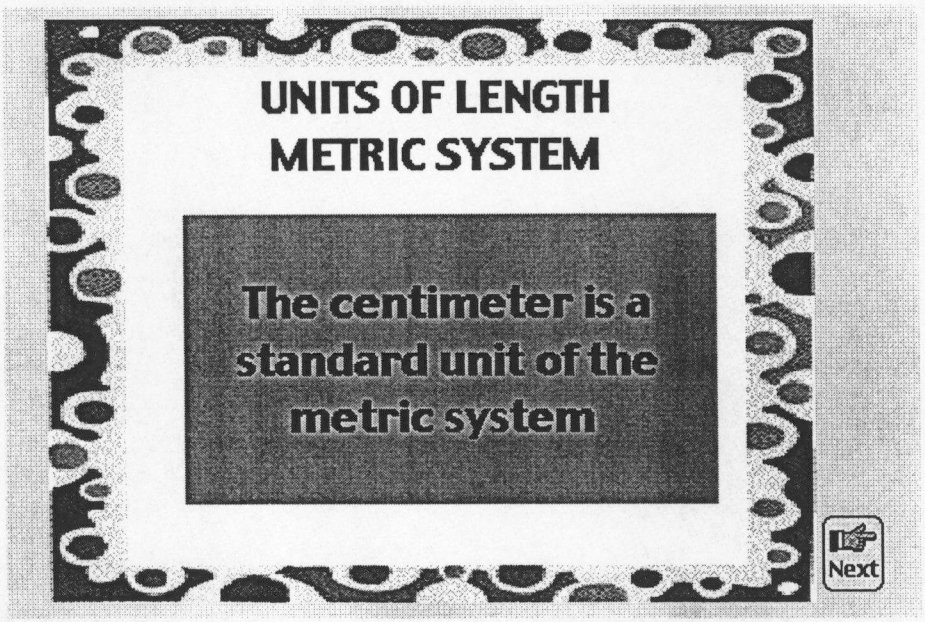

GREAT
RESPONSE!
Exercises
Next

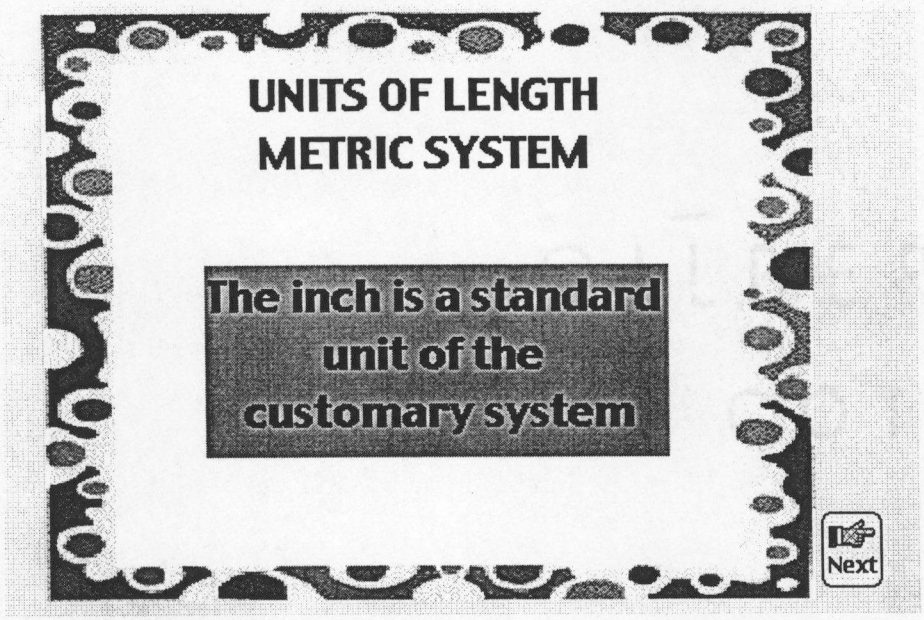

5. 1 yd / 1 mi
6. 1,500 yd / 2 mi
7. 1 mi / 5,000 ft
8. 1,760 yd / 3 ft
Hint
Next

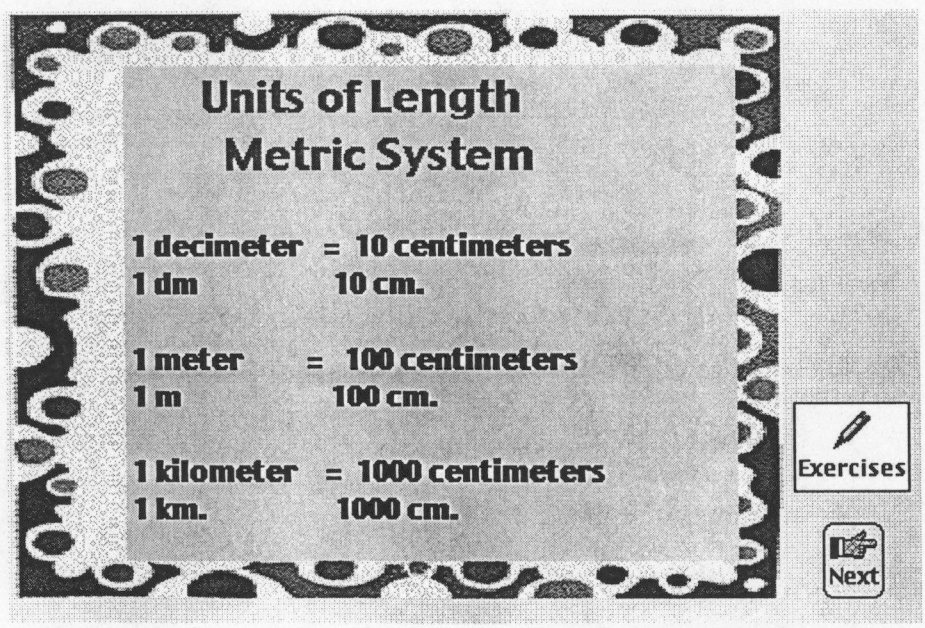

RIGHT
ANSWER!
Exercises
Next

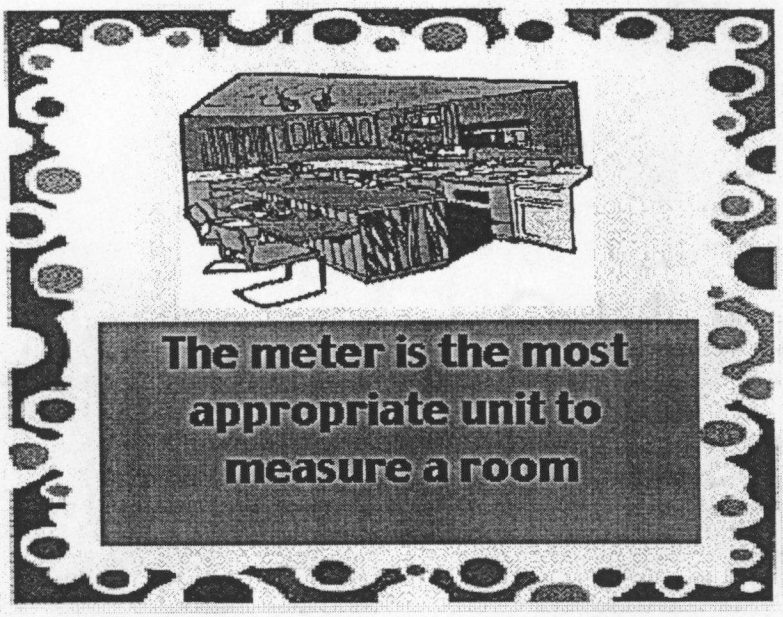

This is not
correct!
Try again
back

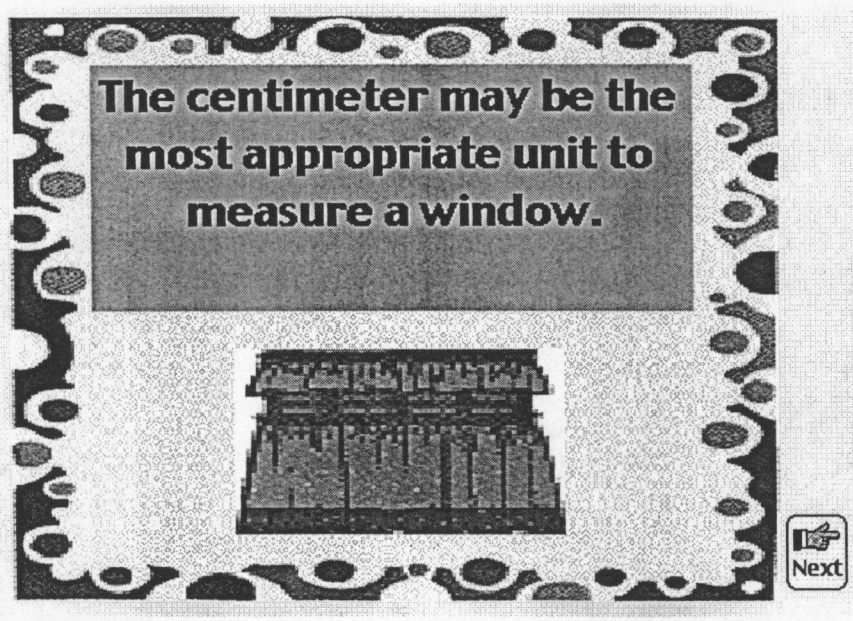

UNITS OF LENGTH
METRIC SYSTEM
All measurement systems use standard units
Next

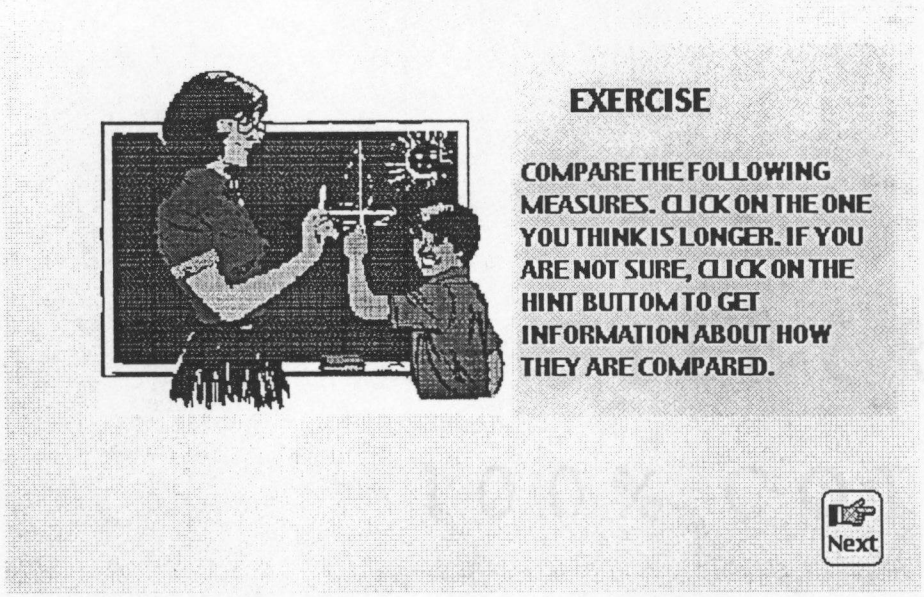

UNITS OF LENGTH
METRIC SYSTEM
The centimeter is a standard unit of the metric system
Next

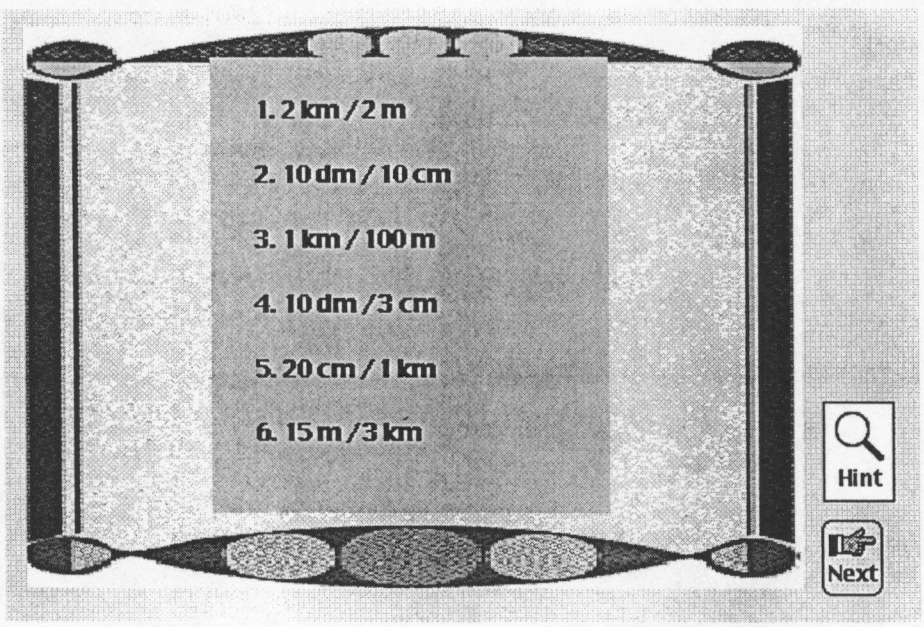

UNITS OF LENGTH
METRIC SYSTEM
The inch is a standard unit of the customary system
Next

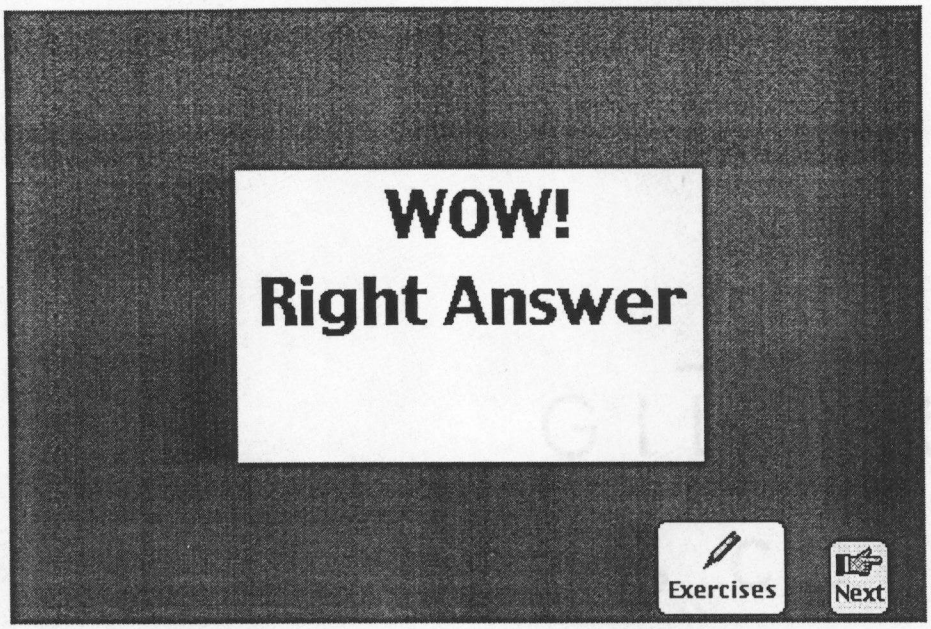

Units of Length
Metric System
1 decimeter = 10 centimeters
1 dm 10 cm.
1 meter = 100 centimeters
1 m 100 cm.
1 kilometer = 1000 centimeters
1 km. 1000 cm.
Exercises
Next


The meter is the most appropriate unit to measure a room
Next

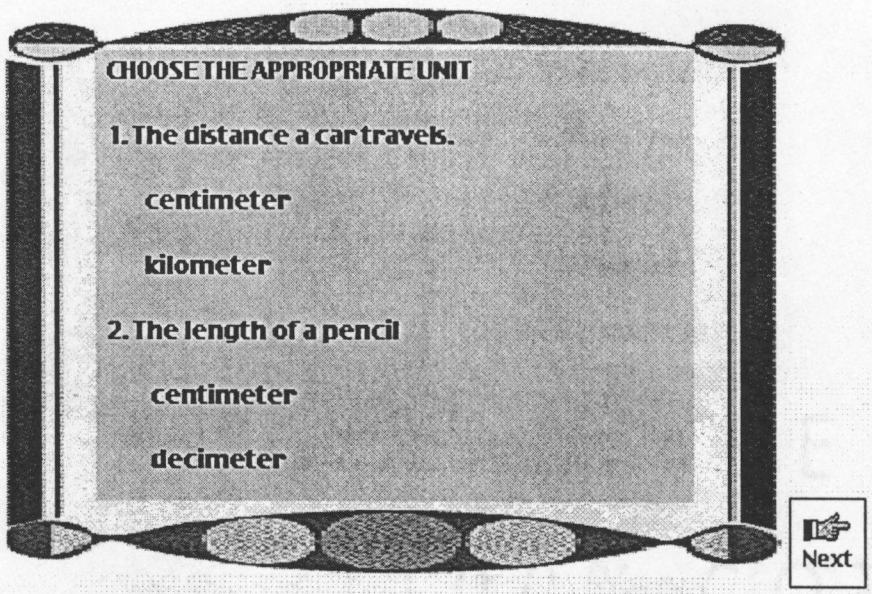

The centimeter may be the most appropriate unit to measure a window.
Next


EXERCISE
COMPARE THE FOLLOWING MEASURES. CLICK ON THE ONE YOU THINK IS LONGER. IF YOU ARE NOT SURE, CLICK ON THE HINT BUTTOM TO GET INFORMATION ABOUT HOW THEY ARE COMPARED.
Next


1. 2 km / 2 m
2. 10 dm / 10 cm
3. 1 km / 100 m
4. 10 dm / 3 cm
5. 20 cm / 1 km
6. 15 m / 3 km
Hint
Next

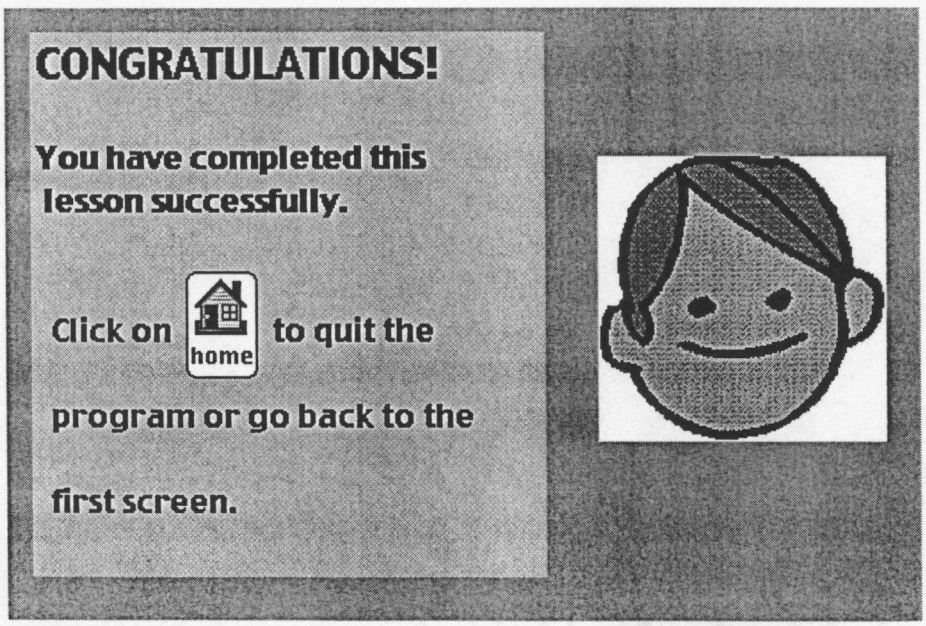

WOW!
Right Answer
Exercises
Next


WRONG,
TRY AGAIN!
Back


CHOOSE THE APPROPRIATE UNIT
1. The distance a car travels.
centimeter
kilometer
2. The length of a pencil
centimeter
decimeter
Next

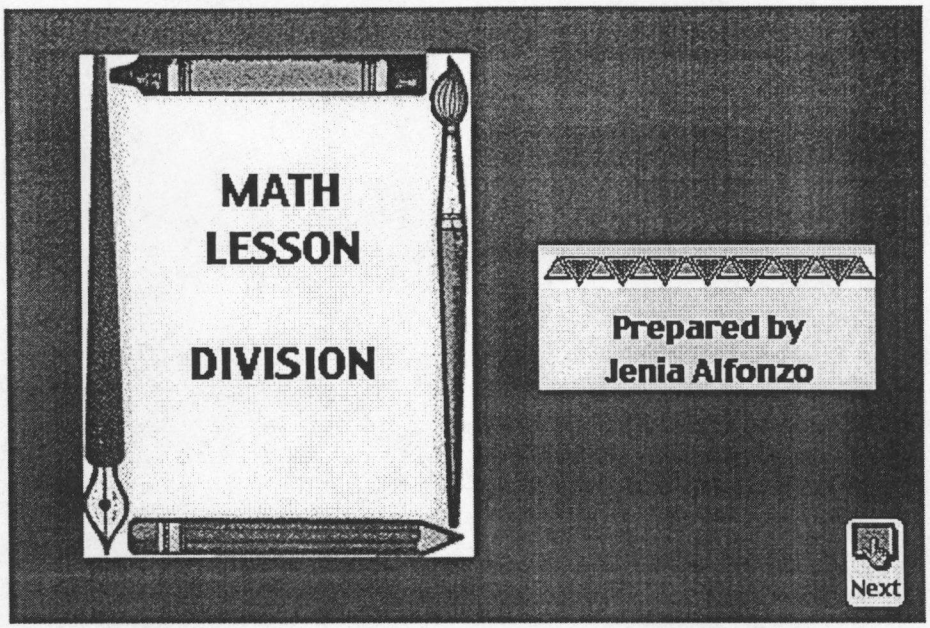

WRONG,
TRY AGAIN!
Back

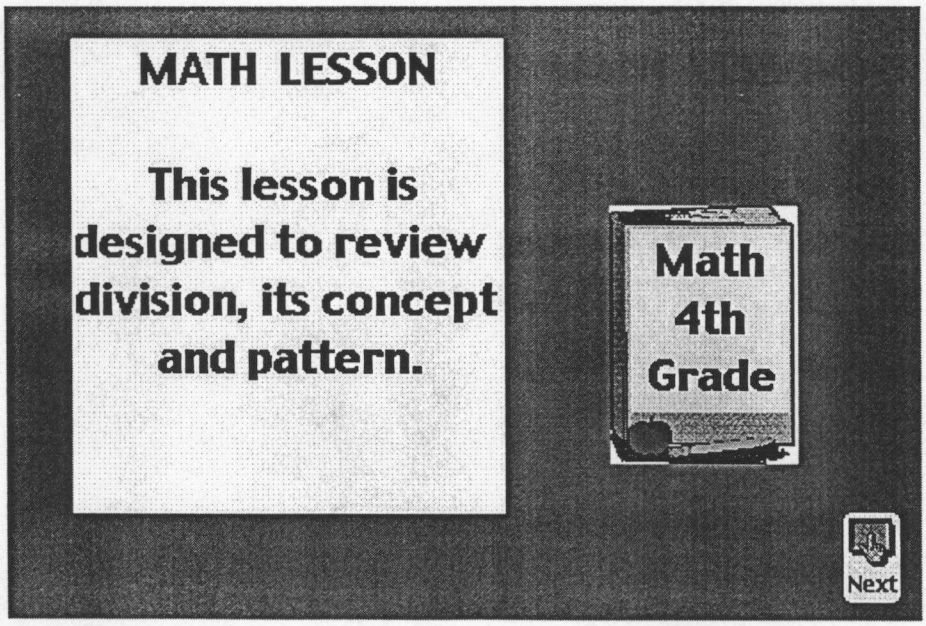

WONDERFUL!
Exercises
Next

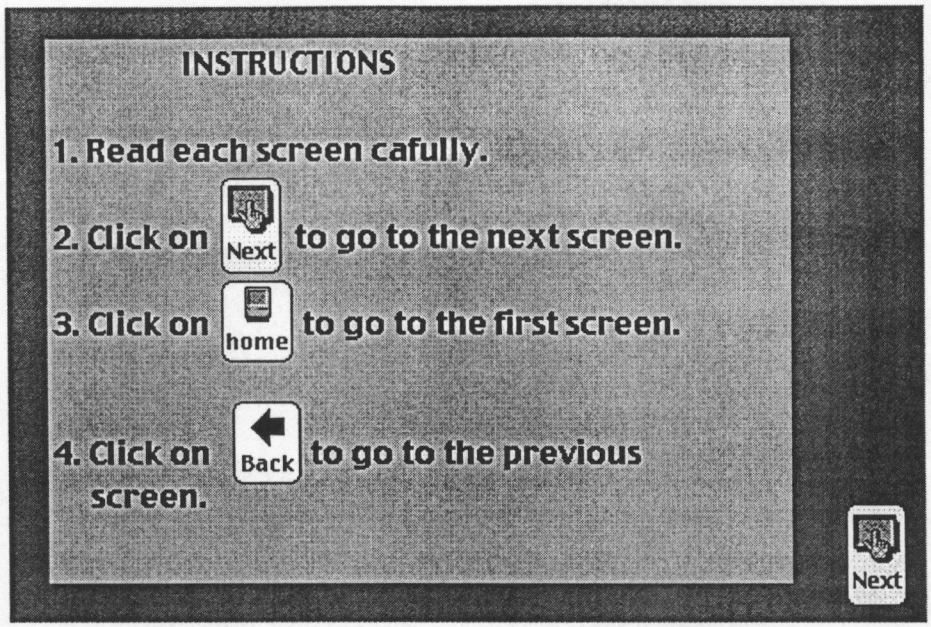

CONGRATULATIONS!
You have completed this lesson successfully.
Click on home to quit the program or go back to the first screen.

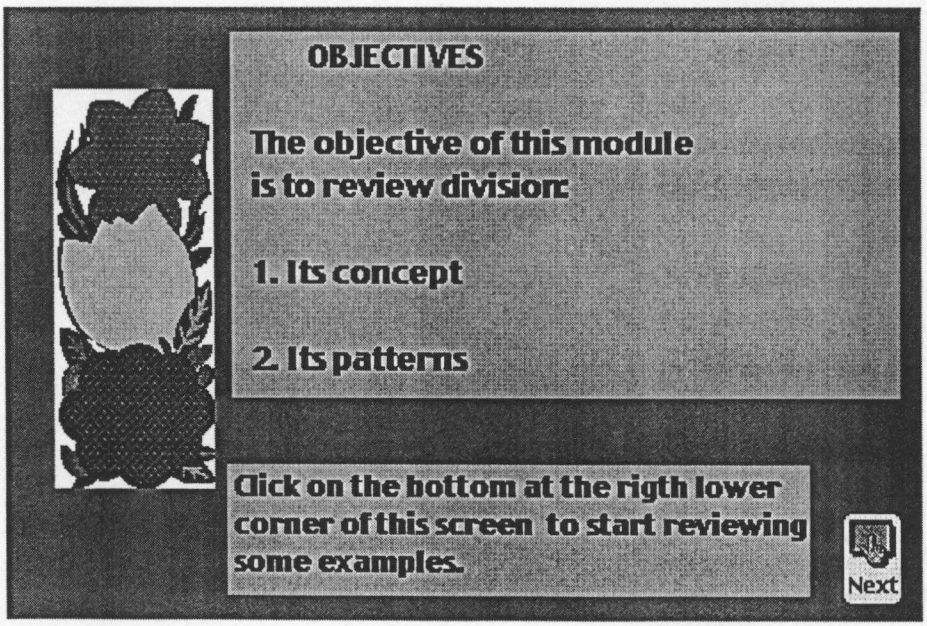
APPLICATION # 3:

DIVISION


MATH
LESSON
DIVISION
Prepared by
Jenia Alfonzo
Next


MATH LESSON
This lesson is designed to review division, its concept and pattern.
Math
4th
Grade
Next


INSTRUCTIONS
1. Read each screen cafully.
2. Click on Next to go to the next screen.
3. Click on home to go to the first screen.
4. Click on Back to go to the previous screen.
Next


OBJECTIVES
The objective of this module is to review division:
1. Its concept
2. Its patterns
Click on the bottom at the rigth lower corner of this screen to start reviewing some examples.
Next

The teacher has 12 cupcakes. She wants equal groups of cupcakes in each basket.

How many baskets are there?

There are 3 baskets

How many cupcakes will she put in each basket?



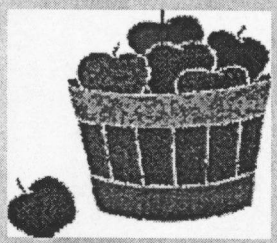


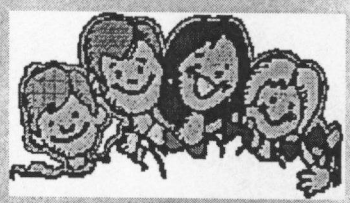
12 cupcakes divided into 3 baskets equals 4

The teacher will put 4 cupcakes in each basket.

Next

Sally wants to share 24 apples equally with Mike, Ted and Sara. How many apples will each person get?





24 APPLES *4 PEOPLE*

24 divided by 4 equals 6

EACH PERSON GETS 6 APPLES

Next

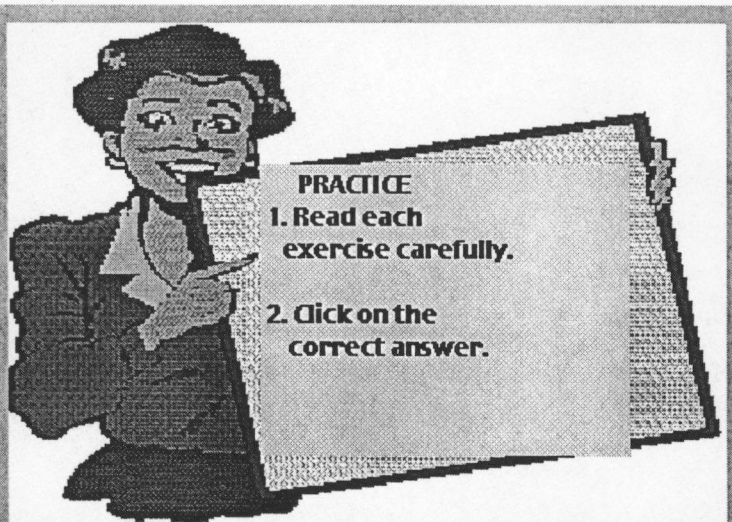
Rachel has 4 dogs. She has 36 treats. She gives each dog one treat each day. How many days will the dog treats last?

36 treats divided into 4 dogs ➡ 8 treats

The dog treats will last 8 days



Next



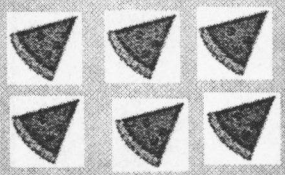
Next

Jeff cut a pizza into 6 slices. He wants to share it equally with his friend Rob.

How many slices will each person get?

a. 4

b. 3



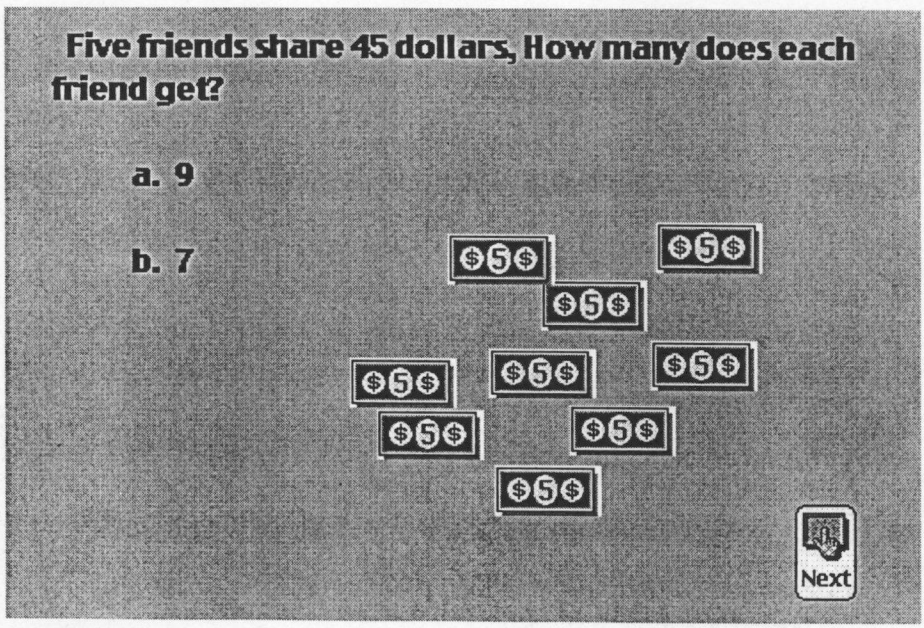
Next

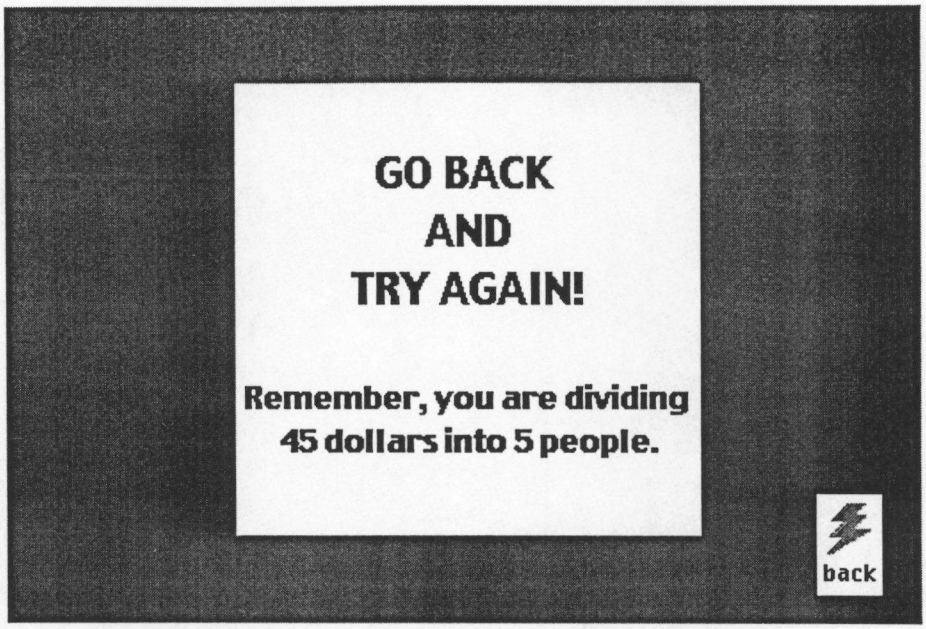
WRONG ANSWER!
TRY AGAIN

HINT
Remember, you are dividing 6 pizza slices equally into Jeff and Rob.

back


GREAT
RESPONSE!
Next


Five friends share 45 dollars, How many does each friend get?
a. 9
b. 7
Next

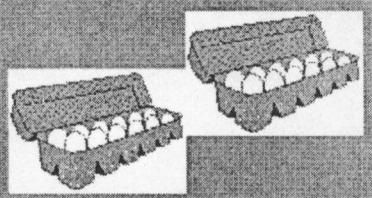

GO BACK
AND
TRY AGAIN!
Remember, you are dividing
45 dollars into 5 people.
back


GOOD
JOB!
Next

My mother has 2 dozens of eggs. She wants to prepare omelletes.
She needs 3 eggs for each omellete.
How many omelletes will she prepare with two dozen of eggs?

a. 6

b. 8

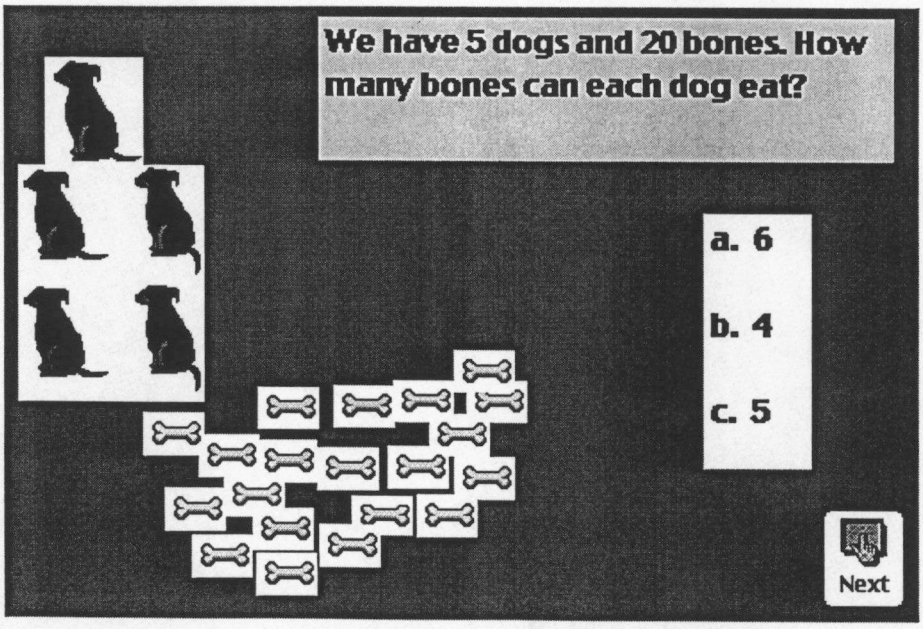


Next

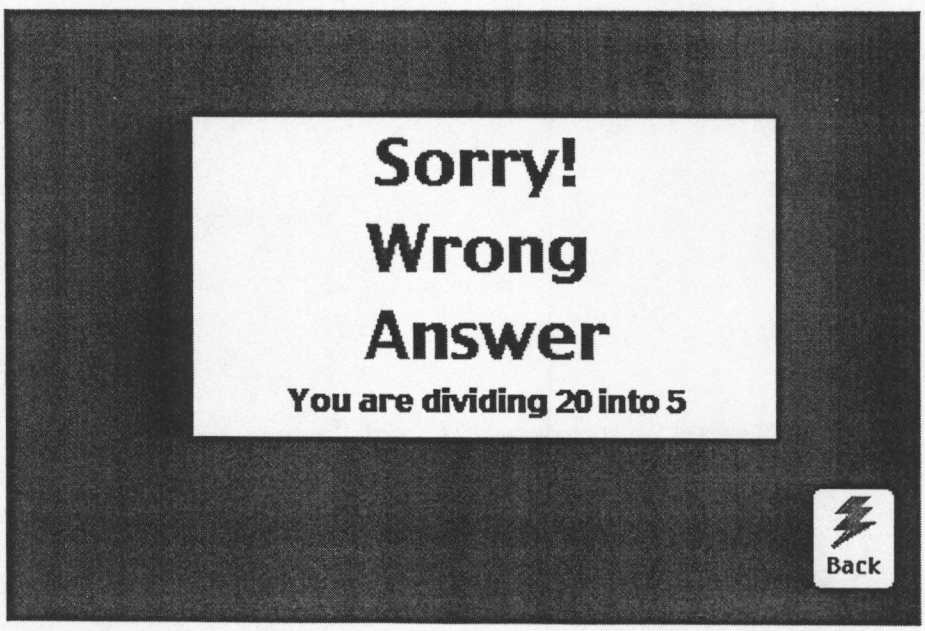
SORRY!
Not a good answer
Remember, You are dividing 24 eggs into 3 to get the number of omelletes.

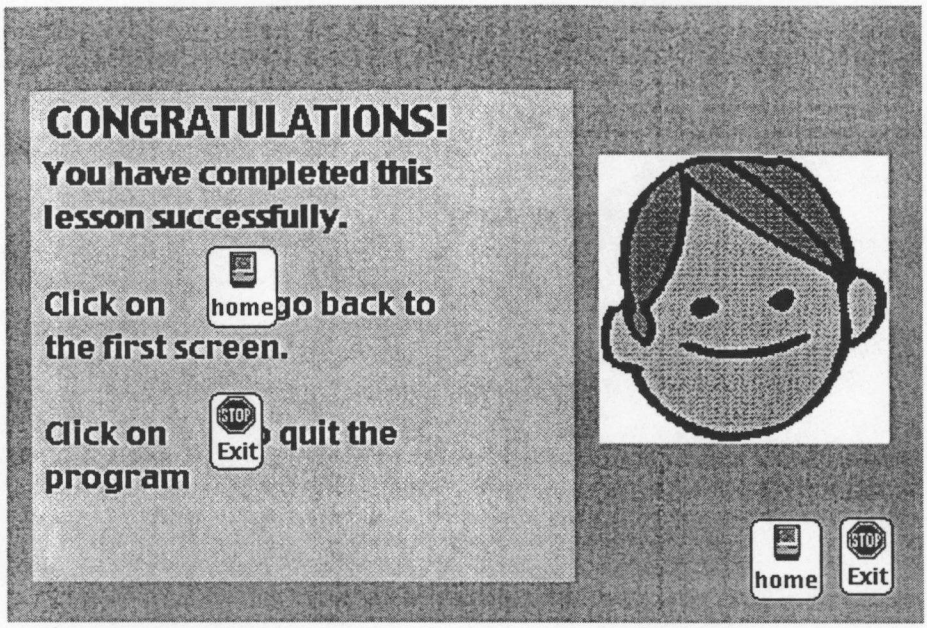
back


WONDERFUL!
Go on.
Next


We have 5 dogs and 20 bones. How many bones can each dog eat?
a. 6
b. 4
c. 5
Next

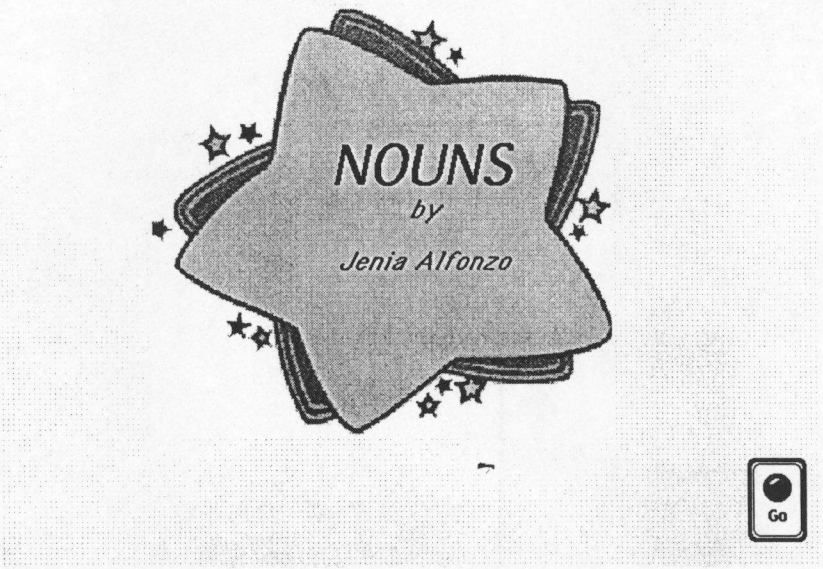

GREAT!
GREAT!
GREAT!
Next

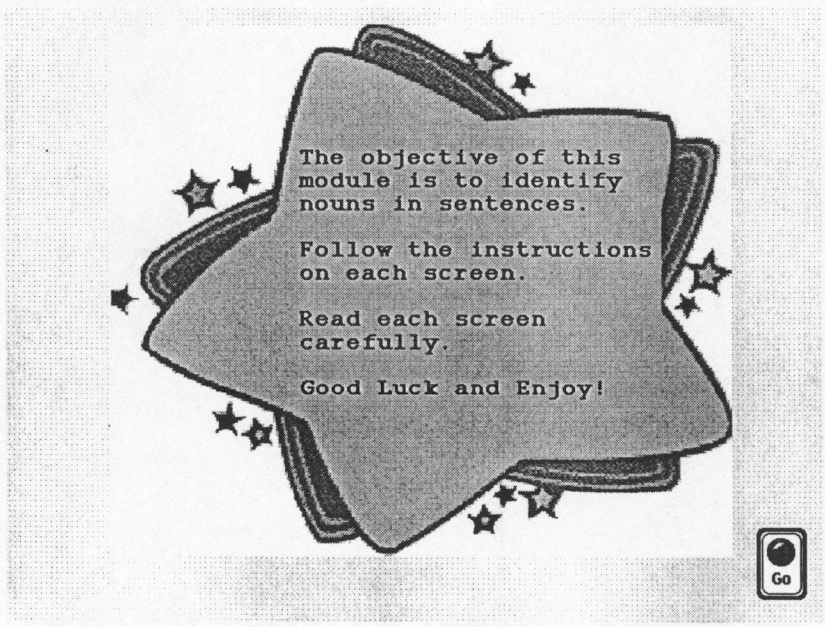

Sorry!
Wrong
Answer
You are dividing 20 into 5
Back

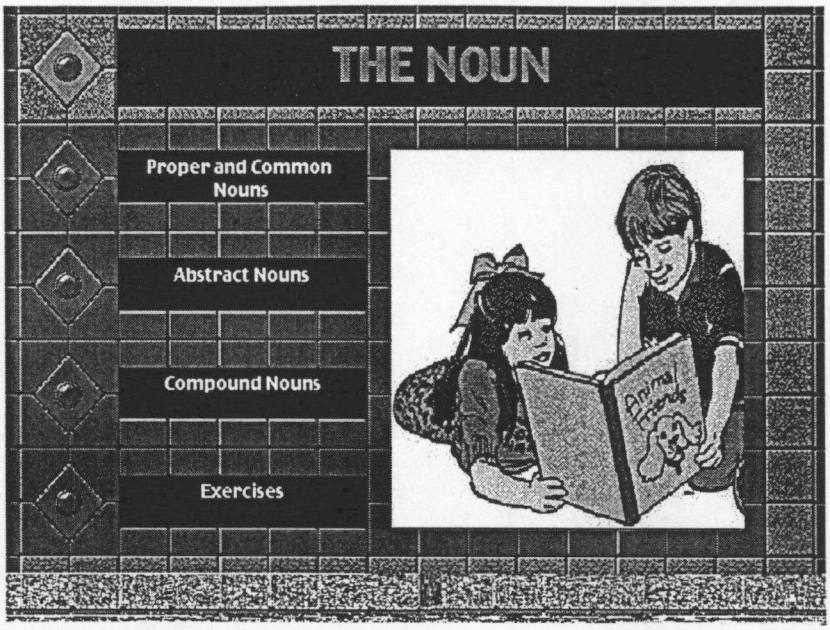

CONGRATULATIONS!
You have completed this lesson successfully.
Click on home go back to the first screen.
Click on Exit quit the program
home
Exit

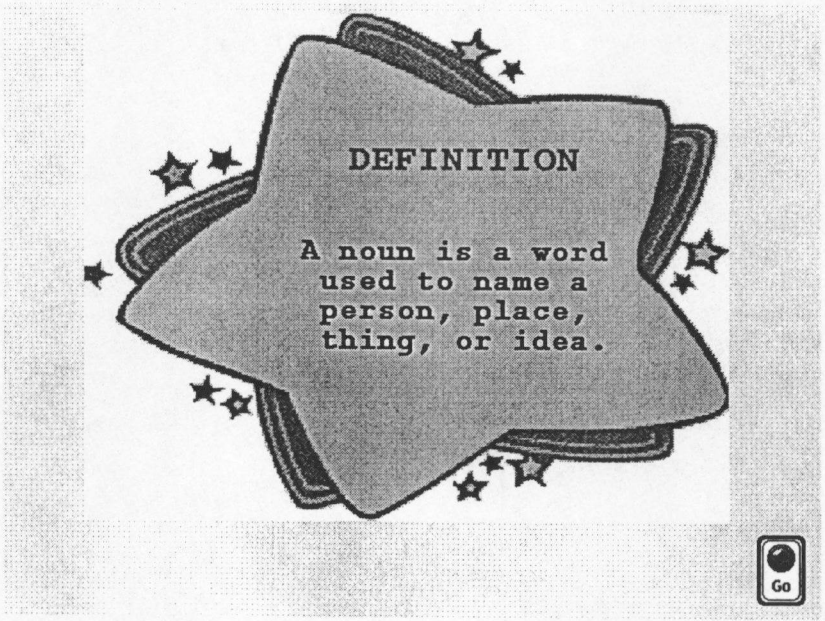
APPLICATION # 4:

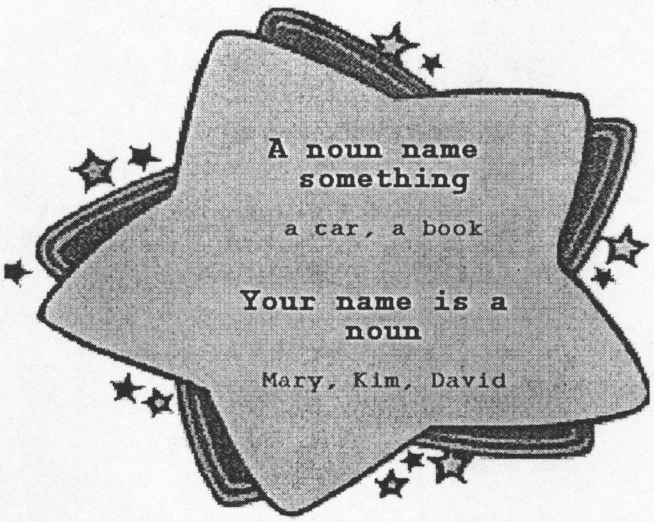
NOUNS


NOUNS
by
Jenia Alfonzo
Go

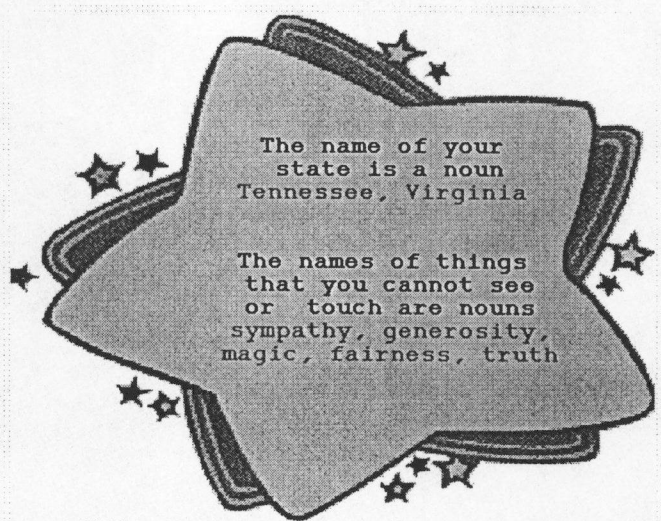

The objective of this module is to identify nouns in sentences.
Follow the instructions on each screen.
Read each screen carefully.
Good Luck and Enjoy!
Go


THE NOUN
Proper and Common Nouns
Abstract Nouns
Compound Nouns
Exercises
Animal Friends

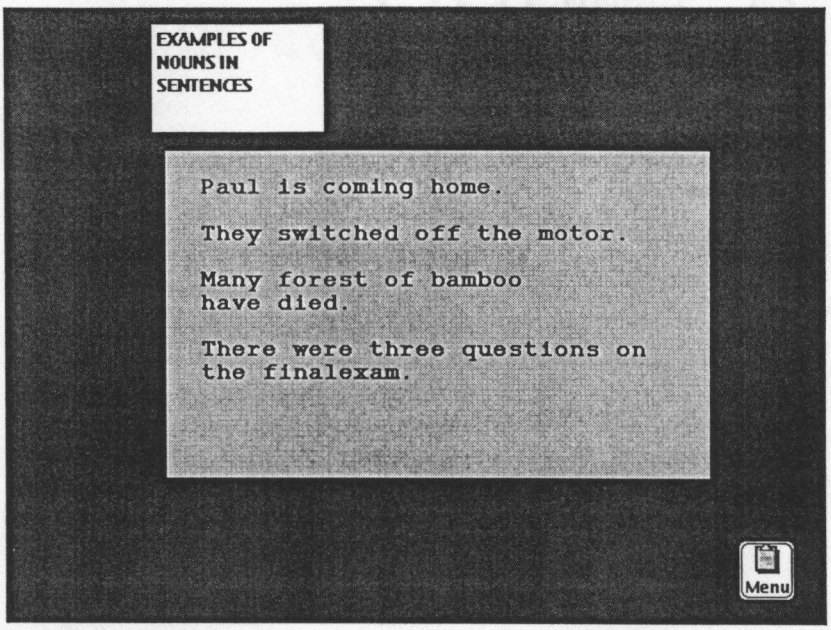

DEFINITION
A noun is a word used to name a person, place, thing, or idea.
Go

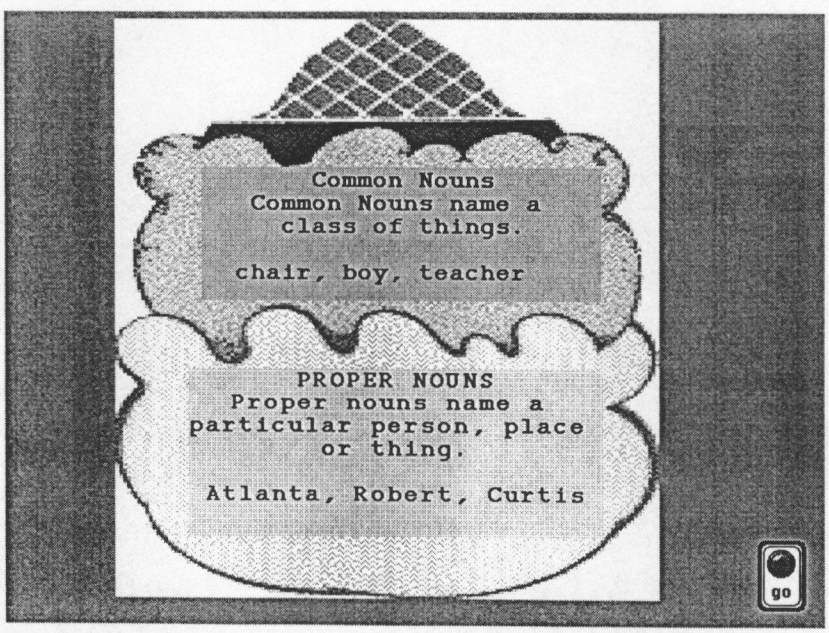

A noun name something
a car, a book
Your name is a noun
Mary, Kim, David

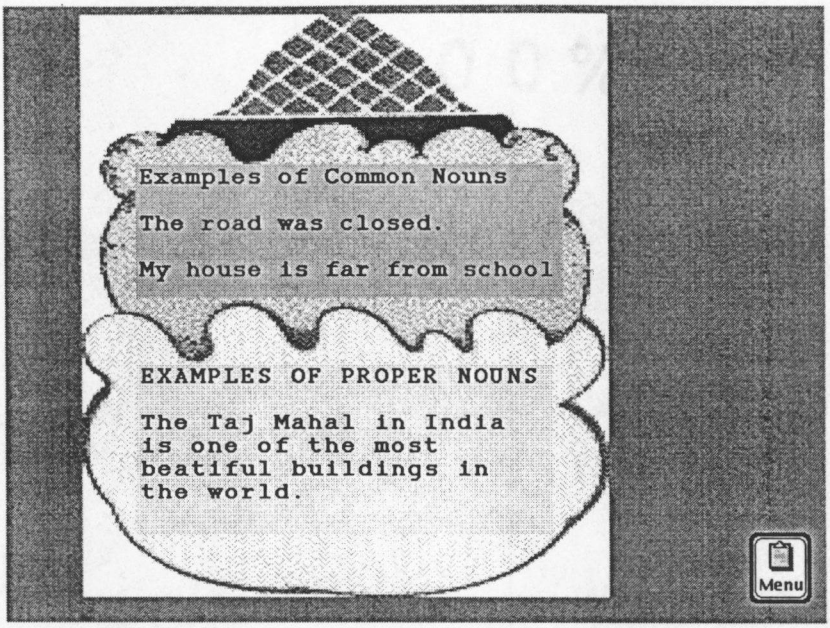

Go

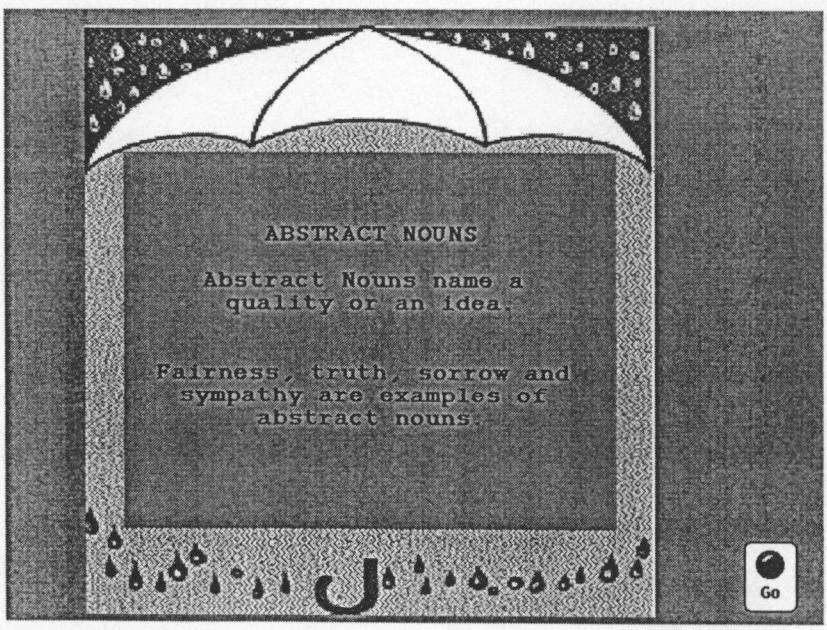

The name of your state is a noun
Tennessee, Virginia
The names of things that you cannot see or touch are nouns
sympathy, generosity, magic, fairness, truth

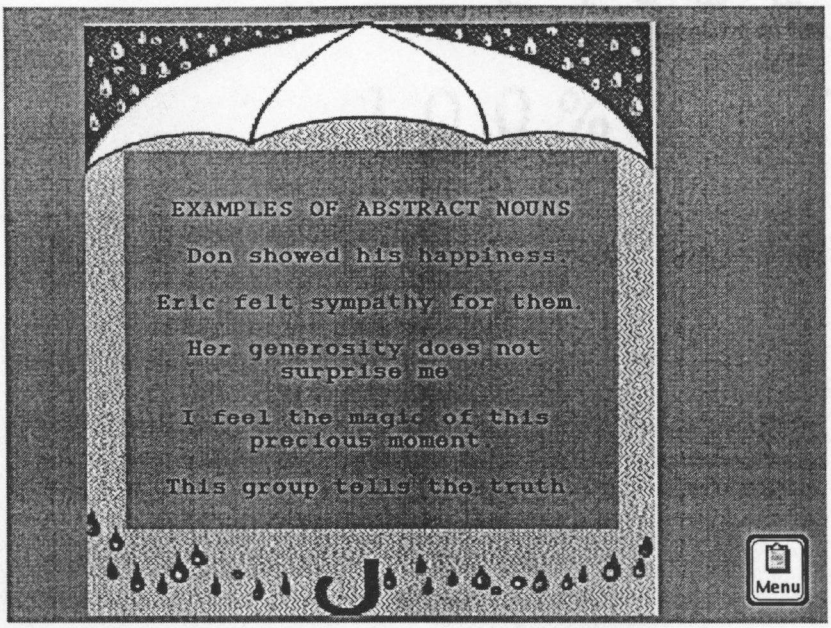

Go

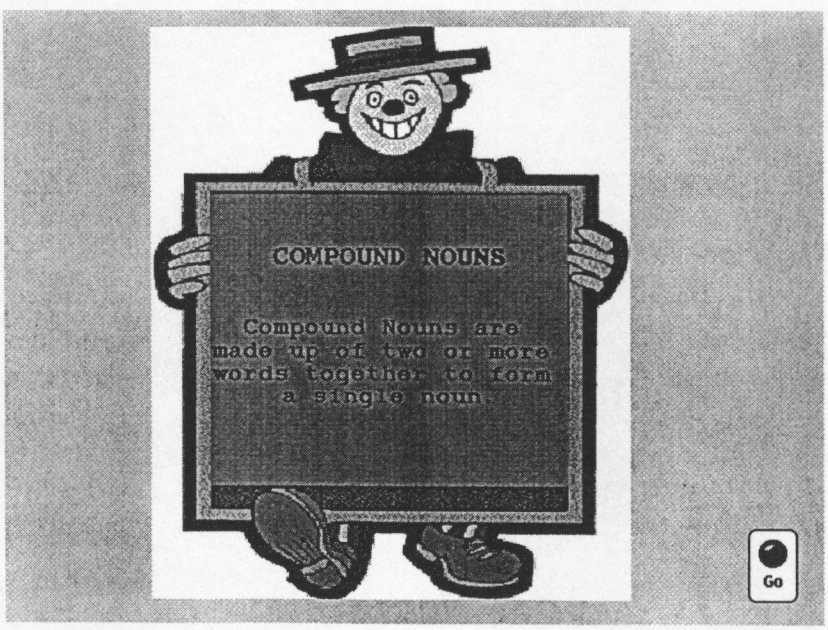

EXAMPLES OF
NOUNS IN
SENTENCES
Paul is coming home.
They switched off the motor.
Many forest of bamboo
have died.
There were three questions on
the finalexam.
Menu

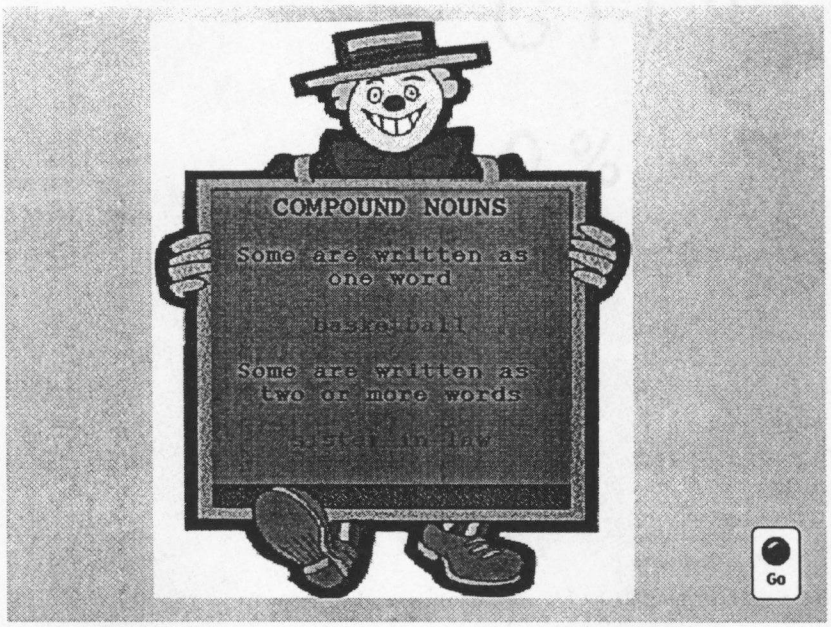

Common Nouns
Common Nouns name a
class of things.
chair, boy, teacher
PROPER NOUNS
Proper nouns name a
particular person, place
or thing.
Atlanta, Robert, Curtis
go

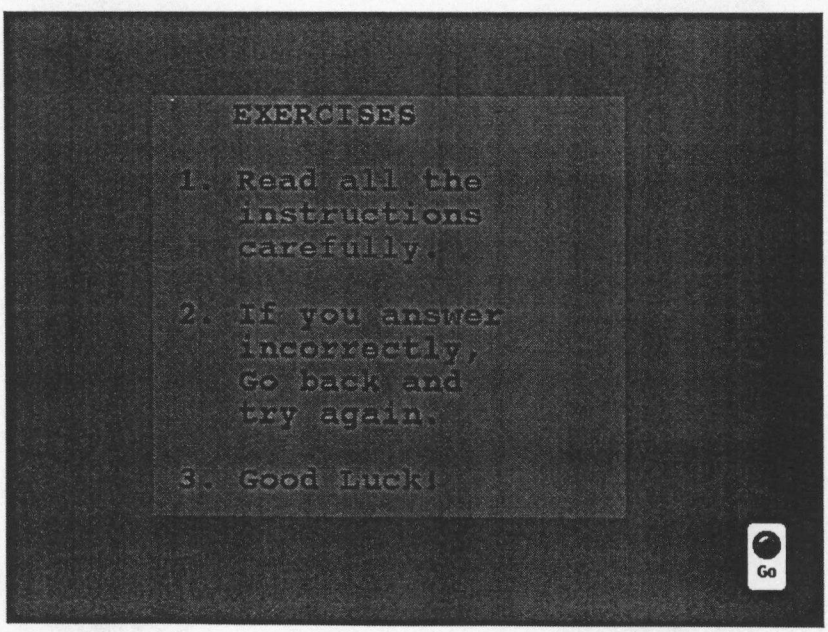

Examples of Common Nouns
The road was closed.
My house is far from school
EXAMPLES OF PROPER NOUNS
The Taj Mahal in India is one of the most beatiful buildings in the world.
Menu

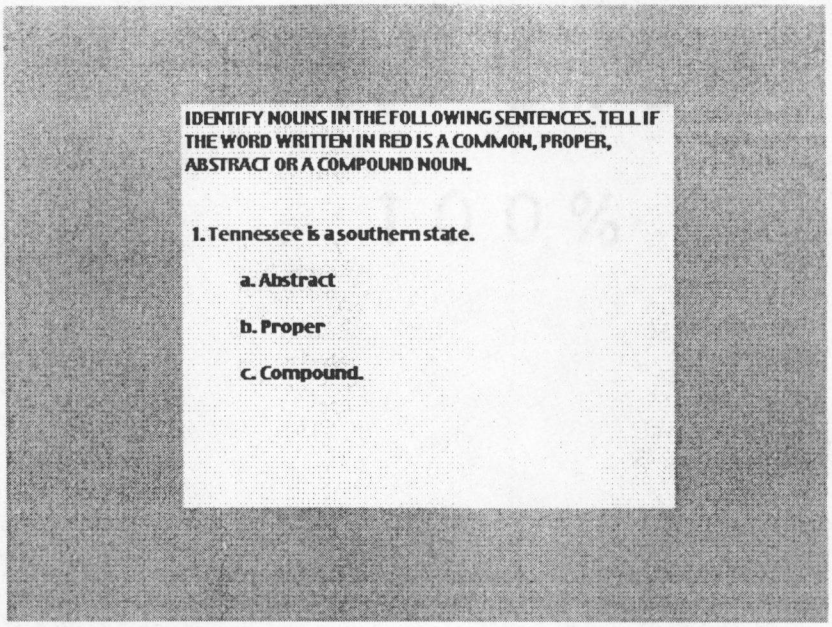

ABSTRACT NOUNS
Abstract Nouns name a quality or an idea.
Fairness, truth, sorrow and sympathy are examples of abstract nouns.
Go


EXAMPLES OF ABSTRACT NOUNS
Don showed his happiness.
Eric felt sympathy for them.
Her generosity does not surprise me.
I feel the magic of this precious moment.
This group tells the truth.
Menu

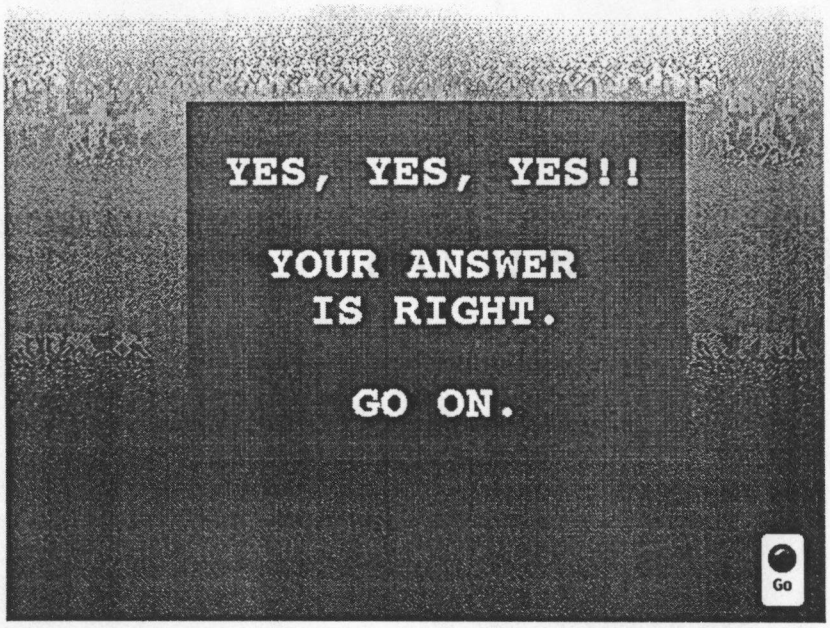

COMPOUND NOUNS
Compound Nouns are made up of two or more words together to form a single noun.
Go

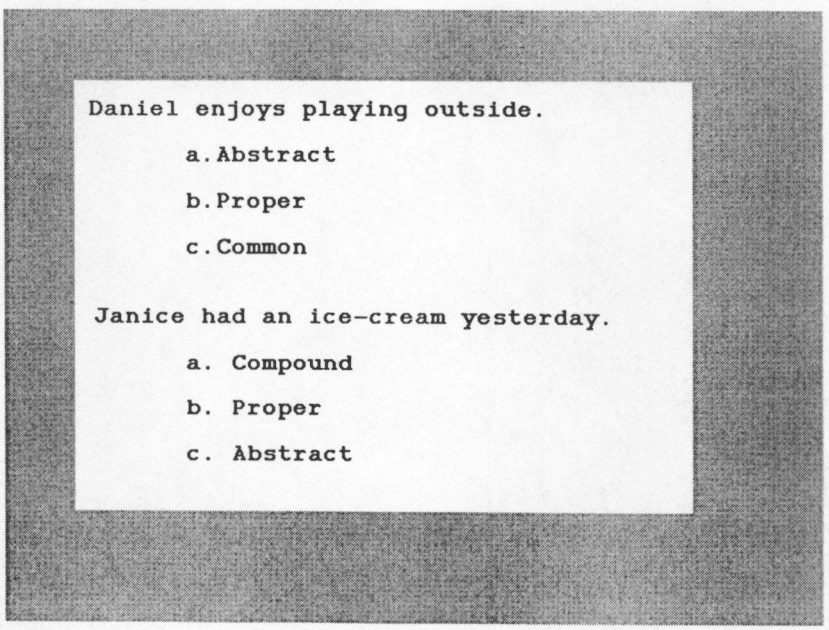

COMPOUND NOUNS
Some are written as one word
basketball
Some are written as two or more words
sister-in-law
Go

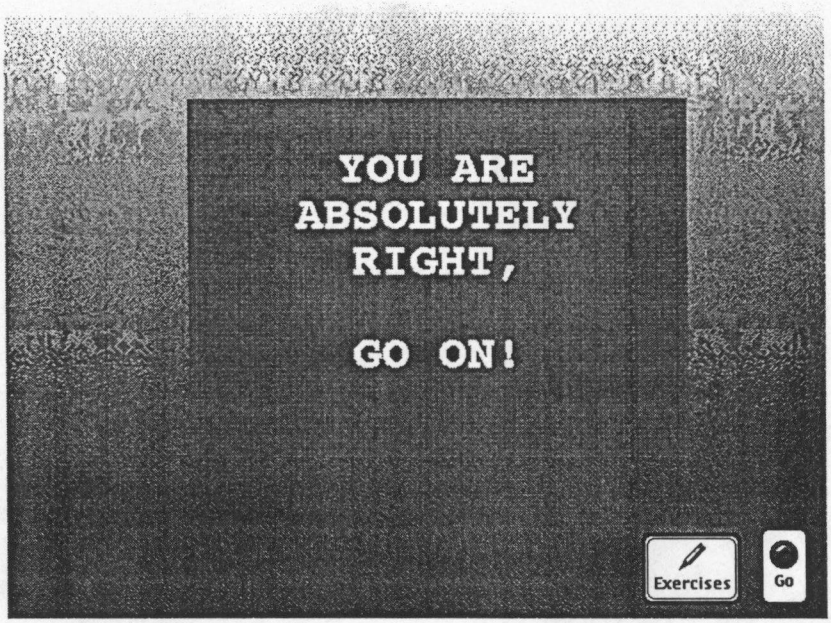

EXERCISES
1. Read all the instructions carefully.
2. If you answer incorrectly, Go back and try again.
3. Good Luck!
Go

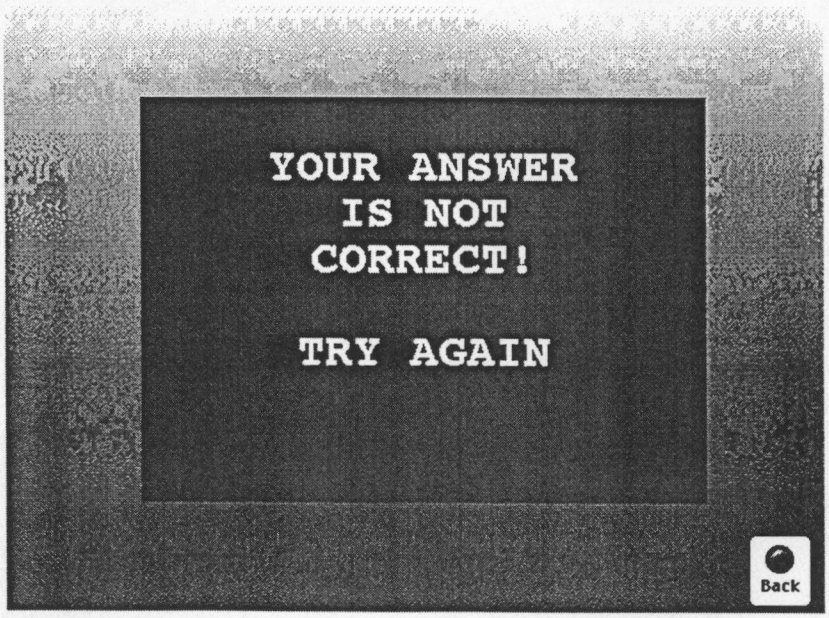

IDENTIFY NOUNS IN THE FOLLOWING SENTENCES. TELL IF THE WORD WRITTEN IN RED IS A COMMON, PROPER, ABSTRACT OR A COMPOUND NOUN.
1. Tennessee is a southern state.
a. Abstract
b. Proper
c. Compound.

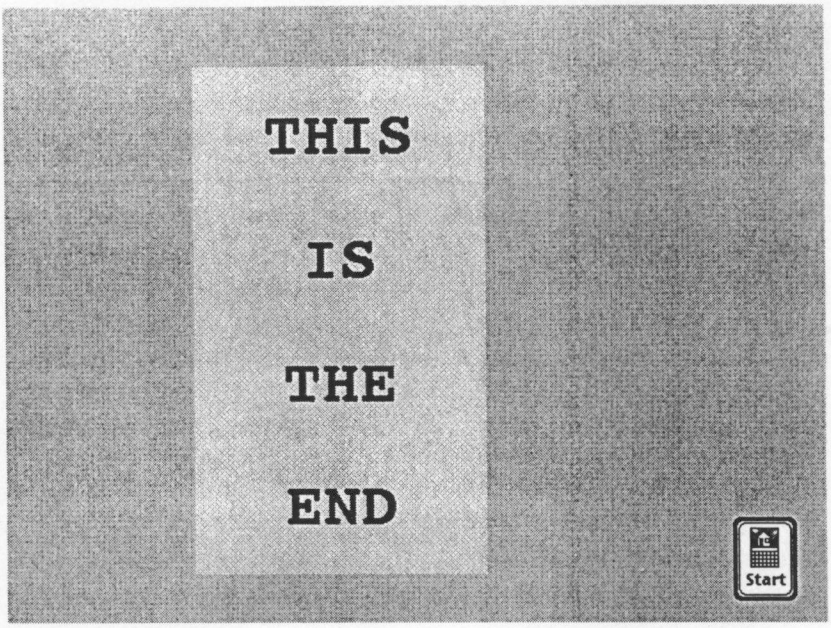

OOPS!
WRONG ANSWER
TRY AGAIN
Back


YES, YES, YES!!
YOUR ANSWER
IS RIGHT.
GO ON.
Go


Daniel enjoys playing outside.
a.Abstract
b.Proper
c.Common
Janice had an ice-cream yesterday.
a. Compound
b. Proper
c. Abstract

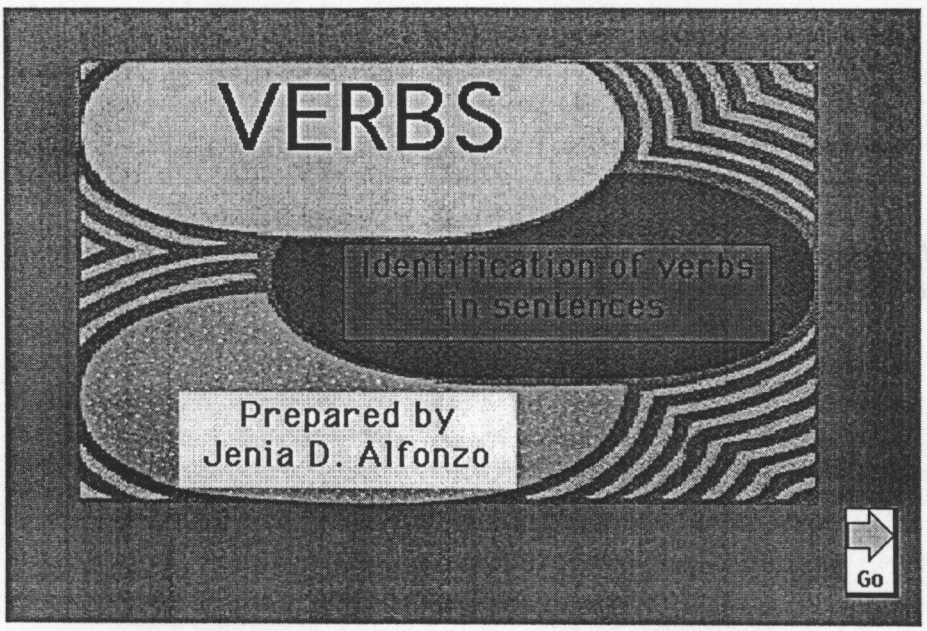

YOU ARE
ABSOLUTELY
RIGHT,
GO ON!
Exercises
Go

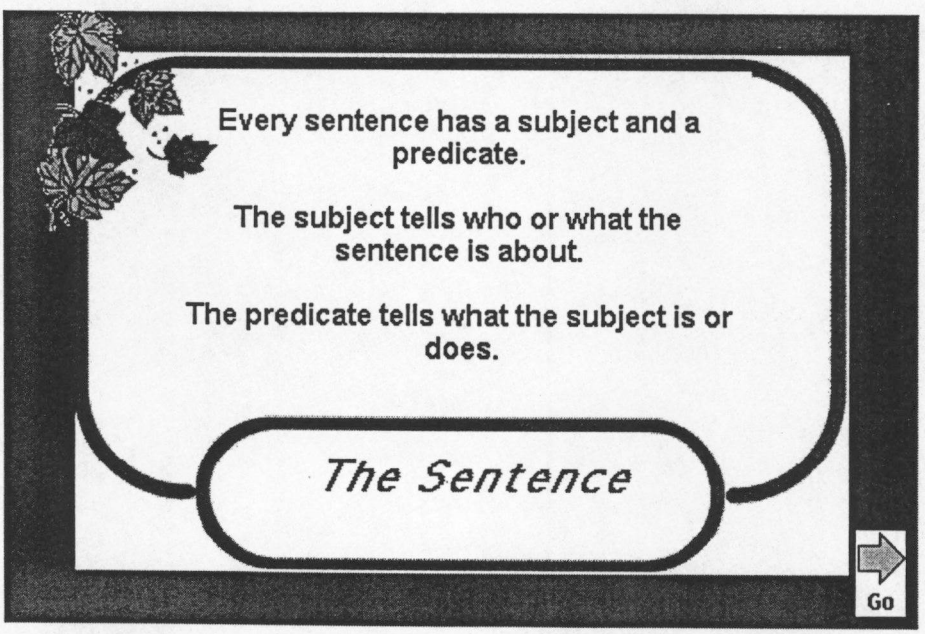

YOUR ANSWER
IS NOT
CORRECT!
TRY AGAIN
Back

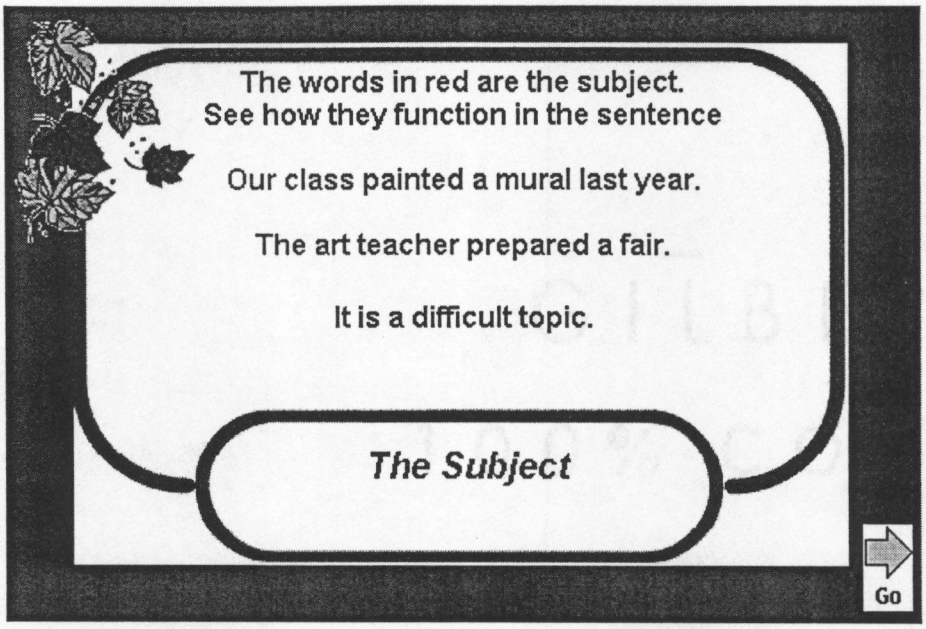

THIS
IS
THE
END
Start

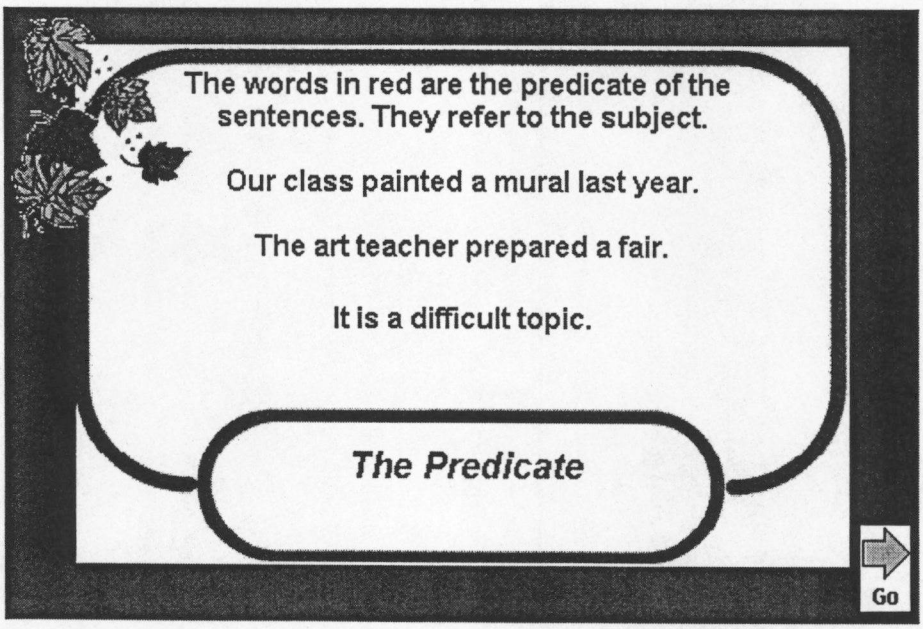
APPLICATION # 5:

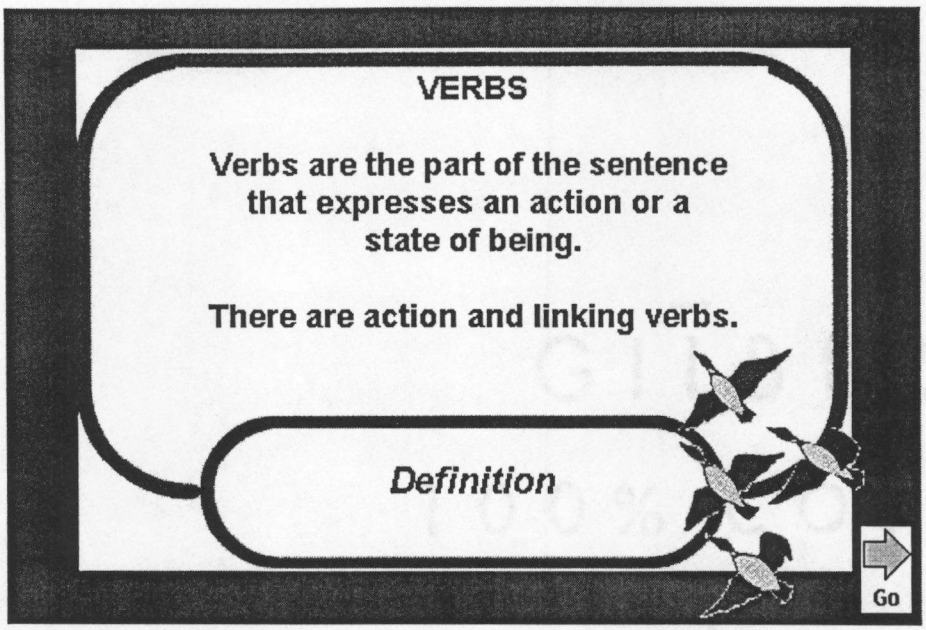
VERBS

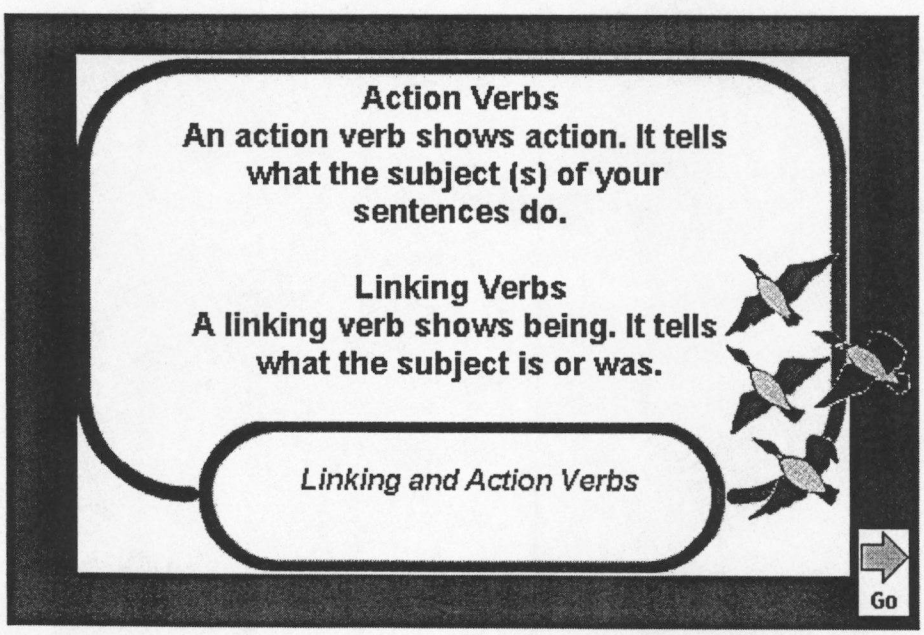

VERBS
Identification of verbs in sentences
Prepared by
Jenia D. Alfonzo
Go

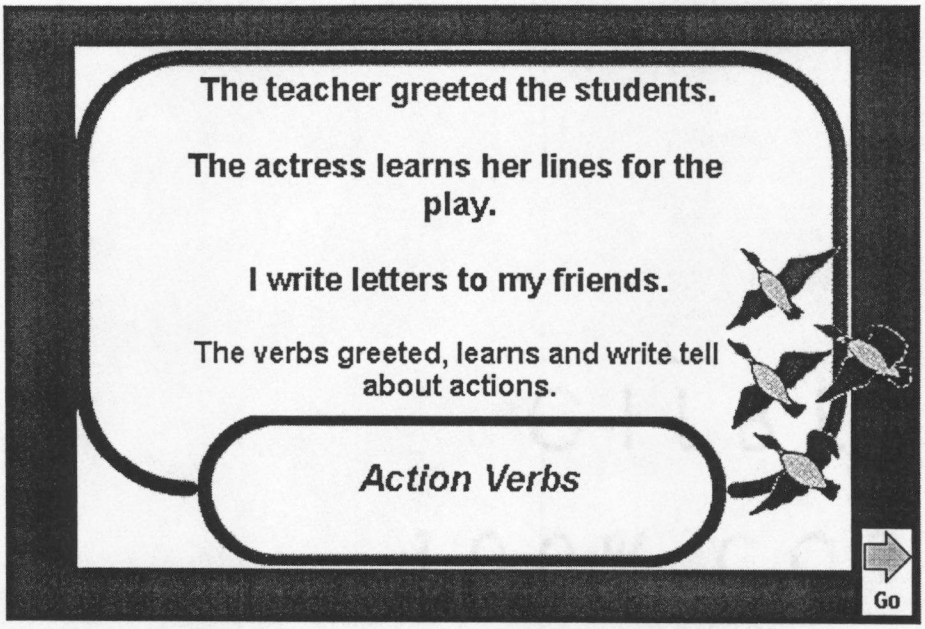

Every sentence has a subject and a predicate.
The subject tells who or what the sentence is about.
The predicate tells what the subject is or does.
The Sentence
Go

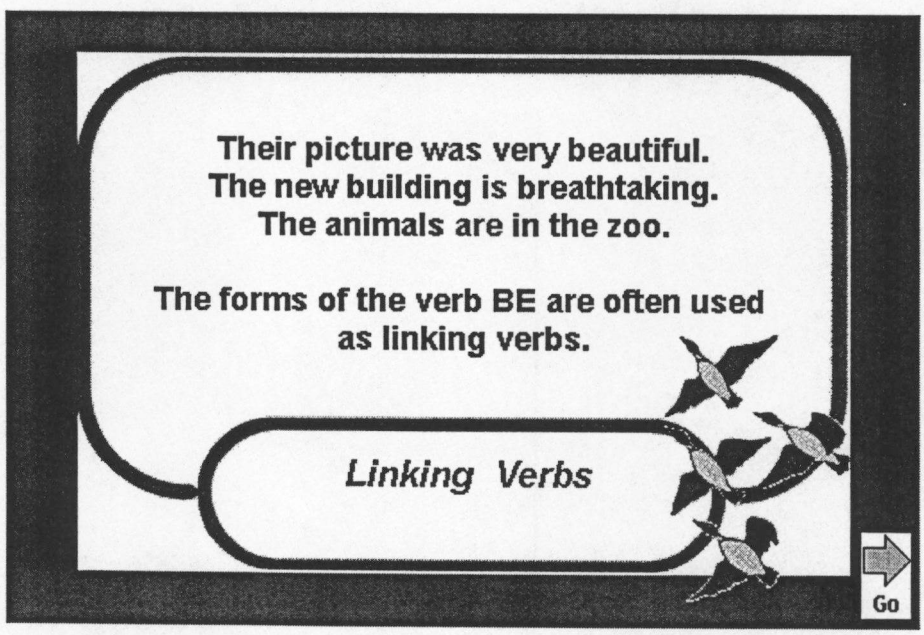

The words in red are the subject.
See how they function in the sentence
Our class painted a mural last year.
The art teacher prepared a fair.
It is a difficult topic.
The Subject
Go

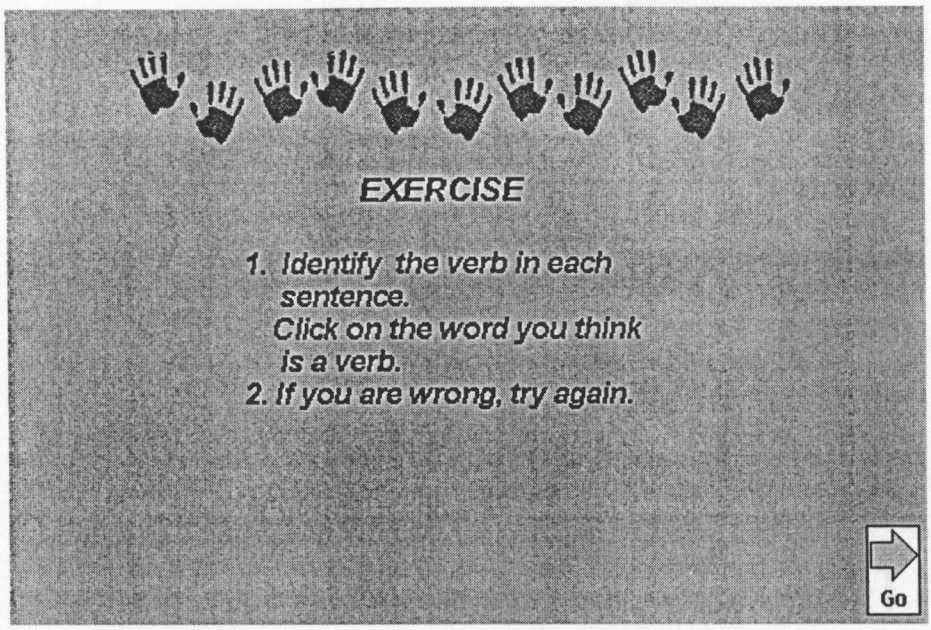

The words in red are the predicate of the
sentences. They refer to the subject.
Our class painted a mural last year.
The art teacher prepared a fair.
It is a difficult topic.
The Predicate
Go

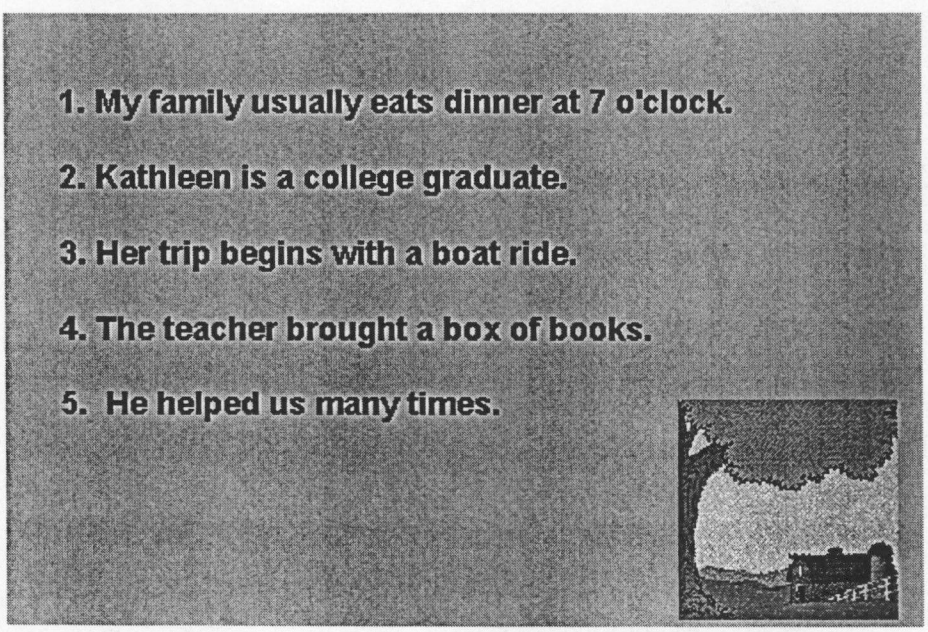

VERBS
Verbs are the part of the sentence that expresses an action or a state of being.
There are action and linking verbs.
Definition
Go

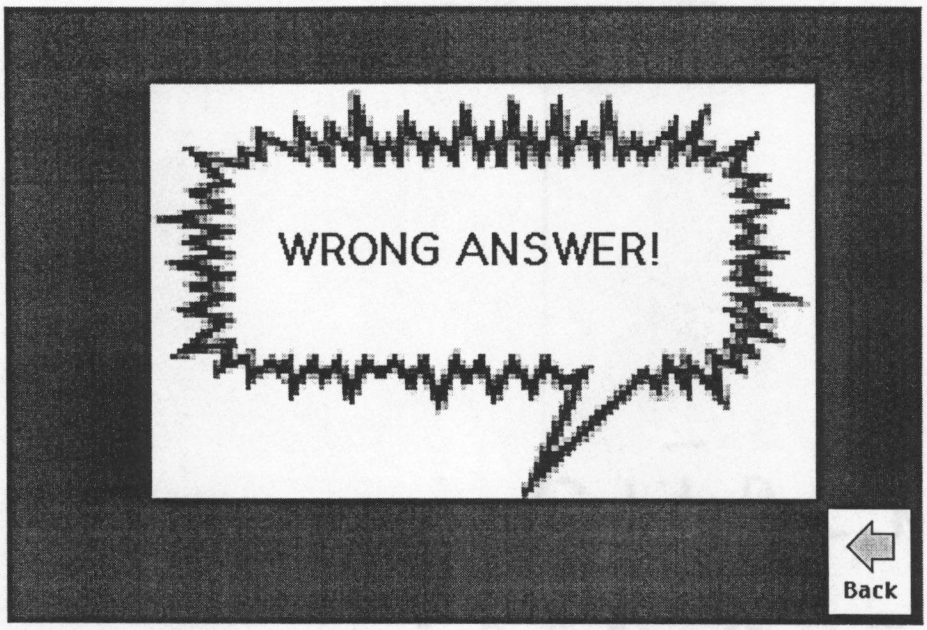

Action Verbs
An action verb shows action. It tells what the subject (s) of your sentences do.
Linking Verbs
A linking verb shows being. It tells what the subject is or was.
Linking and Action Verbs
Go

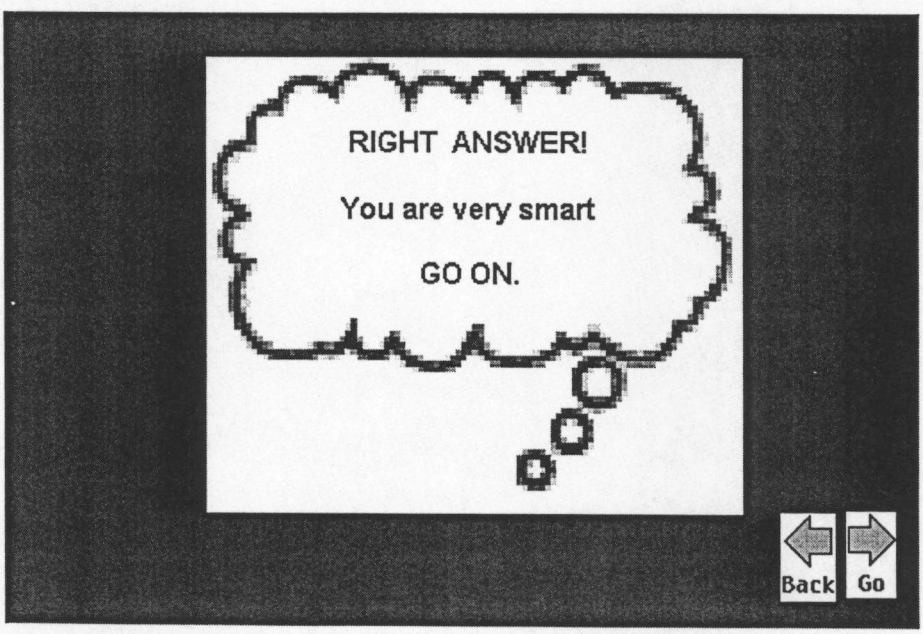

The teacher greeted the students.
The actress learns her lines for the play.
I write letters to my friends.
The verbs greeted, learns and write tell about actions.
Action Verbs
Go


Their picture was very beautiful.
The new building is breathtaking.
The animals are in the zoo.
The forms of the verb BE are often used as linking verbs.
Linking Verbs
Go


EXERCISE
1. Identify the verb in each sentence.
Click on the word you think is a verb.
2. If you are wrong, try again.
Go


1. My family usually eats dinner at 7 o'clock.
2. Kathleen is a college graduate.
3. Her trip begins with a boat ride.
4. The teacher brought a box of books.
5. He helped us many times.


WRONG ANSWER!
Back


RIGHT ANSWER!
You are very smart
GO ON.
Back
Go

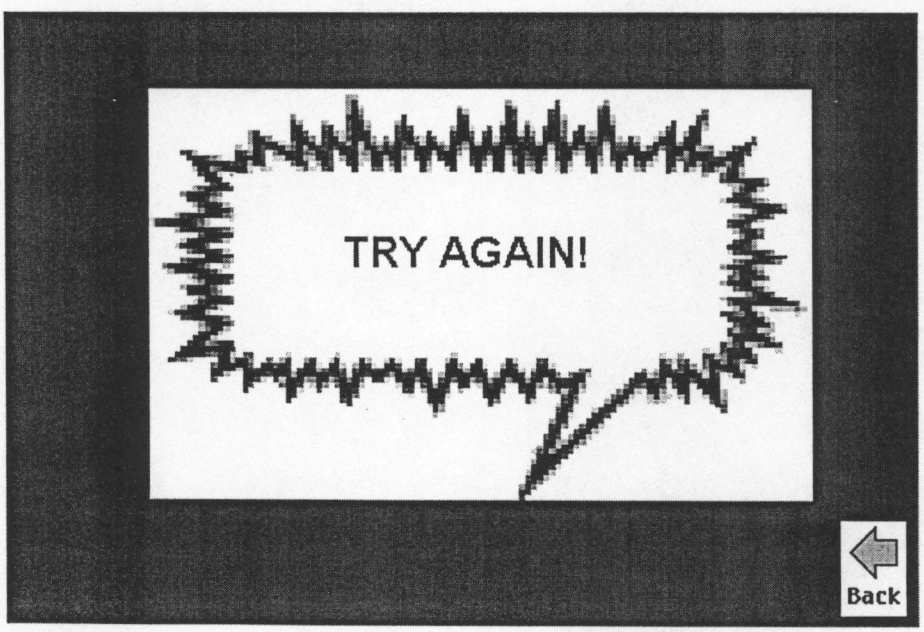
Say if the verb in the following sentences is a linking or an action verb. Click on the right answer.

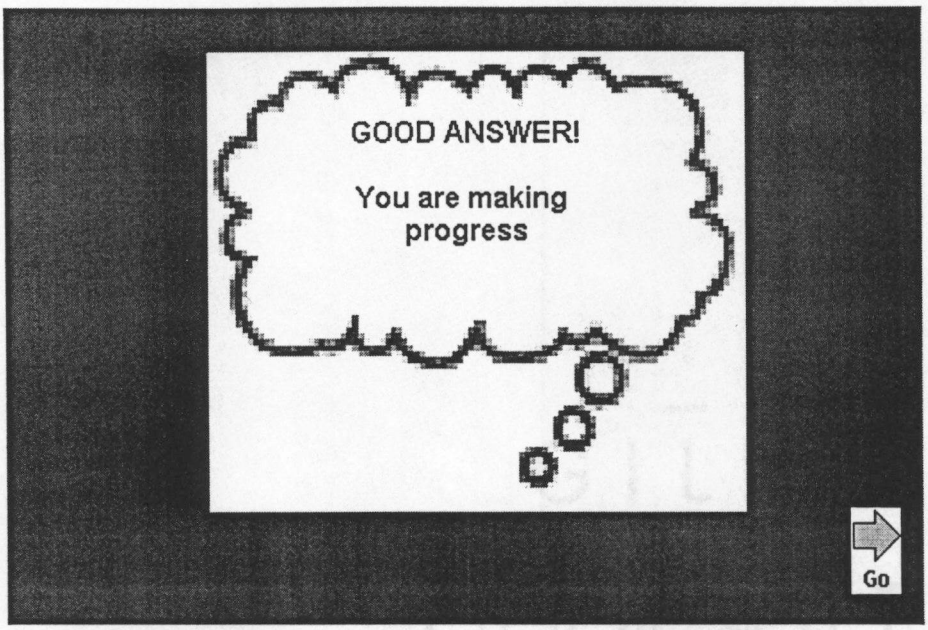
1. The boys were happy with the decision.

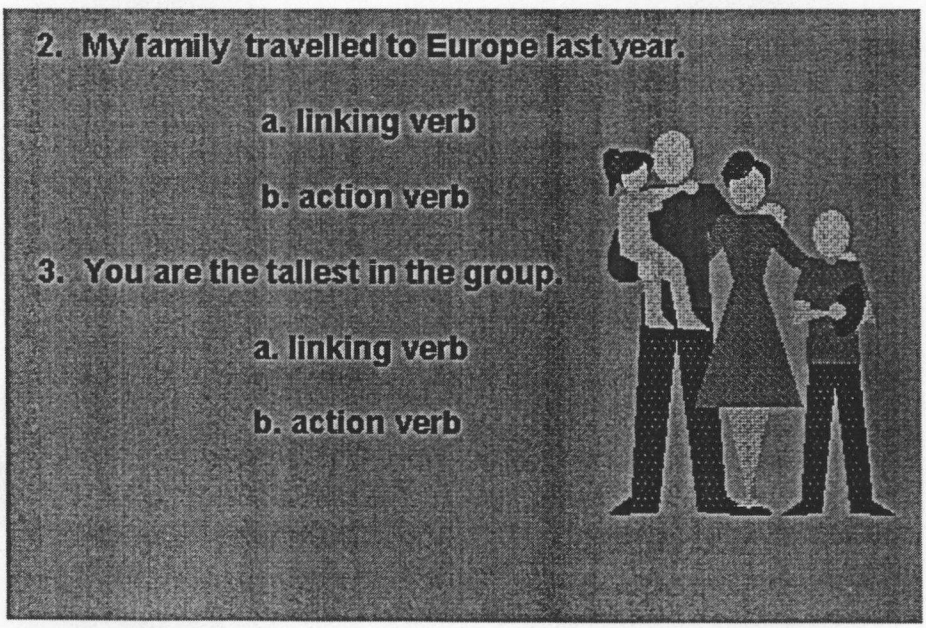
   a. linking verb

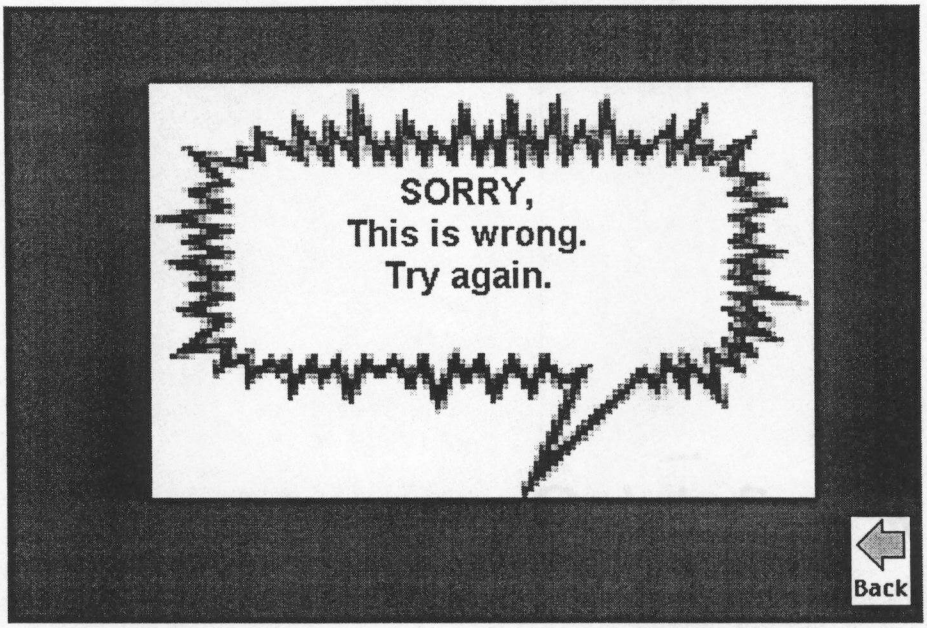
   b. action verb

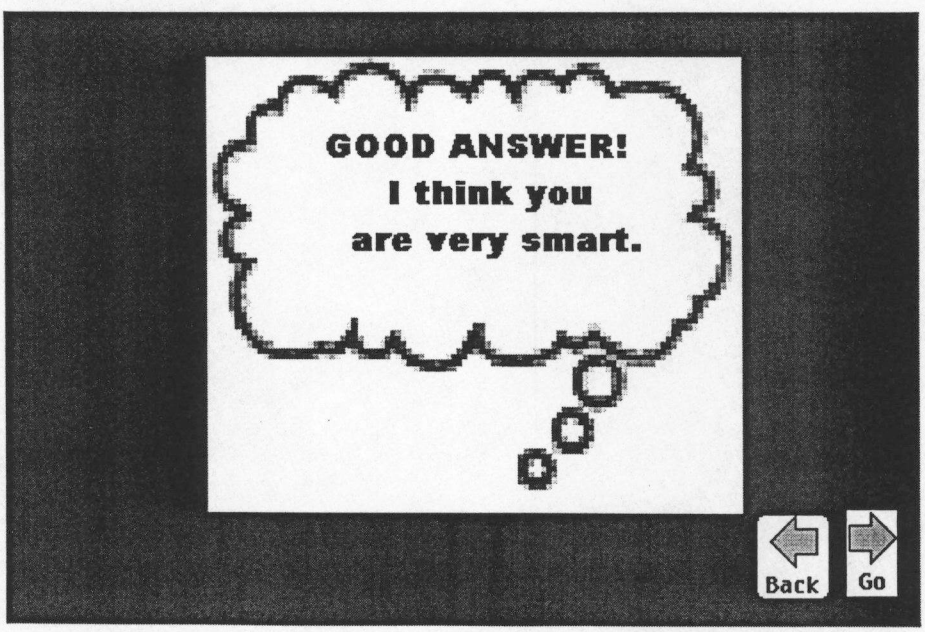





GOOD ANSWER!
You are making progress
Go


2. My family travelled to Europe last year.
a. linking verb
b. action verb
3. You are the tallest in the group.
a. linking verb
b. action verb


SORRY,
This is wrong.
Try again.
Back


GOOD ANSWER!
I think you
are very smart.
Back
Go

2. The dog barks to strangers.

a. linking verb

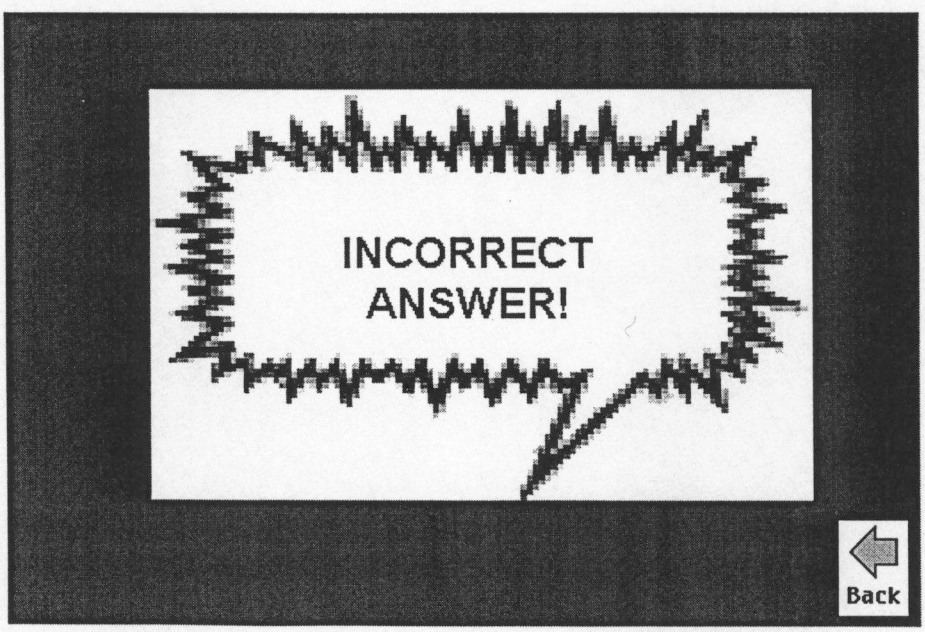
b. action verb

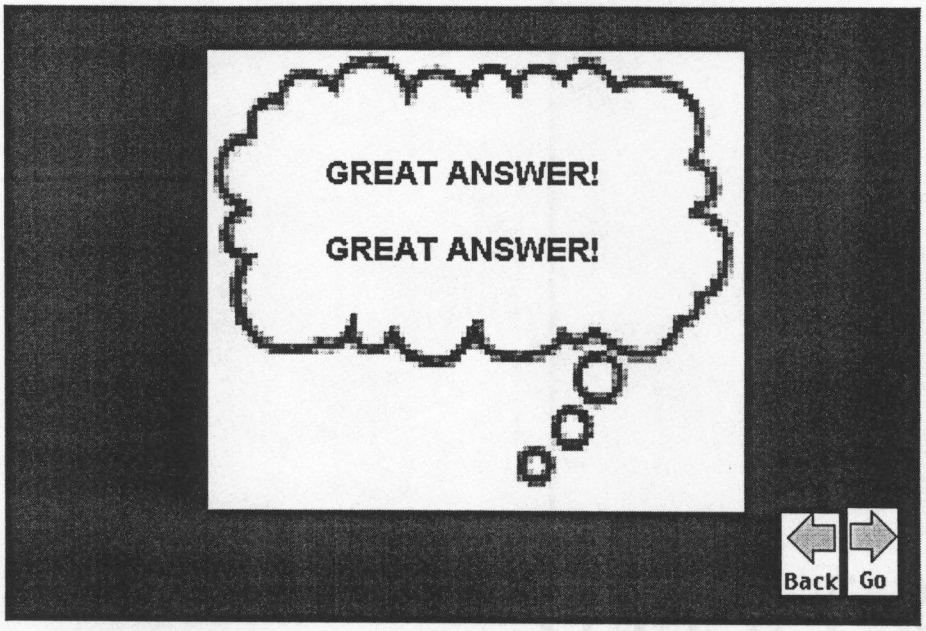
3. My brother was in South America last week.

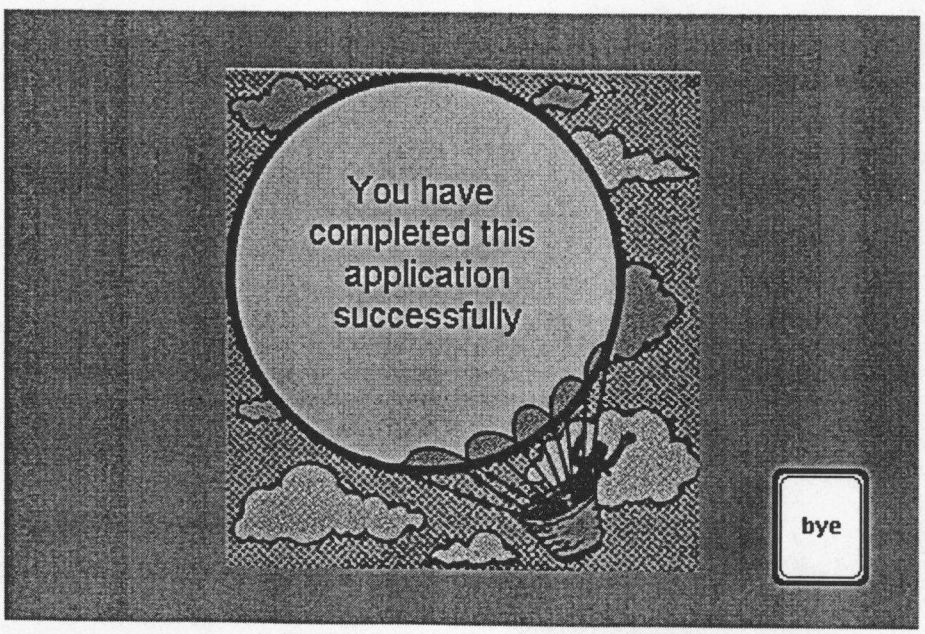
a. linking verb

b. action verb



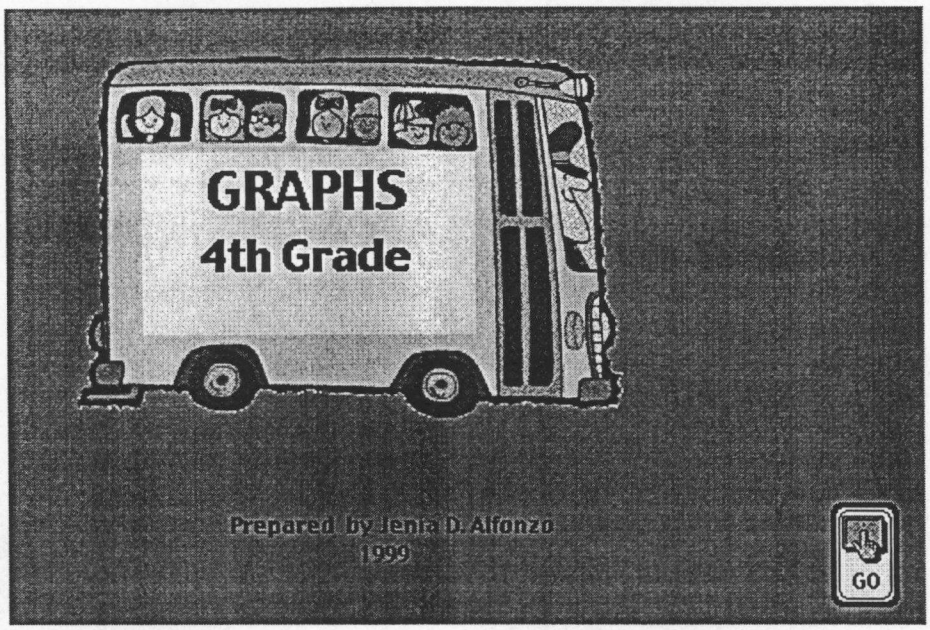


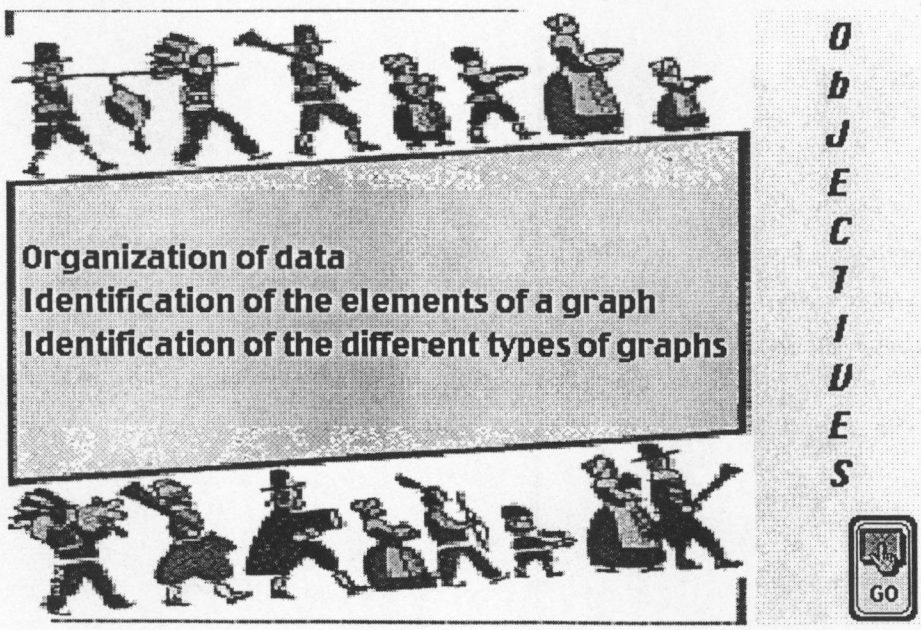

GREAT ANSWER!
GREAT ANSWER!
Back
Go


You have completed this application successfully
bye

APPLICATION # 6:

GRAPHS


GRAPHS
4th Grade
Prepared by Jenita D. Alfonzo
1999
GO


Organization of data
Identification of the elements of a graph
Identification of the different types of graphs
OBJECTIVES
GO

ORGANIZING DATA IN TABLES

Day	Number of Students	Total number of Students
Monday	15	15
Tuesday	13	28
Wednesday	5	33
Thursday	9	42
Friday	17	59

This is a frequency table.

A frequency table has two columns:
frequency column and
cumulative frequency column

GO

ORGANIZING DATA IN TABLES

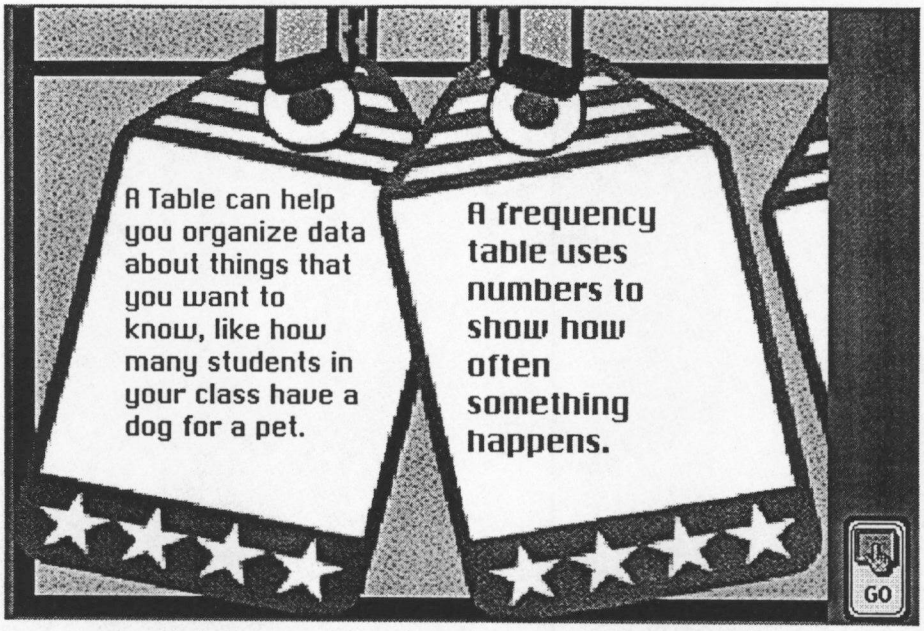
Day	Number of Students	Total number of Students
Monday	15	15
Tuesday	13	28
Wednesday	5	33
Thursday	9	42
Friday	17	59

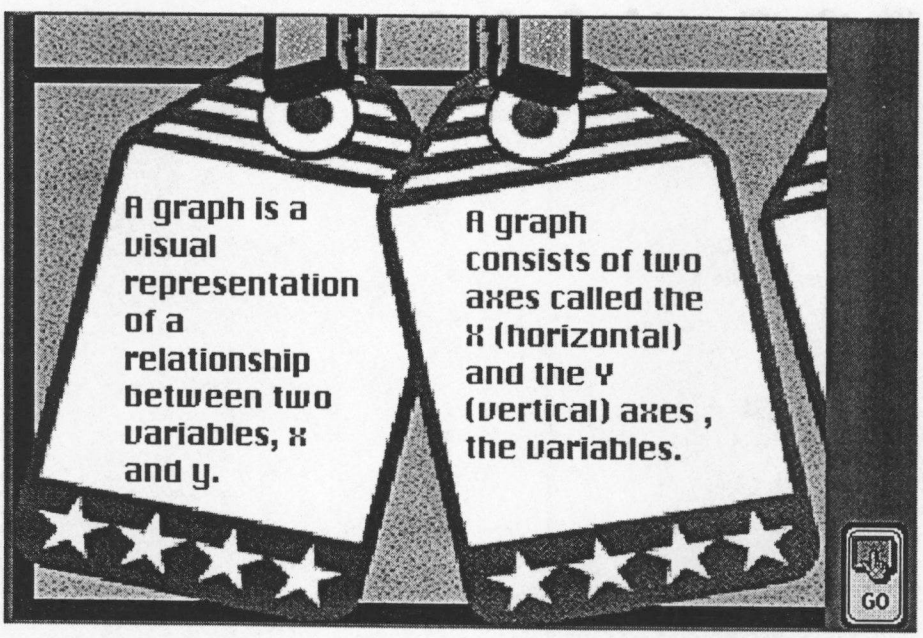
This is a frequency table.

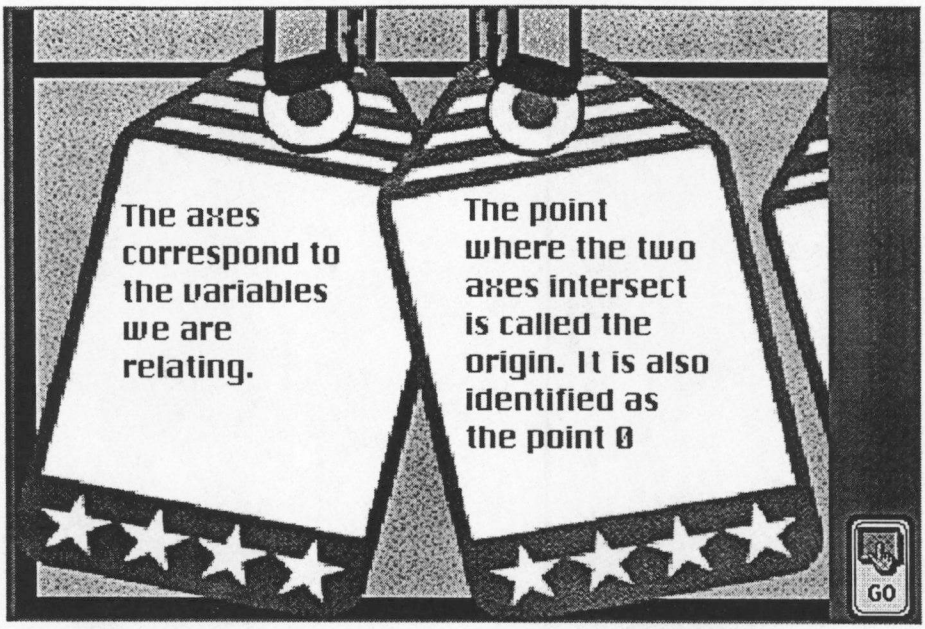
Number of Students represents the frequency column

Total number of Students is the Cumulative Frequency column

GO

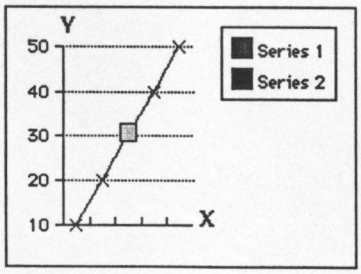

A Table can help you organize data about things that you want to know, like how many students in your class have a dog for a pet.
A frequency table uses numbers to show how often something happens.
GO


A graph is a visual representation of a relationship between two variables, x and y.
A graph consists of two axes called the X (horizontal) and the Y (vertical) axes , the variables.
GO



This graph consists of two axes:

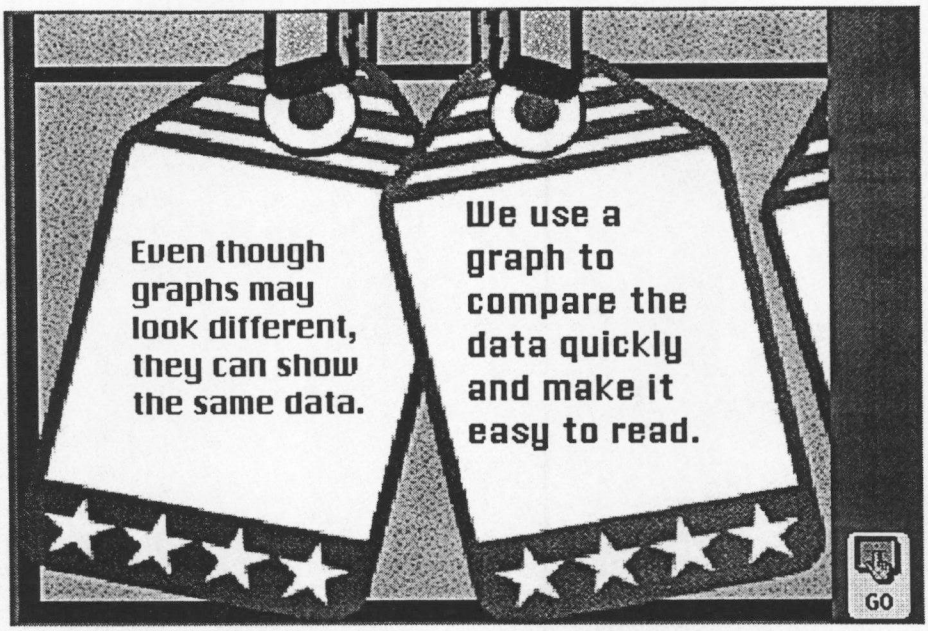
X and Y

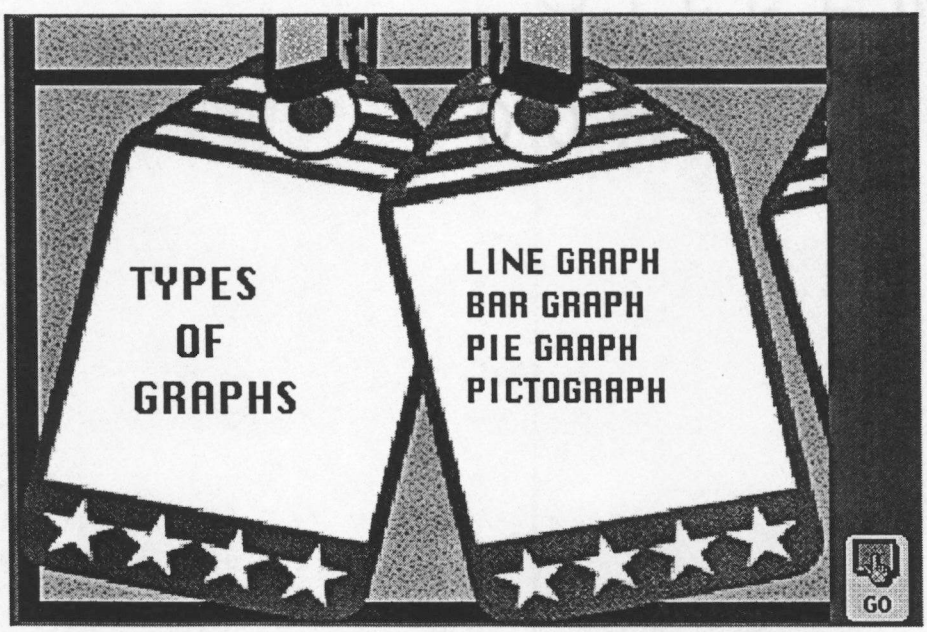


The X coordinate tells you how far from the origin the point is on the horizontal

The Y coordinate tells you how far from the origin the point is on the vertical

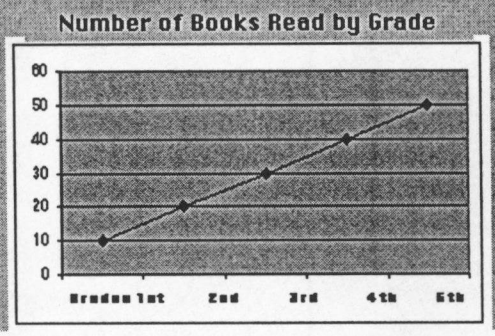



Even though graphs may look different, they can show the same data.
We use a graph to compare the data quickly and make it easy to read.
GO


TYPES OF GRAPHS
LINE GRAPH
BAR GRAPH
PIE GRAPH
PICTOGRAPH
GO

LINE GRAPH

A graph in which a line shows how something changes over a period of time.

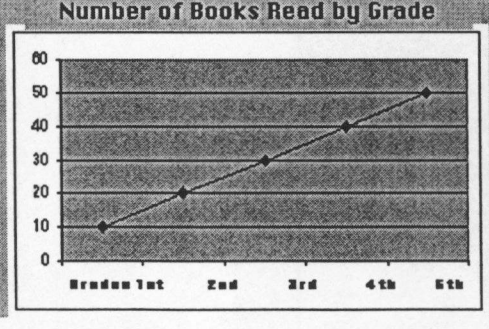


GO

LINE GRAPH

The horizontal line refers to grades, the vertical line represents number of books read.

For example, 1st graders read 10 books.



GO

BAR GRAPH

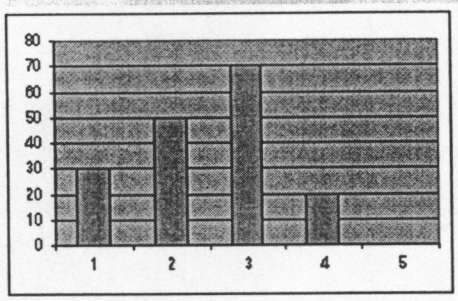


Figure A

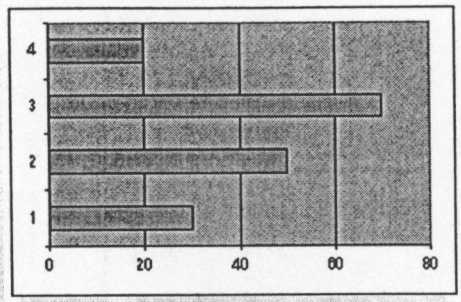


Figure B

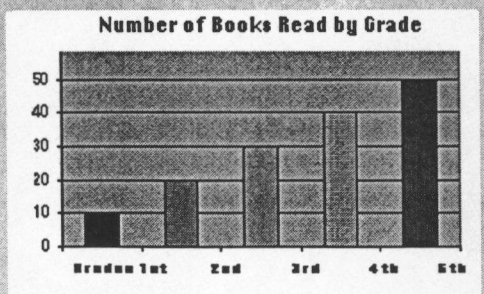
There are Horizontal bar graphs (Figure A) and Vertical bar graphs (Figure B)

GO

Vertical Bar Graph

Data are displayed using vertical bars of different lengths.

For example, the green bar represents the number of books read by 3rd graders.

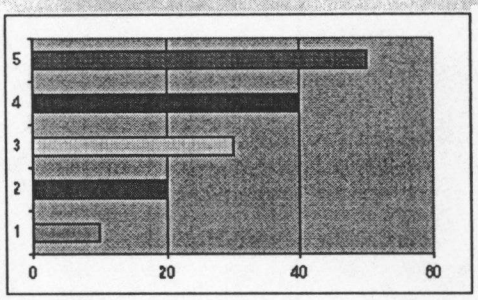


GO

Horizontal Bar Graph

Data are displayed using horizontal bars of different lengths.
For example, the red bar represents the number of books read by 4th graders.

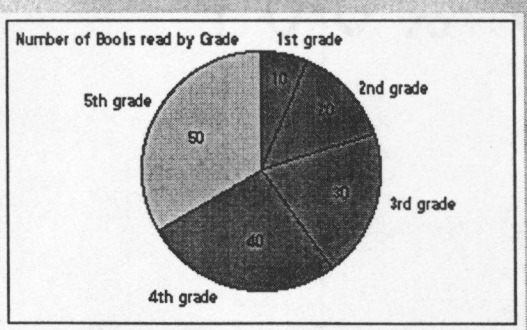
Number of Books Read by Grade



GO

PIE GRAPHS

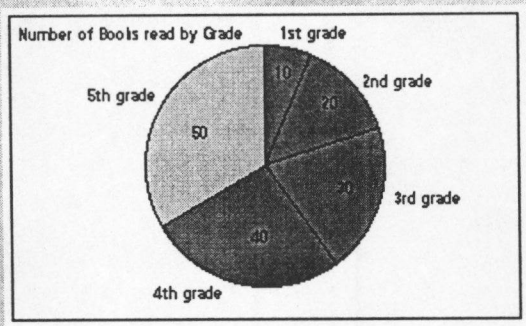
Pie charts are used to show percentages or parts of a whole.
Each section color should be kept consistent.
Labels should be included for each pie section.



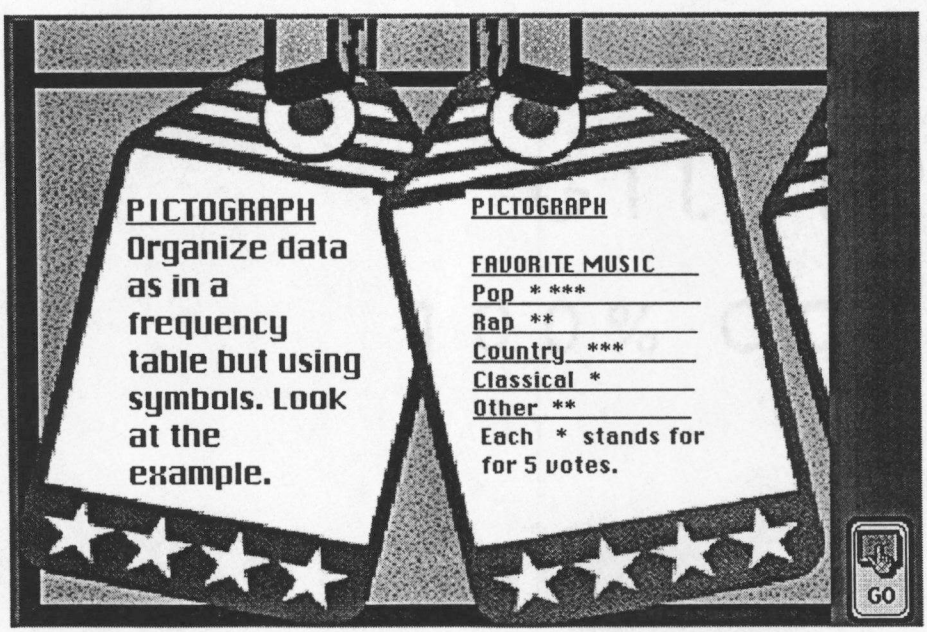
GO

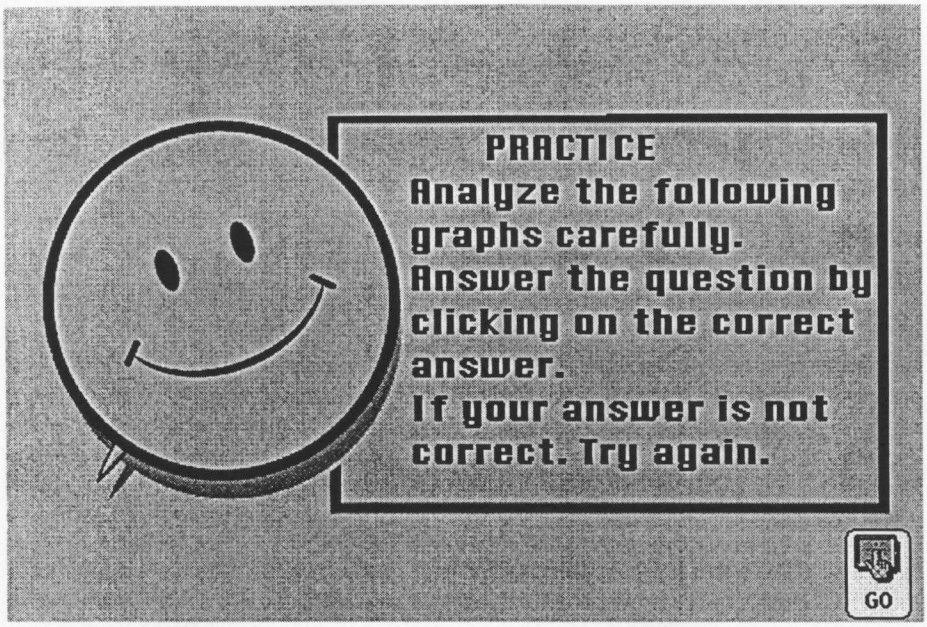
PIE GRAPHS

Sections are easily identified because of the colors used. For example, the yellow section, 5th grade, represents the number of books read by fifth graders.



GO




PRACTICE
Analyze the following graphs carefully.
Answer the question by clicking on the correct answer.
If your answer is not correct. Try again.
GO


CONGRATULATIONS!
THIS IS THE END
GO

APPENDIX D:

Computer Time and Test Result Sheets

COMPUTER TIME

Application:_____

Name	First Time	Second Time	Third Time
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:
	Date: Duration:	Date: Duration:	Date: Duration:

TEST RESULTS

Application: _____

Date: **Pretest** _____
Posttest _____
Retention _____

Name	Pretest	Posttest	Retention

APPENDIX E:

Tests

ADVERBS

Pre:____
Post:___
Ret:____

NAME:_____DATE:_____

I. **IDENTIFY ADVERBS IN THE FOLLOWING SENTENCES. MAKE A CIRCLE AROUND THEM.** (5 Points)

1. The children were playing nicely.
2. My mother cooks fast.
3. This classroom is completely dark.
4. We have a holiday tomorrow.
5. Rose explains her reasons clearly.

II. **IDENTIFY THE UNDERLINED WORDS AS ADVERB OR ADJECTIVE. CIRCLE THE WORD ADVERB OR ADJECTIVE ACCORDING TO WHAT CORRESPONDS. (5 Points)**

1. Mike is a <u>slow</u> runner.	Adverb	Adjective
2. The movie was very <u>exciting</u>	Adverb	Adjective
3. <u>Quickly</u>, I answered her call	Adverb	Adjective
4. They like <u>fast</u> food.	Adverb	Adjective
5. My brother remembers it <u>vividly.</u>	Adverb	Adjective

Pre:___
Post:___
Ret:___

MEASUREMENT

Name:_____Date:_____

I. Make a circle around the longer measurement.(5 Points)

1. 2 yd / 1 mi

2. 15 ft / 5 in

3. 16 in / 1 yd

4. 20 cm / 2 m

5. 1 cm / 9 dm

II. Compare Units. Circle the correct answer according to information related to units comparison.(3 Points)

1. 1 m equals ⇒ a. 10 cm b. 100 cm c. 1000 cm

2. 1 cm equals ⇒ a. 10 dm b. 100 dm c. 1000 dm

3. 1 yd equals ⇒ a. 1ft b. 2ft c. 3ft

III. Fill in the blank with the correct information.(2 Ponits)

1. 1 km equals _____ m.

2. 1 ft equals _____ in.

DIVISION

Pre___ Post___ Ret ___

Name:_____ Date:_____

READ THE FOLLOWING OPERATIONS CAREFULLY. COMPLETE THE INFORMATION REQUIRED.

1. **Daniel has 200 apples. He wants to share them equally with his 20 classmates. How many appless will each one get? (1 point)**

   Daniel divides 200 apples by _____ classmates.

   Each classmate gets _____ apples.

2. **Jason has 55 cookies to divide equally with his 5 friends. (1 point)**

   How many cookies does each one get?

   Jason divides 55 cookies by _____ friends.

   Each friend gets _____ cookies.

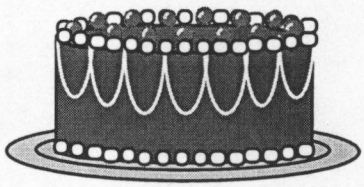
3. **My father ran 28 miles this week. How many miles did he run a day? (1 point)**

   My father ran 28 miles in 7 days.

   _____ miles divided by _____ equals _____ .

   My father ran _____ miles per day.

4. **Teresa has a cake. She is going to cut the cake in 12 pieces.**



How many cakes does she need if there are 36 people invited to her birthday? (1 point)

One cake equals _____ pieces.

_____ people invited to Teresa' s birthday divided by _____ pieces equal _____ cakes.

5. **Sarah and her sister have saved 128 dollars. If they divide this amount equally, How many dollars does each one get? (1 point)**

We divide 128 dollars by _____ sisters.

Each sister gets _____ dollars.

Pre_____

Post____

NOUNS

NAME:_____ DATE:_____

INDICATE IF THE UNDERLINED WORD IS A COMMON (CN) OR A PROPER NOUN (PN) BY MAKING A CIRCLE AROUND THE CORRECT ANSWER. (5 points)

1. Mary's husband gave her a French vase.	PN	CN
2. I visited the ruins in Peru.	PN	CN
3. She makes delicious chocolate cookies.	PN	CN
4. They came from Rome a few years ago.	PN	CN
5. The room was decorated with balons.	PN	CN

IDENTIFY THE UNDERLINED WORD AS ABSTRACT OR COMPOUND NOUNS BY MAKING A CIRCLE AROUND " AB" IF ABSTRACT OR "CO" IF A COMPOUND NOUN. (5 points)

1. My brother plays football at school.	AB	CO
2. Your generosity never surprises me.	AB	CO
3. We admire her fairness.	AB	CO
4. The truth will succeed.	AB	CO
5. The children are in the playground.	AB	CO

PRE_____
POST____

VERBS

Name_____ **Date:**_____

READ THE FOLLOWING SENTENCES CAREFULLY. MAKE A CIRCLE AROUND THE VERB. (5 points)

1. The nurse explained the situation to the patient.

2. All students are in the library

3. My brother studies in a public university.

4. Computers work electronically.

Doris was at home at 10 o'clock.

MAKE A CIRCLE AROUND "AV" IF THE UNDERLINED VERB IS AN ACTION VERB.MAKE A CIRCLE AROUND "LV" IF THE UNDERLINED VERB IS A LINKING VERB. (5 points)

1. The park <u>is</u> two blocks from my apartment.	AV	LV
2. A new group of students <u>arrive</u> today.	AV	LV
3. His final grades <u>were</u> excellent.	AV	LV
4. The girl <u>cried</u> for her mother.	AV	LV
5. The man <u>fixed</u> our car yesterday.	AV	LV

Pretest
Posttest

GRAPHS

Name:_____ Date:_____

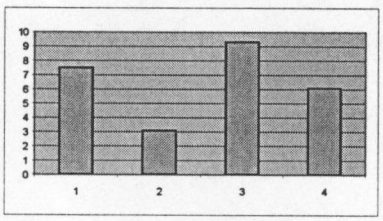
I. CHOOSE FROM THE FOLLOWINGLIST THE NAME THAT IDENTIFIES EACH GRAPH AND WRITE IT IN THE SPACE PROVIDED NEXT TO EACH GRAPH. (3 points)

PIE CHART

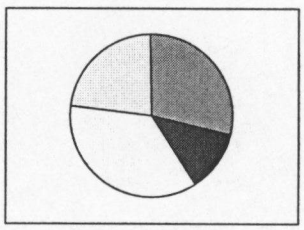
HORIZONTAL BARS

VERTICAL BARS

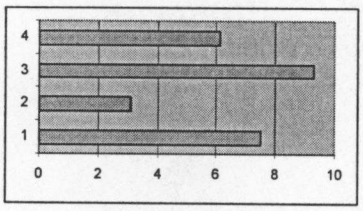
LINE PLOT



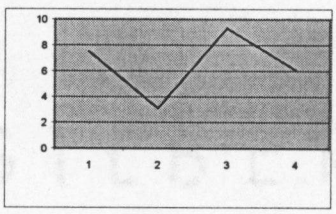
Graph:_____



Graph:_____



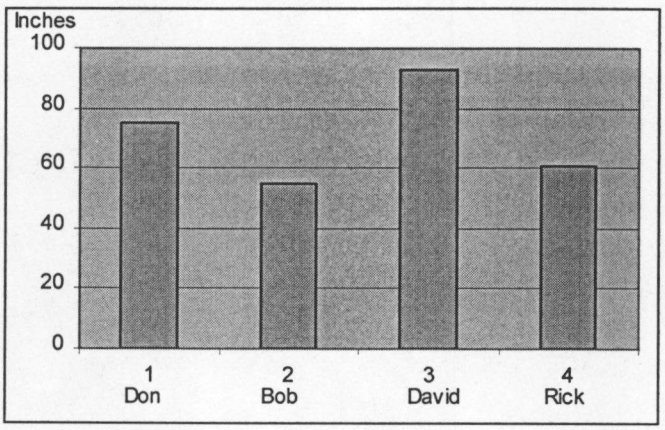
Graph:_____



Graph:_____

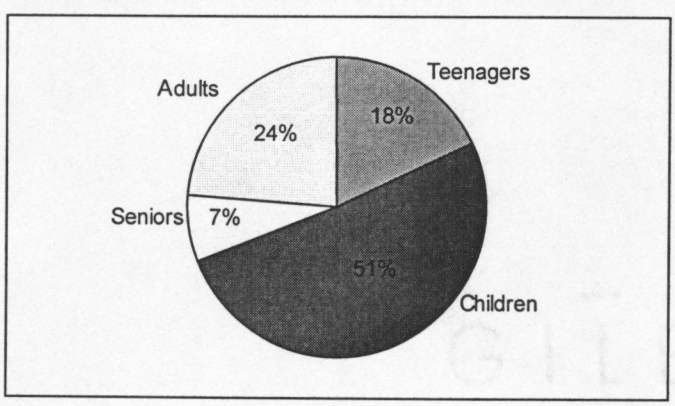
II. ANALYZE EACH GRAPH CAREFULLY. COMPLETE THE INFORMATION ACCORDING TO THE GRAPH. (7 points)

GRAPH 1: BOYS' HEIGHT



1. _____ is the tallest of the four boys..
2. _____ is the shortest of the four boys.
3. David is _____ inches taller than Don.
4. Rick is _____ inches tall.

GRAPH 2: ZOO VISITORS DURING 1998



1. The percentage of seniors who visited the zoo during 1998 was _____
2. What segment of the population has the highest percentage? _____
3. What is the difference between teenager and adult visitors? _____%

APPENDIX F:

Sample of Questionnaire

PERCEPTIONS OF A HYPERSTUDIO™ EXPERIENCE

Please complete the following survey by writing a check mark (√) in the box next to the appropriate answer.

Demographic Information

1. **I am a...**
   ☐ **male** ☐ **female**

2. **My age is...**
   ☐ **9** ☐ **10** ☐ **11**

3. **I like working with computers...**
   ☐ **yes** ☐ **no** ☐ **not sure**

4. **I have a computer at home...**
   ☐ **yes** ☐ **no**

5. **I have experience with computers**
   ☐ **yes** ☐ **some** ☐ **none**

About HyperStudio™ Applications

1. **I enjoyed the time spent using Hyperstudio™ applications**
   ☐ **yes** ☐ **no** ☐ **not sure**

2. I learned about the topics presented using Hyperstudio™ applications
   ☐ yes ☐ no ☐ not sure

3. The information was presented in a way I could understand it
   ☐ yes ☐ no ☐ not sure

4. Instructions were clear and easy to follow
   ☐ yes ☐ no ☐ not sure

5. I like Hyperstudio™ applications because they have color
   ☐ yes ☐ no ☐ not sure

6. I like Hyperstudio™ applications because they have sounds
   ☐ yes ☐ no ☐ not sure

7. I like Hyperstudio™ applications because they have graphics
   ☐ yes ☐ no ☐ not sure

8. I have enough computer skills to use Hyperstudio™ applications
   ☐ yes ☐ no ☐ not sure

9. The time spent using each application was ...
   ☐ appropriate ☐ too long ☐ too short

10. In the future, I would like to use Hyperstudio™ applications again.
    ☐ yes ☐ no ☐ not sure

VITA

Jenia Alfonzo was born in Caracas, Venezuela. She graduated from high school in 1970. She attended the Universidad Pedagogica Libertador and graduated in 1975 with an educational degree majoring in Modern Languages : English as a Second Language. After graduation, she spent five years to ESL teaching at high school level.

She pursued graduate studies at The University of Wisconsin at Madison where she received a Master of Science with a major in Curriculum and Instruction. Following graduation, she started teaching English with specific purposes-science and technology at the Universidad Central de Venezuela in Caracas, and later at the Universidad Centroccidental "Lisandro Alvatrado" in Barquisimeto- Lara.

In July 1995, she began fulltime doctoral studies at the University of Tennessee at Knoxville. In August 1999, she received her Doctor of Philosophy degree in Curriculum and Instruction and Computer applications in education.

Presently, she works at the Universidad Centroccidental "Lisandro Alvarado", Barquisimeto where she serves on the faculty of the College of Science in the Department of Investigacion de Operaciones.