

DOCUMENT RESUME

ED 295 617

IR 013 323

AUTHOR Storey, Kim S.; Julyan, Candace L.
TITLE The Integrated Design and Use of Computers and Television in Education. TR-85-20.
INSTITUTION Educational Technology Center, Cambridge, MA.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Jul 85
CONTRACT 400-83-0041
NOTE 134p.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Educational Television; Elementary Education; Instructional Effectiveness; Instructional Material Evaluation; *Material Development; Microcomputers; *Multimedia Instruction; Questionnaires; Student Attitudes; Teacher Attitudes; *Teacher Role

ABSTRACT

The goals of this study were to understand the expectations of both designers and teachers for the design and use of packages that integrate computer and television technologies, and to investigate the implementation of these packages in the classroom. Interviews were conducted with eight designers of "The Voyage of the Mimi" (MIMI), a package which explores scientific and mathematics concepts using a series of episodes about whale research, and 10 designers of "Solutions Unlimited" (SOLUTIONS), a package that focuses on problem solving and computer applications. A total of 32 teachers, 21 Massachusetts teachers using MIMI and 11 Wisconsin teachers using SOLUTIONS, were interviewed both before and after utilizing the package. Results were examined in the following areas: (1) designers' assumptions and principles, including the development process, logistical considerations, integration of technology, teacher role, and reflections on the project; (2) profiles of teachers and classrooms; (3) strategies of use, including support and training, logistics, teacher role, and time allotment; and (4) effects on teaching and learning, including appeal to teachers and students, learning opportunities, appeal of individual components, evaluation of student learning, and future use. Package materials, interview questionnaires, analyses of teacher responses, and data on how the packages were acquired are appended. (7 references) (MES)

 * Reproductions supplied by EDRS are the best that can be made *
 * from the original document. *

ED 295617

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

- This document has been reproduced as received from the person or organization originating it.
- Minor changes have been made to improve reproduction quality.
- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

THE INTEGRATED DESIGN AND USE OF COMPUTERS AND TELEVISION IN EDUCATION

Technical Report

July 1985



Educational Technology Center

Harvard Graduate School of Education
337 Gutman Library Appian Way Cambridge MA02138

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Beth Wilson

ERIC
Full Text Provided by ERIC
IRO 13 323

THE INTEGRATED DESIGN AND USE OF
COMPUTERS AND TELEVISION IN EDUCATION

TECHNICAL RESEARCH REPORT

Kim S. Storey, Ed.D.
Project Leader
WGBH Educational Foundation

Candace L. Julyan
Senior Researcher
Harvard Graduate School of Education

COMPUTERS AND TELEVISION PROJECT
NEW TECHNOLOGIES GROUP
EDUCATIONAL TECHNOLOGY CENTER
HARVARD GRADUATE SCHOOL OF EDUCATION
CAMBRIDGE, MASSACHUSETTS

JULY 1985

EDUCATIONAL TECHNOLOGY CENTER
HARVARD GRADUATE SCHOOL OF EDUCATION
COMPUTERS AND TELEVISION PROJECT GROUP MEMBERS

Cornelia Carey, WGBH Educational Foundation

Marja Brandon Drevitch, Harvard Graduate School of Education

Candace L. Julyan, Harvard Graduate School of Education

Kim S. Storey, WGBH Educational Foundation

Catherine Wolinsky, Buckingham, Browne, and Nichols School

This report was prepared by Kim Storey and Candace Julyan with research and writing assistance from Cornelia Carey.

Preparation of this research report was supported in part by the National Institute of Education (Contract #NIE 400-83-0041). Opinions expressed are not necessarily shared by NIE and do not represent Institute policy.

ACKNOWLEDGEMENTS

We would like to express our thanks to those who contributed to this project: the participating teachers from Massachusetts and Wisconsin, the package design teams from the Agency for Instructional Technology and Bank Street College of Education, Saul Rockman and Susan Foote for their research guidance, Ellen Mahoney for her help with transcribing and coding data, and Idit Harel for her assistance in research design and data collection.

We would also like to thank those who reviewed an earlier draft of this report: Susan Foote, Saul Rockman, and Ron Slaby. In addition Maxwell Katz, Judah Schwartz, and Charles Thompson of ETC provided valuable guidance throughout the writing of this report.

TABLE OF CONTENTS

	Page
I. Introduction	1
II. Research Design	8
III. Designer Interviews	10
A. Methods	10
B. Results: Designers' Assumptions and Principles	12
1. Development Process	12
2. Logistical Considerations	16
3. Integration of Technologies	17
4. Teacher Role	19
5. Reflections	21
IV. Teacher Interviews	24
A. Methods	24
1. Procedures	25
2. Sample	26
B. Results: Profiles of Sample	28
1. Teacher Profile	28
2. Classroom Profile	29
C. Results: Strategies of Use	31
1. Support and Training	31
2. Logistics	32
3. Teacher Role	33
4. Time Allotment	34
D. Results: Effects on Teaching and Learning	42
1. Appeal to Teacher	42
2. Appeal to Students	43
3. Learning Opportunities	45
4. Appeal of Individual Components	47
5. Evaluation of Student Learning	52
6. Future Use	54
V. Discussion and Conclusion	56
VI. References	66
Appendix A: "Voyage of the Mimi" Materials	
B: "Solutions Unlimited" Materials	
C: Designer Instrument	
D: Teacher Instrument	
E: Package Acquisition	

I. INTRODUCTION

Both educational television and microcomputers are becoming an integral part of our educational system. Over the past decade there has been a dramatic increase in the use of television in schools. According to the recently released national survey by the Corporation for Public Broadcasting (Riccobono, 1985), more than 18.5 million students received some portion of their education from instructional television in 1982-83. Correspondingly, computer hardware and software are entering the classroom at a rapid rate. Whereas 94% of schools have access to television, 78% of schools have access to computers. It is estimated that by 1987 there will be 2.5 million microcomputers in the public schools and that the educational software market will continue to grow (Center for Social Organization of Schools, 1983).

Educational television and microcomputers have different but complementary pedagogical strengths. Television is a powerful and dynamic medium for presenting ideas, influencing learning, bringing the "real" world directly to the learner, and portraying much of the color, excitement, and immediacy that actual experiences can provide. However, in its traditional use, it does not provide interactive opportunities for viewers. The microcomputer not only promotes interaction and provides immediate feedback to each response, but also stores and retrieves vast amounts of data. The computer,

however, lacks the capability to display real-life, moving visual images.

As the availability and interest in the use of both television and computers for education continues to grow, a new phenomenon is emerging: multimedia instructional packages which combine television and computer technologies. Although some have referred to this combination as the "desired technologies of the future" (Designs for Education, 1983, p. B10), knowledge of exactly how materials incorporating computer, television, and print material might be designed or utilized for instructional use is extremely limited.

In 1984 two organizations introduced into the educational market curriculum packages which utilize this combination: Bank Street College's "The Voyage of the Mimi" and the Agency for Instructional Technology's (AIT) "Solutions Unlimited."

"The Voyage of the Mimi," developed for use in grades four through six, contains a series of video programs designed to be used in conjunction with software and print materials. Thirteen 15-minute dramatic television episodes are based upon whale research which takes place on board the Mimi, a ship chartered for a summer expedition. In addition to the dramatic episodes, thirteen 15-minute "expeditions" feature the cast members out-of-character exploring a wide variety of scientific and mathematical concepts by visiting actual scientists involved in current research projects. The designers of these materials have developed a multimedia

package by creating new television, software, and print materials. In the Foreward to the teacher's guide (Holt, Rinehart and Winston, 1985), executive director Sam Gibbon explains the idea behind this package.

"The Voyage of the Mimi" uses several technologies to engage and hold students' interest in some important topics in science and some useful mathematics associated with them...We begin with the concrete and the specific and move toward the abstract and the general. We deemphasize the boundaries of scientific disciplines, focusing rather on real world phenomena and on those aspects of the scientific enterprise which are common to its various parishes. Finally we present science as a human activity conducted by recognizable people and subject to considerations of human values.

This approach is most manifest in the television program which is the heart of the project and the source from which all the other instructional materials arise. The instructional function of the television series is to provoke and sustain the interests of the students by bringing into the classroom some inherently interesting pieces of the real world and by showing some attractive and interesting people engaged in studying them...

The purpose of the learning modules is to allow students to act on their own motivation and to explore further bits of the natural world they have glimpsed in the television program and about which their interest has been aroused. In each module, the microcomputer software is an important enabler of that exploration."

(Holt, Rinehart and Winston, 1985, pp. vii-viii)

The MIMI package includes:

- the "Voyage of the Mimi" television series;
- a student book which adapts the television series to a print format and includes a glossary and additional activities to engage students;
- four learning modules--"Maps and Navigation," "Introduction to Computing," "Whales and their Environment," and "Ecosystems"--which include four different kinds of microcomputer software; and

- an Overview Teacher's Guide which includes the objectives for each television segment, a list of vocabulary words, background information, preview and follow-up questions, student activities, enrichment activities, and a list of extending concepts.

Following is an example of the integration for the components related to the second MIMI episode, "Setting Sail." In the previous episode, the crew members meet one another and begin to pack the gear for the research voyage. This episode begins with the Mimi setting sail for the bank where the study of the whales will take place. As the crew learns about the sails of the ship, they also get an initial look at a group of humpback whales. The content objectives for this episode are listed in the teacher's guide as:

- a demonstration of the sequence of steps involved in raising sail;
- an explanation of the identifying characteristics of humpback whales;
- a presentation of several types of humpback whale behavior;
- a demonstration of a method of identifying individual humpback whales by their fluke patterns;
- a demonstration of techniques for collecting and recording research data; and
- an illustration of the use of the computer as a tool for scientific research.

The computer software modules suggested for use with this episode include the "Introduction to Computing" module in which the students see the computer as a tool and the "Maps and Navigation" module where they learn to chart a course.

Suggested student activities include recognizing patterns through a match game, matching the fluke patterns of whale photos, comparing the length and weight of a whale to other objects, and locating the area where the whale research will take place on an actual chart of the area. (A complete description of this and other "Voyage of the Mimi" materials is included in Appendix A.)

"Solutions Unlimited," developed for use in grades six through eight, includes eight different problem solving units designed to increase the ability of students to solve problems encountered in everyday life. Each video program is a 7-to-10 minute dramatization designed to set up a problem,

demonstrate problem solving skills, and provide a stimulus for engaging in the computer activity. The computer materials are designed to guide students through problem solving situations. The designers of these materials have chosen to use existing footage from their instructional television programs as the basis for the creation of new software and print materials. The purpose of the package is explained in the introduction to the teacher's guide for the "Solutions Unlimited" material (AIT, 1985).

"Everyone has problems. Some may be small, like finding the sum of two and one; others may be large, like being lost in the wilderness. But whether their problems are small or large, both children and adults need problem solving skills everyday. Until recently, most people assumed that it was enough to let these skills develop naturally as children grew older.

Most problems, especially the "real" ones we face day to day, have not one possible solution but many; hence the name SOLUTIONS UNLIMITED. But most youngsters do not recognize that problems have multiple solutions. They need to be taught a general problem solving approach as well as specific problem solving techniques.

SOLUTIONS UNLIMITED consists of eight units that provide middle school students with a means of improving their problem solving skills and of learning about various computer applications... Each unit includes three instructional resources that may be used together or independently:

- A short video program that demonstrates a skill or poses a problem.*
- Computer software that lets students, individually or in groups, think of and try solutions to a problem and evaluate the results.*
- Printed materials that provide teaching suggestions and reproducible student handouts.*

Woven into the units, and featured in Unit One, is a problem solving guide that has been successfully used in classrooms throughout the United States and Canada:

- HEY WAIT! - Stop! There is a problem.
- THINK - Think of ways to solve the problem and make a plan.
- SEE - Try out the plan and see if it works
- SO? - Have you solved the problem or do you need to go back to another step?

Each SOLUTIONS UNLIMITED unit can be used independently. Thus you may select only those units that are particularly appropriate for your students...Typically, students will be able to complete a computer activity in one or two periods. ...Although the television segments and the computer programs can be used independently, you will probably want to follow a pattern of instruction something like this:

- Introduce the topic of problem solving and the specific theme of the unit.
- Show the television program for the unit.
- Discuss the program, with special emphasis on what the problem is and how those in the program tried to solve it.
- Assign students to computers and have them complete the computer activities.
- After all students have completed the computer activities, discuss those activities as a class.
- Assign follow-up activities."

Following is an example of the package integration for one SOLUTIONS unit, "The Whitewater Canoe Race." The video portion of this unit presents a two-day canoe race between the older and stronger Pirates team and the younger and less experienced Scouts. The focus of the video is on the Scouts as they consider alternative routes and strategies in their attempt to win the race.

The computer activity simulates the race portrayed through the video and gives students an opportunity to make decisions about equipment, paddling speed, placement of the canoe in the river, and choice of route, and then learn the consequences of those decisions.

Additional activities suggested in the teacher's guide for this unit include:

- Having the students determine strategies for a one-day race;
- Having the students research what food they should take on the race considering the cost, nutritional value, energy requirements, number of meals, weight of food, and time for preparation;
- Having students watch and discuss other suggested THINKABOUT programs; and
- Inviting a coach of an athletic team to speak to the class about the alternatives that he or she must consider during a game.

(A complete description of this unit and other "Solutions Unlimited" material is included in Appendix B.)

These packages provide a unique opportunity to explore the development and implementation of multimedia packages which combine television, computer, and print materials. In the research presented here, we have taken advantage of this opportunity to investigate the goals, concerns, and reflections of the designers who developed these packages and the teachers who chose to incorporate this new approach into their classrooms. This report also addresses design techniques most appropriate for this combination of technologies, utilization considerations of incorporating two technologies into the classroom, and the benefits that this combination of technologies provides for teachers and students.

II. RESEARCH DESIGN

The goals of this project were to understand the expectations of both designers and teachers for the design and use of packages that integrate computer and television technologies, and to investigate the implementation of these packages in the classroom. Our research questions were:

- 1) What assumptions and principles guided the designers in their development of the packages?
- 2) What strategies do teachers report using in the implementation of these materials?
- 3) What teaching and learning opportunities do teachers find in the design and implementation of the packages?

During the fall of 1984 we conducted a pilot study to collect preliminary information on the implementation of "The Voyage of the Mimi." The variation in use between two classrooms using this package led us to consider the usefulness of our findings to designers, teachers, and others interested in new curricular designs. We realized that an intensive study of a small number of classrooms would not give us a clear picture of the range of use or a "standard" use of the materials, if in fact such a use exists. We chose, therefore, to address the utilization of the materials through teacher interviews which would provide valuable information about the range of utilization concerns of teachers using this type of package.

Although the purpose of any curricular materials are to enhance learning. we believe that defining learning and

establishing what behaviors or responses constitute a demonstration of that learning pose serious challenges for teachers, designers, and researchers. We decided, therefore, to address the learning issue by interviewing the designers about the learning objectives that guided the design of the packages and by interviewing the teachers about their learning goals and their assessment of students' understanding.

It is not our intent to compare these two packages, as the differences in subject matter would defy a valid comparison. We are interested, however, in comparing the design teams' perspectives which shaped the package design with the teachers' experience using the materials. We hope through this type of comparison to uncover any opportunities and difficulties present in the design and utilization of multimedia curriculum packages which would provide valuable insight to both teachers and designers.

The data for this study is divided into two sections, Designer Interviews and Teacher Interviews, with methods and results discussed separately for each.

III. DESIGNER INTERVIEWS

A. Methods

Our research interests regarding the development of the package design fall into three categories. The first addresses the project organization and the composition and functioning of the team which created the package. The second explores the criteria used in developing the packages, including guidelines for the integration of the package components and the classroom utilization concerns. Finally, we are interested in the designer's reflections on this type of package as well as future plans for continuing to develop such materials.

Although we developed a set of questions for all designers, we discovered that because of the wide range of roles of the individuals interviewed, the designer interview measure was best used as a guiding instrument rather than as a rigid tool. This allowed us both to collect information in specific areas and to follow the conversations as they emerged. (The designer interview questionnaire is included in Appendix C.)

Specifically, the designer interview questionnaire was divided into four sections:

- 1) Project Background, which asked questions about the original conception and funding of the package, the project goals, the project's initial perspectives regarding content and technology integration, and the organization and functioning of the project team.
- 2) Component Integration, which explored designers' conceptions about the strengths and purpose of each of the package components, their strategies for connecting these components, and their reflections on the opportunities and difficulties associated with combining computer and television technologies.
- 3) Utilization, which collected viewpoints about how the project design related to the anticipated implementation of the package in classrooms, including teacher role, student interaction, teacher-student interaction, group vs. individual use of the package, and specific guidelines for package presentation. In addition, designers were asked about the anticipated strengths and problems of using the package in the classroom for both teachers and students.

4) Reflections on Future Package Design, which asked designers to consider which aspects of the project they would keep the same or change, which project goals were achieved, whether they plan to continue to create multimedia packages, and whether they would encourage others to create similar packages.

A total of 18 individuals who had worked on the design teams were interviewed, 8 from the MIMI project and 10 from SOLUTIONS. Our selection of the key project members to be interviewed was guided by discussions with the principals involved in each project. For the MIMI project we interviewed the project director, main script writer, administrative coordinator, two evaluators, two teacher trainers, and one of the software developers. For SOLUTIONS we interviewed one project officer for AIT, two project directors (the leadership changed halfway through the project), the chief project designer, the project evaluator, three program designers, and two administrators from the software production house.

Two researchers working as a team conducted all the interviews. Each interview lasted approximately one hour and was conducted with either an individual (5 interviews), groups of two (6 interviews), and in one case three people. All of the MIMI interviews took place in a face-to-face format; all of the SOLUTIONS interviews, with one exception, took place over the telephone. The interviews were taped, with one exception, and transcripts of all interviews were made from the tapes and/or notes.

Interviews were analyzed for statements about design assumptions and principles, from which several themes emerged: the functioning of the team in the design of the package, the designer's views of the opportunities and difficulties presented by the use of three forms of media, the relationship between the video and the computer in the final package product, the role of the teacher in a multimedia package, the future of this type of package in educational settings, and the designer's interest in continuing to develop integrated packages.

B. Results: Designers' Assumptions and Principles

We noted a number of similarities in both the background and the design experience of the Bank Street College of Education and the Agency for Instructional Technology (AIT) design teams. The principals for both packages had a strong background in educational television, not educational software; efforts on both packages began at nearly the same time, the fall of 1981; and both groups were interested in using the package to present students with the various ways that computers are used in the real world. In spite of these similarities, our interviews revealed that each group of designers focused on a different package component which affected the design process as well the package itself. For Bank Street the major focus was the television programs; for AIT, it was the computer component.

Designers for both packages were interested in creating a new type of curricular material which would use the immediacy of television to enhance educational software. Each group viewed the television component as providing a vital stimulus for the package but the emphasis given to this aspect of the curriculum differed. Although both groups saw the television component as the lead-in from which the other materials would develop, Bank Street considered the television component to be the centerpiece of the package, while AIT was interested in developing computer materials which would have video support.

We found this difference in emphasis to be striking and analyzed the interviews to determine its effect on the total design package. Our analysis indicated that this difference in emphasis greatly affected the actual integration of the components within the package, the evaluation procedures, the utilization concerns, and the designers' reflections about continuing to produce this type of curricular material.

1. Development Process

In reviewing the early proposal or prospectus for the projects, we noted that each group's choice of content area was to some extent guided by the funding agency. For the federally-funded Bank Street project, the initial request for proposals from the Department of Education stipulated that the project be a demonstration involving integrated technologies in science and math curricula. Bank Street's executive director explained:

"(The funding agent) was interested in helping children see how technology works in the real world. We took that seriously. The software is analogous to the adult use of the computer."

After surveying which science topics appeal equally and broadly to children across the categories of sex, race, or socio-economic status, Bank Street chose whales as the focus for its scientific investigation. The television series was seen as forming "the foundation for a multimedia package of instructional materials, a package designed to support an integrated approach to science and math instruction in fourth, fifth, and sixth grades....The TV series (would) primarily serve as a vehicle for stimulating children's natural scientific curiosity, for presenting science in a real and richly human context, and for introducing the science and math concepts that the print and microcomputer materials (would) explore in more depth." (Bank Street, 1983, pp.1,9) This series would be a way to reach children both in the schools through the instructional television networks and in the homes through educational television, to "use technology to crack open what kids' notions of science are." The series would also be available on video cassette for nonbroadcast distribution of the complete package of materials.

AIT develops consortium projects involving state and provincial departments of education/telecommunications. AIT began the exploration of its project through an interest in developing quality computer software. At a series of meetings with state and provincial education and technology representatives, the feasibility of this type of venture was explored. These representatives supported the idea and suggested that "problem solving" process skills be the focus for the project. This suggestion was, at least in part, guided by the fact that previously AIT had developed several problem solving series, most notably a critical reasoning and thinking series called THINKABOUT, that teachers had found to be excellent for classroom use. By using existing video, AIT sought to reduce the project's expenses and continue in a subject area where they had already proven themselves successful. "The approach will allow the project to develop microcomputer programs based on visually rich and instructionally effective segments from existing series while saving considerably on production costs." (AIT, 1982, p.6)

One of the AIT project leaders called their effort a "dual technology project or a combination project with no black cords between the machines." A chief designer for AIT echoed a similar philosophy, "TV and computers could be conceptually used together without tying them together on an umbilical cord, thematically linked without being interactively tied." Unlike Bank Street's development of MIMI, this project was designed entirely for school use; the video programs could be broadcast on instructional television networks as well as primarily available on videocassette for nonbroadcast distribution of the package to schools.

The computer materials were designed to "guide the students through problem solving sequences, giving aid as necessary, providing feedback to the students about the problem solving process and their progress toward the solution of the problem at hand, and storing pertinent facts to inform and motivate the students." (AIT, 1982, p.7)

After the initial stages of project clarification and funding, each project created a design team to implement the project goals. Both design teams included content area specialists, script writers, computer programmers, software designers, researchers, teachers, and instructional television producers. For both projects, subgroups of this design team were formed for project design and script development. Participants in both design teams mentioned that they had a variety of roles within the team or that their role changed considerably as the projects progressed. Both projects also relied on advisory groups for the review of design, scripting, and prototype development. Bank Street's review was conducted by a Teacher Panel and Project Advisory Board and AIT held large review meetings with their consortium representatives.

For the first year of its project, Bank Street focused on script development for the video component. Television scripts were written and rewritten. Formative research was conducted to establish which characters and actors had the most appeal for the widest audience of children. The second year included filming and classroom field tests, and the beginning of the work on the computer software. The final year focused on the filming of the documentaries and the completion of the software.

During the first months of the project, AIT's design team reviewed over 75 programs, primarily from the THINKABOUT series, to select video segments that they felt could be expanded into computer and print activities. After the selection of TV programs, the design team spent several months scripting computer activities and outlining the various roles of the video and print. After a review by content specialists, teachers, and consortium members, two prototype units were produced and then reviewed. In the next year and a half, the remaining computer scripts and prototypes were evaluated by students and the six additional units were developed and produced.

Both groups encountered problems in the first year of development which forced them to reorganize their projects. Bank Street did not receive funding to complete an additional 13 dramas and decided to substitute 13 lower-budget documentaries to complete the video component of the package. AIT changed project directors. In addition, AIT had a disagreement with its first contracted computer software house

about the feasibility of keeping the computer software materials within AIT's 48K restriction. Triggered by this dispute, AIT selected a new software production house.

Another area of difficulty encountered by both groups was the problem of evaluating the computer software scripts. Both groups were experienced in television evaluation but found that software scripts and mock-ups were much harder for students to follow.

"It wasn't like having a rough video or even having a prototype. What we had were basically starting from story board ideas to software mock-up with paper inserts on screens... (In the end) it was much easier for us to write it out on paper and ask kids what they would have done if this appeared and what do you think about this prompt." (Bank Street)

"People out there cannot read a computer script. They can read a video script. You've got to give them a detailed frame-by-frame description of all the routing. It would take hours to follow all the branching when you are working with a computer project. Very complex. We can't show the script to a kid and say, 'What do you think?' You can't even show it to a teacher and say, 'Does it work for you?'" (AIT)

Both Bank Street and AIT realized that there was no existing procedure they could rely on for the evaluation of computer scripts.

"There are a lot of questions with software and we are really new in trying to figure out how to represent those questions ... There was a bit less groundwork laid in how you do research on software." (Bank Street)

"Given the fact that you have so many branches, people just don't have enough experience looking at that sort of material. We haven't been able to hit on a way to evaluate the script with the feedback we need at that stage to head off these concerns." (AIT)

Using the CTW model for television evaluation, Bank Street began to create a model for software evaluation:

"As I recall, there were three levels that we were interested in as we did this prototype project. First, did the kids understand the surface of the thing, the vocabulary, the layout? Second, could

they get around the program? Did they know how to use a menu, where they were and how to get out? Third and most difficult, did they learn the concepts that we had in mind? That is difficult with complex pieces of software in the third level because often kids are just learning what the software is and more extensive contact is needed to see if they really understand. That kind of stuff is less easy to get in the formative research."

2. Logistical Considerations

The designers of each package had different views of how the materials should fit into the regular teaching schedule. Bank Street's package modules provided teachers with an abundance of material that required more time than one or two class periods. AIT's curriculum was carefully designed so that each multimedia unit would fit into the confines of one or two class periods.

Bank Street designers wanted to create materials to encourage students "to become active participants in the process of scientific investigation and inquiry." (Bank Street, 1983, p.14) The various topical units were only loosely joined to one another. Although MIMI's dramatic adventure episodes followed in a sequential order, the related documentaries could be viewed either as one program with the dramas or separately. The computer software and print materials, linked to the recurring topics of whales, navigation, and temperature, were designed as self-contained modules. Although designers saw pieces of the software linked to sections of the video, they did not envision that all components would or should be used within a set number of class periods nor did they design the materials keeping in mind the problems of using the multiple forms of technology.

AIT designed its materials to fit into the structure of regular classroom routines. Designers envisioned that each student would have the opportunity to work on the computer for a 10-20 minute period. Each unit was designed to incorporate the package components into different management models of teacher/student interactions. Some units emphasized individual or small group interactions, others focused on interactions with the classroom as a whole. Although the video was always used as the set-up, the computer, print, and teacher-directed activities could be used in different sequences and combinations, and individual units could be used in any order.

Another logistical consideration for AIT was to make their package accessible to a wide audience. AIT believed that,

"For many teachers and students, this project will introduce the classroom microcomputer. For almost all, the combined use of the computer and the television will be novel." (AIT, 1982, p.14) Therefore, AIT reconsidered the integration of the television and computer technologies to produce as inviting a package as possible.

According to an AIT project officer, "SOLUTIONS is not an overwhelming project for teachers to use. It just won't baffle people when they begin to put their hands on it. It's probably soft on instruction per se, in terms of content, and strong on getting your hands on a computer." This emphasis on accessibility helped to shape several features of SOLUTIONS.

One of these features involved providing support for teachers within the materials themselves. For example, one difficulty they envisioned was that teachers would need additional disks to use with the class. A SOLUTIONS design team member explained how AIT approached that potential problem:

"Most people try to keep the user from duplicating the product. We take the opposite approach. Steal the hell out of it. Duplicate it as much as possible. If you need ten copies, take ten copies. We have a program on the disk that tells the teacher how to copy."

3. Integration of Technologies

Early in the SOLUTIONS project, after some classroom research, a decision was made to design the software so that students could use it without ever seeing the video segment. This was done, according to an AIT project leader, because there was speculation that "a lot of teachers would be using it without the video" due to problems of accessibility to both television and computers.

"The research on classroom use particularly sensitized us to the logistical problems. It moved us to make the computer materials self-contained. People who hadn't seen the video would still be able to use the computer lessons."

AIT redesigned the package so that the video did not have to be used at all, by "breaking the link" between television and computers and "letting the computer materials stand alone." Each computer program contains a review of the important aspects of the video on the computer program. Although AIT designers hoped that the TV component would be used, they did not feel that it was realistic to assume that

it would be.

"To tell you the truth I'm not so hopeful (that teachers will use both the video and the computers). They won't bother. They'll see that the kids are doing okay without the video and they'll just say, ah, to hell with it. That's my realistic opinion. Being an idealist though, I'd still prefer they used it."

"Our preference is that they use the video. We have an instinctual bias that way, but we feel that it works as well without the video....The video adds interest and appeal but doesn't enhance learning."

"We wanted to try to motivate the kids to want to get on the computer and do something. But we knew from the word go that all people weren't going to have access to the video so we had to develop it so it could be put to use without the video."

"We as a group had to run through a scenario of how the materials would be used, looking at the way schools had computers in labs or one per classroom. We tried to think about how you got students, one, to watch a TV program and then two, through the computer lesson in a reasonable amount of time. It was a nightmare."

However, one of the software developers for SOLUTIONS, a former teacher, believed that the video was important to the project:

"The TV was crucial because it set the tone, it set the theme. The software, in a sense, became an extension of the video. It was rich to have the video and be able to incorporate it.... It was a disappointment to think that teachers might not use the video. It fits together so beautifully. In the canoe race you can see the kids on the screen and they get all fized up about it and you are really ready to go to that computer and do it. There is this little bit of something missing if the kids just read it or the teacher introduces it."

In contrast, the designers for MIMI never questioned the importance of keeping the television and computer together.

"When we were producing the first year, we were really hoping that this little segment in the video

would lead nicely into this part of the software. And this thing in the software would be picked up by something here in the print and that things were connected."

"I think when we first started the project we had certain intuitions about how the TV would involve kids in the drama of the science and what it would be like to go on an expedition... and that the software and print allowed them to expand on various themes or topics - concepts that we introduced in the drama."

Although at first one of the Bank Street computer software developers agreed, he later commented that the video was less important, from his perspective, than the computer software:

"Certainly the video component adds a lot of sparkle and interest both from the teacher's point of view and from the kid's point of view. I think that there is no question about that. So having that in the package seems to be important. I think this is a nice model. There is not a one-to-one correspondence with the video and the software, it is not tightly bound. It gives creative people a lot of flexibility in what they do.

(However, later he added)... I am always appalled at the cost of doing the video. If you gave me \$3 million to do software I think the school would get more sparkle out of the software than from watching the video show... I think there was also a desire to make these powerful tools stand alone as tools that don't necessarily have to be linked to the video at all....It is hard from a curriculum point of view to link everything together. If you have powerful software, it would be useful to market it and have it be available separately."

4. Teacher Role

Although both packages offer teachers a new approach to teaching involving a combination of technologies, the underlying assumptions of the two groups were substantially different. It appeared that Bank Street's interest was in expanding the way that the teacher viewed the content area and AIT was interested in working within the existing classroom constraints to develop a package that could be widely used.

MIMI's executive director viewed the teacher as "the critical variable" and explained what the teacher must bring to the MIMI package:

"It's not just background but it's also attitude. With one teacher who is not afraid, the materials can come alive. There needs to be a sense of an intellectual adventure on the teacher's part."

Another Bank Street staff member expanded on this idea:

"I think it's important for the teacher to be around as a colleague who can help form and ask the questions, and be willing to say, 'I don't know.' A co-investigator as it were. That's hard for some teachers. They want to have all the answers. They simply will not accept that role. And there are others that understand that it is important."

In the AIT prospectus the teacher role was defined as "limited but important." AIT proposed that "the teacher would play a central role in introducing and managing the instruction" and "helping (students) extend and apply the problem solving skills presented in the materials." (AIT, 1982, p.5) The AIT team often commented on the teacher as a facilitator, "getting everybody to the right place at the right time, making sure the video is there, making sure the kids know how to use the computer." Another AIT designer saw the teacher as "a motivator," bringing enthusiasm to the classroom and extending the materials to fit into the existing curriculum. Still another designer mentioned that in his vision of the program the teacher's role would increase as the program went on by focusing the students' attention on the four-step problem solving model of SOLUTIONS.

The different views of teacher role in using the package are particularly poignant in relation to the way that each group talked about how they hoped the package material would relate to classroom pedagogy.

Bank Street organized teacher training that went beyond the specific activities of the package into "the pedagogy of science and math instruction, the math and science concepts that teachers aren't familiar with, and the planning problems the technology poses." Bank Street sought funding to provide interested teachers with training in connection with the MIMI material as a philosophy rather than a series of classroom activities.

"We decided that there was a model of science instruction that would permit us to give the

teachers more than a how-to in using these materials. It simply wouldn't be adequate to show the materials, explain the different functions, what the function of TV was in relation to print material and what the software was going to do. In fact we did very little of that. What we did mostly was present them with perspectives on teaching. What they got was a view of pedagogy that made them step back and rethink their whole way of teaching."

One of the software developers for AIT saw the SOLUTIONS package as a way to help teachers reconsider the boundaries of their specific disciplines.

"I think the strength of SOLUTIONS is for the teacher who can really see the world other than through the compartmentalized view of the school curriculum. To see that we are the ones that cut it up in the first place. Then we try to lay a reality on top of that, whereas for kids and for the real world, everything is together. It's not cut up into math and social studies and science. A teacher who has that view will think of this as a real strength."

Most of the other members of the AIT design team, however, had a different view of the materials. Rather than focus on a new pedagogy or philosophy, AIT had a heightened sensitivity to the logistics involved in implementing multimedia packages incorporating two technologies. This sensitivity is consistent with AIT's background as an organization that has dealt with the distribution and utilization of instructional materials for more than a decade.

5. Reflections

Both design teams acknowledged that designing multimedia packages was hard work, especially the computer software component. One Bank Street researcher commented, "I think that one of things we learned was that we took on a huge piece of work." An AIT project officer agreed:

"One of the biggest problems with software projects is that they wander. The creation of computer software is a very, very difficult and labor-intensive and ever-learning situation. The problem was in understanding how the computer task and the TV all fit together. We also didn't understand how long it took to make changes....We really didn't know how much it would all cost...The software is a more creative beast and has a life of its own. It

is its own organism and may not be what was envisioned when we completed the print materials."

Both design teams realized that while their packages were being created other groups were setting new standards for software development. A Bank Street designer reflected, "I think what is happening now is that there is much more interesting, existing software than when we began." An AIT designer reflected, "We are trying to give them something that they had never done before in computers. And to some extent we achieved that except that the clock caught up with us here and so did other kinds of programs."

The most significant change that AIT is making as it continues to work on other computer software series is to eliminate the television portion of the package altogether. AIT staff members explained:

"The video wasn't worth the hassle. I'd leave it out. It's certainly not worth the effort to produce the programs from scratch..."

"I think that the educational value is sound. I think that realistically it is very difficult to bring a class to a viewing session where you have computers, TV, and print tied together in some sort of sensible manner given the state of today's technology... I would simplify the logistics by breaking the link and letting the computer materials stand alone."

Although several AIT designers agreed that the combination of technologies was exciting, they questioned the feasibility of that type of combination within a school setting.

"The strengths of schools are such that, if you take what is conceptually a great idea for small groups or individual instruction, it becomes a real hassle in a school setting. It might be better in a home setting."

One participant in the AIT project viewed projects like SOLUTIONS and MIMI "as the first steps toward the kind of interactive goal that is maybe ten years away." Others at AIT supported the idea of interactive video as the way of the future: "There is no question about the fact that interactive video is the answer in time." Another designer declared that "this mode (computers and television) is dead." Both of these project members acknowledged, however, that schools are not currently equipped with interactive video or videodisc equipment.

Although the Bank Street Executive Director concurred that videodisc may be the answer in the future, he felt that this model of computers and television still had much potential, at least for the immediate future, and that he "couldn't imagine not doing it (the combination of computers and television)." One Bank Street researcher concluded:

"I think it can do some great things if done well, the whole key is that you can have different media but if you use them all the same way, you're not going to be really adding to the whole or realize the potential."

Both organizations had as their overarching goal the creation of an outstanding demonstration project: Bank Street set out to provide "a model for the classroom use of the new information technologies." (Bank Street, 1983, p.3) AIT's desire was to "set a benchmark to which other educators could refer when other microcomputer materials were proffered by educational publishers" and "illustrate the best of what education could do..." (AIT, 1982, p.3) Thus, in many ways, these two organizations developing these projects independently in different parts of the country had a shared vision about what the combination of technology offered teachers. Both projects were operating with few precedents in the development processes for creating projects that combine television and computer technologies. Yet, the packages are markedly different in terms of how each technology is viewed alone and in combination with the other. Given the dramatic differences in each groups' philosophy and design strategy, we were interested to learn of teachers' experiences in using these packages.

IV. TEACHER INTERVIEWS

A. Methods

Our interviews with teachers were designed to address three questions:

- 1) What are the factors that might affect how teachers use these multimedia curriculum packages?
- 2) What are the strategies which teachers use to implement these packages?
- 3) What are the teaching and learning opportunities associated with these packages?

We expected that a teacher's background, teaching style, experience with computers and television, as well as the accessibility of the necessary equipment, were important variables to consider when assessing how the teacher chose to use the materials under study. In addition, we hoped to compare the ways in which the teacher envisioned using the materials with the actual implementation of the materials in a classroom. Lastly, we were interested in the teacher's evaluation of the materials and their impact on the classroom environment as well as on individual students.

Our interviews with teachers were designed to be conducted by telephone before or early in the teacher's presentation of the material to the class and then several weeks after actual use. The interviewer asked both closed and open-ended questions to be completed in a half hour, although we realized that some interviews would run longer. (A tallied teacher interview questionnaire is included in Appendix D.)

The pre-utilization interview addresses the first two questions listed above and includes the following sections:

- basic information about the school location, teacher's subject area, and teacher's plan for using the package;
- teacher's amount of experience in teaching and in the use of television and computer technologies;
- availability of the equipment;
- classroom's physical layout, including the location of the equipment;
- characteristics of the students;
- ways the teacher learned about and obtained the package;
- teacher's plans for use of the package; and
- teacher's expectations about the package's approach and its impact on teaching and learning.

The post-utilization interview was designed to focus the teacher on an analysis of both the package materials and the impact of the package on the classroom environment. More specifically, we collected information on:

- logistics of using the package, including equipment and time;
- actual utilization of the package, including the teacher role, classroom organization, and student interaction and participation;
- reactions to the materials, including the combination of technologies, appropriateness for grade level and course, and the use of the teacher's guide;
- reflections on the way in which the package materials affected teaching practices;
- perceptions regarding the connections among the computer, television, and print materials;
- perceptions on the package's strength--subject matter or technology; and
- comments about future use of the package and recommendations to other teachers.

Our intention with this instrument was to learn the teacher's view of any changes that occurred in the classroom as a result of using the package and the teacher's thoughts about how, if at all, the combination of technologies affected teaching and learning.

1. Procedures

The teacher interviews spanned a ten-week period from the beginning of March to the beginning of May, 1985. Initial contact with each teacher was made by phone, at which time the research project was explained, the teacher's plans for utilization were discussed, and, if appropriate, participation was requested.

Each teacher was interviewed twice by one of five researchers from the project team. The first interview ranged in length from 15 to 45 minutes, with an average length of about 30 minutes. The second interview, which took place 3 to 4 weeks after the first, ranged in length from 30 minutes to 75 minutes with an average length of about 45 minutes. All teachers but one participated in a second interview. Teachers were interviewed by the same researcher for both the first and second interviews. The telephone interviews were conducted at home whenever possible, although in many cases the interviews took place at school.

The first interview was conducted using the pre-utilization interview. If the teacher had already begun

using the package, questions 34-43 were omitted as they ask for the teacher's expectations about how the students will respond to the materials. At the conclusion of the first interview, a second interview date was agreed upon. The second interview was conducted using the post-utilization interview.

The majority of interviews were taped with the permission of the teacher. When taping was not possible, careful notes were kept of the teacher's responses. The tapes or notes were transcribed to create a verbatim account of the teacher's responses. Once all the interviews had been completed, the responses were coded and tallied to gain an overall picture for the study. In addition, we grouped all narrative comments into a number of categories: student reaction, teacher reaction, understanding of the combination of components, and comments on each of the package components singly. This information was analyzed for similarities and differences among teachers and between the two packages.

2. Sample

In selecting teachers to participate in this project, we were concerned about three issues: 1) that the teacher was a first time user of the materials; 2) that the teacher was planning to use all of the components of the package (television, computer, and print materials); and 3) that the teacher had not begun or was just beginning to use the package at the time of our first interview. By requiring that our participants had at least this much in common, we hoped to ensure some similarities among our sample.

Our original intention was to conduct the study in one state in which both packages were widely used. After conversations with national distributors for each package, we found no state which had a wide distribution of both packages. We decided, therefore, to select two states for our sample. The states selected, Massachusetts for MIMI and Wisconsin for SOLUTIONS, were chosen because, according to the distributors, each contained a large number of schools that had purchased the package.

We selected teachers using the MIMI package from the distributors' lists of 18 schools in Massachusetts that had purchased the materials in the fall of 1984. Our sample of the 21 individuals (from fourteen schools) who met our requirements includes 12 teachers who had not yet begun using the package and 9 teachers who had just introduced the package to their classes. Only one teacher decided not to participate in the study because he felt that he was not familiar enough with the material to assist us. The remaining teachers using

the package but not selected for the study had been using the material for several weeks or had completed the package.

We selected the teachers using the SOLUTIONS package from a list of Wisconsin schools and school districts that had purchased the package from the Wisconsin Educational Television Network, the state distributor of these materials. Of the 61 schools and school districts on this list, we contacted 44 institutions of which only 11 fit the requirements of our sample. The majority of teachers contacted were not suitable for the study because they were not planning to use the package until the following school year. Therefore, the teacher sample consisted of a complete census (but one) of teachers in the states of Massachusetts and Wisconsin whose purchase was known by the publisher and who had just begun or were about to use the materials.

B. Results: Profiles of Sample

1. Teacher Profile

A total of 32 teachers were interviewed, 21 Massachusetts teachers using "The Voyage of the Mimi" and 11 Wisconsin teachers using "Solutions Unlimited." Of the MIMI teachers, 52% were women and 48% were men; of the SOLUTIONS teachers, 64% were women and 36% were men. Following is the background information we collected on our sample; detailed data are included in Appendix D.

Most of the Massachusetts schools used in this study were suburban (71%), almost one quarter (24%) were urban; in contrast, most of the Wisconsin schools were urban (64%), slightly more than one quarter (27%) were rural. The majority of the MIMI teachers taught the fifth grade; the majority of the SOLUTIONS teachers taught the sixth grade. For both packages, the majority of teachers using the materials were homeroom teachers (57% MIMI, 55% SOLUTIONS). A substantial number of the remaining MIMI teachers (43%) were science teachers. The remaining SOLUTIONS teachers were either math teachers (18%) or taught other subjects (36%) such as library skills, guidance, or problem solving.

Most of the teachers using either package had been teaching for over 10 years (77% MIMI, 55% SOLUTIONS). None of the teachers using MIMI had taught for less than 6 years and almost one quarter (23%) had taught for more than 20 years. Less than one fifth of the SOLUTIONS teachers (18%) had taught for less than 6 years and only 9% of the SOLUTIONS sample had taught for more than 20 years. The relatively high number of teachers from our sample with more than 10 years of teaching experience is representative of teaching experience for the nation's teacher population. According to a 1981 NEA survey of teaching experience, more than one half of the nation's teachers (57%) have between 3 and 14 years of teaching experience and 37% have been in the field for more than 15 years (NEA, 1981).

Teachers were asked about the availability of television and computer technologies for classroom use and their experience with these technologies. The majority of both MIMI and SOLUTIONS teachers reported that television and video recorders were very accessible. However, whereas almost one quarter of the MIMI teachers reported that they had never used television in the classroom and slightly more than one half who do use it report that they use it irregularly, all of the SOLUTIONS teachers reported that they use television in the classroom and that they use it regularly. Furthermore, only 19% of the MIMI teachers who use television in the classroom rated themselves as very experienced in teaching with

television, in contrast to more than half the SOLUTIONS teachers (64%) who considered themselves very experienced teaching with television.

There was no difference between the MIMI and SOLUTIONS teachers in their experience with computers. All of the teachers in this study reported that they had used a computer before for a variety of purposes. The majority of teachers (71% MIMI, 64% SOLUTIONS) began using a computer between one and three years ago.

The majority of teachers (76% MIMI, 82% SOLUTIONS) had used computers in their classrooms and reported that a computer was very accessible for their classroom use; no teachers reported that it was not accessible. In addition, a large percentage of the teachers in the study reported that they owned computers themselves (38% MIMI, 46% SOLUTIONS). Of the teachers who did not own computers, 17% of the MIMI teachers and 50% of the SOLUTIONS teachers reported that they were able to take the school's computer home. The majority of MIMI and SOLUTIONS teachers rated themselves as either experienced (43% MIMI, 55% SOLUTIONS) or moderately experienced (43% MIMI, 36% SOLUTIONS) computer users.

The responses of MIMI and SOLUTIONS teachers to the question "Who decided to purchase the package?" differed greatly. Whereas more than half of the SOLUTIONS teachers (55%) indicated that they made the decision to purchase or worked through a media specialist (27%), none of the teachers who used MIMI indicated that they had made the decision to purchase the package. For MIMI teachers the decision was made primarily by either administrative personnel (43%), other teachers (24%), or a combination of the two (14%). The differences in the responses may be related to the different costs involved (approximately \$1,000 for MIMI versus approximately \$95 for SOLUTIONS) and the differences in the way that supplies are ordered in the two states.

2. Classroom Profile

After providing background information on teaching experience and their use of computers and television in their classrooms, the teachers were asked to select one of their classes, preferably an average class, to focus on for the remainder of the first interview and all of the second. Following is background information on these selected classes; detailed data are included in Appendix D.

Most classes had between 21 and 30 students (81% MIMI, 70% SOLUTIONS), which were approximately evenly divided between boys and girls. Almost half of the MIMI teachers (48%)

reported that their class was comprised of students from high or middle socio-economic levels. The SOLUTIONS classes were reported to be evenly divided among high, middle, and low socio-economic levels. Approximately one half of both MIMI and SOLUTIONS classes were all white; the remaining classes were predominantly white (less than 10% minority children).

The high percentage of white classrooms does not correspond with the racial balance within each state. The 1983 statistics from the National Center for Educational Statistics reports that in Massachusetts minority students represent 10.7% of the total enrollment and in Wisconsin they represent 9.3% of the total enrollment. This would indicate that our sample contains an unusually high number of white classrooms. Further studies would be needed to determine why this imbalance is present.

We are aware that there are several limitations regarding the sample. The MIMI package had been purchased by a small number of school districts. In Massachusetts our twenty-one teachers were from eleven public schools and three independent schools within six school districts. The fact that a number of the teachers were from the same school may mean similar approaches and a sharing of classroom activities. Secondly, the flexibility and logistical arrangements that these materials may require might affect the type of teacher who is willing to tackle a new type of curriculum unit. Lastly, we realize that utilization strategies employed by teachers during the first year of use may change in subsequent years; however, we consider the initial contact that a teacher has with the materials to determine how and if the package will be used again.

C. Results: Strategies of Use

In our interviews with teachers, we gathered background information on how the teacher made the decision to purchase the package. A detailed discussion of this data is in Appendix E. One striking difference which we found between the two packages was in who authorized the purchase of the package. More than half of the SOLUTIONS teachers (55%) reported they made the decision to purchase the materials themselves as compared to none of the MIMI teachers. A large number of MIMI teachers (43%) reported that administrative personnel made the decision to purchase the package. This difference between the two packages may be related to both the different costs involved (approximately \$1,000 for MIMI versus approximately \$95 for SOLUTIONS) and the different procedures for ordering supplies found in different states and schools.

In analyzing the data from the teacher interviews, we focused on two levels of utilization: strategies of use and effects on teaching and learning. This section includes information about utilization support, logistical arrangements, and classroom management.

1. Support and Training

Most teachers received utilization training out of the classroom and teaching assistance in the classroom.

Half of the MIMI teachers (48%) and the majority of the SOLUTIONS teachers (73%) indicated that they attended some type of workshop that was devoted to the utilization of the materials in the classroom. Whereas the majority of MIMI teachers attended workshops sponsored by the package distributors, the majority of SOLUTIONS teachers attended an inservice workshop. As a part of the package, AIT produced ABOUT SOLUTIONS, a televised inservice program which was distributed to all of the consortium members and available for interested teachers. In addition to the MIMI distributors' workshops, a Boston area college developed a semester course around the MIMI materials in which four of our sample teachers participated.

The majority of teachers (71% MIMI, 55% SOLUTIONS) indicated that they received some form of assistance from other school personnel while implementing this package. Table 1 shows the positions of those supporting the teachers.

TABLE 1

SCHOGL ASSISTANCE	MIMI	SOLUTIONS
Media/computer specialist	40%	33%
Principal	33%	33%
Student teacher/teacher aide	7%	50%
Other teachers	33%	17%

Half of the SOLUTIONS teachers had in-class support from a student teacher or teacher's aide, whereas MIMI teachers received support from outside the classroom, primarily from the media specialist, the principal, or other teachers. Many teachers commented that this support was invaluable to them. The media specialist frequently coordinated all of the video sessions; the principal often gave teachers support in the form of additional planning time; teacher aides assisted particularly in the computer portion of the curriculum; and other teachers often coordinated lessons to provide a more interdisciplinary approach to the packages.

2. Logistics

We asked teachers if they had any difficulty obtaining the equipment necessary to use the packages. The majority of the MIMI teachers (75%) and all of the SOLUTIONS teachers reported that they did not have any difficulty getting the equipment. Yet despite this response, many teachers went on to contradict themselves by describing scheduling or scarcity of equipment difficulties.

One MIMI teacher at the time of the second interview had still not been able to use the computer component. The problem of getting her class to the computers or the computers to her class proved too complicated for her. She felt that moving her entire class to the media center was "a drag" and that bringing the computers, which are stored on the first floor, to her second floor classroom was "an impossibility." Instead, she decided to hook one computer to her classroom television but even this compromise caused delays, "I still haven't really gotten in on the computer yet because I was waiting for a part for the television." Ironically, when this teacher responded to the question, "Did you have any difficulty obtaining the equipment necessary for this package?" she stated that she did not.

A number of MIMI teachers noted the problems of limited equipment in their schools: "We have over 550 kids and only seven computers." "There is only one (VCR) in our school." For several teachers the lack of sufficient equipment meant that they could not use the materials in the way that they would have preferred. One teacher mentioned that the room in

which the television was kept was often used for other purposes. Although the machine was not being used and was available for her class, the room was not, thus restricting her use. Another MIMI teacher stated that because she had limited access to the VCR she was unable to teach the package in the way that she would have liked:

"Because of the VCR and a rotating schedule, I can only do it (MIMI) two days a week and that is not adequate. It's adequate to show the tapes, but I would rather have a block of time each day to work on it in some way."

One SOLUTIONS teacher explained that in order to use the television in her room, a new outlet had to be installed in her classroom, yet she did not consider this an equipment difficulty.

One third of the MIMI teachers mentioned that the packaging of the MIMI material was responsible for another equipment difficulty. Unlike other curriculum-oriented software that uses one disk to boot up several machines, the MIMI software requires one disk per computer. Additional disks may be purchased from the distributor, however many teachers commented that they did not feel that they could find the additional funds. As a result, although many teachers would have preferred to have students work on computers in small groups, they taught the computer portion of the materials as an activity for the entire class using one machine. The SOLUTIONS software did not have this restriction.

3. Teacher Role

Although the majority of SOLUTIONS teachers (64%) reported that implementing the package resulted in a change in their classroom organization and teaching approach, the majority of MIMI teachers (70%) indicated that they did not make any changes in their classroom or teaching approach as a result of these materials. In addition, the majority of all teachers (60% MIMI, 64% SOLUTIONS) reported no change in the way that students related to them during the use of these materials. However, the number of comments on the change in teacher role was striking. Teachers using both MIMI and SOLUTIONS commented that the package made their role more of facilitator than didactic lecturer:

"The way that I would usually teach my class would be more lecture method... It does change my regular schedule, I'm not at the blackboard." (MIMI)

"My role as teacher is changing. I'm more a facilitator, I help them get into things they're interested in without teaching a lesson so to speak. Before it was strictly textbook, experiments, tests every two weeks, much more structure." (MIMI)

"I see the teacher as an aide, as a reference source. The teacher being a tool in trying to find all the other aids. I see me being the reference source in the classroom. They come to me. It's not me standing in front trying to pound it into their heads. This package facilitates teaching." (MIMI)

"Usually I did a lot of talking; it was very teacher-oriented ...This package sets the stage for what we are going to be doing and the teacher doesn't do all of the instructing." (SOLUTIONS)

Other teachers noted that the package initiated a closer relationship between teacher and student:

"I think it encourages me to let the kids have a little bit more to say about what goes on in the classroom." (MIMI)

"I have more participation and involvement than in other science classes...There is a greater rapport back and forth between the teacher and student." (MIMI)

"I felt that we were working together on something rather than me being the leader. It was more of a team effort." (SOLUTIONS)

4. Time Allotment

Teachers varied in the amount of time that they devoted to the MIMI and SOLUTIONS packages (see Table 2). Almost half of the MIMI teachers spent up to three months using the package; more than a quarter of the SOLUTIONS teachers spent up to two months.

Table 2

TIME SPENT ON PACKAGE	MIMI	SOLUTIONS
Less than one month:	5%	0
Up to two months:	14%	27%
Up to three months:	48%	18%
Up to four months:	19%	18%
Up to five months:	14%	18%
As long as it takes:	0	18%

There was also some variability in the number of times per week teachers used the packages (see Table 3). Whereas over one third of SOLUTIONS teachers (36%) used the package less than once a week, none of the MIMI teachers used the materials this infrequently. Furthermore, 35% of the MIMI teachers used the package 5 times a week in contrast to only 9% of the SOLUTIONS teachers.

TABLE 3

PACKAGE USE PER WEEK	MIMI	SOLUTIONS
Less than 1 x per week:	0	36%
1 x per week:	5%	0
2 x per week:	30%	27%
3 x per week:	30%	18%
4 x per week:	0	9%
5 x per week:	35%	9%

We propose that this variance in time spent on the materials is related to the differences between the two packages in the amount of material and the organization of the units between the two packages.

The MIMI package is based on twenty-six, 15-minute television programs designed with ordinal units, at least some of which follow in a particular sequence which require some proximity to one another. In contrast, the SOLUTIONS package contains 8 finite units designed to be used either intensively or sporadically. Thus, although there were differences in time allotment between MIMI and SOLUTIONS teachers, the majority of teachers (70% MIMI, 82% SOLUTIONS) stated that the time they chose to allot for the material was adequate.

A few MIMI teachers said that although they allotted enough time for what they had planned to do with the package, the materials were rich enough to deserve even more time. One MIMI teacher elaborates on this point:

"It was enough time for what I did with it. There's all kinds of materials there that I think could be very useful that I didn't use but in the length of time that I had scheduled for this, I couldn't use them. The biggest issue I have with this package is the time."

Although SOLUTIONS teachers for the most part stated that they allotted enough time to do the package, there were specific lessons that they thought required more time than they had anticipated.

In addition to questioning teachers about the amount of time spent on the total package, we asked teachers to estimate the percentage of time that they devoted to the various components (see Table 4). In this case, our results present a clearer understanding of the differences between the packages. While some teachers were able to answer this by noting which components received equal time, many teachers responded by giving the component that they used the most and the one they used the least.

Few teachers (19% MIMI, 0 SOLUTIONS) spent an equal amount of time with all three components. Print materials were the least used by SOLUTIONS teachers (55%) but appeared more important for teachers using the MIMI package. Whereas MIMI teachers spent the least amount of time with the computer materials and the most amount of time with the television and print materials, almost all the SOLUTIONS teachers (91%) spent most of their time with the computer materials. This contrasts sharply with the teachers' background: whereas Solutions teachers were very experienced television users, very few of the MIMI teachers had used television in the classroom. However, both SOLUTIONS and MIMI teachers were experienced or moderately experienced computer users.

TABLE 4

TIME SPENT ON COMPONENTS	MIMI	SOLUTIONS
Equal TV/Computer/Print:	19%	0
Equal TV/Computer:	10%	9%
Equal TV/Print:	24%	0
Equal Computer/Print:	0	0
Most TV	24%	0
Most Computer	0	91%
Most Print	10%	0
Least TV:	10%	36%
Least Computer:	48%	0
Least Print:	5%	55%

For both packages, several teachers commented that utilization of the package within a short time span limited the amount of time available for the combination of technologies and the teachers tended to focus on just one component - TV for MIMI and computers for SOLUTIONS. In contrast, teachers who devoted several months to the materials had enough time to complete the video, computer, and print components and conduct all the teacher guide activities. To illustrate how these differences in use were implemented in classrooms, we have compiled comments from two MIMI teachers and two SOLUTIONS teachers. The names used in the following descriptions are not the actual names of the teachers interviewed.

MIMI Teachers

Bob Engles used the MIMI package daily for two weeks and Frank Smith used it daily for four months. Both are sixth grade teachers. Bob is a math/science teacher at an independent suburban day school and Frank teaches reading, English, and science at a public rural elementary school.

Bob decided to "blitz" through the MIMI between two vacation periods in February. He was on sabbatical in the fall and while he was gone his school purchased the MIMI. The package sat unused all fall and Bob stated that he was "the only one who wanted to try it." The other teachers were "afraid of it" because "the package seemed overwhelming to them."

Bob and his class devoted only two weeks to the MIMI package, using it everyday during a 40-minute period. Bob said that he treated the package as a new curriculum unit.

In the first interview Bob stated that he planned to use the teacher's guide selectively:

"I plan to use what seems to be good for each unit. I think there is too much in the teacher's guide; they sort of give you all of the possibilities on what you might do with the information. There is really not time ... so I pick and choose what I think are the best materials."

Bob was able to get through all of the videos, the maps and navigation software, and the student print materials, estimating that he spent 55% of the time on the videos, 25% on student print materials, 10% on the computer and the teacher's

guide.

In the second interview, we asked Bob if the time that he spent on the package was adequate.

"No, I tried to do the entire package between two vacation periods, a little over two weeks. There was a lot more room for discussion that did not get to happen. I wish we could have gotten a bit more into depth with it, we just didn't have time. Next time I would devote more time to it."

* * *

Frank Smith used the MIMI materials from October to February, everyday for one 45-minute period. He felt that using the materials less intensely would be difficult.

"I can't envision someone trying to do the package two or three times a week. If you do the extra things, the activities that go along with it, it's a full-time program."

Frank's original plan was to use the MIMI materials as a supplementary part of his curriculum on whales, but "it ended up being close to the entire thing." He attributed the appeal of the programs and all of the activities to its dominant role in his curriculum. He added: "I got so wrapped up in it myself that I couldn't get away from it."

Because of time limitations, Frank originally thought he would not show the documentary clips or would omit some of the dramatic episodes, but he discovered that this plan would not work:

"I found out that if you use the program the way it was intended to be, you can't cut. They really do build, so I came to the conclusion that if you want to do justice to the program, you can't cut."

Frank used both the introduction to computers and the maps and navigator software as well as the student print materials. Unlike Bob, he followed the guidelines and activities in the teacher's guide very closely. He felt that the materials were "terrific" and found the guide "so well done and so well set up that there would be no reason why a teacher wouldn't follow it." He stated that he used the teacher's guide everyday, spent an equal amount of time on the video and computer components and the least amount of time on the student print materials.

Although Frank was pleased with the general design of the package and with his students' interest in the material, he would reduce the amount of time when he uses the package next year:

"The children's interest did begin to wane toward the end of the unit because they probably had never spent that much time on a unit before. It was a tremendous unit and I really didn't hear much of anything negative about it until near the end. I think that they had about had their fill of it by then."

SOLUTIONS Teachers

Unlike the MIMI teachers, the overall amount of time that teachers devoted to SOLUTIONS did not affect how they used the package. Most teachers reported that they followed the suggestions for use in the teacher's guide and introduced the video first, showed it to the class, and then followed the viewing with a class discussion. Often the discussions were designed to prepare the students for the software part of the package. For the computer component students were normally separated into pairs or groups of three and worked on the software activities by themselves. After completing the software for the unit, the students would come together to discuss what happened.

What did affect package use was whether teachers had the flexibility and/or time in their schedule to complete individual units of the package. Because the SOLUTIONS units are self-contained, teachers were more concerned with completing individual units in a designated amount of time than they were with getting through the entire package. As a result, there was a difference in use between homeroom and single subject teachers. For the most part, homeroom teachers were able to extend the amount of time for the package when needed, whereas subject teachers were often limited to specific days and times for using the package.

Two public school teachers illustrate this difference in use: Kathy Regis, a sixth grade homeroom teacher in an urban elementary school, and Tim Wohl, a seventh- and eighth-grade guidance counselor in a rural elementary school.

Kathy, a homeroom teacher, used SOLUTIONS with her class for two months, from the beginning of January to the beginning

of March, 1985. She used the package as a new curriculum unit and had two scheduled periods for the package per week. The first period she used to show the video and get her students started on the software, and the second she used to summarize and evaluate the unit, in particular the software. Between these two periods, each student was scheduled to work on the computer software for one half-hour. Kathy described how she used the package with her class.

"There was a good twenty minutes to introduce the program, go through the material and tell them what to look for when they would go down to the computer. I would then schedule each student for their half hour on the computer. Supposedly they would all be through with the disks for that unit by Friday afternoon and then have an evaluation on Friday afternoon."

Kathy stated that the time that she had allotted for the package was adequate. This was due in large part to the fact that she is a homeroom teacher and, therefore, has the flexibility to extend SOLUTIONS into other subjects in order to complete a unit she is working on. In addition to the two scheduled periods per week and the students' computer time, Kathy was able to "slip it in" to other subjects like social studies and math. She stated:

"It's amazing what you can do with fifteen minutes here and fifteen minutes there just by implementing it and discussing it and setting up a schedule so that if something needed to be discussed there would be time."

Kathy was able to use all of the video and computer software components with her class. She followed the teacher's guide "somewhat closely." One of the most useful aspects of the teacher's guide, for Kathy, was the estimates it provided on how much time would be needed to complete the different software units.

Kathy did not use all of the printed materials. She felt that some of them were a waste of paper and that in many cases it was much easier to read the information to her students than make duplicates for the entire class. She did state, however, that she liked the student print materials for at least one of the units.

Kathy estimated that she spent 40% of her time on the computer component, 40% on her preparation for each unit, 19% on the video, and only 1% on the student print materials. She stated that were she to use SOLUTIONS again she would use it in the same way.

* * *

Tim Wohl, a guidance counselor, started using SOLUTIONS in mid-January 1985 and planned to use it until his students had completed all of the units. He treated the package as an integrated part of his curriculum on decision making and problem solving. He used SOLUTIONS with his students once every two weeks for 45 minutes.

Tim's objective was to have his students watch the video and do the computer software for one unit in a 45-minute period. When time permitted he would also include a discussion and/or activities related to the unit. Tim had 16 computers for 20 students as well as a VCR in his classroom, all of which facilitated his being able to complete a unit in a 45-minute period.

Tim used all of the video and computer software and part of the teacher's guide and student print materials. He estimated that he spent 70% of the overall time on the computer component, and 30% of the time on the videos, student print material, and teacher's guide. He found the teacher's guide to be very helpful but because of time limitations he could only follow it "somewhat closely." He stated:

"I really haven't had the time for the written materials and the discussion questions, we only had time to watch the video and do the computer part, and sometimes have a brief discussion."

Tim was satisfied with what his students learned from using SOLUTIONS. He stated, however, that were he to use it again he would like to have more time for discussion and written exercises and, if necessary, shorten the amount of time his students had on the software.

D. Results: Effects On Teaching and Learning

1. Appeal to the Teacher

The most important test for any set of curricular materials is how it enhances teaching and learning in the classroom. We discovered that almost all of the teachers (95% MIMI, 100% SOLUTIONS) rated the package materials as excellent or very good. In addition, most believed that the use of technologies made their teaching more fun (67% MIMI, 73% SOLUTIONS), while some found it easier (38% MIMI, 18% SOLUTIONS), and more efficient (33% MIMI, 27% SOLUTIONS). In addition, several teachers (24% MIMI, 18% SOLUTIONS) reported that coordinating the various technologies and projects complicated their teaching.

A number of the teachers noted differences between these multimedia packages and their regular teaching approach. They viewed the combination of components as representative of a new teaching approach that used technology to create a positive learning experience.

"I like the mixed approach that it takes and the fact that it's sort of a hands-on activity. The science program that I have now is more book related. Although there are activities, the school had not yet provided us with the materials to do the activities which is not really the way that I envision science being taught." (MIMI)

"My kids can't wait to see the tape, but the whole package together has been exciting for them. It's a new and exciting way to learn. You're incorporating the use of videos and computers, both of which they love to use. You are not reading out of a textbook. This is a new and exciting way for them to approach learning, and it's exciting for me too." (MIMI)

"As teachers working with books and the printed word, we are in constant competition with the TV, video, and computers. A lot of my students have their own computers and are into visual things. To come to school and have to read a book is dull. It's just not motivating enough and to motivate we have to do a lot. Reading takes too long. This brings computers and TV into the classroom in a positive way; it's a learning experience. We are no longer competing with it, we are using it. That's what I like." (MIMI)

"I've enjoyed what I've been able to do with my students this year. I am always looking for other ways to enhance learning besides books, and if that involves TV and computers, then I'm all for it." (SOLUTIONS)

In addition to a professional appreciation for the materials, many teachers added that the package appealed to them personally.

"I got really excited about it. I brought it (the tapes) home and showed my husband...It was just very exciting so you can't help but want to get involved in it." (MIMI)

"It's rejuvenating for me having been a teacher for so long (11 years). You can get bored after a while and this is a new subject area, something that hasn't been utilized before...I am very excited about the idea of wading through these materials and developing ideas." (MIMI)

"For the first time in a long time I have found something that I can really sink my teeth into and am really excited about...I think that this is the best thing that has come up in the 18 years that I have been teaching. The potential that I see is tremendous." (MIMI)

Although SOLUTIONS teachers were generally less descriptive in their responses, a number of teachers also mentioned that the materials appealed to them.

"It was motivating for me; it really got me going."

"(After attending a workshop on the materials,) I couldn't wait to get back to my classroom and use it!"

2. Appeal to Students

The most enthusiastic and positive responses from teachers about these packages were in reference to the reactions of their students. The majority of teachers (95% MIMI, 73% SOLUTIONS) reported that they had no difficulty in getting full participation from their students and that students very much liked the combined technology approach (100% MIMI, 90% SOLUTIONS). If there was one word that would describe the teachers' impressions of their students' reactions to the materials it would be "enthusiastic."

"I've never seen such a response to anything! They just come in and take over." (MIMI)

"I would say that the excitement level was very, very high and as a group it was certainly equal if not greater than anything that I've seen before."
(MIMI)

At least 15 of the 32 teachers responded to "The one event I remember which happened when I used this package was ..." with some comment on the enthusiasm and excitement of their students.

"One event I remember specifically was an average to low student coming back and saying, "We lived! We survived!" He was so excited and happy that he had done all of the right moves in order to get where he needed to be. But I would hate to confine that to just one instance because it happened all the time." (SOLUTIONS)

Over one-half of the SOLUTIONS teachers and one-third of the MIMI teachers reported a change in the way that students worked with one another while using the package materials. The majority of these teachers (63%) stated that students were more cooperative with one another.

"There was more cooperation, the computer and activities required people to work together. All the computer activities required more than one person to record all the information that was on the screen. They're all working together to decide what to do next, and they have to agree before they do any more work." (MIMI)

"From the first day of 'Rescue Mission' (a computer software game in the 'Maps and Navigation' module) to the last there was a big difference in how they worked together. At first they're running around like chickens with their heads cut off and panicking when the information went off the screen too soon. They were yelling at their shipmates. By the end they were working very smoothly and calmly with lots of organization and cooperation."
(MIMI)

"I think they cooperated a lot more. They listened to others' suggestions and the way others would solve a problem and then together they decided. It wasn't as though they were competing with each other. They waited to hear all of the answers, as a cooperative effort." (SOLUTIONS)

"The students were more cooperative, especially when there were two of them on the computer and they had to come up with a unified solution. These kids know they are bright and like to show it off and they tend to try to outsmart each other; this program required them to work together more."
(SOLUTIONS)

Two teachers reported that students continued to work on the materials on their own without the teacher's knowledge.

"One of the projects was to build a copy of the MIMI. Some students just duplicated a drawing, but four of them actually built the model. I thought that was wonderful. I would say that it's the best set of projects I have ever had in that so many children did really careful work." (MIMI)

"Two of my students got together and set up their own canoe trip (like the computer simulation). They decided that they were going to weigh things out to see if the computer was as accurate as it should be. So they did research on their own by checking the information from the computer. They came out pretty close." (SOLUTIONS)

3. Learning Opportunities

The majority of teachers (95% MIMI, 82% SOLUTIONS) believed that the multimedia packages assisted in the students' learning, although some teachers (20% MIMI, 55% SOLUTIONS) also believed that specific areas of the package inhibited their students' learning as a result of confusing computer activities. Teachers had various views on why the materials were so successful, but most agreed that the combination of all of the components helped their students' learning.

"Some children need it all. They can't just read something. They need to see it, read, work with it. Most kids need more than one kind of presentation on anything." (MIMI)

"The whole time that we did it the kids were interested and couldn't get enough of it. That was nice to see because so often these kids are bored. I think that it has to do with the dynamics of being presented in three different formats. I think that's a big part of it." (MIMI)

"The students got more information in less time and probably retained more because there were different approaches each day. Different approaches spark their imagination in different ways and offer more than I could." (MIMI)

"We can talk about problem solving in the classroom and I can work with them, however, unless they can apply it specifically as they did on the computer, it really doesn't stick as well. The fact that it was something that didn't relate to them personally but is on the video. They see it, they get kind of frustrated because there isn't any ending to it and they always want an ending to everything. But then they go down to the computer and they create their own ending and by giving them that application of the problem solving method, they learned a great deal. They had the opportunity to apply what they had seen on the video to the computer." (SOLUTIONS)

For others the key was the reinforcing nature of the components.

"I think that all the components are so good, the more components you have the better off you are. In fact, one of the things that I have found quite interesting is that the TV reinforces the book and the book reinforces the TV. There is a nice reemphasis there and then the discussion also gets them involved." (MIMI)

"Rather than me having to stand up there and tell them something five times, they can read it in the book, see it on the tape, and they can do some outside research." (MIMI)

"Their attention span is not too long and here you have an opportunity to use video for 15 minutes, then computers for 15 minutes, and the print materials for 15 minutes, followed by a discussion for 15 minutes. You can go through the same material in 4-5 different ways and they don't get bored. Still, you have gone over the material again and again. It really offers the opportunity to reinforce the material without them knowing it." (MIMI)

Many teachers also noted that the combination of technologies seemed particularly important to the slower learners.

"The slower child seems to be the one responding so much better than previously." (MIMI)

"It ends up in elementary school that science and social studies becomes nothing more than a reading comprehension activity. This seems to take science out of that mode. Children who are low readers could succeed in science by doing it through this package. We do have reading components in it, but still the videotape and the other activities give those kids a chance at enjoying science." (MIMI)

"Even my slowest children could watch the video, work on the computer, come back and not feel like a loser. Yet my top students would go down (to the computer lab) and not come back saying it was too simple. I feel like it was designed to meet different levels." (SOLUTIONS)

4. Appeal of Individual Components

Although our ultimate interest was in the way in which the combination of technologies affected learning, we also asked about the strengths of each of the components individually. We discovered that, for both packages, teachers believed that the television component was an extremely important part of the package. One teacher defended the value of the television in these packages.

"Some complaints have been that they are just sitting and watching television, well I don't buy that at all. Yes they are sitting, yes they are watching, but the techniques are varied. Quite often I will show them a video twice, once to enjoy and a second time to look for something specific." (MIMI)

Teachers using either package remarked that the story line and real characters were especially important to both the appeal and educational value of the package.

"I really like the idea of dramatizing a story. The kids really enjoyed that part of it. It became clear to me that you can mix an educational story up within a fictional context and use that to teach." (MIMI)

"I think the attraction of the characters has helped our class to talk about other things that some of the kids in the class are dealing with - like divorce, parents, and feelings and people." (MIMI)

"Students could relate to the characters very well. They were real life people. They weren't animated characters. They had realistic stories like the one on insulation, so the design in the subject matter and the layout was something they could relate to."
(SOLUTIONS)

For many teachers the video provided an important link for the entire package.

"The videos are very intriguing. They have designed the videos with many hooks that I as a teacher can use in a number of ways." (MIMI)

"The kids like the video as well as the computer part. I think that having the video adds a positive dimension to the computer unit."
(SOLUTIONS)

"The videos are great. I think the videos allow the students to better envision what they are doing with the software. I think it is very effective, but especially the video." (SOLUTIONS)

Several teachers tried to teach the package without the video component and concluded that the package was not as strong without it. These teachers realized that the links between the TV and the computer software were important for both motivation and learning.

"I thought because of time I would try to either cut the expeditions out or cut some of the dramas out, but I found that if you really use the program the way it was intended to be, you really can't. They really are dove-tailed and really build on one another. I finally came to the conclusion that if you really want to do justice to the program you can't cut it." (MIMI)

"The first time we did one we did it without the video because the librarian had taken the video home with her. The kids used the disks but I think that after they saw the video it made it a little more interesting for them. Got them more involved with it than they would have been if they hadn't seen the video. I think that it helped. They would talk about the video while they worked on the computer. They would even talk about the computer while they watched the video a second or third time." (SOLUTIONS)

"Once it was too hard to get the TV for that time so we did it without the TV. Some of them were really anxious to use the computer but still it wasn't as exciting as watching the TV first and then moving to the computer." (SOLUTIONS)

General comments about the computer component were mixed. Many of the MIMI teachers were concerned that the package was not challenging enough for their students. Several MIMI teachers reported that their students had already learned LOGO and, therefore, the teacher did not use several of the software programs.

"The software is probably the weakest part of the package." (MIMI)

"The software I am not as impressed with at this point. I think that there is a hell of a lot of work that has to be done with the software developments. The idea is right, but I think there has to be a lot more development in the area."
(MIMI)

"I'd say the computer part is only average, OK to poor. I think somehow the computer stuff has got to be made more relevant and more challenging."
(MIMI)

One MIMI teacher did not agree.

"We had had experience with computers before. Some kids whose only experience with computers was learning the LOGO language had been turned off. But with the advent of MIMI software, it has opened up their world to computers. I have kids wanting to work on computers who at the beginning of the year didn't want to touch them."

SOLUTIONS teachers have primarily favorable comments about the computer software. Although one teacher stated that it was "too easy" or considered by students to be a "waste of time," all of the remaining comments were very positive. These teachers especially liked the dramatic presentation of problem solving situations and the emphasis on process.

"The problems they present and the alternatives get presented in an excellent way. The outcome is so dramatic. Pencil and paper can't show all the directions but the computer can automatically do all the routes. I couldn't do that as a teacher. It is important and a good way to use the computer."

"It really gets into a lot of good things. I think that many times, computers are glorified workbooks and I think this program is so different from the software I've seen where it's working on a particular skill. I think this working out a process is really the route to go with a computer and it's really actively involving the kids rather than just working on one isolated skill at a time. It's getting them involved as a group, really thinking. I get really positive feedback from every teacher I've showed it to."

Student print materials did not fare well with either group, although the strongest objections were voiced by SOLUTIONS teachers.

"I give them the worksheets but they prefer not to do those. They usually read them through and say, 'yeah, yeah'."

"I find them to be a waste of paper. I found that if I just read that information to them and discuss it with them, I wouldn't have to waste any sheets of paper. Rather than have them look at it for five minutes and then throw it away."

"The print materials are also reinforcing but I think that I would probably toss out the worksheets if you told me that I had to get rid of one thing in this program."

MIMI teachers seemed to agree:

"The written part of it is always the downer. The follow-up questions were the most boring. After the viewing, it was kind of anti-climatic to answer questions."

"I haven't really been able to see a way that the books fit in. I don't exactly know how they'll be useful. They may be useful if somebody's absent and missed a video."

"Some of the kids liked the written materials a lot and others thought they were boring because it was a repeat."

"The stuff they do out of the books is a step down as far as they are concerned. It's work."

Reactions to the teacher's guide were generally favorable. Almost all teachers (100% MIMI, 91% SOLUTIONS) used the

teacher's guide and the majority (75% MIMI, 80% SOLUTIONS) reported that they considered it to be helpful. SOLUTIONS teachers found that the most helpful section of the guide contained the logistical support--a synopsis of the video component and instructions for copying disks. In addition, teachers commented that the introduction for the SOLUTIONS units helped them gauge the amount of time needed and prepared them in advance for possible difficulties. Several MIMI teachers believed that the guide provided essential background and preparatory information.

"Without the guide you really couldn't do justice to the program. The guide is very carefully put together. There's nothing about it that anyone could object to. The people involved knew something about children, something about how to put things across, and something about the development of ideas." (MIMI)

"The questions and a little bit of background is given to us (in the guide) so we don't have to spend a lot of time researching it ourselves. That helps us to talk with a little more understanding and a little more knowledge on the topic. I think a lot of the work is done for us, and that makes my job a little easier. Now I don't have to sit down and write up a lot of lesson plans. I know what I have to teach and can be more creative with it." (MIMI)

"The information written for the teacher about whales is great. You can bone up on whales without ever having to go to the library. That's great. Everything you ever want to know is right there." (MIMI)

"I liked the chart of the different kinds of whales and the background information. I don't know that I really used it with the kids, but it made me feel more securely about whales." (MIMI)

As with any material, some teachers were dissatisfied.

"It's really a very creative and new program but the teacher's manual is set up very traditionally. The people who set it up were very creative, but not in the manual. The questions tend to be very basic, common sense. I guess I'm looking for something a bit more. There are some good ideas, but overall I found the teacher's manual not to be all that special." (MIMI)

"Other people in the science department have thought that it's very sketchy and difficult to work with. I think there is too much in the teacher's guide." (MIMI)

5. Evaluation of Student Learning

Neither package provides teachers with any formal test; therefore, we were interested in how the teachers evaluated their students and what they considered to be important information provided through the package. In our first interview, using an open-ended question, we asked teachers to indicate why they chose the package (Table 5) and in the second interview we asked teachers what they thought their students had learned (Table 6). Although only a small number of teachers reported that they selected the package solely on the basis of its content, following utilization the majority of teachers believed that their students' learning was more in the content of the materials than in the use of technology.

Table 5

REASON FOR CHOOSING PACKAGE	MIMI	SOLUTIONS
Content	29%	9%
Technology	14%	0
Content and Technology	38%	73%
Appeal	38%	9%
Unclear	5%	9%

Table 6

WHAT STUDENTS LEARNED

Content	80%	100%
Technology	5%	36%
Insight into human behavior	24%	9%
Collaborative behavior	14%	9%
New view of subject matter	29%	0

Given the teachers' positive responses about the materials themselves as well as about the subject matter, we were interested in learning how the teachers chose to evaluate their students' learning. While the majority of teachers (95% MIMI, 100% SOLUTIONS) reported that they were satisfied with their students' learning, we discovered that little formal evaluation was conducted for either of these packages. Although almost half of the MIMI teachers (48%) indicated that they used tests for evaluation, many quickly added that the tests were primarily "vocabulary." Most teachers seemed to

prefer to use class discussion for their evaluation of student learning (see table 7).

Table 7

METHOD OF EVALUATION	MIMI	SOLUTIONS
Observation	24%	45%
Test	48%	9%
Written activity	29%	18%
Class Discussion	62%	55%
Projects	5%	0
Carry over to other subjects	0	18%

For both packages, teachers seemed to feel that tests were an inappropriate way to evaluate students with these materials. Several SOLUTIONS teachers simply stated that they did not test on this material. MIMI teachers expanded on their responses.

"MIMI is a whole different category and I don't like to impinge on that by testing."

"This doesn't really lend itself to the standard kind of test."

"I don't want to stifle their enthusiasm by saying, 'OK, we're going to have a quiz on MIMI tomorrow' because I don't think that's the purpose of the program."

"I have been grading them on participation. I didn't really want to hold them responsible for a lot of factual information."

Most of the MIMI teachers who did choose to test reported easy tests and high grades.

"I just finished with their grades for this term and this is the first time all of their grades came up."

"The kids really knew it. I asked them many open-ended questions and they knew the answers. The lowest score was 86."

"I've felt a little guilty. I haven't done any testing except for some vocabulary and it's been so easy... basically anyone who couldn't get 100% on these tests is ridiculous."

"The kids really enjoy it because it is all oral and a lot of discussion. They're not really responsible for test material... I call on someone and they don't necessarily have to raise their hand to be called on and I haven't had anybody not know what's going on. Everybody seems to be in on it."

The only SOLUTIONS teacher who was planning a test reported that "the test is going to be hitting very lightly. If they miss anything, they are really hurting." These responses are puzzling as it is not clear whether or not the lack of tests is related to the change in teaching approach or the fact that neither package provided the teacher with a packaged system of evaluation.

6. Future Use

Almost all teachers (95% MIMI, 100% SOLUTIONS) reported that they intended to use this package again. For many teachers (60% MIMI, 45% SOLUTIONS) the greatest strength of the multimedia package seemed to be the combination of technology and subject matter rather than either alone (see Table 8).

TABLE 8

THE GREATEST STRENGTH OF THE PACKAGE	MIMI	SOLUTIONS
Subject matter	5%	27%
Technology	35%	27%
Combination of Subject Matter and Technology	60%	45%

Almost all teachers (100% MIMI, 91% SOLUTIONS) reported that they would recommend the multimedia package to other teachers. When asked if they had any comment on this type of package for future teachers, their responses were very enthusiastic.

*"The possibilities are endless, from just the little bit that I have worked with it, from seeing my kids reaction to it. I think this is the way education should go. I think there should be more use of technology. I think the wave of the future is to put together packages like this that could revolutionize the way we teach and they learn."
(MIMI)*

"I look forward to seeing some things like this happening in the future. It certainly isn't a

cheap experience by any means but I think it bodes well for education in the future." (MIMI)

"I think it's the coming thing. I think it's the way the world is going. I wish there were more of it. This is a great way to begin to get computer literate." (MIMI)

"I am really happy with it. I think it's really terrific and I hope this becomes the route in the future. I wish more teachers could discover what it is. I think a lot of these things spread pretty quickly when it's something this good. The people who designed this really deserve a pat on the back." (SOLUTIONS)

V. DISCUSSION AND CONCLUSION

The multimedia packages created by Bank Street College of Education and the Agency for Instructional Television have provided educators with new ways of combining technologies and incorporating them into education. Both groups set out to create an innovative curriculum which would combine television, computer, and print materials. For both groups, the television component served as a motivating force for the package, while the computer materials were designed to acquaint students with a number of ways that computers are used in the adult world. Bank Street's "Voyage of the Mimi" package was designed to teach science concepts and featured television as the heart of the package. AIT's "Solutions Unlimited" package focused on problem-solving process skills and featured the computer as the central package component. Based on their first-time use of these packages, teachers reported that the designers of each package succeeded in creating lively, exciting materials that enhance classroom learning.

Teacher reports confirmed the designers' predictions: the packages appealed strongly to students and engaged their interest more than other curricula. Although all teachers anticipated a positive experience with the packages, for many the packages went beyond their expectations. Many teachers were surprised to find high levels of student participation

and a real eagerness to work on the package materials. In addition, teachers themselves enjoyed the package professionally as well as personally, mentioning that it held their interest and facilitated their teaching. However, although most teachers believed that the package made their teaching more fun, they did not report that it made their job easier or more efficient. These results suggest that although multimedia packages are considered powerful classroom materials, they may bring more work and complications to teachers.

Although both packages appeared to have met most of the expectations of both designers and teachers, the two packages present very different views of what a multimedia package is. The MIMI materials, revolving around the television component, were designed to challenge the traditional presentation of science with a new way of looking at that discipline. The SOLUTIONS design team acknowledged the realities of teaching and created a set of materials that would work within the confines of regular classrooms, while centering on the computer software. These differences in emphasis affected both the design of the package and the classroom experience.

Bank Street envisioned the MIMI project as an opportunity to introduce a new way of thinking into the science and math curriculum. The design team wanted "to crack open kids' notions about science" and encourage teachers to join their students in the inquiry. This desire motivated the design

team to look beyond current approaches to science teaching. The television dramas and expeditions were designed to provide classrooms with a rich medium through which a number of issues about both science and values could be explored.

For AIT the primary motivating force in entering the project revolved around the computer. The design team was interested in developing creative computer software which would increase the use of computers as tools in classrooms. In addition, they wanted to be sure that the computer materials would be easy to use as well as appealing and, to that end, spent considerable energy anticipating logistical difficulties and addressing them in their package.

Consistent with the emphasis expressed by the design teams, teachers were, in fact, the most enthusiastic about the component designed as the centerpiece for the package. MIMI teachers had a high regard for the television component and the new view of science that the materials offered them and their students. Teachers using SOLUTIONS had the highest praise for the computer software, the ease of use of the package, and the helpful, supportive qualities of the teacher's guide. This contrasts sharply with the teachers' background: SOLUTIONS teachers were very experienced in teaching with television whereas few MIMI teachers had used television in the classroom. Apparently, the package emphasis had more impact on utilization than did the teachers' previous experience.

Both Bank Street and AIT designers commented on the need for logistical support in the use of multimedia packages. AIT's concern about the logistical requirements for combining technologies caused the designers to include a review of the video in the software material, thus allowing for the computer to be used without the television. Although they believed that television would be an important motivator for the package, the SOLUTIONS team decided it was not critical to the appeal and teaching value of the package. "Breaking the link" between the television and computer components, they thought, would increase accessibility. This perspective became the largest discrepancy between the views of the AIT designers and the teachers using SOLUTIONS. Unlike the designers, teachers believed that the video was not only important but vital to the package for both motivation and learning. Those few teachers who chose to use the materials without the television component were dissatisfied with the result and chose to reestablish the link between the television and the rest of the package materials.

Although it appears that AIT's strategy to break the link to improve accessibility was not warranted, AIT's attention to other details of logistics appeared to pay off. Teachers using SOLUTIONS were pleased with the logistical aids, such as the video review and disk copying, that the designers had built into the computer software component. Most SOLUTIONS teachers commented that the package fit well into the

framework of their classes.

Whereas AIT provided teacher support within the package materials themselves, Bank Street envisioned that more administrative support would be needed for the MIMI package. For both packages, many teachers reported that they did receive support, often in the form of school staff support for the MIMI teachers and inservice workshops for the SOLUTIONS teachers. Both forms of support were reported to be effective in assisting the teachers.

In contrast with SOLUTIONS, logistical difficulties were the major complaints from teachers using MIMI. While the MIMI materials offer an extremely rich medium for classroom activities, many teachers commented on the difficulties that they encountered from not being able to boot up more than one machine with the software program. In addition, some teachers reported that the sheer volume of material provided in the MIMI package was initially intimidating. Although those teachers who chose to tackle the materials felt rewarded by the richness of the package, we received several reports that other teachers in the same school refused to even consider the materials because they seemed overwhelming and difficult to use.

In spite of these problems, MIMI teachers all praised the package, particularly the television component. The teachers appreciated the attention that the MIMI design team paid to the details of the scripting and the incorporation of many

different ideas into each drama.

A change in the teachers' approach to teaching in general and to the package content area more specifically was one finding anticipated by Bank Street designers and alluded to by the AIT team. Designers at Bank Street stressed the teacher's role as collaborative investigator, while AIT designers mentioned the teacher's role as facilitator between the package materials and the students. Both of these roles were mentioned by teachers as occurring through the use of the multimedia approach. Teachers noted that the materials altered the way that they worked with their students--a shift from teacher-centered presentations to a more collaborative approach. In addition, a number of teachers reported that coordinating the mix of media was an important role. For both packages, the teachers' actual experience using the package appears to have been a combination of the two key roles anticipated by designers.

Differences emerged, however, in the amount of time teachers allotted to using the packages. MIMI teachers tended to use the materials more intensively than SOLUTIONS teachers, both in terms of number of times per week and number of months. One reason for this difference is that the amount of information in the MIMI package was greater than that in the SOLUTIONS package, thus encouraging a longer and more intensive use. Another explanation may be that the MIMI television series provides a continuous thread throughout the

materials and many teachers reported that their students were eager to continue the dramatized story. In contrast, SOLUTIONS units were not dramatically connected, but rather joined by an approach to problem solving which allowed for more sporadic usage.

The impact of the packages on student learning was addressed by the teachers in two ways. First, teachers repeatedly stated that they believed that multimedia packages are an important shift in curriculum development. They noted that students who have become experienced with the entertainment forms of television and computer programs are eager to apply that experience to a learning situation.

Second, teachers discovered that the different package modalities were important to student learning, especially for those students who normally had difficulty with written classroom work. For all students, each technology offered a different approach to learning and a different way to review and reinforce ideas than are provided by traditional print materials and teacher lectures. A number of teachers noted that this combination of technologies provided valuable assistance to many of their students. In some cases, for the first time, teachers found that all of their students, including those who had been slow to learn or reluctant to participate, were able to join in class discussions and activities.

Although teachers talked about the learning value of the packages, the designers did not provide any formal assessment of learning within the package materials and the majority of teachers did not directly assess the students' learning. Teachers using both packages stated that the standard form of evaluation, the test, was not appropriate for this type of material. The majority of teachers turned, instead, to class discussions as a measure of student learning and were satisfied by the quality and quantity of student responses. It is not clear whether the lack of formal testing is a result of the packages' not providing a set of tests or whether the material helped teachers reconsider their methods of evaluation and their role of testing within this new curriculum. One hypothesis for further research is that the new role of the teacher as collaborator may not be consistent with the traditional forms of evaluation. Multimedia packages may require that teachers rethink how testing fits into this new role. Additional research in the area of multimedia packages and student learning is needed to fully understand the impact of these types of packages on teaching and learning.

In conclusion, our interviews with teachers reveal that both packages met their objectives. AIT provided teachers

with an interesting series of accessible computer activities that engaged and appealed to students. Bank Street succeeded in beginning to change the way that both students and teachers approached the discipline of science. Teachers using each package reported that the materials had appeal to both their students and themselves. Students became more involved and enthusiastic about classroom activities; classroom learning became a more collaborative enterprise between teachers and students, to the surprise of both.

What can be learned from these packages about multimedia packages in general? First, both teachers and designers should be aware that the combination of television and computer technologies is an extremely popular approach for both teachers and students. This combination appears to be important to both appeal and learning. It offers a variety of modes for the presentation of ideas and provides an interesting way for students to explore and reinforce the same ideas through a number of different modalities.

Second, although the teachers integrated the material into the classroom in a variety of ways as the designers had anticipated, teachers found that, regardless of utilization strategy, the function of each component remained the same. The television provided motivation and was the vital link for the entire package, the computer aided in hands-on experience and the application of ideas, and the print materials expanded on both the television and the computer components.

Last, we believe that the enthusiasm the teachers reported for both themselves and their students merits further study to understand fully the impact of this type of curricular material on the classroom. We are intrigued by the repeated mention of the value of this material to the "slow learner." Teachers noted that these students, because of their poor reading skills, were often slow in classroom work. The multimedia packages enabled slow students to participate equally with their classmates and gain more confidence in their abilities. Indeed, it suggests that some children previously thought to be "slow learners" may be more accurately characterized as simply slow in learning via the print medium.

Thus, the combination of television and computer technologies in education offers a powerful new medium for motivating both students and teachers and for providing a rich variety of learning experiences. Its success in the classroom seems dependent not on the logistics of obtaining television and computer equipment, but rather on the skillful role of the teacher as the ultimate package facilitator--a teacher who is willing to take an "intellectual adventure" with the students as well as discard the role of didactic lecturer for that of a knowledgeable collaborator.

VI. REFERENCES

- Agency for Instructional Technology. (1985). Solutions Unlimited. Teacher's Guide. Bloomington, IN: Agency for Instructional Technology.
- Agency for Instructional Television. (1982). Advancing the Use of Computers In the Schools: A Cooperative Project to Develop Quality Programming, In-Service Activities, and Policy Studies. Bloomington, IN: Agency for Instructional Television.
- Bank Street College Project in Science and Mathematics Education. (1983). Revitalizing Science and Mathematics Education in the Upper Elementary Grades: A Multi-media Approach That Incorporates New Technologies. New York: Bank Street College of Education.
- Bank Street College Project in Science and Mathematics Education. (1985). Voyage of the Mimi: Overview Teacher's Guide. New York: Holt, Rinehart and Winston.
- Center for Social Organization of Schools. (1983). School Uses of Microcomputers: Reports from a National Survey. Baltimore, MD: Johns Hopkins University.
- Designs for Education. (1983). Telecommunications and the Schools. A Report to the Corporation for Public Broadcasting. Lexington, MA: Designs for Education.
- Riccobono, J. (1985). School Utilization Study. Availability, Use, and Support of Instructional Media. (1982-83 Final Report). Washington, D.C.: Corporation for Public Broadcasting.

APPENDIX A:

"Voyage of the Mimi" Materials

Additional information about the "Voyage of the Mimi" package is available from:

Bank Street College Project in
Science and Mathematics Education
Bank Street College of Education
610 West 112th Street
New York, NY 10025
(212) 663-7200.

Introduction

Welcome to "The Voyage of the *Mimi*." If that sounds like you've just entered a place rather than opened a book, it is no mistake. The components described below are in many ways the basic elements of the world that is about to unfold in your classroom. The television series that lends its name to these materials might be described as the environment—the unifying context that establishes both the tone and the operating principles that characterize this world. Within that environmental framework, this *Overview Teacher's Guide*, the *Student's Guide (The Book)*, the *Learning Modules*, the wall charts, and the activities and projects can be arranged to suit the unique setting of your classroom. This is a world in which curiosity and wonder thrive, in which science is understood to be a dynamic enterprise founded on questions and not a static discipline that serves as a repository for a rigid set of answers. And this is a world in which you participate actively, not only as a guide through the landscape you help shape, but also as a learner right along with your students.

The central role of the teacher as agent of success is nowhere more important than in the presentation of the science curriculum. A teacher who approaches the science content with a sense of wonder and excitement communicates the wonder along with the content. A teacher who emphasizes that science is a human activity subject to human values and related to other human concerns, and that scientists are people like the rest of us, will encourage children to number among their life options a continuing involvement with science. Most important of all, a teacher who says, whenever possible, "That's a great question! I don't know the answer. Let's see if we can find out" will communicate the essential spirit of science to his or her students. The scientific enterprise rests on the framing of good questions.

It is a brave act indeed to say to a classroom full of students, "I don't know." It alters the politics of the classroom drastically. Instead of the all-knowing teacher pouring knowledge into the empty vessels which are students, students and teachers are collabora-

tors, working together to increase their joint knowledge. This new relationship can give the student a sense of real intellectual power and allow the exhilarating pleasure of figuring things out.

There is a pitfall associated with "Let's find out." Many science curricula emphasize discovery of scientific concepts through hands-on experimentation. Students and teachers frequently approach these laboratory exercises as tests of the student's skill in coming up with the "correct" data and the "right" conclusion. In fact, a laboratory exercise gone awry provides an opportunity to figure out what caused the unexpected outcome, and this experience may prove a more useful learning opportunity than a lab exercise done book-perfect.

The Components

OVERVIEW TEACHER'S GUIDE

This Guide, as its title suggests, shows how the various elements of "The Voyage of the *Mimi*" are linked through the medium of the television series. It includes:

- Twenty-six sequential "units," one for each 15-minute segment of the television series. Each unit is a suggested plan for working with the content of one episode or expedition, including questions for class discussion, activities, and opportunities for making connections with other components of these materials or with other aspects of your classroom curriculum.
- "About Whales," a comprehensive (though not exhaustive) treatise on whales, designed to give you a ready source of information when students have questions (as they inevitably will) about the other "stars" of "The Voyage of the *Mimi*"—the whales. "About Whales" undoubtedly contains more information than you will ever need about whales. It is not necessary that you read it all or be able to recite the facts it contains. It and the bibliography that follows it are

intended as resources to enrich your class's experience.

- Blackline masters for use with activities in *The Book* or with enrichment activities suggested in this Guide.
- A metric-English measurement conversion chart. Because the metric system is the measurement language used by the scientific community, most measurements in these materials are given in metric units.

TELEVISION SERIES: "THE VOYAGE OF THE MIMI"

The television series consists of thirteen, 15-minute episodes in a continuing adventure/drama, and thirteen, 15-minute documentary-format segments called expeditions. The two formats were designed to alternate: one dramatic episode followed by its companion expedition.

The dramatic/adventure story is about the people and events on a research voyage to study humpback whales in the Gulf of Maine. It accurately depicts how science is done and how scientists think about the world and seek to answer questions about its workings. The purpose of the drama is to provide a compelling context within which to exemplify science as a worthwhile enterprise and scientists as real human beings who care about the same things we do.

The documentary-format expeditions are visits to places where interesting people are doing interesting work that relates to an aspect of science or other topic touched on in the dramatic episodes. Hosted by one of the young actors from the cast of the dramatic series, the expeditions show how real people are working in the real world with the ideas and issues brought out in the fictional context of the drama.

THE VOYAGE OF THE MIMI: THE BOOK (STUDENT'S GUIDE)

The Book contains illustrated versions of all 26 television segments adapted to a print format. For each segment there is also one or more suggested activities to engage students directly with the content of the show. A comprehensive glossary gives clear definitions

for science and other specialized vocabulary.

At the front of *The Book* are detailed, labeled illustrations of the *Mimi* and of a humpback whale.

The Book is not a substitute for the television shows. It stands on its own as an attractive book that contains an exciting story, interesting information about some unusual places, engaging illustrations and photographs, and activities that are fun to do. And it also serves to complement the television series as a vehicle for review, to heighten the pleasure of recalling previous shows and of anticipating the events of those to come. Finally, *The Book* is there for the student who was absent during the showing of an episode or expedition.

NAVIGATION CHART (GULF OF MAINE AND GEORGES BANK)

Included with this guide is an actual navigator's map of the area in which the events of "The Voyage of the *Mimi*" take place. The same chart is seen repeatedly in the dramatic series as it is used to chart the *Mimi*'s course and provide the captain with important information about features of the ocean where the boat is sailing.

As you and your students follow the events of the *Mimi*'s voyage, all of the locations portrayed in the story can be found on this chart. References to locations occur throughout the series, so your class will be able to watch for them, plot them on the chart, and see the actual course of the *Mimi* as it traverses the Gulf of Maine.

You should expect that the chart will draw crowds of children, who will be fascinated by the sheer quantity of information contained in the chart. It should be hung low enough on the wall so they can consult it easily. To protect it from the wear and tear it is likely to receive, you might want to cover it completely with clear contact paper. In this way, you can use marking pens to plot the *Mimi*'s course, locate towns, islands, lines of latitudes and longitude, banks, shoals, the scenes of specific events, and other information conveyed in the series. The chart can then be easily cleaned with a sponge and be ready for another voyage.

"MARINE MAMMALS OF THE WESTERN HEMISPHERE" CHART

This beautiful chart has accurate scale drawings of most species of whales, as well as other marine mammals. The chart is useful for showing the variety of whale species, for clarifying distinctions between them, and for comparing sizes of different kinds of whales.

THE LEARNING MODULES

The Learning Modules are four different kinds of microcomputer software, each accompanied by a teacher's guide and student's guide. The themes for the modules are derived from the content of the television series. In addition, all of the software applications in the Learning Modules exemplify ways the computer is used to perform specific tasks in the real world.

Maps and Navigation, with Navigation Computer Activities

Maps and Navigation leads students through a sequenced set of concepts and activities designed to help them make the transition from the two-dimensional world of maps and charts to the three-dimensional world of navigation—"getting from here to there." The skills and concepts learned through paper and pencil and other classroom activities are actually applied by students in a series of computer activities. These computer activities culminate in "Rescue Mission," a simulation in which students apply map skills and math concepts to a challenging navigation problem. These activities relate directly to the navigation skills and instruments seen in the television series.

Introduction to Computing, with Turtle Graphics Activities

Introduction to Computing places the computer in historical and social perspective, and

explains what the parts of a computer are and what their functions are. The software activities introduce students to fundamental concepts of computer programming through the use of Turtle Graphics. By controlling the movements of a "turtle" that draws a line on the screen as it moves, students learn to put commands together in the form of programs to create specific patterns or pictures.

Whales and Their Environment, with The Bank Street Laboratory

Whales and Their Environment deals with the physical environment of whales and people. The Bank Street Laboratory is a combination of software and hardware that turns the microcomputer into a laboratory utility for gathering and displaying data about the physical world. Sensors collect data about heat and temperature, light, and sound that can be displayed and stored. Activities are designed to explore the properties of these physical phenomena through a variety of measurement and display formats.

Ecosystems, with Ecosystem Modeling Activities

As of this writing, the Learning Module on Ecosystems is still on the drawing board. However, it is envisioned as an introduction to the elements of ecosystems, how they are affected by change, and how certain general principles apply in all such systems.

A Note About Sequence and Classroom Management

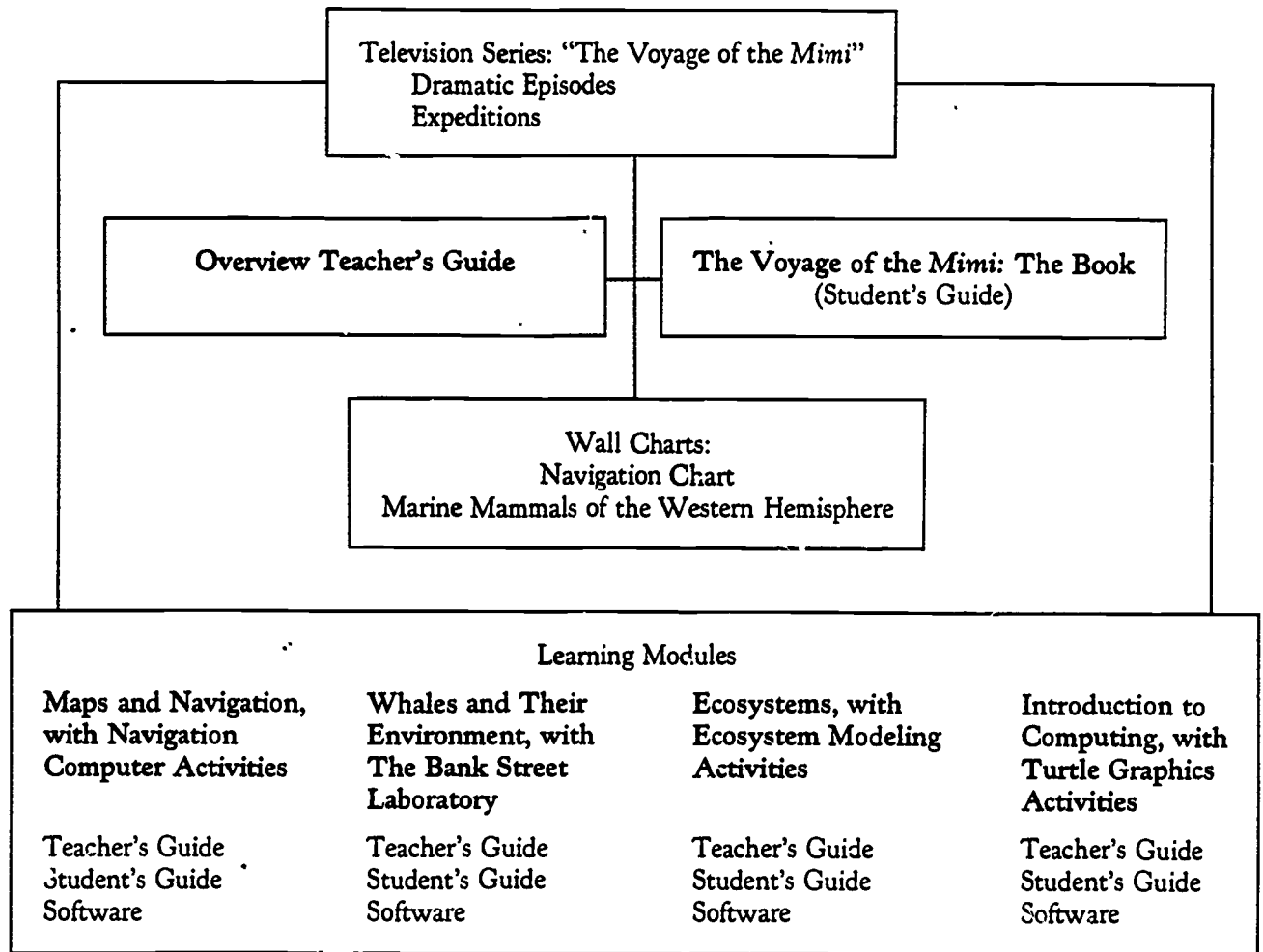
The Learning Modules derive their themes from the content of the television series, and the television series units in this Guide include "Software Connections"—points of linkage between the content of the television show and the Learning Modules. However, there is no inherent sequential connection among these components. Nor is there a par-

ticular order in which the four Learning Modules should be introduced in your classroom. In planning how to use "The Voyage of the *Mimi*" in your classroom, your first consideration will be how and when the television component will be used. How you organize time with the Learning Modules will depend largely on computer availability in your classroom or school. Working with one

Learning Module at a time will probably be more than adequate. The Learning Modules also lend themselves in most cases to simultaneous work with computer and non-computer activities. The flexibility afforded by the informal links among components means that work with the Learning Modules can be extended beyond the necessary sequential constraints of the television series.

The Bank Street College Project in Science and Mathematics

Program Components



1st
EPISODE

ALL ABOARD

Content Objectives

This episode

- introduces the crew of the *Mimi*
- identifies the purpose of the expedition
- introduces American Sign Language as a method of communication
- examines some commonly-held attitudes toward deafness

Vocabulary

The following science words and other specialized vocabulary, printed in italics in the Student's Guide, appear in the glossary of that book (pp. 156-159).

fo'c'sle oceanographer
marine biologist saloon

Program Components

Television Series, "The Voyage of the *Mimi*," Episode 1
Student's Guide, "The Voyage of the *Mimi*: The Book," pp. 8-13
Navigation Chart, "Gulf of Maine and Georges Bank"

Television Series

Episode 1: Summary

Two scientists have chartered the *Mimi* for a seagoing research expedition to study humpback whales in the Gulf of Maine. The scientists and the other members of the crew assemble at the boatyard in Gloucester, Mas-

sachusetts. The cantankerous owner and captain of the *Mimi* proves to be an intimidating presence as the crew members stow their gear and prepare to get underway.

THE CREW

Anne Abrams, Ph.D.—oceanographer from an oceanographic research institute; she is the chief scientist and is in charge of the research expedition.

Ramon Rojas, Ph.D.—marine biologist and colleague of Anne's at the institute.

Sally Ruth Cochran—senior research assistant; a marine biology major at Gallaudet College; she is deaf.

Rachel Fairbanks—15-year-old high school student from Connecticut; chosen by Ramon to serve as a research assistant on this expedition; an experienced sailor.

Arthur Spencer—16-year-old high school student from the Bronx; chosen by Anne to serve as a research assistant on this expedition; an electronics whiz with a particular interest in computers.

C. T. Granville—11-year-old farm boy from Ohio who has been sent by his parents to spend the summer with his grandfather; he has never seen the ocean before.

Clement Tyler Granville—owner and captain of the *Mimi*; C.T.'s grandfather.

BACKGROUND FOR THE TEACHER

During the last part of the nineteenth century and the first half of the twentieth century, whaling was a lucrative trade. Many species of whales, including humpbacks, were

1st EXPEDITION PLANET OCEAN

NEW ENGLAND AQUARIUM

Content Objectives

This expedition

- includes a visit to the New England Aquarium in Boston, Massachusetts
- describes the work of a marine biologist/deep-sea diver
- explains how the ocean affects our daily lives
- explains how mammals have adapted to the marine environment

Vocabulary

environment mammal
evolution

Program Components

Television Series, "The Voyage of the Mimi," Expedition 1
Student's Guide, "The Voyage of the Mimi: The Book" pp. 14-17

Television Series

Expedition 1: Summary

At the New England Aquarium, Ben Affleck, who plays C.T. in "The Voyage of the Mimi," learns about some of the ways in which marine biologists explore the ocean, and about how the ocean affects our daily lives.

SCIENCE BACKGROUND


The ocean not only provides us with a vast supply of food, but also acts as a steadying influence on temperature and climate. About two-thirds of the sun's heat is collected by

the sea. This heat is constantly being exchanged between the land, sea, and atmosphere. The upper layers of water in the oceans absorb heat from the sun during the day, and slowly give it off during the night. Masses of warm water, such as the Gulf Stream, may be carried into cold latitudes, thus warming the climates of colder northern countries. Alternatively, cold water is carried into warmer latitudes, cooling their waters and climate.

PREVIEW QUESTIONS

Have students predict answers to the following questions before viewing Expedition 1. Accept all answers.

1. What percentage of the earth is covered by oceans?
2. Do you think more life exists in the oceans or on land?
3. What are some of the ways in which the ocean affects life on land?
4. Do people have an influence on what happens to life in the ocean? In what way?

 Have students watch Expedition 1 ("Planet Ocean") of the television series.

FOLLOW-UP QUESTIONS

Asterisks (*) denote questions that are particularly challenging and may require additional discussion time.

1. Why would it be necessary to study life in the ocean to learn about life on land? *All living things on earth started out in the oceans before evolution brought them to land.*
2. In what way does the ocean affect our daily lives? *It generates and stabilizes climate, weather, temperature, rainfall, and oxygen.*
3. What effect does dumping trash and chemicals into the sea have on aquatic life? *It changes the environment of sea creatures and*

can kill or poison them. How does this affect life on land? *The sea can become contaminated and useless as a source of food.*

4. How has technology helped Sylvia Earle to explore the sea? *Her diving suits and submersible vehicles help recreate the air and pressure conditions found on land.*

5. What did the Tektite II experiment enable the scientists to do? *remain underwater for two weeks while they studied the underwater environment*

6. How have whales and other mammals adapted to the marine environment? *bodies are sleek and streamlined; their skin is smooth and nearly hairless; they have a thick layer of blubber that serves as insulation to help them maintain body heat in cold water; they breathe through blowholes in the top of their heads; flat tails help propel them through the water.*

7. Why do bottlenose dolphins do well in captivity? *The aquarium environment is similar to the shallow areas near shore where they live.*

*8. Do you think it is important to protect life in the sea? Why or why not? What kinds of controls could be established to help protect sea life? *Answers will vary.*

*9. What qualities do you think would be necessary to become a marine biologist? a deep-sea diver? *Answers will vary.* Do you think this would be an interesting profession? Why or why not? *Answers will vary.*

"The Voyage of the Mimi: The Book"

ACTIVITY, p. 16

These quotations deal with the strong attraction human beings feel to the ocean. Let your students' own reactions and responses guide the class discussion. You might ask students to compare these statements with Sylvia Earle's statement, "I don't know why people aren't just jumping into the water all over the place!" A group discussion might

naturally include topics such as the ocean's role in climate and weather, as a source of food, water, and energy, and as a vast, largely unexplored world.

Enrichment Activities

SEA THOUGHTS

Encourage students (even those who haven't seen the ocean) to write about or do other creative work that expresses their own feelings and experiences related to the ocean.

OCEAN FACTS

Materials: chart paper, markers

Have students investigate interesting facts about the ocean and ocean life. New facts can be listed on a sheet of chart paper that is posted on the wall. A good starting place might be: Oceans cover 70 percent of the earth's surface. Any and all relevant facts can be included, whether the information comes from these materials or from outside reading or research. The chart can be an ongoing project throughout the course of "The Voyage of the Mimi."

Software Connection: If you are or will be using the Ecosystems module, you might want to relate it to the issues of environment and adaptation raised in this expedition.

Extending Concepts

To relate the content of the Expedition to your core science curriculum or other curriculum areas, use these topics as guides:

Ocean (as a food source; pollution)
Whales/dolphins (evolution, adaptation)
Climate Marine biology
Weather Aquarium
Deep-sea diving

SETTING SAIL

Content Objectives

This episode

- demonstrates the sequence of steps involved in raising sail
- explains the identifying characteristics of humpback whales
- shows several types of humpback whale behavior
- demonstrates a method of identifying individual humpback whales by their fluke patterns
- demonstrates techniques for collecting and recording research data
- illustrates the use of the computer as a tool for scientific research

Vocabulary

belay	galley
bow	halyard
breach	lobtail
companionway	mainsail
crow's nest	mizzen
dorsal fin	peril beads
flukes	sectors
furling line	sloop

Program Components

Television Series, "The Voyage of the Mimi," Episode 2
Student's Guide, "The Voyage of the Mimi: The Book," pp. 18-27
Navigation Chart

Activity Materials

Tape measure
Metric ruler

Television Series

Review: Episode 1

The crew of the *Mimi*—Captain Granville, C.T., Anne, Ramon, Sally Ruth, Arthur, and Rachel—assembled at the dock, prepared for their voyage and got underway.

Have students recall the reactions of the crew members as they became acquainted with each other.

Episode 2: Summary

The hands on board the *Mimi* learn the ropes as they raise sail and head for Stellwagen Bank en route to the humpback whales' main feeding grounds on Georges Bank. They get their first crack at scientific observation when they spot a group of humpbacks. C.T., Arthur, and Rachel do some fluke matching.

BACKGROUND FOR THE TEACHER

Humpback whales are distinguishable from other whales by their long white flippers and small dorsal fins. Their flukes (part of the tail) are black on top and black and white underneath. The black and white patterns on the undersides of humpbacks' flukes can be used to identify individual whales. When a whale dives, the flukes are often visible enough to be photographed. These photographs can then

be catalogued, enabling scientists to track and study individual whales.


Humpbacks are not naturally aggressive, and they appear to be friendly. Much of their behavior, like lobtailing (whacking their tails on the water), breaching (jumping clear of the water), and flipper slapping (hitting the surface of the water with their flippers as they roll over) seems playful, but scientists really do not know why whales behave as they do. Scientists, however, are careful not to anthropomorphize whale behavior.

For additional background information on whales pertaining to this episode, see the section on Behavior (pp. 78–80) in "About Whales" in this Teacher's Guide.

PREVIEW QUESTIONS

Accept all answers.

1. How big do you think a whale is?
2. How do you think a whale would react to a boat coming toward it?
3. Do you think scientists can tell one whale from another? If so, how?
4. Who do you think will have the hardest time adjusting to life aboard the Mimi? Why?

 Have students watch Episode 2 ("Setting Sail") of the television series.

FOLLOW-UP QUESTIONS

Answers and/or guidelines are given in parentheses. Asterisks (*) denote questions that are particularly challenging and that may require additional discussion time.

1. What did you find out about the members of the crew? *Answers will vary, but might include: Rachel knows about sailing; Rachel's parents are separated; Sally Ruth goes to a college for the deaf; C.T. wants to help, but his grandfather won't let him.*
2. What are some of the characteristics of a humpback whale? *It has long white flippers, a bumpy head and chin, a small dorsal fin, and a black and white pattern on the undersides of the flukes.*
3. How do scientists identify individual humpback whales? *by their fluke patterns*

4. What do scientists learn by tracking individual whales? *where they go, how fast they travel, mating behavior, and so on*

5. What were some of the whale behaviors that the crew spotted? *lobtailing, breaching, flipper slapping* Describe these behaviors. Refer to "Background for the Teacher."

6. What did Captain Granville think of his crew? *Answers will vary, but should include that he was particularly skeptical about the teenagers' inexperience and about communicating with Sally Ruth.*

7. What did the different members of the crew think about Captain Granville? *Answers will vary.*

*8. How do scientists use computers to help identify humpback whales? *Scientists divide every fluke picture into 14 sectors. Using a special computer program, they give the computer information that describes each sector. The computer stores this information, which is recalled when a scientist attempts to identify a whale from a new fluke photograph. The computer compares the information about the flukes in the photo with the stored information and provides a list of possible matches. Final selection is made by eye. Do you think this process is useful? Why or why not? Answers will vary.*

*9. Why do people spend so much time, effort, and money to learn about whales? Should they? *Answers will vary.*

Navigation Chart

Have students locate Stellwagen Bank on the chart. Discuss the depth of the bank (indicated by numbers) compared to other areas of the Gulf of Maine. A bank is an area of shallow water.

Have students locate Georges Bank (where the Mimi will be going next).

Software Connection: If you are using Maps and Navigation, see: navigation charts; planning courses; latitude and longitude; ocean-bottom topography (water depth).

Introduction to Computing, see the computer as a tool (as in the fluke-matching program).

"The Voyage of the Mimi: The Book"

ACTIVITIES

"It's a Fluke," page 26

The uniqueness of fluke patterns provides the same key to humpback whale identification as fingerprints do to human identification. By matching photos of flukes and then matching fingerprints, students will practice an important scientific technique, as well as begin to understand the role of human judgment and perception in science. After completing the activity, have students discuss whether they agree on their matches and how they arrived at their choices. Discussing the pattern-recognition techniques used by the students in this activity and comparing the techniques will reveal wide differences in their techniques and perceptions. *Answers:* fourth photo down is the match of Fringe's flukes; going from left to right, the fifth and seventh ones are the matching fingerprints

"How Big is a Whale?" page 27

Materials: Metric ruler, tape measure

A. The best way to comprehend the length of a humpback whale is for students to compare it to other objects in their environment. They will measure the drawings, convert them according to the scale, and then compare their relative sizes. *Answers:* whale—12.8 m; school bus—11.2 m; car—1 m

B. Fringe's length will have the most personal meaning to students when they compare it to their own height. Have them work in pairs so that they can measure each other and then use the scale given in A above to convert the information to a scale drawing. *Answers will vary depending on individual heights. Students should divide Fringe's length by their height after converting both to meters.*

C. If some students don't know their own weight, have them estimate it based on the weights of other students who are about the same size. Before doing the problem, ask students to predict how many children of their weight would equal the weight of a humpback. Students should determine their weight in kilograms, change the humpback's weight

to kilograms, then divide the humpback's weight by their weight.

D. Children should consult other reference sources to find the weights of other animals. *Answers will vary depending on the specific animals the children choose. Have them divide the humpback's weight by each animal's weight after converting the weights to kilograms.*

Enrichment Activity

THE MATCH GAME

Materials: Blackline Master 2, scissors

Recognizing patterns is a part of everyday life, as well as a necessary scientific skill. Understanding the mental and perceptual processes we employ to discern patterns is a rewarding and important insight for students. They can be challenged by pattern recognition by playing the Match Game.

Have students look at the pictures on the master. Point out that although the pictures look similar, each has only one exact match.

The Match Game can be played in pairs. Begin by having one partner from each pair of players cut out the cards along the dotted lines, shuffle them, and place them face up on a table. Players then take turns picking up one card and then trying to find its match. It is important, however, that both players examine each pair of cards to see if they match. When two unmatching cards are chosen, they should be returned to their original positions. The player with the most pairs wins.

Extending Concepts

To relate the content of this episode to your core science curriculum or other curriculum areas, use these topics as guides:

Sailboats/sailing

Whale species

Animal migration

Observation and recording techniques

Pattern recognition

Measurement and scale

2nd
EXPEDITION

WHALEWATCH

PROVINCETOWN CENTER FOR COASTAL STUDIES

Content Objectives

This expedition

- explains the major classifications of whales: *odontocetes* (whales with teeth) and *mysticetes* (whales with baleen)
- describes and shows the unique characteristics of several species of whales
- describes and illustrates how scientists work in the laboratory and in the field
- explains the motivation for the scientific study of whales

Vocabulary

baleen	food chain
callosities	mysticete
echolocation	odontocete
endangered	pod
extinction	species

Program Components

- Television Series, "The Voyage of the Mimi," Expedition 2
- Student's Guide, "The Voyage of the Mimi: The Book," pp. 28-31
- Navigation Chart
- "Marine Mammals of the Western Hemisphere" Chart

Television Series

Expedition 2: Summary

Research on whales goes on in the lab and in the field, as Mark Graham, who plays Arthur in the dramatic episodes of the television series, learns during his visit to the Province-

town Center for Coastal Studies. Marine biologists Carole Carlson and Charles (Stormy) Mayo convey their commitment to and sense of joy in learning about all whales. During the visit, Mark learns about the unique characteristics of a variety of whales.

SCIENCE BACKGROUND

All whales belong to the order of mammals called cetaceans. There are two suborders of cetaceans: whales with teeth and whales without teeth. The toothed whales are given the scientific name *odontocetes* and include the killer whale, most of the smaller whales (including all porpoises and dolphins), and one Great Whale, the sperm whale. The whales without teeth include the rest of the Great Whales (including the humpback) and a few smaller whales. Instead of teeth, these whales have a filter system made up of long, thin, horny plates called baleen (a material much like our fingernails), which hangs from the upper jaw. The scientific name for the suborder of whales with baleen is *mysticetes*. They are also known as baleen whales or whalebone whales.

For additional information, refer to the Introduction (pp. 62-64) and the section on Food and Feeding (pp. 65-68) in "About Whales" in this Teacher's Guide.


During your class discussion of this Expedition, refer to the wall chart, "Marine Mammals of the Western Hemisphere."

PREVIEW QUESTIONS

Before viewing Expedition 2, have pupils predict answers to the following questions. Accept all answers.

1. What do you think scientists learn about the world by studying whales?
2. Where do you think scientists who study whales do their work?

3. How do you think whales eat?
4. What other kinds of whales are there besides humpbacks?
5. Would it make any difference if whales became extinct?

 Have students watch Expedition 2 ("Whale-watch") of the television series.

FOLLOW-UP QUESTIONS

1. How do Carole and Stormy combine their work in the field and in the lab? *They go out to sea when the weather is warm, and spend most of the winter in the lab analyzing the data they collected in the field. Do you think this is a good way to work? Why or why not? Answers will vary.*

2. What is the significance of the fact that whales are at the top of their food chain? *No species depends on whales for food; if whales become extinct there will be an increase in the animals on which they feed.*

3. What was the purpose of the aerial survey? *to keep track of the number of humpbacks in the area. What did Carole and Mark learn from it? that the humpbacks may have already migrated south*

4. What is the main difference between the way baleen whales eat and the way toothed whales eat? *Baleen whales take in a large mouthful of water containing many small animals, filter the water out through their baleen, and swallow their food whole; toothed whales bite into a fish or squid and then swallow it whole.*

5. What are some types of baleen whales? *minke, blue, gray, right, humpback*

6. Why are right whales the most endangered (that is, in danger of becoming extinct) of whale species? *Large numbers were killed because they were the "right" whales to hunt in that they are slow-moving and easy to catch, float when killed, and yield large amounts of oil*

7. How is it possible for species to come back from near extinction? *by being legally protected from being killed so that they have a chance to reproduce. What is an example of a whale species that is no longer near extinction? gray whales*

8. What special talent do toothed whales

possess? *echolocation. How does this process work? They make sounds that bounce off living and non-living objects in the water. The returning echo provides information about the size, shape, and distance of objects that reflect the sound.*

9. What is one way in which beluga whales are well adapted to their environment? *Their white coloring makes them look like floating chunks of ice on the surface of the icy Arctic waters in which they live.*

10. Humpback whales can be identified by the patterns on their flukes. How are individual members of some of the other species of whales identified? *sperm whales, by the unique pattern of clicking sounds; orcas, by scars on their huge dorsal fins; right whales, by the shape and patterns of the callosities or growths on their heads*

*11. What are some ways that humans cause the extinction of an animal species? *Answers will vary, but may include: over-hunting, ruining the animal's habitat (e.g., by polluting or otherwise changing it so the animal can no longer survive in it), using insecticides (e.g., DDT) that interfere with a species' life cycle, interfering with the food chain*

*12. Do you think it would make any difference if humpback whales, or any other whale species, became extinct? Why or why not? *Answers will vary. The two scientists in the show point out that we would lose an opportunity to learn more about unique, interesting, and apparently intelligent animals.*

"The Voyage of the Mimi: The Book"

Use *The Book* for review, reference, or enrichment in other curriculum areas.

ACTIVITY, p. 31

This account of the consequences of the disappearance of a hippopotamus population will focus students' attention on the meaning of the term "balance of nature." Have an open discussion of students' conclusions. Students should understand that we can almost never be certain of the consequences of eliminating an animal from an ecosystem.

Enrichment Activities

ENDANGERED SPECIES

Materials: chart paper, crayons or markers

Have students investigate animals that have officially been designated endangered species. Research could include finding out what measures have been taken to protect these animals. This could include government intervention as well as activities of various environmental groups. Students might make a chart or other kind of display on endangered species that includes information about and pictures of (found in newspapers and magazines or drawn by students) some animals that are on the endangered species list.

BALANCE OF NATURE

Discuss ways nature has of balancing itself. A student project might be to investigate relationships in nature in which living crea-

tures naturally control population growth—within or among species. A research question: How has human interference upset some of these relationships, and what have been the consequences of that interference?

Software Connection: If you are or will be using the *Ecosystems* module, use the themes and content of this expedition to extend the concepts and activities in the module.

Extending Concepts

To relate the content of this expedition to your core science curriculum or other curriculum areas, use these topics as guides:

Animal populations	Food cycle
Whales/marine mammals	Sound waves
Extinction/survival	Marine biology
Adaptation	Pollution of the sea

speed of sound through water. (Help students recall the discussion about the echo sounder in Episode 3 of the dramatic series.)

4. How is the information from echo sounders used to make a contour map? *The repeated measurements of water depths in a small area are plotted to yield a profile of the ocean floor in that area.*

5. How did Kim Kastens and Mary know where on the map to write the appropriate depths? *They matched the date and time of day on the echo sounder profile with the ship's positions at those dates and times of day.*

6. What do the different colored areas on a contour map indicate? *different depths*

7. What does Bill Haxby use to gather information about the sea floor? *satellite data*
How does this method work? *An altimeter on the satellite measures the time it takes microwaves to travel to the ocean surface and return to the satellite. An echo sounder measures the contours of the ocean floor; an altimeter measures the contours of the ocean surface.*

8. What do height differences on the ocean surface tell you about the features on the ocean bottom? *Mounds and dips on the ocean surface reflect high and low places on the ocean floor. The high places have greater gravitational force than do the low places. More water is pulled to areas of greater gravitational force, thus causing mounds on the ocean surface.*

9. What are the advantages of using satellite measurements? *Larger areas can be covered in a shorter time. What are the advantages of using an echo sounder? It provides fine details about a specific area.*

10. Do you think learning about the ocean bottom has any relationship to life on land? If so, what? *Answers will vary.*

"The Voyage of the Mimi: The Book"

ACTIVITY, p. 43

Exploring the ocean bottom is particularly difficult because humans require very special

equipment to descend to certain depths. That special equipment is expensive to buy, and the mapping expeditions are very time-consuming and cover only a small portion of the ocean floor at any one time.

Enrichment Activity

A CONTOUR MAP

Materials: Navigation chart (Gulf of Maine), colored markers

Mark off an area of the navigation chart (at least 4" × 4"), preferably an area that includes several changes in water depth (e.g., shoals and a channel). Have students make a contour map of the area. On a sheet of paper, students mark off a space the same size as the area on the chart. Then they transfer the numbers indicating water depth to their papers in approximately the same places. (All the numbers need not be included—a representative sample from all parts of the area should serve.) Next, show students how to draw contour lines—lines of constant depth—connecting all numbers that indicate the same depths. Finally, students will enjoy coloring the map, using light colors for the shallowest areas and dark colors for the deepest.

Software Connection: If you are using *Introduction to Computing*, this expedition exemplifies the use of the computer as a tool for handling tasks that would otherwise be time-consuming and tedious.

Extending Concepts

To relate the content of this expedition to your core science curriculum or other curriculum areas, use these topics as guides:

Oceans
Oceanography
Mapping

Marine geologist
Geophysicist

4th
EPISODE

COUNTING WHALES

Content Objectives

This episode

- explains why and demonstrates how scientists estimate the size of humpback whale populations
- demonstrates another use of the computer as an aid in recording, analyzing, and interpreting data
- provides a close-up look at the head of a humpback whale
- discusses whale physiology in terms of the whale's evolution from a land animal
- describes the pursuit and killing of a whale, as found in the journal of a nineteenth-century whaler

Vocabulary

barnacle	rigging
census	rostrum
characteristic	transect
latitude	tubercle
longitude	

Program Components

Television Series, "The Voyage of the *Mimi*," Episode 4
Student's Guide, "The Voyage of the *Mimi*:
The Book" pp. 44-49
Navigation Chart

Activity Materials

Blackline Master 3

Television Series

Review: Episode 3

Inaccurate readings from the navigation instruments created a problem that placed the *Mimi* in dangerously shallow waters. The voyage was about to come to an early end when Arthur discovered the source of the problem in the boat's electrical system and repairs were made.

1. What problem almost ended the voyage of the *Mimi* in the last episode? *A short circuit in the electrical system caused the ship's instruments to misread.*

2. Who discovered the source of the problem and helped solve it? *Arthur*

3. What sound did C.T. hear at the end of the episode? *the sound of whales breathing near the boat*

Episode 4: Summary

Captain Granville shows C.T. a nineteenth-century whaler's journal passed down in the Granville family. Arthur and Rachel find there's more to counting whales than simple addition as they learn how a whale census is conducted. Anne explains how the humpback population is estimated based on data collected by sampling (counting whales in a number of delineated areas). Several humpbacks swim very near the *Mimi*, providing a chance for close-up observations.

BACKGROUND FOR THE TEACHER

Census figures for given populations of humpbacks are obtained through a process of sampling—conducting censuses in a number


of areas and then extrapolating estimates based on the area covered and on the number of whales counted. Relying on only one or even a few samples could result in inflated or deflated estimates based on conditions particular to the area and/or other variables (weather conditions, time of day, etc.). Because of heavy over-hunting, the humpback whale is an endangered species numbering perhaps 7,000 to 8,000 worldwide. (There were probably over 100,000 before large-scale whaling began to decimate the populations by the early 1800s.) A recent census figure for the western North Atlantic is approximately 3,500 humpbacks.

For additional information, refer to "About Whales," particularly the section on whaling.

PREVIEW QUESTIONS

Have pupils predict answers to the following questions before viewing Episode 4. Accept all answers.

1. Why do you think scientists might be interested in counting whales?
2. Do you think there's any way in which a computer could be used to help keep track of whales? If so, how?
3. Do you think whales would come close to a boat in real life? Why or why not?
4. What do you think would happen if a whale swam under the Mimi?

 Have students watch Episode 4 ("Counting Whales") of the television series.

FOLLOW-UP QUESTIONS

Asterisks (*) denote questions that are particularly challenging and that may require additional discussion time.

1. What gesture of good will did Captain Granville make toward C.T.? *He showed him the whaler's journal and told him one day it would be C.T.'s.* How do you think this made C.T. feel? *Answers will vary.*
2. What was the purpose of the census? *To help scientists make a better estimate of the number of whales in the area of Georges Bank.*
3. What information was recorded when a whale was sighted during the census? *Answers should include time, sighting cue (what was seen first), species of whale, location as*

indicated by the bearing compass, and distance.

4. Why was it important to keep the Mimi traveling at a speed of five knots during the census? *Humpbacks can swim at three to four knots. If the Mimi weren't going faster than the whales could swim, whales could pass the boat and be counted twice in the census.*

5. How does a finback whale differ from a humpback? *A finback is bigger, its dorsal fin is sharper, and it doesn't hump its back when it dives, as does a humpback.*

6. Why is it necessary to make several census transects in different areas of the Bank? *Help students understand the importance of sampling—collecting the data in several different areas—to avoid making a distorted estimate of the total population because of the special conditions that may apply in one area.*

7. What was one possible reason there were so many whales sighted in one transect? *The transect covered a shallow area of the bank where the whales might concentrate because of the plentiful food supply.*

8. How did the computer help analyze the census data? *It took all the whale sightings for each transect and provided a visual display of the number and location of the whales counted.*

9. Why do humpbacks have hair growing from the tubercles on their heads? *The ancestors of whales lived on land and were covered with hair, like other mammals. As whales became better adapted to living in water, most of their hair disappeared. The hairs on the tubercles are all that remain.*

10. Why do you think the journal entry Rachel read at the end of the day was particularly upsetting? *C.T., Arthur, and Rachel had seen whales close up and the whales seemed to be so gentle and trusting.*

*11. When Rachel asks if barnacles hurt the whales, Ramon jokingly says to ask the whales. Do you think it is possible for people to accurately interpret animals' feelings? Why or why not? *In the discussion, help students understand that scientists must be careful not to anthropomorphize animal behavior by going beyond the evidence.*

Navigation Chart

Help students locate Georges Bank, where the census is being conducted. Try to find

parts of the Bank that are more shallow than other parts and where humpbacks might concentrate.

C.T. calls out the specific latitude and longitude where the first census transect is to begin: $67^{\circ}42'$ west longitude, $41^{\circ}30'$ north latitude. Have a student pinpoint the *Mimi*'s position at that point.

The Car 'ain says the *Mimi* is on a course of 270° . Use the compass rose on the chart to determine the direction in which the *Mimi* is heading.

Software Connection:

Maps and Navigation. See: navigation chart; compass rose; bearing; latitude and longitude.

Introduction to Computing. See: computers as tools; degrees of a circle (Turtle geometry) as related to heading and use of compass rose.

"The Voyage of the Mimi: The Book"

ACTIVITY

"*Making Sense of a Census,*" page 49

Materials: Blackline Master 3

Students can use the information given in the table on master 3 to calculate the estimated number of humpbacks in the Georges Bank population. They should infer that the number in each transect series can vary greatly depending on variable conditions. Thus, an accurate estimate can be made only by computing the average of several transects, and then relating the result to the total area.

Depending upon grade and achievement level, students may need help with mathematical procedures.

Answers:

1. transect series #2 = 144 sq. mi.; #3 = 100 sq. mi.; #4 = 48 sq. mi.; #5 = 128 sq. mi.; #6 = 120 sq. mi.
2. 700 sq. mi.
3. 84 humpbacks
4. 12 humpbacks
5. 1440 humpbacks

Enrichment Activities

NAUTICAL KNOTS

Materials: Blackline Master 4, rough-textured rope

Learning how to make different knots can be a good way to pass the time at sea as well as a useful tool. Have students refer to Master 4 to become familiar with some of the more useful knots. They can then practice making these knots.

Extending Concepts

To relate the content of this expedition to your core science curriculum or other curriculum areas, use these topics as guides:

- Census (sampling, data collection)
- Whaling (history)
- Whales (anatomy, evolution)
- Evolution, adaptation
- Mammals (characteristics)

4th EXPEDITION WHALE BONES

SMITHSONIAN MUSEUM OF NATURAL HISTORY

Content Objectives

This episode

- visits the Smithsonian Institution in Washington, D.C.
- illustrates the work of a mammalogist and vertebrate paleontologist
- explains how whales have evolved from land mammals
- explains how evolution is a genetic process

Vocabulary

artifact	specimen
fossil	vertebrate
mammalogist	paleontologist

Program Components

Television Series, "The Voyage of the *Mimi*," Expedition 4
Students' Guide, "The Voyage of the *Mimi*: The Book" pp. 50-53
"Marine Mammals of the Western Hemisphere" Chart

Television Series

Expedition 4: Summary

Ben Affleck (C.T.) visits the Museum of Natural History of the Smithsonian Institution in Washington, D.C., where he learns about the natural history of the whale. After examining fossils as old as fifty million years, Ben is convinced that whales, beautifully adapted to life in the sea, evolved from land mammals.

SCIENCE BACKGROUND


Since 1693, Cetaceans have been classified as mammals. Prior to that, scientists were well aware of the fact that whales breathe through their lungs, have hair, nurse their young, and have horizontal rather than vertical flukes. However, proof that the original ancestors of whales lived on land and were built like other land mammals has been supported most strongly by fossil records. They have indicated that the closest relatives of whales are the Carnivores and Ungulates (particularly the Artiodactyls which include cattle, sheep and camels).

For further information about the evolution of whales, see "About Whales," particularly the Introduction and the section on Physiology.

PREVIEW QUESTIONS

Have pupils predict answers to the following questions before viewing Expedition 4. Accept all answers.

1. Do you think whales have always been sea creatures? Why or why not?
2. How do you think scientists could learn more about the ancestors of whales?
3. What actually causes changes to take place in living things over millions of years?

 Have students watch Expedition 4 ("Whale Bones") of the television series.

FOLLOW-UP QUESTIONS

Asterisks (*) denote questions that are particularly challenging and may require additional discussion time.

1. Why does the Smithsonian need such a large collection of specimens? *Scientists can only learn about a species as a whole by studying and comparing many specimens.*
2. What characteristics of mammals do

whales have? *They have hair, give birth to live young, nurse their babies, breathe air above water through nostrils and lungs.*

3. What does a vertebrate paleontologist study? *the fossils of animals with backbones*
Why? *to learn about the evolution of animals with backbones*

4. What did Dr. Whitmore find when he traced back the whale fossils? *that the earliest fossils looked a lot like land mammals*

5. How has the position of the blowhole changed over the years? *It has moved from the front of the snout to the top of the head. What does this indicate? that the whale was once a land animal with a nose in front of its head like other land animals*

6. What conclusions did Dr. Whitmore draw from comparing the skulls of a dog and a 50-million-year-old whale? *that dogs and whales had a common ancestor who walked on land*

7. What caused whales to adapt to living in the water? *a need to become more efficient at eating the food in the sea*

8. Why are genes referred to as the "blueprint for life"? *They determine what a living creature will look like and in what ways it will be similar to and different from other members of the same species.*

*9. How do you think life on earth might change in the future? How do you think human beings might evolve to adapt to these changes? *Answers will vary.*

*10. Do living things always adapt successfully to a changed environment? Give some examples to support your reasoning. *Answers will vary.*

"The Voyage of the Mimi: The Book"

Refer to the classroom chart of "Marine Mammals of the Western Hemisphere" and to the illustration of a humpback whale on pp. 6 and 7 of *The Book* to examine whales' adaptation to the marine environment.

ACTIVITY, p. 51

(Note: This activity is to be done by students at home.)

Materials: cardboard, chicken bones, rubber cement

By reconstructing the skeleton of a chicken, pupils will be able to simulate the work of a paleontologist as he or she attempts to use fossil remains to recreate the skeletons of various extinct creatures.

Enrichment Activities

MAKING FOSSILS

Materials: Plaster of Paris, petroleum jelly, mixing bowl and stick, cardboard or plywood, spoon, assorted found objects such as leaves, bones, shells

Pupils will enjoy making their own fossils. Have them collect assorted objects to be fossilized such as leaves, bones and shells. Have them place a layer of petroleum jelly on each object to be used. Then, follow the directions on the box of Plaster of Paris to make a thick, smooth mixture. Students can then drop spoonfuls of the Plaster of Paris mixture onto the cardboard or plywood and press a coated object into each mound. After the plaster hardens, remove the object. A fossilized print should result.

Software Connection: If you are or will be using the *Ecosystems* module, refer to the topics of evolution and adaptation.

Extending Concepts

To relate the content of this episode to your core science curriculum or other curriculum area, use these topics as guides:

Fossils
Paleontology
Whales (evolution)

Mammals
Genes/genetics

APPENDIX B:
"Solutions Unlimited" Materials

Additional information about the "Solutions Unlimited" materials can be obtained from:

Bob Fox
Agency for Instructional Technology
Box A
Bloomington, IN 47402
(800) 457-4509

INTRODUCING



What is *Solutions Unlimited*?

Solutions Unlimited consists of eight units that provide middle school students with a means of improving their problem-solving skills and of learning about various computer applications:

- Unit One Hey Wait! Think, See, So?
A Problem-Solving Guide
- Unit Two Plan Ahead
Time Management and Problem Solving
- Unit Three The Whitewater Canoe Race
Considering Alternatives When Problem Solving
- Unit Four Letters from the Past
Problems of Communicating in Writing
- Unit Five Saving Energy
Using Graphics When Problem Solving
- Unit Six Who Says So?
Judging Sources of Information
- Unit Seven Do I Know Enough?
Drawing Conclusions When Problem Solving
- Unit Eight Survival
A Problem-Solving Application

Each unit includes three instructional resources that may be used together or independently:

- A short video program that demonstrates a skill or poses a problem.
- Computer software that lets students, individually or in small groups, think of and try solutions to a problem and evaluate the results.
- Printed materials that provide teaching suggestions and reproducible student handouts.

Woven into the units, and featured in Unit One, is a problem-solving guide that has been successfully used in classrooms throughout the United States and Canada:

- Hey Wait! — Stop! There is a problem.
- Think — Think of ways to solve the problem and make a plan.
- See — Try out the plan and see if it works.
- So? — Have you solved the problem or do you need to go back to another step?

In addition to this general problem-solving guide, *Solutions Unlimited* lessons also involve specific problem-solving techniques. These include questioning, note-taking, visualizing a problem, time management, and generating alternatives.

Why Use *Solutions Unlimited*?

Everyone has problems. Some may be small, like finding the sum of two and one; others may be large, like being lost in the wilderness. But whether their problems are small or large, both children and adults need problem-solving skills everyday. Until recently, most people assumed that it was enough to let these skills develop naturally as children grew older.

Now, however, it is recognized that, as with any other skill, instruction and practice can make people more proficient problem solvers. The National Council of Teachers of Mathematics in its *Agenda for Action*, for example, has called upon schools to increase the amount of instruction given to the development of problem-solving skills.

Most problems, especially the "real" ones we face day to day, have not one possible solution but many; hence the name *Solutions Unlimited*. But most youngsters do not recognize that problems have multiple solutions. They need to be taught a general problem-solving approach as well as specific problem-solving techniques.

How to Use *Solutions Unlimited*

Each *Solutions Unlimited* unit can be used independently. Thus you may select only those units that are particularly appropriate for your students. Of course, the more units you use, the more practice your students will have in systematically solving problems.

Once you have selected the units you wish to use, you will need to make arrangements to use a video-cassette player and one or more computers. Ideally you will have at least one computer for every two or three students, permitting the entire class to complete the unit simultaneously. In other cases, individual students or small groups of students will take turns using the computer while the rest of the class does related problem-solving activities or proceeds with regular class activities.

Typically, students will be able to complete a computer activity in one or two periods. However,

some students may need more time for some units. Unit Two, for example, encourages students to keep coming back to use the computer as a time-management tool.

Although the television segments and the computer programs can be used independently, you will probably want to follow a pattern of instruction something like this:

- Introduce the topic of problem solving and the specific theme of the unit (time management, considering alternatives, etc.).
- Show the television program for the unit.

- Discuss the program, with special emphasis on what the problem is and on how those in the program tried to solve it.
- Assign students to computers and have them complete the computer activities.
- After all students have completed the computer activities, discuss those activities as a class.
- Assign follow-up activities.

The lesson materials in this guide provide suggestions to help you with each of these steps.

Solutions Unlimited was programmed by Decision Development Corporation under the supervision of the Agency for Instructional Technology in cooperation with a consortium of educational agencies throughout the United States and Canada.

Solutions Unlimited participating agencies: Alaska State Department of Education; Alberta Education; Arizona Department of Education; Arkansas Department of Education/Arkansas ETV Commission; British Columbia Department of Education; California Department of Education; Colorado Department of Education, participating BOCES, and television stations KRMA and KTSC; Connecticut State Department of Education; Florida State Department of Education; Hawaii Department of Education; Illinois State Board of Education; Indiana Department of Public Instruction; Iowa Public Broadcasting Network; Kentucky Department of Education/Kentucky Authority for Educational Television and participating school systems; Maine Department of Educational & Cultural Services; Manitoba Department of Education, Instructional Media Services Branch; Maryland State Department of Education, Division of Instructional Television; Massachusetts Department of Education; Michigan—Wayne County Intermediate School District and Kent Intermediate School District; Minnesota State Department of Education; Missouri Department of Elementary and Secondary Education; Nebraska Department of Education; Nevada Department of Education; New Jersey Department of Education/New Jersey Network; New Mexico Media Network; Center for Learning Technology, New York State Education Department; North Central Council for School Television, Inc. (North Dakota); Ohio Department of Education; Oklahoma Department of Education; TVOntario; Oregon Department of Education; Pennsylvania—A Coalition of Thirteen Intermediate Units; Quebec Ministry of Education; Rhode Island Department of Education; Saskatchewan Department of Education; Tennessee Department of Education, including television stations WSJK, WTCI, WCTE, WLJT; Texas—Ector County Independent School District, Midland/Education Service Center #18, and Richardson Independent School District; Utah State Office of Education; Vermont Department of Education/Vermont Educational Television Network; Virginia Department of Education; Washington State Video Consortium of Educational Service Districts; Wisconsin Educational Communications Board.

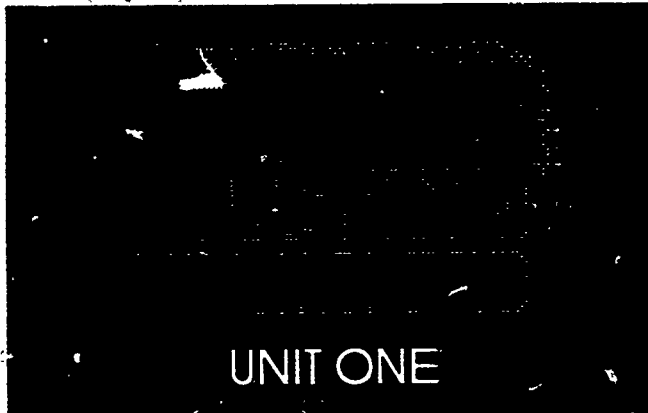
Additional funding for *Solutions Unlimited* was provided by the Exxon Education Foundation.

If you have questions or comments on *Solutions Unlimited* you may call AIT, 800/457-4509 or 812/339-2203.

The problem-solving strategies and many of the television segments in *Solutions Unlimited* are from the instructional television series *ThinkAbout*. A consortium of state and provincial education agencies under the direction of AIT developed *ThinkAbout* as part of the Skills Essential to Learning Project.



The Agency for Instructional Technology is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television and related printed materials for use as major learning resources. It makes many of these materials available in audiovisual formats. From April 1973 to July 1984, AIT was known as the Agency for Instructional Television. Its predecessor organization, National Instructional Television, was founded in 1962. AIT's main offices are in Bloomington, Indiana.



UNIT ONE

Winter 1985

TEACHER'S GUIDE

This is one of eight instructional units that integrate computer software, videocassettes, and print to improve the problem-solving abilities of students in grades six, seven, and eight and to make them familiar with the problem-solving applications of computers. (TRS-80 version running in MMSFORTH, under Bulk License Serial Number 2245 to Decision Development Corp. from Miller Microcomputer Services, Natick, MA 01760. USA.)

Hey Wait! Think, See, So?

A Problem-Solving Guide

About the Lesson

This unit presents four steps that can be used as a guide to systematic problem-solving:

Hey Wait! — Means "Stop! There is a problem."

Think — Think of ways to solve the problem and make a plan.

See — Try out the plan and see if it works.

So? — Have you solved the problem or do you need to go back to another step?

Introducing the Video

Ask students to discuss situations in which they have had some problem to solve. Did they have a systematic way to find a solution? Tell students to watch for the problem-solving steps described in the program.

The Video (8 minutes)

A family is setting up camp when their tent pole breaks. They use the problem-solving guide *Hey Wait! Think, See, So?* to arrive at a solution. Students then see Alexander Graham Bell use the guide when he hits a snag during his experiments on the transmission of continuous sound waves. In a third example, a touch football team can't score. One complete *Hey Wait! Think, See, So?* cycle produces a fizzle, so they return to the See step, try another alternative, and make a touchdown.

Discussing the Video

1. Review the four steps of the problem-solving guide. How did each set of characters—the campers, Alexander Graham Bell, the football team—use *Hey Wait, Think, See, So?*
2. What happens if, like the football team, you don't solve a problem on the first try?

Preparing for the Computer

1. You will need one program disk per computer. To make extra copies, insert the disk in the disk drive and turn on the computer. Answer yes to the question "Do you know about the problem-solving guide?" When you are asked "Do you want to review the problem-solving guide?" type the word COPY and press RETURN. The computer will then direct you in making copies of the disk.
2. Schedule when students will use the computer. (A maximum of three students should be assigned to a group.) If you do not have enough computers for all students, rotate the groups. Those not on the computers can work on other assignments or on special problem-solving activities.
3. Introduce the computer activity, emphasizing that students will be learning a guide to help them solve problems systematically.
4. If *Solutions Unlimited* is to be run on an Apple IIe, direct students to keep the CAP LOCK on.

The Computer Activity

The program is divided into two parts: (1) an optional review of the problem-solving guide and (2) an activity requiring students to use the guide to solve a problem. A young person has borrowed a guitar from a friend. The guitar must be returned by noon, but will it be? As students try to return the guitar, they encounter potential problems. Their ability to recognize these and respond to them appropriately as they use *Hey Wait! Think, See, So?* will ultimately determine their success.

After the Computer

1. Have students report on whether they safely returned the guitar. What problems, if any, did they

encounter? How did they use *Hey Wait! Think, See, So?*

2. Discuss how *Hey Wait! Think, See, So?* might be used to try to solve real, school-related problems of concern to students.

Additional Activities

1. Have each student make a problem-solving guide on a 3x5 card, listing the steps of *Hey Wait! Think, See, So?* and what each means. They could use this card at the computer or away from it.
2. Distribute the Student Handout "Irving Langmuir: The Man Who Made Rain." Have students compare his problem-solving process with the steps of the *Hey Wait! Think, See, So?* guide. This can also be done with the activities of other scientists or problem solvers.
3. Identify a real, school-related problem, such as a dangerous street crossing, and as a term project use *Hey Wait! Think, See, So?* to try to correct the problem.

Irving Langmuir: The Man Who Made Rain

Read the following account of a scientific discovery and indicate where each step of the *Hey Wait! Think, See, So?* process is used.

Anyone who has watched the skies knows that it will not always rain just because there are clouds. During times of drought, that can be a serious problem—the water vapor may be in the air but it is needed on the ground.

Over the years many people tried to learn the secret of making rain, but none succeeded until the 1940s when Irving Langmuir set to work on the problem. Langmuir was associate director of research at the General Electric laboratory in Schenectady, New York. In 1932 he had won the Nobel prize for his work in chemistry.

Langmuir wanted to test the theory that the presence of very small particles—dust—in the air would cause raindrops to form. He built a chamber in his laboratory and put water vapor in it. He then cooled the vapor so that he would have his own “cloud” on which to experiment. But when he added dust, nothing happened. No raindrops formed.

There was another problem. On hot days it was difficult to keep the cloud cool. Langmuir had several options. He could abandon the experiment. He could refrigerate the box. Or perhaps he could cool the cloud with dry ice (solid carbon dioxide, about -80 degrees centigrade).

When dry ice was added something unexpected happened: the vapor in Langmuir’s cloud turned to ice. He had created artificial snow, but that was close enough. If snow could be created in real clouds it would turn to rain as it reached warmer air closer to the ground. Langmuir had found that dust was not necessary for rain to form; it was enough to make the water vapor in the cloud very cold.

In 1946 Langmuir’s idea was tested. Tiny crystals of dry ice were dropped into a cloud bank from an airplane. In less than thirty minutes it began to rain. Langmuir had solved a problem.

Solutions Unlimited was programmed by Decision Development Corporation under the supervision of the Agency for Instructional Technology; in cooperation with a consortium of education agencies throughout the United States and Canada.

Solutions Unlimited participating agencies: Alaska State Department of Education; Alberta Education; Arizona Department of Education; Arkansas Department of Education/Arkansas ETV Commission; British Columbia Department of Education; California Department of Education; Colorado Department of Education, participating BOCES, and television stations KRMA and KTSC; Connecticut State Department of Education; Florida State Department of Education; Hawaii Department of Education; Illinois State Board of Education; Indiana: Department of Public Instruction; Iowa Public Broadcasting Network; Kentucky Department of Education/Kentucky Authority for Educational Television and participating school systems; Maine Department of Educational & Cultural Services; Manitoba Department of Education, Instructional Media Services Branch; Maryland State Department of Education, Division of Instructional Television; Massachusetts Department of Education; Michigan—Wayne County Intermediate School District and Kent Intermediate School District; Minnesota State Department of Education; Missouri Department of Elementary and Secondary Education; Nebraska Department of Education; Nevada Department of Education; New Jersey Department of Education/New Jersey Network; New Mexico Media Network; Center for Learning Technology, New York State Education Department; North Central Council for School Television, Inc. (North Dakota); Ohio Department of Education; Oklahoma Department of Education; TVOntario; Oregon Department of Education; Pennsylvania—A Coalition of Thirteen Intermediate Units; Quebec Ministry of Education; Rhode Island Department of Education; Saskatchewan Department of Education; Tennessee Department of Education, including television stations WSJK, WTCI, WCTE, WLJT; Texas—Ector County Independent School District, Midland/Education Service Center #18, and Richardson Independent School District; Utah State Office of Education; Vermont Department of Education/Vermont Educational Television Network; Virginia Department of Education; Washington State Video Consortium of Educational Service Districts; Wisconsin Educational Communications Board.

Additional funding for *Solutions Unlimited* was provided by the Exxon Education Foundation.

If you have questions or comments on *Solutions Unlimited* you may call AIT, 800/457-4509 or 812/339-2203.

The problem-solving strategies and many of the television segments in *Solutions Unlimited* are from the instructional television series *ThinkAbout*. A consortium of state and provincial education agencies under the direction of AIT developed *ThinkAbout* as part of the Skills Essential to Learning Project.



Together... serving education.

The Agency for Instructional Technology is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television and related printed materials for use as major learning resources. It makes many of these materials available in audiovisual formats. From April 1973 to July 1984, AIT was known as the Agency for Instructional Television. Its predecessor organization, National Instructional Television, was founded in 1962. AIT's main offices are in Bloomington, Indiana.



TEACHER'S GUIDE

This is one of eight instructional units that integrate computer software, videocassettes, and print to improve the problem-solving abilities of students in grades six, seven, and eight and to make them familiar with the problem-solving applications of computers. (TRS-80 version running in MIMS FORTH, under Bulk License Serial Number 2245 to Decision Development Corp. from Miller Microcomputer Services, Natick, MA 01760, USA.)

Winter 1985

The Whitewater Canoe Race

Considering Alternatives When Problem Solving

About the Lesson

It is common for 11- to 13-year-olds to make decisions without considering alternatives. Successful problem solving requires a more thoughtful approach, one in which the advantages and disadvantages of alternatives are considered before a choice is made. Using the computer to simulate a canoe race, this lesson emphasizes the importance of thinking about alternatives and their consequences when problem solving. Woven into all of the *Solutions Unlimited* units is the *Hey Wait! Think, See, So?* problem solving guide:

- Hey Wait!* —Means "Stop! There is a problem."
Think —Think of ways to solve the problem and make a plan.
See —Try out the plan and see if it works.
So? —Have you solved the problem or do you need to go back to another step?

This unit highlights the *Think* step of the guide.

Introducing the Video

Have students talk about situations in which they made decisions without considering the alternatives. What happened? What might have been a better way to make the decision? Remind students of the *Hey Wait! Think, See, So?* problem solving guide introduced in Unit One. Tell them that the video emphasizes the importance of the *Think* step.

The Video (12 minutes)

The Scouts take on the older and stronger Pirates in a two-day canoe race. Throughout the race, the Scouts consider alternatives and possible consequences each time they are confronted with a problem. Their problem-solving ability gives them a last

minute advantage over the Pirates and they win the race.

Discussing the Video

1. What did the Scouts think about before they decided to carry their canoe overland? What were the advantages and disadvantages of this alternative compared to the others?
2. What alternatives did the Scouts have as they approached the final rapids? What were the advantages and disadvantages of each? Did they make a wise choice? Why?

Preparing for the Computer

1. You will need one copy of the program disk per computer. To make extra copies, insert the disk in the disk drive and turn on the computer. When the computer asks whether you are beginning or continuing the race, type COPY and press RETURN. The computer will then direct you in making copies of the disk.
2. Schedule when students will use the computer. (A maximum of three students should be assigned to a group.) If you do not have enough computers for all students, rotate the groups. Those not on a computer can work on other assignments or on special problem-solving activities.
3. (Optional) Duplicate and distribute the Student Handout for this unit. Have students use the map of the river and the rules of the race to consider the advantages and disadvantages of various routes. This will permit them to plan their tactics in advance.
4. If *Solutions Unlimited* is to be run on an Apple IIe, direct students to keep the CAP LOCK on.

The Computer Activity

The computer program simulates an overnight canoe race against the Pirates. The teams in the video each had two, two-person canoes. The teams in the computer activity each have one, three-person canoe. During the simulation, students will need to decide what equipment they want to take, what route they want to follow, and how fast they want to paddle. The computer makes students reconsider their selection of equipment (to make sure that they have considered all the alternatives), helps them review the advantages and disadvantages of each route, and provides numerous opportunities during the race for them to revise their routes or paddling speed. Equipment selection is important, because unnecessary equipment will increase the weight of the canoe and cause the team to become tired. Failure to take necessary equipment can also have adverse effects on the team.

Decisions about equipment, paddling speed, placement of the canoe in the river, and route will influence the outcome of the race. But thoughtful consideration of the alternatives does not guarantee a win, since random events may intervene.

The first part of the race ends when students reach the overnight campsite. At this point, they can opt to continue with part two of the race or, if time is short, to leave the computer and resume the race later. If they choose to stop, they will be asked to write down the weight of their canoe, their physical condition, and their time ahead of or behind the Pirates. They will need to supply this information to resume the race later.

After the Computer

1. Review the students' success in the race. (The outcome will be presented to them in number of minutes ahead of or behind the Pirates.) How do students think they might improve their performances? How did they use the *Hey Wait! Think, See, So?* guide?
2. Discuss how each decision made during the race became part of a chain of decisions that affected the outcome of the race. Can students think of one decision they made that had more of an impact on the outcome than did other decisions? Why or why not?

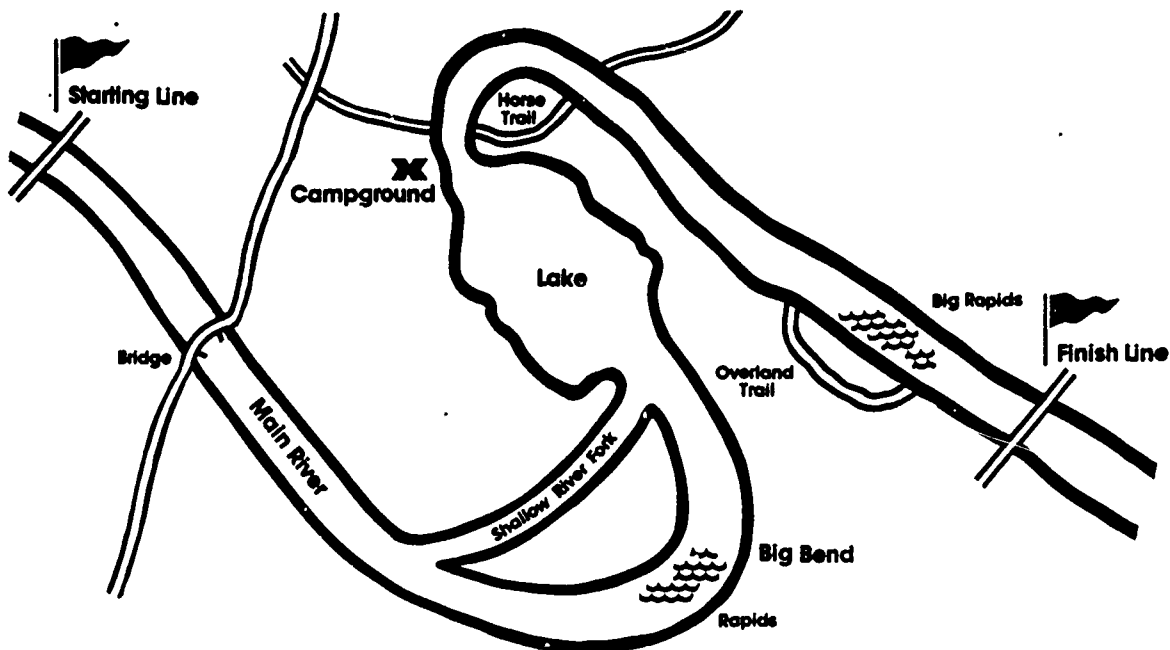
3. Discuss the importance of being flexible, of reevaluating, and of occasionally changing your mind and choosing another alternative.

Additional Activities

1. Using the Student Handout (map and rules), discuss as a class how the alternatives would be affected if the race were a one-day race with no overnight stop.
2. Have students form teams of three. Each team should imagine that they are going to provide their own food for the two-day canoe race, and that they are going to carry the food with them in the canoe. Each team should research the alternatives—perhaps visiting a grocery or camping supply store to check prices—and write a menu for the trip. They should consider:
 - cost
 - nutritional value
 - energy requirements
 - number of meals
 - weight of food
 - time of preparation
3. Students should consider the alternatives and solve a problem from real life. Using the *Hey Wait! Think, See, So?* problem-solving guide, students might:
 - plan a vegetable garden,
 - redecorate a room,
 - plan an energy conservation program for school or home,
 - organize a neighborhood garage sale, or
 - develop a plan to correct a neighborhood health or safety hazard.
4. To help students understand that solving problems by considering alternatives is a common practice in game-playing, have students write an analysis of a game of checkers, chess, or a card game that requires decision making. Students should play the game slowly, recording possible alternatives and noting which alternatives are selected.
5. Invite the coach of an athletic team to speak to the class about alternatives that he or she must consider during a game.
6. Show and discuss one or more of the following *ThinkAbout* video programs: "Brainstorming," "Blockbusting," or "Why Bother?"

The Whitewater Canoe Race: Information and Rules for Contestants

1. Defending champions of the Whitewater Canoe Race are the Pirates. The total racing time of the challenging team will be compared to the racing time of the Pirates.
2. This is a two-day race. Each team will spend one night at a designated campground along the river. The Race Committee will provide food for the racers at the campground, but each team is responsible for all necessary equipment and cannot leave any trash behind.
3. Each team should have three members and one canoe.
4. Each team is required to finish the race with all the equipment with which it started.
5. Weather conditions on the river may vary at this time of year (summer). Teams should be prepared in case of a rapid change in weather conditions.
6. The Race Committee advises that each team study the river map carefully. Teams will need to be prepared for a variety of river conditions and hazards. In addition to the conditions that are marked on the map, canoeists may encounter: changes in speed of the river's current, shallow water or sandbars, wind or waves, and unexpected obstacles along the shoreline.
7. Each team may use whatever route seems best to get to the finish line.
8. Carrying the canoe overland (portaging) is permitted at the Horse Trail and at the Big Rapids. However, the Race Committee is not responsible for conditions along any trails.



Solutions Unlimited was programmed by Decision Development Corporation under the supervision of the Agency for Instructional Technology in cooperation with a consortium of education agencies throughout the United States and Canada.

Solutions Unlimited participating agencies: Alaska State Department of Education; Alberta Education; Arizona Department of Education; Arkansas Department of Education/Arkansas ETV Commission; British Columbia Department of Education; California Department of Education; Colorado Department of Education, participating BOCES, and television stations KRMA and KTSC; Connecticut State Department of Education; Florida State Department of Education; Hawaii Department of Education; Illinois State Board of Education; Indiana Department of Public Instruction; Iowa Public Broadcasting Network; Kentucky Department of Education/Kentucky Authority for Educational Television and participating school systems; Maine Department of Educational & Cultural Services; Manitoba Department of Education, Instructional Media Services Branch; Maryland State Department of Education, Division of Instructional Television; Massachusetts Department of Education; Michigan—Wayne County Intermediate School District and Kent Intermediate School District; Minnesota State Department of Education; Missouri Department of Elementary and Secondary Education; Nebraska Department of Education; Nevada Department of Education; New Jersey Department of Education/New Jersey Network; New Mexico Media Network; Center for Learning Technology, New York State Education Department; North Central Council for School Television, Inc. (North Dakota); Ohio Department of Education; Oklahoma Department of Education; TVOntario; Oregon Department of Education; Pennsylvania—A Coalition of Thirteen Intermediate Units; Quebec Ministry of Education; Rhode Island Department of Education; Saskatchewan Department of Education; Tennessee Department of Education, including television stations WSJK, WTCI, WCTE, WLJT; Texas—Ector County Independent School District, Midland/Education Service Center #18, and Richardson Independent School District; Utah State Office of Education; Vermont Department of Education/Vermont Educational Television Network; Virginia Department of Education; Washington State Video Consortium; of Educational Service Districts; Wisconsin Educational Communications Board.

Additional funding for *Solutions Unlimited* was provided by the Exxon Education Foundation.

If you have questions or comments on *Solutions Unlimited* you may call AIT, 800/457-4509 or 812/339-2203.

The problem-solving strategies and many of the television segments in *Solutions Unlimited* are from the instructional television series *ThinkAbout*. A consortium of state and provincial education agencies under the direction of AIT developed *ThinkAbout* as part of the Skills Essential to Learning Project.



Together...serving education.

The Agency for Instructional Technology is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television and related printed materials for use as major learning resources. It makes many of these materials available in audiovisual formats. From April 1973 to July 1984, AIT was known as the Agency for Instructional Television. Its predecessor organization, National Instructional Television, was founded in 1962. AIT's main offices are in Bloomington, Indiana.

UNIT FIVE

Winter 1985

TEACHER'S GUIDE

This is one of eight instructional units that integrate computer software, videocassettes, and print to improve the problem-solving abilities of students in grades six, seven, and eight and to make them familiar with the problem-solving applications of computers. (TRS-80 version running in MMSFORTH, under Bulk License Serial Number 2245 to Decision Development Corp. from Miller Microcomputer Services, Natick, MA 01760, USA.)

Saving Energy

Using Graphics When Problem Solving

About the Lesson

Doodles, illustrations, diagrams, charts, graphs, and maps can help both young people and adults solve problems. Studies of expert problem solvers, for example, show they are more likely than non-experts to start their problem-solving activities by trying to visualize the problem in some way. This can mean simply thinking with a pencil—creating simple sketches, pictures, diagrams, charts, and graphs—or it can mean using the various graphic capabilities of the computer.

In this lesson, students will use one such capability—the ability of the computer to display data visually—to explore various alternatives.

Introducing the Video

Ask members of the class if they believe the saying "A picture is worth a thousand words." In what sense is the saying true? Are there times when having an illustration or diagram has helped them? Tell them to notice in the video program how being able to visualize something was useful.

The Video (8 minutes)

Everyone is chilly, but the thermostat must not be changed. Dad's bad leg prevents him from working and the family must make do with its limited income. David and Vickie suggest that Dad insulate the house, but he rejects this as too expensive, at least for now. Grandma, however, has some savings and, with the advice of David and Vickie, decides to use it to buy insulation and to surprise Dad.

Discussing the Video

1. How did having a diagram help the family buy the right amount of insulation?
2. How can making a drawing or picture of something help solve a problem?
3. Graphs and maps are "tools" that allow information to be presented visually. What advantages do they have over other ways of presenting information?

Preparing for the Computer

1. You will need one program disk per computer. To make extra copies, insert the disk into the disk drive and turn on the computer. When the program asks you if you have used the program before, type the word COPY and then press RETURN. The computer will direct you from there.
2. Schedule when students will use the computer. (A maximum of three students should be assigned to a group.)
3. Introduce the computer activity, emphasizing that students will be using graphs to help the Smith family solve an important problem.
4. If *Solutions Unlimited* is to be run on an Apple IIe, direct students to keep the CAP LOCK on.

The Computer Activity

In this activity, students assume roles as members of the Smith family. They live with Dad, Grandmother, and their brother and sister in an old farm house. Dad's been injured and can't work for at least a year. The family must live off the \$7,200 a year Dad gets as a result of his disability. There is \$450 in a savings account.

Projected increases in the price of heating fuel have thrown Dad's budget out of balance. What should the family do? Using graphs, students can analyze the problem and consider various alternatives. Students who make wise choices will, with a little luck, have sufficient money to pay the heating bills and even increase the family's savings. Poor decisions and some bad luck could lead to their losing the farm.

After the Computer

1. Review with students what happened. What decisions did they make? What were the consequences? Why did they make the decisions they did? How did having data presented to them graphically assist their decision making?
2. Discuss how having a computer simplifies the process of using graphs to help answer "what if" questions.

Additional Activities

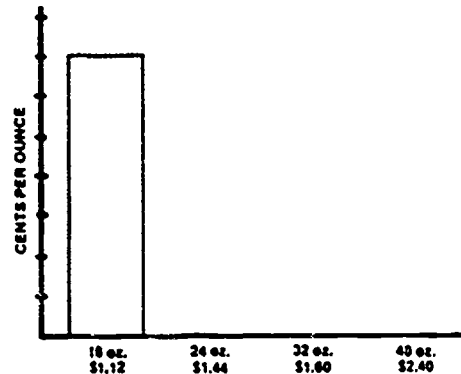
1. Distribute and discuss the student handout "Some Ways to Picture a Problem." Encourage students to "think with a pencil" when problem solving. Remind them that this skill, like any other, takes time and effort to perfect; they should not expect amazing overnight improvement in their problem-solving skills. They can retain the handout as a reminder to keep trying and as a way to review skills.
2. Have students examine popular publications to see how they use graphics to communicate complicated information. Students can then present their findings graphically, by making a poster, for example.
3. Have students research computer-aided design systems and business graphics software. What can these do? How have they changed the way people work?

Some Ways to Picture a Problem

Here are a few kinds of "pictures" that people have found useful for solving problems. Could any of these methods be useful to you?

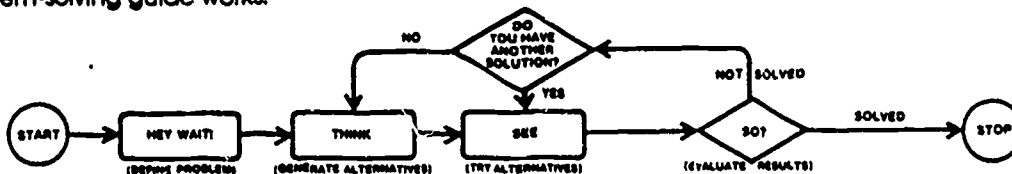
Graphs

Graphs are particularly useful when comparing numbers might help solve a problem. Suppose you want to find which size box of breakfast cereal is the best buy—16 ounces for \$1.12; 24 ounces for \$1.44; 32 ounces for \$1.60; or 40 ounces for \$2.40. You can do this on a bar graph like the one to the right. The cost of the 16 ounce box is already shown as 7 cents per ounce ($\$1.12/16 = 7$ cents). Compute the cost per ounce of each of the other boxes and show those costs as bars on the graph. Which size costs the least per ounce? Does the bar graph make that easier to see? Could a computer make a problem like this easier?



Flow Charts

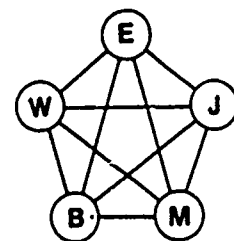
Flow charts are a good way to break a complicated process into smaller steps and to think about the order in which the steps could be done. Computer programmers often use flow charts to help them understand and plan the steps of a process. The flow chart here shows how the *Hey Wait! Think, See, So?* problem-solving guide works.



Follow the arrows through the chart until you understand the guide. You will notice that the flow chart keeps sending a problem-solver back to earlier steps until a satisfactory solution has been found. *Plan some simple process by using a flow chart.* You can use circles to show the beginning and end, rectangles to show individual steps, and diamonds to show decision points. Use arrows to show the order in which the steps should be done. How can drawing such a chart help you solve a problem?

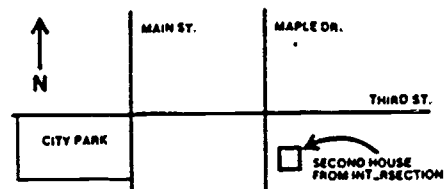
Sketches and Doodles

Often when you are trying to solve a problem, making a sketch or doodle will help you better understand what is happening. Suppose you had to solve the following problem: Eleanor, James, Bob, Marsha, and Wilma each shook hands with the other. What was the total number of handshakes among them? One way to solve this problem is to draw a picture. Represent each person by a circle and then connect all the circles. The number of lines between circles (10) is the number of handshakes. *Try using a sketch to help solve this problem:* Southport, Alpine, Clayton, and Greenview all lie on the same straight highway. Clayton is halfway between Southport and Greenview. Southport is halfway between Alpine and Clayton. Greenview is 50 miles from Southport. How far is Alpine from Clayton?



Maps

When a problem involves helping someone find a place, you might tell that person how to get there, you might take the person there yourself, or you might draw a simple map. The map here was drawn by Consuela Alvarez to help some of her friends find her house. It does not include every street in town nor all the landmarks. It has just enough information to show where Consuela's house is. *Draw a simple map that could help someone find your home or that could help solve some other problem.* Be sure to include at least one landmark or intersection that would be known to most people.



Solutions Unlimited was programmed by Decision Development Corporation under the supervision of the Agency for Instructional Technology in cooperation with a consortium of education agencies throughout the United States and Canada.

Solutions Unlimited participating agencies: Alaska State Department of Education; Alberta Education; Arizona Department of Education; Arkansas Department of Education/Arkansas ETV Commission; British Columbia Department of Education; California Department of Education; Colorado Department of Education, participating BOCES, and television stations KRMA and KTSC; Connecticut State Department of Education; Florida State Department of Education; Hawaii Department of Education; Illinois State Board of Education; Indiana Department of Public Instruction; Iowa Public Broadcasting Network; Kentucky Department of Education/Kentucky Authority for Educational Television and participating school systems; Maine Department of Educational & Cultural Services; Manitoba Department of Education, Instructional Media Services Branch; Maryland State Department of Education, Division of Instructional Television; Massachusetts Department of Education; Michigan—Wayne County Intermediate School District and Kent Intermediate School District; Minnesota State Department of Education; Missouri Department of Elementary and Secondary Education; Nebraska Department of Education; Nevada Department of Education; New Jersey Department of Education/New Jersey Network; New Mexico Media Network; Center for Learning Technology, New York State Education Department; North Central Council for School Television, Inc. (North Dakota); Ohio Department of Education; Oklahoma Department of Education; TVOntario; Oregon Department of Education; Pennsylvania—A Coalition of Thirteen Intermediate Units; Quebec Ministry of Education; Rhode Island Department of Education; Saskatchewan Department of Education; Tennessee Department of Education, including television stations WSJK, WTCI, WCTE, WJLT; Texas—Ector County Independent School District, Midland/Education Service Center #18, and Richardson Independent School District; Utah State Office of Education; Vermont Department of Education/Vermont Educational Television Network; Virginia Department of Education; Washington State Video Consortium of Educational Service Districts; Wisconsin Educational Communications Board.

Additional funding for *Solutions Unlimited* was provided by the Exxon Education Foundation.

If you have questions or comments on *Solutions Unlimited* you may call AIT, 800/457-4509 or 812/339-2203.

The problem-solving strategies and many of the television segments in *Solutions Unlimited* are from the instructional television series *ThinkAbout*. A consortium of state and provincial education agencies under the direction of AIT developed *ThinkAbout* as part of the Skills Essential to Learning Project.



Together... serving education.

The Agency for Instructional Technology is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television and related printed materials for use as major learning resources. It makes many of these materials available in audiovisual formats. From April 1973 to July 1984, AIT was known as the Agency for Instructional Television. Its predecessor organization, National Instructional Television, was founded in 1962. AIT's main offices are in Bloomington, Indiana.

Printed in U.S.A.

APPENDIX C:
Designer Instrument

Interview Questionnaire for Designers

Interviewer _____ Date _____

Name _____

Involved with _____ Solutions Unlimited _____ Voyage of the Mimi

Role in project _____

Length of time worked in the project _____

1.1 Background Information about the Project

This section gathers information about:

- o conception of package
funding
original idea for content and integration
- o goals for the project
- o organization of team

1. How did the idea for the package originate? (subject matter? integration of the three components?)
2. Were specific goals set for this project? If so, what were they?
3. What did you expect to accomplish by this package?
4. What was the funding source for this project?
5. Did that funding source place any stipulations on the project design? If so, what?
6. How long did each phase of production take? (the conceptualization, funding, design, distribution)
7. What kind of team did you create for this package? What were the roles of the players? How did the team work together?
8. How do you think that this type of teamwork affected the design of the package?
9. What role on the team do you think had the most impact on the thinking behind the package?
10. At what points did you farm things out?
11. What were the roles of the consultants and at what points in your design were they the most influential?

12. Did you test your package components during design and production?
13. If so, what did you learn? Were there any surprises from the field test?
14. Did you make any changes after that field test?
15. Did you test your materials after the package was completed?
16. If so, what did you learn? Were there any surprises from the field test?
17. Did you make any changes after that field test?
18. Did you find that working with one media was any more or less difficult/easy than working with any other?
19. Did you find that working with the people involved with one media any more or less difficult/easy than working with any other?
20. What kind of special training, if any, do you think that teachers will need in order to use your package?
21. How have you arranged for the distribution and outreach of this package? Was it part of the original design or added on?

1.2 Component Integration:

This section gathers information about the integration of the package.

22. Why did you choose the combination of computers, television, and print materials?
23. What do you feel are the strengths of:
television
computers
print materials - teacher's guides
student worksheets
24. How did you connect the information presented in the three components?
25. In what ways are you satisfied with the integration of your package?
26. In what ways are you dissatisfied?

1.3 Utilization Considerations:

This section gathers information about:

- o classroom environment
 - o teacher role with package
 - o student peer and teacher interaction
 - o opportunities and difficulties for students and teachers
 - o learning potential for students
27. Under ideal circumstances what kind of classroom environment do you think that your materials might create?
 28. In reality is this similar to most of the classrooms in the country?
 29. What role do you envision for the teacher who uses your package?
 30. Do you think that the package will have any effect on the way that the students interact with one another? With the teacher?
 31. Is your package designed for work with one child individually or in groups? Was this emphasis intentional?
 32. Do you think that your package should be taught in a certain manner or have a specific order of presentation? If so, why?
 33. What do you feel are the greatest strengths that this package has to offer teachers?
 34. What major problems do you envision that teachers might have in teaching this package?
 35. What do you feel are the greatest strengths that this package has to offer students?
 36. What major problems do you envision that students might have with this package?
 37. Overall, what do you think that students will learn from your package?
-

1.4 Designers' Reflections About Multimedia Packages

38. What would you change if you were to undertake this project again?
39. What would you keep the same or similar?

40. Overall, did you meet your goals?
41. Do you think that you will continue to create multimedia packages?
42. Would you encourage others to create this type of package?
43. Any other comments that you would like to add?

APPENDIX D:
Teacher Instrument

COVER SHEET FOR PRELIMINARY INFORMATION

Interviewer's Name _____

Date of this contact _____

Name of School District _____

Name of School _____

Address _____

Telephone _____

TALLIED RESPONSES (BY PERCENT)

* percentages totaling more than 100% are a result of multiple responses

	MIMI	SOLUTIONS
Name of Teacher : Female Teachers:	52%	64%
Male Teachers:	48%	36%
Overall N =	21	11

Classroom Information

Category of school:

Rural:	5%	27%
Suburban:	71%	9%
Urban:	24%	64%

Grade:

Fifth grade:	57%	18%
Sixth grade:	19%	55%
Seventh grade:	29%	9%
Eighth grade:	14%	18%
Ninth grade:	5%	0
Special Ed.:	0	9%

Subject(s):

Homeroom:	57%	55%
Science:	43%	0
Math:	5%	18%
Other:	0	36%

of classes teaching with package:

1 Class:	62%	54%
2 Classes:	24%	0
3 Classes:	5%	0
4 Classes:	5%	18%
5 Classes:	5%	9%
6 Classes:	0	0
7 Classes:	0	18%

Amount of time spent on package:

	Mimi	Solutions
Less than 1 month:	5%	0
Up to 2 months:	14%	27%
Up to 3 months:	48%	18%
Up to 4 months:	19%	18%
Up to 5 months:	14%	18%
As long as it takes:	0	18%

How many sessions per week:

1 x per week:	0	27%
2 x per week:	19%	18%
3 x per week:	43%	0
4 x per week:	5%	9%
5 x per week:	29%	9%
Varied:	5%	36%

Which components the teacher plans to use:

Television:	10%	100%
Computer:	95%	100%
Student Materials:	100%	100%
Teacher's Guide:	95%	100%

How many computers will the teacher use:

One:	43%	27%
Two:	19%	27%
Three to four:	10%	9%
Six to nine:	19%	9%
More than ten:	5%	27%

Other general comments on utilization plans:

Time/date set up for next interview _____

phone number for that interview _____

PRE-UTILIZATION QUESTIONNAIRE FOR TEACHERS

Teacher's name _____
 Today's date _____
 Interviewer's name _____

1.1 Background Information

- This section gathers general classroom/teacher info.
- o background of teacher
 - teacher's experience
 - classroom style
 - o background on the students

We would first like to ask you some questions about yourself and your teaching career to help us explore if and how the package use varies with a teacher's background.

1. How long have you been in the teaching field?

	Mimi	Solutions
1-5 years:	0	18%
6-10 years:	19%	27%
11-15 years:	38%	18%
16-20 years:	19%	27%
21-25 years:	9%	9%
26-30 years:	14%	0

2. What subject/grade are you teaching now?

Fifth grade:	57%	18%
Sixth grade:	19%	55%
Seventh grade:	29%	9%
Eighth grade:	14%	18%
Ninth grade:	5%	0
Special Ed.:	0	9%

3. How long have you been teaching that subject?

1-4 years:	38%	27%
5-8 years:	0	18%
9-12 years:	24%	27%
13-16 years:	19%	9%
17-20 years:	0	18%
21-24 years:	10%	0
Over 25 years:	10%	0

4. Have you ever used television programs in your teaching?

Yes:	76%	100%
No:	24%	0

If yes, which programs? (N=16/11)

	Mimi	Solutions
FTV:	50%	9%
ITV:	25%	73%
Unclear:	25%	18%
5. How would you rate your experience with television in the classroom?		
experienced:	19%	64%
moderate:	48%	27%
inexperienced:	33%	9%
6. How accessible is a television for your classroom use?		
very:	71%	91%
a little:	29%	9%
not at all:	0	0
7. How accessible is a video recorder for your classroom use?		
very:	76%	73%
a little:	24%	27%
not at all:	0	0
8. How accessible is a computer for your classroom use?		
very:	76%	82%
a little:	24%	18%
not at all:	0	0
9. Have you ever used a computer for any reason?		
Yes:	100%	100%
No:	0	0
10. If yes, when did you begin to use one?		
1-3 years ago:	71%	64%
4-6 years ago:	24%	36%
6-10 years ago:	5%	0
11. What types of programs have you used?		
word processing:	71%	64%
spread sheets:	29%	9%
games:	43%	45%
other:	10%	27%
classroom management:	0	36%
programming:	67%	36%
simulations:	10%	27%

12. Do you have a computer at home?

	Mimi	Solutions
Yes:	38%	46%
No:	52%	27%
Can bring school's home:	10%	27%

13. Have you ever used computers in your classroom?

Yes:	76%	82%
No:	24%	18%

if yes, for what subject? (N=16/9)

Math:	63%	44%
Science:	19%	11%
English:	6%	22%
Enrichment:	6%	11%
Social Studies:	13%	11%
Other:	19%	33%

How often?

1-2 x per week:	50%	44%
3 x per week:	6%	11%
more than 3 x per week:	13%	11%
infrequently:	6%	33%
regularly:	6%	0

What programs?

LOGO:	81%	11%
Bankstreet Writer:	38%	33%
Other:	69%	144%

14. Do you consider yourself an _____ computer user?

experienced:	43%	55%
moderate:	43%	36%
inexperienced:	14%	9%

15. Have you ever taught a unit which required the combination of two or more forms of technology (such as television, computer, tape recorder, film,)?

Yes:	48%	27%
No:	52%	73%

16. Was it an existing package or did you develop your own?

17. If we group teaching activities into 4 categories, such as lectures, group work, individual work, or open work stations, which of these these occurs most often in your classroom?

(Keep prompting for next most often, etc., until you have a number by each category. Be sure to read the reply back to the teacher to allow for any corrections!)

UNCODABLE

For all of the rest of the questions both today and for our next phone call, we would like you to choose just one classroom to focus on for all of our questions. It should be an average class. If there is anything which happens in one of your other classes that you think might be useful for our study, please feel free to mention it as an aside, not as the main response to these questions.

18. We would like to be able to visualize your classroom. Could you describe the arrangement of the desks and if you have a computer or tv in the room where they are located.

UNCODABLE

19. For the class that you have chosen, could you tell us: How many students in the class _____

	Mimi	Solutions
Less than 20	19%	30%
Between 21-25	52%	30%
Between 26-30	29%	40%

Number of boys and girls:

Equal # boys and girls:	52%	28%
More girls than boys:	19%	36%
More boys than girls:	29%	36%

If you are willing, we are also interested in the racial mix and socio-economic level of this class. Would you be willing to answer that type of question? Yes No

20. If yes, could you tell us the racial mix of your class?

All White:	50%	45%
Predominantly White:	50%	55%

21. What is the socio-economic mix of your class?

High-middle:	29%	10%
Middle:	19%	20%
High/middle/low:	24%	40%
Mid-low:	29%	39%

22. How many times per week are you planning to use this package?

	Mimi	Solutions
less than 1 x per week:	0	36%
1 x per week:	5%	0
2 x per week:	30%	27%
3 x per week:	30%	18%
4 x per week:	0	9%
5 x per week:	35%	9%

23. How would you characterize your students. Do they prefer:

to work independently:	19%	36%
to work in groups:	71%	45%
50:50:	10%	18%

1.2 Teacher's Knowledge about the Package

This section gathers information about:

- o initial thoughts about the package
- o package accessibility
- o teacher's plans for class organization

24. How did you learn about this package?

from another teacher:	5%	9%
from media/computer specialist:	29%	18%
from a principal:	14%	0
from a promo lit./ presentation:	19%	45%
from combination of promo/admin:	24%	9%
from conference	10%	9%
from other:	5%	9%

25. Did you get all of the information that you needed to decide on the package from the above source?

Yes:	75%	73%
No:	25%	27%

26. Who made the decision to purchase it?

Administration:	43%	9%
Media Specialist:	5%	27%
Science Specialist:	5%	0
Group Decision:	14%	0
Self:	0	55%
Other Teachers:	24%	0
Unsure:	14%	9%

27. Where did you find the funds for this purchase?

	Mimi	Solutions
Unknown:	40%	30%
School Budget:	30%	10%
Dept Budget:	15%	40%
School Grant:	10%	10%
Other:	5%	10%

28. What are the reasons for your decision to use it?

Content:	29%	9%
Technology:	14%	0
Combination:	38%	73%
Appeal:	38%	9%
Unclear:	5%	9%

29. How do you plan to use it:

as a supplement to regular material:	19%	55%
as an integrated part of curriculum:	5%	18%
as a new curriculum unit:	71%	27%
unclear:	5%	0

30. Are you getting any support from anyone else in your use of this package?

Yes:	71%	55%
No:	29%	45%
Who? (N=16/6)		
media/computer specialist:	40%	33%
principal:	33%	33%
student teacher/teacher aide:	7%	50%
other, please specify:	33%	17%

31. Did you have difficulty getting any of the material for this package?

Yes:	29%	28%
No:	19%	36%
No, but...:	52%	36%

If yes, which materials and what was the problem: (N=17/7)
* N includes "No, but..." responses

Software:	29%	29%
Workbooks:	12%	0
Individual Units:	6%	14%
Teacher's Guide:	6%	0
Problem not mentioned:	47%	57%

Problem: (N=7/3)

Late Arrival:	100%	100%
---------------	------	------

32. Did you attend any type of workshop or inservice about using this package in your classroom?

Yes:	48%	73%
No:	52%	27%

If yes, where? run by whom? (N=10/8)

Promotion:	50%	13%
Course:	20%	0
In-service:	30%	63%
Conferance:	20%	25%

33. Will your students view the video...

at home:	0	0
in class:	100%	100%

if in class, was the video...

rented:	0	0
purchased:	70%	9%
taped off air:	32%	73%
unsure:	0	18%

34. At this stage, does the teacher's guide provide assistance in your lesson planning? (N=12/2)

Yes:	92%	100%
No:	0	0
Unsure:	8%	0

35. How do you plan to use the teacher's guide? (N=12/2)

step by step:	58%	50%
random:	33%	50%
not at all:	0	0
do not know yet:	9%	0

1.3 Teacher's Thoughts about the DESIGN of the package

This section will gather information about:
 o appeal of package to teacher and learner
 o integration of computer, tv, and print

36. Do you envision anything about the package materials that might be difficult for your students? (N=12/2)

Yes:		Mimi	Solutions
No:	123	58%	50%
		42%	50%

Of those who said "Yes", the reasons were: (N=9/2)

	Mimi	Solutions
Inexperience with computers:	71%	0
Language:	14%	0
Concepts:	43%	50%
Working as a group:	0	50%

37. Do you envision anything about the materials that will make teaching this package particularly difficult? (N=12/2)

Yes:	66%	50%
No:	25%	50%
Unsure:	9%	0

Particularly enjoyable? (N=12/2)

Yes:	100%	100%
No:	0	0

38. Do you think that the combination of television, computers, and print materials will provide an important aid in your teaching about this subject matter? (N=12/2)

Yes:	92%	100%
No:	8%	0

39. Do you think that the combination of television, computers, and print materials will have any impact on how your students understand this subject matter? (N=12/2)

Yes:	100%	100%
No:	0	0

40. Do you think that this package requires any change in the way that you would regularly teach your class? (N=12/2)

Yes:	42%	100%
No:	58%	0

41. Is there anything about this group of students which will have an effect on the way that you teach this package? (N=12/2)

Yes:	34%	100%
No:	66%	0

42. (Ask this only if teacher didn't mention equipment in #39!)
Is there anything about equipment arrangements in your school which will have an effect on the way that you are able to teach this package? (N = 12/2)

	Mimi	Solutions
Yes:	45%	100%
No:	55%	0

43. Are there any other comments that you would like to make at this time?

UNCODABLE

If possible, I thought we might set up a date and time for our next interview now. Are you still planning to use these materials until _____.

Next Interview date/time _____

Phone number for next interview _____

POST UTILIZATION QUESTIONNAIRE FOR TEACHERS

N=20/11 for the entire post utilization questionnaire

2.1 Classroom Analysis

This section gathers information about

- o actual experience of package:
- student/student interaction
- student/teacher interaction
- student reactions
- effect on teaching
- effect on learning

44. Overall, how would you rate the package now that you have used it?

Excellent:	70%	64%
Very Good:	25%	36%
O.K.:	0	0
Poor:	0	0
Varying:	5%	0

45. Did you have any difficulty obtaining the equipment necessary for this package?

Yes:	25%	0
No:	75%	100%

Of those who said "Yes" was it:

Television:	50%	0
Computer:	25%	0
Both:	25%	0

46. Was the time that you chose to allot for the material adequate?

Yes:	Mimi 70%	Solutions 82%
No:	30%	18%

125

47. Overall, what percentage of time do you estimate that you devoted to each of these components?

Most Print:	10%	0
Most TV:	24%	0
Most Computer:	0	91%
Equal TV/C/P:	19%	0
Equal TV/C:	10%	9%
Equal TV/P:	24%	0
Least TV:	10%	36%
Least Computer:	48%	0
Least Print:	5%	55%

48. Did you find that your role in teaching this package required you to be:

Very involved:	80%	45%
A little involved:	20%	45%
Not very involved:	0	10%
Not at all involved:	0	0

49. Did this package cause any changes in the way that you regularly organize your classroom?

Yes:	30%	64%
No:	70%	36%

50. Did you notice any change in the way that students worked with one another while using the materials for this package?

Yes:	35%	55%
No:	60%	45%
Unclear:	5%	9%

Of those who said "Yes", in what way?: (N=8/8)

More cooperative:	63%	63%
More enthusiastic:	25%	25%
More participation:	12%	12%

51. Did you notice any change in the way that students related to you while using the materials?

Yes:	30%	27%
No:	60%	64%
Unclear:	10%	9%

Of those who said "Yes", in what way: (N=3/2)

	Mimi	Solutions
More rapport:	33%	0
More cooperative:	33%	0
Resource:	33%	50%
Team:	0	50%

52. Did you experience any problems in getting full participation from your students?

Yes:	5%	27%
No:	95%	73%

53. What did you learn about the educational possibilities of combining television, computers and print materials from using this package?

UNCODABLE

54. What were your students reactions to the combination of television, computers, and print materials. They liked it:

Very much:	100%	90%
A little:	0	10%
Not very much:	0	0
Not at all:	0	0

55. Did the use of these technologies make your teaching:

Easier:	38%	18%
More fun:	67%	73%
More efficient:	33%	27%
More complicated:	24%	18%
Other:	10%	18%
All:	10%	0

2.2 Materials Analysis

This section gathers information about:
 materials used
 teacher's guide
 student reactions
 teacher reactions

56. Were all of the materials appropriate to your grade level of students?

Very appropriate:	40%	64%
Somewhat appropriate:	55%	18%
Not very appropriate:	0	0
Inappropriate:	0	0
Uneven:	5%	18%

What was not appropriate:

	Mimi	Solutions
Software:	15%	18%
Print:	40%	18%
Video:	0	9%
Varied:	20%	9%
No problems:	30%	45%

57. Was the subject matter appropriate for the course that you were teaching?
- | | | |
|------|-----|-----|
| Yes: | 90% | 91% |
| No: | 10% | 9% |
58. Is this area of learning usually covered in your curriculum?
- | | | |
|------|-----|-----|
| Yes: | 70% | 64% |
| No: | 30% | 36% |
59. Did you use the teacher's guide?
- | | | |
|------|------|-----|
| Yes: | 100% | 91% |
| No: | 0 | 9% |
60. Was the teacher's guide:
- | | | |
|-------------------|-----|-----|
| Very helpful: | 75% | 80% |
| Somewhat helpful: | 25% | 20% |
| Not helpful: | 0 | 0 |
61. What were the most useful parts of the guide?
- | | | |
|------------------------|-----|-----|
| Additional activities: | 43% | 27% |
| Discussion questions: | 48% | 36% |
| Background info: | 52% | 0 |
| Drawings/charts: | 10% | 0 |
| Overview: | 14% | 55% |
| Info on computer etc: | 0 | 64% |
| Other: | 10% | 0 |
62. How closely did you follow the guidelines and activities outlined in the teacher's guide?
- | | | |
|-------------------|-----|-----|
| Very closely: | 40% | 30% |
| Somewhat closely: | 60% | 70% |
| Not at all: | 0 | 0 |
63. How would you characterize your students reactions to the materials? They liked them:
- | | | |
|----------------|------|-----------|
| | Mimi | Solutions |
| Very much: | 80% | 73% |
| A little: | 5% | 9% |
| Not very much: | 0 | 9% |
| Not at all: | 0 | 0 |
| Uneven: | 15% | 9% |
64. Do you think that the students understood the subject matter?
- | | | |
|------|------|------|
| Yes: | 100% | 100% |
| No: | 0 | 0 |

65. What do you think that your students learned from using this package?

Content:	81%	100%
Technology:	5%	36%
New view of science:	29%	0
Human behavior:	24%	9%
Collaborative behavior:	14%	9%

66. How have you determined this?

Observation:	24%	45%
Test:	48%	9%
Written activity:	29%	18%
Class discussion:	62%	55%
Projects:	5%	0
Carry over to other subjects:	0	18%
Unclear:	10%	0

67. Were you satisfied with what your students learned?

Yes:	95%	100%
No:	5%	0

We are interested in your opinion about the way that the same subject matter is presented through computers, television, and print for teaching and learning.

68. Did you see any connections among the ideas/information which were presented through these three?

Yes:	100%	100%
No:	0	0

69. Do you think that your students understood the connections among the computer, television, and print materials?

Yes:	84%	73%
No:	5%	18%
Unclear:	11%	9%

70. What makes you think so/ think not.

71. Could you finish the following sentence?

The one event that I remember which happened when I used this package was

UNCGDABLE

72. Was there anything that in the design of the materials for this package that you felt assisted in your students' learning?

	Mimi	Solutions
Yes:	95%	82%
No:	0	9%
Unsure:	5%	9%

129

73. Was there anything in the design of the materials which you thought inhibited students' learning?

Yes:	20%	55%
No:	75%	45%
Unsure:	5%	0

74. Will you use this package again?

Yes:	95%	100%
No:	0	0
Unsure:	5%	0

75. If yes, will you use it in the same way?

Yes:	19%	36%
Yes, minor changes:	0	27%
No, change time:	43%	27%
No, change activities:	38%	27%
No, change order:	14%	9%
No, change unsure:	10%	0

76. What do you think would be useful/helpful information to be covered in a workshop on this package.

Evaluation format:	5%	0
Work with computers:	38%	56%
Enrichment activities:	38%	11%
Content:	19%	0
Logistics:	14%	11%
Unsure:	10%	22%
Other:	14%	0

77. Do you think that the greatest strength of the package is its subject matter focus or the use of technology?

Subject matter:	5%	27%
Technology:	35%	27%
Both:	60%	45%

78. How would you suggest that these materials be improved?

	Mimi	Solutions
Rethink computer software:	38%	18%
More display materials:	14%	0
Rethink print materials:	24%	27%
Widen range of difficulty:	10%	0
Other:	24%	18%
No comment:	14%	45%

79. Would you recommend this package to other teachers?

Yes:	100%	91%
No:	0	0
Maybe:	0	0
Unsure:	0	9%

80. What suggestions would you give other teachers who are planning to use this package for the first time?

Review all material first:	48%	55%
Read teacher's guide:	29%	0
Keep open mind:	10%	0
Other:	3%	45%
Unsure:	5%	18%

81. Do you have any other comments?
UNCODABLE

APPENDIX E:
Package Acquisition

PACKAGE ACQUISITION

We were interested in finding out background information which led to the eventual use of the package in the classroom. The information we collected included: how the teacher was first exposed to the package, the adequacy of the information from that first exposure, the decision makers in the purchase of the package, and where the funds for the purchase came from. Lastly, we were interested in the appropriateness of the subject matter of the packages for the course being taught and whether the learning addressed in the package is normally covered in the curriculum.

As reported in Table 1, there was no single way in which the package was presented to teachers, although almost half of the SOLUTIONS teachers received promotional information or a presentation, whereas slightly more than half the MIMI teachers learned about the package either from media/computer specialists or from a combination of a promotional presentation and a school administrator.

TABLE 1

FIRST EXPOSURE TO PACKAGE	MIMI	SOLUTIONS
from promotional info. or presentation	19%	45%
from media/computer specialists	29%	18%
from a combination promo/admin.	24%	9%
from a conference	10%	9%
from another teacher	5%	9%
from a principal	14%	0
other	5%	9%

In spite of this diversity of initial contact, the majority of teachers (75% MIMI, 73% SOLUTIONS) indicated that they obtained enough information in their initial contact to make the decision to use the materials.

As Table 2 indicates, whereas more than half the teachers who used SOLUTIONS made the decision to purchase it themselves or worked through a media specialist, none of the teachers who used MIMI made the decision to purchase it themselves. Instead, the decision was made either by administrative personnel or other teachers. Table 3 indicates where the funding for the purchases came from.

TABLE 2

DECISION MAKERS FOR PURCHASE OF PACKAGE	MIMI	SOLUTIONS
Administrative personnel	43%	9%
Self	0	55%
Other teachers	24%	0
Group decision	14%	0
Media specialist	5%	27%
Science specialist	5%	0
Unsure	14%	9%

TABLE 3

FUNDS FOR PACKAGE	MIMI	SOLUTIONS
School budget	30%	10%
Department budget	15%	40%
Special grant	10%	10%
Unknown	40%	30%

The differences in the responses may be related to both the different costs involved (approximately \$1,000 for MIMI versus approximately \$95 for SOLUTIONS) and the differences between the ways that supplies are ordered in different states and schools.

Appropriateness of subject matter

An overwhelming majority of teachers (90% MIMI, 91% SOLUTIONS) stated that the subject matter covered in the package was appropriate for their courses. A slightly smaller number (70% MIMI, 64% SOLUTIONS) reported that the area of learning addressed in the package was usually covered in their curriculum.