

**EFFECTS OF A HYPERTEXT-BASED SIMULATION  
IN HIGH SCHOOL SCUBA INSTRUCTION**

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B.Sc., University of Alberta, 1983  
B.Ed., University of Lethbridge, 1986

A Thesis  
Submitted to the Faculty of Education  
of The University of Lethbridge  
in Partial Fulfillment of the  
Requirements for the Degree

**MASTER OF EDUCATION**

**LETHBRIDGE, ALBERTA**

April, 1994

## ABSTRACT

A study was conducted to investigate the effects of a hypertext - based computer simulation on the knowledge, skills and attitudes of students participating in a high school scuba program in Edmonton, Alberta.

The study compared two groups of students: one which used the simulation as a supplementary (laboratory-type) activity, and another which was taught using traditional methods. The two groups received an equal amount of instructional time. The simulation and non-simulation groups were found to be equivalent at the beginning of the study with respect to age, gender, previous diving experience, previous computer experience, attitude toward computers and attitude toward diving.

After instruction, the simulation and non-simulation groups were examined for differences with respect to knowledge, attitudes and behavior, using the following measurement instruments:

- Knowledge:** Marks from students' certification examinations were used as a measure of general diving knowledge.
- Attitudes:** Students were post-surveyed for attitudes toward diving using a locally developed attitude scale.
- Behavior:** Students were evaluated using a locally developed skills assessment to determine their degree of proficiency at out-of-air emergency skills.

Reliability estimates for the locally developed instruments were .86, .88 and .93 for the diving attitude, computer attitude and out-of-air skills instruments, respectively.

A series of t-test comparisons revealed no significant differences ( $p < .05$ ) between simulation and non-simulation groups with respect to knowledge, skills and attitudes.

The relationships between knowledge, skills and attitudes were examined using Pearson's correlation coefficient, and a significant ( $p < .01$ ) positive correlation was found between the knowledge and skill measures, with  $r = 0.69$ .

A "diversion index" ( $DI = \# \text{ of non-ideal cards in attempt} / \text{total} \# \text{ of cards in attempt}$ ) was calculated for each attempt made by each student on each of the scenarios. A pattern in diversion indices was revealed, and generalized into a model consisting of four stages: discovery, refinement, solution and exploration. This model is suggested as one way students may approach simulation learning.

Six volunteers were interviewed to determine students' opinions regarding the effects of the simulation. Students stated that the simulation helped with the development of in-depth knowledge about out-of-air emergencies, but not with the development of out-of-air emergency skills. Students said that they liked the simulation and enjoyed using it.

Implications of the study are discussed with emphasis on research methodology, diver education, and environmental education, and a number of suggestions for future research are offered.

**'Give a small boy a hammer, and he will find that  
everything he encounters needs pounding.'**

(Kaplan, 1964, p.28)

## ACKNOWLEDGEMENTS

First and foremost, I owe thanks to my wife Susan, who has been supportive throughout my graduate program. My greatest debt is to her. Second only to my wife are my children Zac, Amy, Jessica and Max. Playing with them and watching them, I have learned more about education than one can possibly imagine. I also owe a tremendous debt to my Father and Mother, who raised and taught me to have confidence in myself, and to find joy in learning.

Several people in the academic arena have helped with this research considerably. Dr. Rick Mrazek has been a guiding influence throughout the past few years, and his experience in the field of environmental education has opened my mind to countless insights and opportunities. Dr. Dale Burnett was responsible for getting me interested in *HyperCard* to begin with, and his comments and suggestions have acted as a catalyst when I needed one. Dr. Peter Chow, Dr. Richard Butt, and Dr. Larry Katz were all very open and approachable, and I appreciate the input I received from each of them at various stages of this research.

Jack and Liz Madro of Subsea Experience/DiveRescue Canada were open enough to listen to what ideas I had, and graciously provided an arena where this project could be carried out. I thank them and their students, without whom this study would never have been possible.

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## CHAPTER I

### INTRODUCTION

This chapter is a description of the study, and introduces the background relevant to the study. Chapter II reviews the literature with respect to environmental education, scuba diving instruction and computer simulations, as well as literature relating to the theoretical framework within which the study was carried out. Chapter III describes how the study was conducted, including the development and implementation of the simulation, collection of data, and analyses performed. Chapter IV is a summary of the data collected, and tests performed on the data. Chapter V describes the effects the computer simulation had on students, summarizes the findings of the study and suggests directions for further research.

#### **Background**

There is a program offered in Edmonton where high school students become certified divers as part of a course designed under Alberta Education's Special Projects guidelines (Alberta Education, 1990). Students attend classroom, pool and openwater activities, and are awarded credit toward their high school diploma requirements upon successful completion of the course. The program is implemented by a local dive operator, meets the standards of several diver certifying agencies, and was originally intended to "teach inexperienced people how to dive so that they could explore the fresh water ecology of an alpine lake" (Madro, 1982, p.5). Recent modifications to the program have expanded its scope to allow students to experience a wider range of underwater environments, including those found in the ocean.

#### **The Problem**

A problem which exists in the above program is that students sometimes learn to perform skills very well in a pool situation, but fail to perform those skills to the same level when

exposed to the variable environments typical of openwater diving. Some students lack affective traits such as maturity and self-confidence, and when they are confronted with cold water, currents, waves, rocks, weeds, and the possibility of encountering hazardous sea life, these students experience a degree of fear, which can escalate to panic (Mrazek, 1989). The outcome is that students sometimes abandon what they have learned, resulting in a breakdown in diving skills. This is particularly true in the case of out-of-air emergency skills (Madro, 1989).

The purpose of this study was to determine if a computer simulation can help students overcome the obstacles of transferring out-of-air emergency skills learned in the course to openwater situations.

#### **Importance of the Study**

The National Association of Underwater Instructors (NAUI) states in its *Instructor Guide* that a "basic value of NAUI is that of constantly striving to find better ways for learning to occur" (1987, p. 1.1). Other certifying agencies have similar values. In addition to the moral obligation to improve diving instruction, a legal obligation also exists for the sport diving industry. In Eisenstat (1976), it is reported that

**A scuba instructor may be held liable for negligence in failing to exercise the ordinary skill of his profession which results in the instruction and supervision of students in learning scuba diving and for any injuries incident to that instruction.**

and that

**The liability of a scuba instructor may not necessarily be limited to the specific student. An instructor may be liable to third persons to whom injury may occur as a result of inadequately or improperly instructing the student in question if it can be established that the instructor's negligence was the cause or a substantial contributing cause to the third person's injury or wrongful death.**

With both a moral and a legal responsibility to teach as effectively as possible, diver certifying agencies and the sport diving industry as a whole have an interest in improving their instruction.

This study should be of interest to environmental educators. Increased interest in environmental education in general, and in the specific subset of environmental education called marine education, makes diver education important. The Edmonton program uses scuba diving as a vehicle to teach about the underwater environment, and if the obstacles to diving instruction can be overcome, scuba diving can be a more useful and effective tool in accomplishing the larger goal of marine education.

The community of education professionals are dedicated to understanding how people learn, and should also be interested in the outcome of this study. The primary function of the study is to describe the effects of a particular teaching strategy in a specific setting. While the phenomena described may not be common to other fields of education, they may be of interest to educators in general.

### **Design of the Study**

The experimental design chosen for this study was the non-equivalent control group design. It was necessary to utilize this design, since the mechanics of the Edmonton program made it impossible to arrange experimental groups. Two groups were examined in the study: one group received instruction according to traditional methods; the other had their instruction enhanced by incorporating the use of a computer simulation. The two groups were examined with respect to several demographic factors to establish their comparability, and were then compared with respect to knowledge, attitudes and behavior. The simulation group were examined in more detail concerning their behavior and attitudes toward the simulation by means of direct observation and interviews.

## **Definitions**

Several terms will be used repeatedly in the following text, and those terms are defined below for the convenience of the reader:

Environmental education, broadly defined, is teaching and learning about the world we live in.

Outdoor education is teaching and learning which takes place in a natural setting. Since the natural world exists primarily out-of-doors, much environmental education takes place in that arena. Outdoor education, thus, becomes a vehicle for accomplishing environmental education.

Marine education is the subset of environmental education which addresses ocean environments and related concepts and concerns.

Out-of-air emergency skills are those techniques used to remedy the situation where a diver experiences a loss of air supply. For the purposes of this study, the individual skills examined are:

1. Controlled Emergency Swimming Ascent.
2. Buoyant Emergency Ascent.
3. Alternate Air Source Ascent.
4. Buddy Breathing Ascent.

These skills are described in detail in Pierce (1985a), as well as in most scuba instructor manuals.

Knowledge is the result of achieving an objective which "emphasize[s] remembering or reproducing something which has presumably been learned, [or] which involve[s] the

solving of some intellectual task for which the individual has to determine the essential problem and then reorder given material or combine it with ideas, methods, or procedures previously learned" (Krathwohl, Bloom and Masia, 1964, p. 6).

Attitude is the result of achieving an objective which "emphasize[s] a feeling tone, an emotion, or a degree of acceptance or rejection" (Ibid. p. 7).

Behavior is the result of achieving an objective which "emphasize[s] some muscular or motor skill, some manipulation of material and objects, or some act which requires a neuromuscular co-ordination" (Ibid.).

Simulation refers to an "operating model [which] demonstrates not simply the state of the system at some given time, but also the way the system changes" (Greenblat and Duke, 1981, pp. 21-22).

Hypertext is defined by Nelson (1967) as "a combination of [nonlinear] natural language text with the computer's capacity for interactive branching, or dynamic display".

Hypermedia is "the extension of hypertext ... in which the elements which are networked together can be text, graphics, digitized speech, audio recordings, pictures, animation, film clips, and presumably tastes, odors, and tactile sensations" (Conklin, 1987, p.18).

### **Delimitation**

The following items describe what the study intends to do:

1. This study will examine the products and process of learning using a hypertext-based simulation in high school scuba education.

2. This study aims to examine relationships between knowledge, attitude and behavior in high school scuba education.

### **Limitation**

The following items describe what the study does not intend to do:

1. Since the scuba program setting made long-term follow up of subjects impractical, the study was unable to examine long-term effects of simulation use.
2. The population of all high school scuba students is not defined. Therefore, extrapolation to other scuba programs must be done only if the target population is similar to the population used in this study.
3. The exact timing of simulation use was not addressed as an issue in this study, because the logistics of the scuba program did not allow it.
4. The study was unable to collect data for large numbers of students. Statistical analyses must therefore be interpreted in light of the fact that samples were small.
5. Since diver education is not a well defined field, this study should be considered solely as exploratory, and cannot make statements about diver education in general.



## CHAPTER II

### LITERATURE REVIEW

#### **Marine Education**

Marine education as a field of environmental education is a relatively recent phenomenon. Fortner and Mayer (1989) trace the origin of marine education in the United States to the mid-seventies. Ortiz, Ortiz and Jiménez (1990) date efforts in Puerto Rico to the mid-eighties, and point out that educators in many areas, including Europe, have yet to discover marine education.

A number of North American organizations are currently involved in delivering and supporting marine education programs. These include the American Cetacean Society, the Center For Environmental Education, the Marine Science Institute, the National Marine Education Association, Ocean Alliance, Project WILD / Project Aquatics, the Sea Grant Program, Sea World, the National Marine Fisheries Service, and the National Oceanic and Atmospheric Administration (Andrews, 1990a). Programs vary in content and depth, dependent upon the particular aims of each organization.

#### **The Sea World Program**

Since 1988, Sea World of Texas has offered a number of marine education programs for students and teachers. Student programs range in age from pre-kindergarten to post-secondary, and offer a variety of topics centered around the park's facilities (Sea World, 1990a). Outreach programs are available to areas which are too distant to take full advantage of the park (Sea World, 1990b), and a full complement of curriculum resources have been developed for both in-park and outreach programs (Sea World, 1990c). Included in the teacher's manual are goals and objectives of the program, as well as a listing of the Texas State Board of Education "Essential Elements" which are covered by

the program. This provides a direct link to the State's "Rules of Curriculum" for teachers.

The Sea World program also provides opportunities for teachers to participate in professional development activities, which are co-sponsored by the regional Education Service Center (Sea World, 1990d). Teachers receive advanced training credit for participation in workshops, and take part in activities such as research vessel excursions, beach cleanup operations, simulated oil spills, shark and squid dissections, aquarium building, and many others.

Summer programs are available through Sea World for students and teachers (Sea World, 1990e), and are similar to the regular programs except for scheduling.

#### Project OCEAN

Ocean Alliance, formerly known as the San Francisco Bay Chapter of the Oceanic Society, has developed a marine education curriculum known as Project OCEAN. The curriculum is intended for kindergarten to eighth grade students, and has been successfully implemented in California, Nevada, and Texas (Cook, 1990). In the program, students study physical, biological and human aspects of the ocean in several marine habitats: rocky seashore; sandy beach; marshes and mudflats; bay and estuary; kelp forest; and open ocean. The program is supported by a full range of teacher resources (San Francisco Bay Chapter of the Oceanic Society, 1988).

Project OCEAN is composed of a series of integrative multisensory activities, implemented in a cooperative learning environment. The activities are normally conducted over a period of several weeks, and culminate in a school-wide "Ocean Week", during which marine topics become the focus of the entire school's activities. The ocean theme permeates every subject area at every grade level, as well as extracurricular activities and assemblies.

Additionally, community resources are drawn upon, and were considered an important contribution toward the success of the program in Texas (Cook, 1990).

#### University of Puerto Rico Marine Education Center

The origin of the Marine Education Center's curriculum has been described by Ortiz, Ortiz and Jiménez (1990). The program began as a series of workshops to provide teachers with first-hand experience in the marine environment. In attempting to understand biological principles such as the origin and nature of beaches, it was found that certain physical and geological principles were also important to know. In addition, issues of beach use arose, requiring a knowledge of social, economic, and policy factors. Teachers were confronted with moral and ethical decisions on environmental issues, and the need to reevaluate educational practice was also seen as an issue.

After a number of workshops, a syllabus was prepared to address the content and mode of delivery of a marine education curriculum. The syllabus, *Introduction to the Marine Environment*, presents the marine environment from biological, physical and human perspectives, and stresses the interdisciplinary and holistic nature of marine education. The program has subsequently been offered to students, and Ortiz, Ortiz and Jiménez estimate that nearly one thousand students had participated by 1990. The teacher enhancement potential of the program is also notable: four of the five teachers who implement the program have been selected as Distinguished Science Teachers and Presidential Awardees; two have won the Christian MacAuliffe Award for research.

#### **Scuba Programs**

Experiential approaches have been widely accepted in the field of environmental education, and marine education is no exception. Andrews (1990b) states that within marine education, "hands-on techniques utilizing all senses must be implemented to maintain high

levels of interest among students". In light of this, it makes sense that scuba diving might be used as a means to teach students about the marine environment.

Diving programs at various post - secondary institutions have been described. A partial list includes Florida State University (Orr, 1989), the University of California, Santa Cruz (Widmann, 1989), Temple University (Leahy, 1989) and the University of Toronto (Belcher, 1989). Each of the above are typical examples of an institutional program: the entire curriculum is defined by a certifying agency, and that curriculum is implemented "as is" by the institution. The particulars of such curricula are much too extensive to relate, but a typical example can be found in National Association of Underwater Instructors (1987). Other certifying agencies have similar publications, and the curricula are nearly identical in most respects.

The contributions of post - secondary institutions to the sport diving industry have been summarized by Graver (1989). Primarily acting in a support role, these institutions have provided an arena where research, continuing education, and curriculum development and support can take place. The result of these efforts, once implemented by certifying agencies, has been to define diver education and refine its standards.

There is little literature to describe high school scuba programs. Madro (1982) describes a program which was extended to secondary school students with some degree of success. Students were introduced to the underwater environment within the framework of a normal scuba course, in order to study the fresh water ecology of an alpine lake. Madro emphasizes the quality of the learning outcomes, which he attributes to the experiential nature of the course:

The observations made by the participants was (sic) indeed incredible.  
Plant life, invertibrate (sic) life and the various fish life came together to

present a total picture of the magnitude of interactions that actually take place in a fresh water environment. Studies and observations were made without the primitive use of dragging, dredging or netting techniques. Students gained a new respect for the underwater environment and will hopefully discourage the industrial and public misuse of our fresh water resources. The most important part of the program is that people enjoyed what they were doing.

Although no formal recommendations were made in the report, Madro emphasizes the advantages of having students experience the underwater environment by means of scuba diving.

### **Stress and Performance**

Toft (1985) defines outdoor pursuits as "those activities that are either self or naturally-propelled in (often) wilderness settings where there is potential for personal harm in absence of immediate life support systems". Scuba diving can be considered an outdoor pursuit in light of this definition. Toft also notes that "through outdoor pursuits we can interact with the outdoor physical environment on an intense personal level". The "potential for personal harm", coupled with the intensity of one's interaction with the environment introduces another concept common to most outdoor pursuits, namely stress.

Anxiety, fear and stress are so closely related that they are difficult to distinguish from each other. Scheepers (1991) defines **anxiety** as "an experience opposite to pleasure [which] consists of apprehension, expecting some internal or external power to overcome the concern at any moment". **Fear** is defined by Scheepers as "a condition similar to anxiety, specifically regarding the emotional experience and physiological symptoms involved, to the extent that it is very difficult to differentiate between the two phenomena". **Stress** has been defined by Selye (1976) as "the non-specific response of the body and mind to any demand". Selye's (1974) work further denotes two types of stress: eustress, which has positive effects on one's well-being; and distress, which has negative effects.

Scheepers (1991) defines how stress affects performance in diving. Some stimulus, called a stressor, places a demand on an individual. The stressor may be in the form of an event, a circumstance, or a demand. The individual has a belief system, composed of thoughts, attitudes, values and philosophies, through which the stressor is interpreted. The consequences are feelings and behavior which are referred to as the stress response.

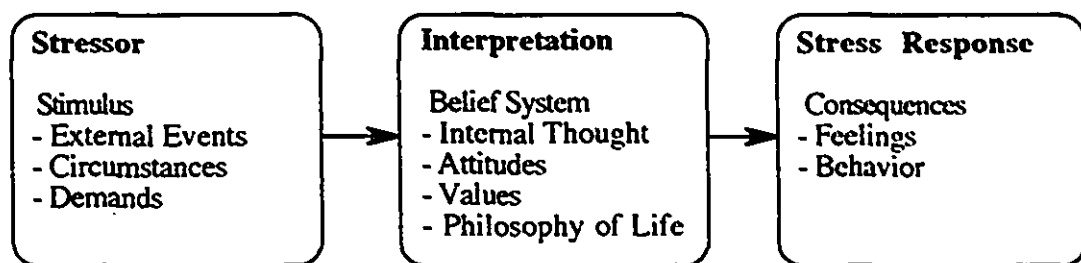


Figure 1. A theoretical model of stress (from Scheepers, 1991).

The signs and symptoms of negative stress in diving have been described by Pierce (1985b) and include fixation, abnormal breathing, wide eyes, erratic movement, or any combination of these. Pierce also notes that the outcome of unchecked negative stress is panic. Griffiths (1989) states, "Typically, after divers become overly stressed they make mistakes which ultimately lead to a total loss of control", and the result can be as serious as death. With this in mind, it is obviously in the diver's best interests to control negative stress.

Several methods have been suggested for coping with stress in scuba diving. Scheepers (1991) points out that since stress is self-initiated and self-propagated, the solution to the problem of negative stress must also originate with the self. He continues by stating that "the education of the diver should, therefore, be emphasized and involves giving the

person an understanding of the nature of the problem, the numerous potential remedies available, etc.”.

The development of problem-solving skills has also been proposed as a solution. Scheepers states, "stress is often the result of ineffective decisions or the inability to solve daily problems", and "due to the high-risk nature of the sport, it is, therefore, of great importance for the diver to master a simple but effective problem-solving strategy". The strategy which is subsequently described consists of four steps: stop; get control; think; and act. This model is commonly taught in most scuba diving courses.

Social support has been recognized as a factor in overcoming negative stress. Scheepers points out that "people with healthy and well-developed social support systems (family, friends, organizations) are better at coping with stress than people without such support".

The value of enjoyment in diving instruction as a means of controlling stress has been acknowledged. Wienke (1992) states that "substituting fun games for rote practice is not only relaxing, but off-loads undue stress".

Mental rehearsal has been described by Griffiths (1989) in the following text:

**Mental practice is just as important as physical practice and ... basic diving skills and emergency techniques should be mentally practiced on a regular basis. The mental scenes created by the diver should be as vivid as possible, and the diver should perform the skill perfectly in his/her mind. In this way the physical skills become ingrained in the mind and stress is reduced because the diver has mentally rehearsed the proper procedure to follow in a given situation.**

Griffiths stresses the importance of positive self-concept, mental practice through imagery and relaxation to success in overcoming stress.

Scheepers' model suggests the possibility that stress can be controlled by modifying one's interpretation of stressors. While many stressors in scuba diving are beyond the diver's control, the way those stressors are interpreted is not. Therefore, if one can influence a diver's knowledge and attitudes, one should also be able to influence the accompanying feelings and behaviors.

### **Knowledge, Attitudes and Behavior**

The literature on knowledge-attitude-behavior (K-A-B) relationships in environmental education has been summarized by Hines (1985). In this meta-analysis, it was found that both knowledge and attitudes have relationships to behavior, but that these relationships are dependent upon a number of other factors, which have yet to be clearly delineated. The following factors are suggested as playing a significant role in the strength of K-A-B relationships:

1. Type of knowledge/attitude/behavior examined.
2. Type of instrumentation used.
3. Other intermediary variables:
  - General knowledge of environmental issues
  - Knowledge of specific factors related to an environmental issue
  - Attitudes
  - Efficacy perception
  - Locus of control
  - Personal responsibility
  - Verbal commitment
  - Economic orientation
  - Androgyny
  - Level of moral valuing
  - Political ideology
  - Needs and values
  - Self-esteem
  - Alienation
  - Materialism
  - Personal interest
  - Social pressures
  - Pessimism
  - Tolerance
  - Dominance
  - Health and comfort concerns
  - Science and technology beliefs
  - Income



- Education
- Age
- Gender
- Incentives
- Appeals
- Information
- Feedback
- Issue identification
- Issue investigation skills
- Problem solving skills
- Values identification and clarification
- Knowledge of ecological concepts
- Environmental action skills
- Significant life experiences
- Past experience with the target behavior

To further complicate matters, the study reports higher correlations for verbal commitment, locus of control, and efficacy perception with behavior than for knowledge or attitude. Hines suggests that the nature of the K-A-B relationship is complex and unclear at best, and that previous models have been oversimplified. Her work culminates in a "meta-model" which attempts to accommodate the many factors in the K-A-B relationship.

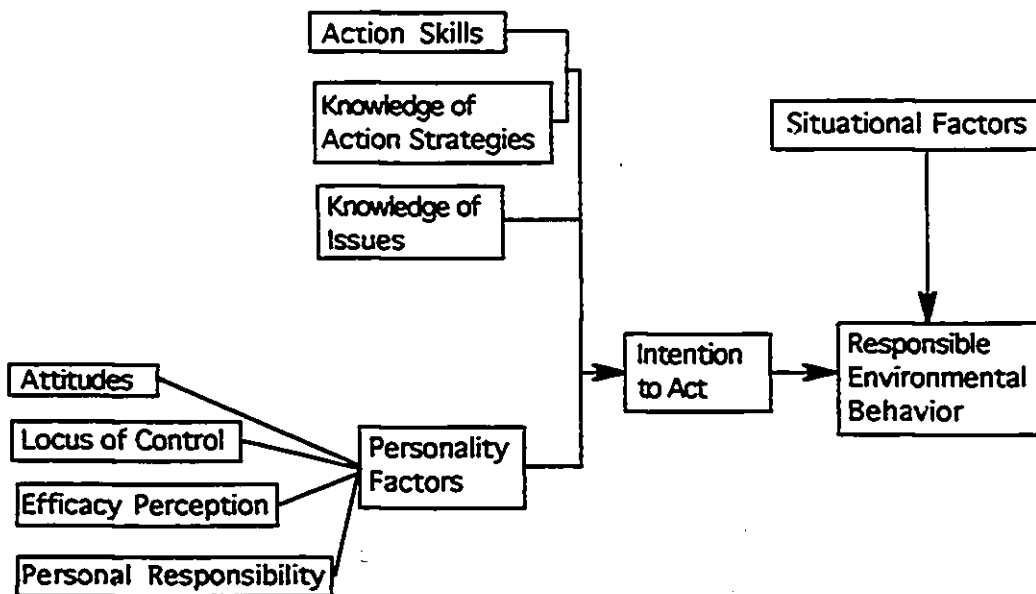


Figure 2. Hines' model of responsible environmental behavior.

While Hines' model is certainly comprehensive, most studies are not able to account for all of the variables proposed.

A study by Shrigley (1990) points out the correlation between attitude and behavior, but qualifies the statement by noting that "attitude and behavior covary to the degree that valid measurements and mediating variables are considered". Five different perspectives on the attitude-behavior relationship are presented, all of which can be viewed as accurate representations under certain circumstances:

1. Attitude precedes behavior
2. Attitude is behavior
3. Attitude is not directly related to behavior
4. Attitude follows behavior
5. Attitude and behavior are reciprocal

Shrigley shows in detail how each of these theories can be defended, and goes to considerable length to specify what circumstances would lead one to conclude that the various theories are correct (Shrigley, 1990). He notes that under certain unspecified conditions, other variables such as intention can be seen as better indicators of behavior, and concludes by identifying qualitative methods as a useful tool in understanding the complexity of attitude-behavior relationships.

The most recent summary of research on the K-A-B relationship was compiled by Marcinkowski (1991). This work updates the research since Hines' (1985) meta-analysis, and serves as a summary of what modifications and alternative models have been proposed. The monograph highlights the situational and contextual nature of the correlations between knowledge, attitude and behavior, and points out the complexities in defining one model for environmental education. Marcinkowski states:

While there are patterns of relationship between knowledge and attitudes,

and between attitudes and behavior, these relationships tend to be conditional. They depend upon the kind(s) of knowledge, attitude and/or behavior being measured, the measurement techniques employed for each, circumstantial moderator variables, and the presence/absence of a series of other variables which are also correlated with REB (responsible environmental behavior).

While Marcinkowski does not specify what the "circumstantial moderator variables" and "other variables" are, one could suppose that he means the same variables which were exhaustively catalogued by Hines.

The only consensus regarding the nature of the K-A-B relationship is that it is complex. While defining a universal K-A-B model for environmental education seems nearly impossible, determining the conditions necessary to strengthen K-A-B relationships should be worthwhile. Qualitative research methods may help in this respect, by defining the circumstances under which individual studies were conducted.

### **Simulations**

A simulation is a representation of something that is real. It is distinguished from a model in that it can show the state of a system, as well as the way it changes over time. In this sense, the description of a simulation as an "operating model" (Greenblat and Duke, p. 21) is accurate.

Simulations have been used for a variety of purposes. One of the earliest devices referred to as a simulation was the "Link trainer", used to train pilots in World War II (Taylor and Walford, 1972, p. 13). It consisted of a cockpit covered with canvas, within which pilots could gain flying experience in a risk-free environment: the pilot could manipulate controls, and learn the effects by observing instruments. If the pilot "crashed" the plane, the simulation could be restarted, and the pilot would have the opportunity to try again.

Simulations have also been used in business management training. Ellington, Addinall and Percival (1981, p. 22) date the beginning of this activity to the mid-fifties, and more recent simulations allow management students and trainees to make business decisions in cooperative or competitive environments, and examine the results without penalty. Financial, marketing and administrative strategies can be tested in a variety of situations, and students can determine the soundness of given practices in a variety of circumstances (Carlson and Misshauk, 1972).

Simulations have application in scientific research as well. Where certain basic principles are understood, simulations can be used to determine how dependent variables change as independent variables are manipulated. This activity can be useful in discovering relationships between variables, which may in turn help in building theories (Cunningham, 1984, p. 219).

Simulations can be classified according to types, although, as Cunningham (1984, p. 214) notes, there is no generally accepted taxonomy of simulations. Cunningham suggests that simulations can be divided into four main groups, based on the purpose of the simulation: experimental, predictive, evaluative and educational. Experimental simulations are those which are meant to test hypotheses or propositions; predictive simulations are used to estimate what the outcome of certain actions or circumstances will be; evaluative simulations are intended to examine the feasibility of an alternative; and educational simulations function primarily in the transfer of knowledge. Cunningham gives examples and references for each of the types described, and goes on to discuss some of the assumptions inherent in each of them.

Another way of classifying simulations is proposed by Dodge (1980), and is based on the activity undertaken in using the simulation: role-playing, problem solving, bargaining, and

process. In role-playing simulations, participants act as if they were the person or group they are simulating; in problem-solving simulations, students are given a problem and are expected to develop a solution to the problem; in bargaining simulations, students receive different levels of power, influence and resources, and develop relationships involving exchanges; and in process simulations, participants model a procedure of some sort.

There are other ways of classifying simulations, but for the purposes of this study, the discussion can be narrowed to those simulations which are primarily educational in nature. The history of educational uses of simulations has been documented by Boocock and Schild (1968), and describes three different stages of development .

Phase One, titled "acceptance on faith" describes the discovery of simulation as a classroom technique, accompanied by "great and diffuse enthusiasm ... without much concern with collecting 'hard' evidence to support the enthusiasm". This stage was characterized by a lack of rigorous research, presumably because most researchers were busy developing simulations rather than evaluating them.

Phase Two, "post-honeymoon", was a period when some controlled experiments were attempted, and some sobering conclusions were reached: simulations could not solve every problem; simulations of the day had some serious flaws; and obtaining a measure of the impact of simulations was difficult or impossible with the available instruments. The lack of conclusive studies was interpreted in two different ways: simulations teach, but we do not understand why or how; or simulations do not teach in the way once believed, but can cause certain effects, particularly with respect to motivation.

Research then proceeded into a third phase, "realistic optimism", characterized by three types of research: testing of simulations in a variety of settings to determine their

appropriateness; accumulation of information regarding the effects of simulations; and reworking of theories in light of acquired experience with simulations in educational settings.

### **Using Computers to Implement Simulations**

In an examination of 24 consecutive issues of *Educational Technology*, Jacobs and Baum (1987, p. 392) noted that every article concerning simulations described computers as the mode of delivery. This is interpreted as an indication of the close association between computers and simulations: computers are being used extensively to implement simulations.

Willis, Hovey, and Hovey (1987, pp. 48-51) have suggested a number of advantages of using computer simulations in education: computer simulations are fun; they may be less expensive than real experiences; they are safe; they can make education more real; they can yield better transfer of learning; they have relatively low development costs; they reduce threat and anxiety; they teach critical thinking as well as content; they encourage socialization and collaboration; and they maximize use of learning time.

While these advantages suggest considerable potential for the use of computer simulations, they do not necessarily apply universally nor exclusively to computer simulations. There are also associated problems: simulations often behave differently than the real world; their use may not be practical in a classroom where time is a limiting factor; and teachers must plan carefully to make use of simulations (Ibid, p. 51). These factors, and presumably others, are all important when considering the use of a computer simulation in a particular setting.

Smith (1987) has suggested that some general conclusions can be drawn from a review of

the literature on educational computer simulations:

1. Computer simulations have potential in teaching specific responses for given situations.
2. Computer simulations can be effective in teaching students to identify and solve problems.
3. Learning derived from computer simulations has the potential of transfer to real situations.
4. The degree to which a simulation is real may not be as important as the degree to which it exercises students in realistic problem solving processes.
5. Computer simulations can be costly to produce, but have potential for efficient, low-cost development.
6. Students enjoy computer simulations.
7. Students report higher levels of self-understanding and greater confidence after receiving simulation training.

Smith's fourth concern above is reiterated and discussed in detail by Cunningham (1984, p. 225). If a simulation is not real enough, "it may be viewed [by the student] as simplistic and unreal. If the simulated elements are too realistic, it may not be possible to understand or focus on the researcher's objectives or issues, simply because they are lost in the complexity of the design." Cunningham notes that "there is no formula for trading off simplicity and realism", and suggests that designers should "consider starting with the simplest model and then adding complexity only as the need arises."

### **Computer Simulations in Environmental Education**

While the use of computer simulations in environmental education has not been widespread, a number of attempts have been made. Some applications include soil erosion (Huber and Falkenmayer, 1987), water resource management (Mills, 1985) and prediction skills in biology (Lavoie and Good, 1988). At least one simulation has had a strong media component (McCormick, 1987).

The effects of computer simulations on student perceptions of environmental relationships have been studied at a post - secondary level. Fortner, Schar and Mayer (1986) found that the use of simulations yields significant gains in factual recall, but not in higher cognitive processes. However, their study examined simulations in a context where students were left "to their own devices for interpreting and applying their simulation results". Fortner, Schar and Mayer mention that "a major value of simulations is derived from the discussion and the applications they generate, but a student working alone with a machine does not benefit from such interactions". Given this, it is possible that the implementation of a simulation could be as important, or perhaps even more important, than the simulation itself.

Most of the studies concerning simulation use in environmental education have not been conclusive, and have not detailed exactly how the simulations were implemented. It should be no surprise that no concensus exists in light of these factors. Methodologies are not well established for this type of research in environmental education, and the methods used for studying simulation use in general have not been tested in environmental education. Until this situation can be resolved, one must approach simulation studies in environmental education with a degree of caution, recognizing that generalization may not be appropriate.

Recent work by Rohwedder (1990) addresses a number of issues with respect to the use of computer simulations in environmental education. Rohwedder's monograph is primarily descriptive in nature, serving to update environmental educators on what types of projects are being undertaken, and takes the form of a "catalog" of case studies in the application of computers to environmental and outdoor education.

Rohwedder attempts to summarize some ideas about computer-aided environmental education which have circulated for some time, and suggests a number of directions which



environmental educators can explore. In the overview of the monograph, Rohwedder acknowledges that the field offers ". . . a vast expanse of uncharted territory filled with both problems and promises."

The problems identified by Rohwedder (p. 2) include:

1. Lack of teacher and district planning and preparation.
2. Limited teacher knowledge of recent developments and applications.
3. Inadequate training which focused on how to use computers as opposed to how to teach with computers.
4. Unfounded euphoria.
5. Equity of access.
6. Environmental substitution.
7. Environmental impact.

Rohwedder elaborates on each of these problems, and suggests how they might be overcome. The following statements illustrate some of his suggestions:

The best computer-aided environmental education is achieved when we do not allow the misapplication or inherent limits of computer technology to compromise what we know about how people think and learn. (p. 3).

In order for computer-aided environmental education to be effective, it must also be affordable and accessible to all. (p. 3).

Computer-aided environmental education has positive potential only when used as a catalyst, and never as a substitute, for field based instruction or exploration. (p. 4).

Computer-aided environmental education must be held to the same environmental impact assessment we would give any technology. Only judicious use can result in a positive net impact on the biophysical environment. (p. 4).

While Rohwedder's suggestions are not wholly substantiated to date, they seem reasonable, and warrant further investigation.

Another section of Rohwedder's work focuses on uses of hypermedia in environmental education. While there is no real research component to this section, it illustrates how hypertext and hypermedia are being used in environmental education.

### **Hypertext and Hypermedia**

At the close of World War II, Vannevar Bush (1945) proposed that scientists turn their attention toward "making more accessible our bewildering store of knowledge". Bush described a problem which existed at that time, where large bodies of knowledge were available, but accessing that knowledge was difficult and only possible through sequential indexing. As a solution, he proposed a device he called a "memex":

A memex is a device in which an individual stores all of his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

Bush also described the principle of association, and saw this as an essential component of the memex:

The human mind ... operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain.

Bush's idea of chunks of text connected by associative links formed the conceptual basis for the memex. This concept was developed over a period of many years using computer technology (Heller, 1990), and by the mid-eighties, a number of systems existed which attempted to realize Bush's ideas in one way or another (Conklin, 1987). This technology

has come to be known as hypertext, a term coined by Nelson (1967).

Hypertext and hypermedia have been used in a wide range of educational applications. Far too numerous to mention, examples of these applications can be found in Ambron and Hooper (1990) and Price (1991, pp. 246-270). While the actual impact of these activities can only be established with time, Ambron and Hooper claim that "learning in schools, businesses, and homes will take on a new dimension" through the use of hypertext.

The advantages of hypertext have been outlined by Conklin (1987) and include ease of creating references, ease of tracing those references, support for organizing information into chunks, and the ability to trace several paths at once. Conklin also defined problems with hypertext, including disorientation and cognitive overload. These problems, common to other discovery learning environments, are discussed in detail in Heller (1990), and solutions for them have been proposed. Oren (1990) suggests reducing cognitive load through information hiding, externalizing information, and appropriate organization of information. Apple Computer's (1989) *HyperCard Stack Design Guidelines* outlines how stacks should be designed in order to avoid user disorientation.

Heller (1990) has called for research in two main areas with respect to hypertext: "... those studies focusing on the techniques of the media such as information presentation and navigational aids that will help to refine the technical presentation of HAI [hypermedia assisted instruction], and those studies that will identify the educational setting, types of students, and the areas of education that will benefit from HAI".

### **Summary**

This study represents the integration of the above fields into a single project, to determine the effects of using a hypertext-based computer simulation in a high school scuba program.

## CHAPTER III

### METHODS

#### **Hypothesis**

The intent of this study was twofold: to determine the effects of a hypertext-based computer simulation in high school scuba education; and to determine whether relationships exist between knowledge, attitudes and behavior in the same setting. Two null hypotheses can be stated on this basis:

1. There will be no difference in the knowledge, attitudes and behavior of students who were taught out-of-air emergency skills using a hypertext-based simulation and those who were taught without it.
2. There will be no correlation between knowledge, attitudes and behavior of students in a high school scuba program.

#### **Design**

The experimental design chosen for this study was the non-equivalent control group design, also known as the quasi-experimental design. It involved the examination of two groups: one which was taught using a computer simulation, and one which was taught without. The overall design of the experiment is shown below:

|                       |         |           |          |
|-----------------------|---------|-----------|----------|
| Simulation Group:     | Pretest | Treatment | Posttest |
| Non-simulation Group: | Pretest |           | Posttest |

#### **Subjects**

The target population for this study was high school scuba students. The sampling population for the study was students involved in the Edmonton scuba program. Neither the target nor the sample populations have been described in previous literature. Whether the Edmonton program is typical of all high school scuba programs is difficult to establish, yet this assumption would be necessary should one wish to draw inferences from the Edmonton population to all high school scuba programs.

The logistics of the Edmonton scuba program made it necessary to rely on convenience sampling for selection of subjects. Two classes were arbitrarily selected, and randomly chosen as either simulation or non-simulation groups. Course instructors were asked to evaluate whether the classes selected for the study were typical of the Edmonton scuba program. In their opinion, this was the case. As an additional precaution, a wide range of both numerical and anecdotal data regarding the sample was collected.

Demographic data is routinely collected as part of the process in applying for scuba diver certification. This is done at the beginning of a course, and access to such records did not present a problem in this study. Information such as age, sex and medical history of the subjects was readily available, and additional information was collected, including previous experience in water sports, and length and depth of computer experience.

#### **Development of the Simulation**

In Apple Computer's (1989) *HyperCard Stack Design Guidelines*, a process for the development of hypertext-based software is outlined. While the guidelines were not available at the time the scuba simulation was developed for this study, the process used was very similar.

An area of subject matter was defined to begin with: scuba emergency management. After considering the full range of emergency skills taught in a typical introductory scuba course, it quickly became apparent that this focus was too broad to concentrate on clearly. An attempt was made to determine which emergency skills are most important for the beginning diver to know, and instructors in the Edmonton program identified four skills:

1. Controlled Emergency Swimming Ascent.
2. Buoyant Emergency Ascent.
3. Alternate Air Source Ascent.
4. Buddy Breathing Ascent.

These skills coincide with the most critical emergency skills defined by almost every scuba curriculum. Each of the skills was validated by at least five instructors, both within and without the Edmonton program.

A decision was reached between Edmonton instructors and the developer of the simulation to create four scenarios within the simulation: one for each of the four skills. The same procedure was followed for the development of each scenario.

The next step was to take each skill, in the first case a Controlled Emergency Swimming Ascent, and to break it down into its component subskills. The question was posed, "How does one correctly perform a Controlled Emergency Swimming Ascent, and under what

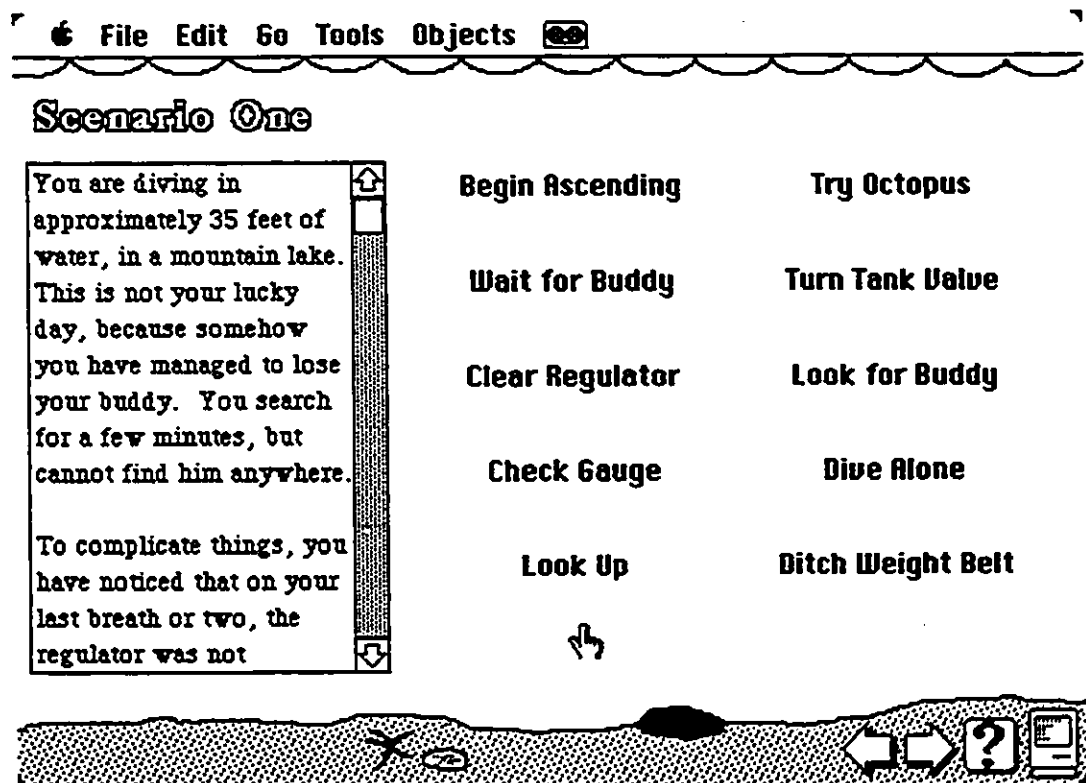


Figure 3. A card from the scuba simulation.

conditions is it the appropriate course of action?" A situation was then invented where a Controlled Emergency Swimming Ascent would be the correct action to be taken, and a set of "hypercards" was developed (see Figure 3), describing the consequences of taking the correct course of action. These cards were then linked together into a chain of subskills. The sequence of the subskills was as follows for the first scenario:

1. Check Gauge.
2. Look Up.
3. Reach Up.
4. Ascend Slowly.
5. Exhale Steadily.

The final card in the sequence congratulated the student for obtaining the correct sequence of actions, and reinforced the learning by restating the important points. Getting to this point did not require a lot of time and effort, but it did require careful definition of the skills to be learned.

Having defined a correct path, attention was turned to developing a number of false paths within the simulation which would be plausible enough to distract students who were unsure of their skills. This involved anticipating the students' thinking, which was harder than one at first might imagine. Multiple ways of looking at each step of the situation had to be considered, possible courses of action had to be postulated, and then the consequences of each of those actions had to be formulated. It quickly became apparent that each step of the situation might be interconnected with many other steps, and that the path chosen by the student might possibly weave a very elaborate network, depending on what decisions the student made. In an environment where the expandibility of the scenario was virtually unlimited, it became a challenge to ensure that every possible path would lead to some logical conclusion. In connecting the false paths, there was significant overlapping, and the possibility of reversing one's actions also had to be considered.

Once all the paths were followed through to a conclusion, the simulation finally became a closed system, within which students would be able to discover the correct method for performing their skills. A map of the simulation structure, as well as a complete description of one of the scenarios, is given in Appendix I.

The simulation was field tested by inviting instructors and students from a number of diving courses to use the simulation. While no major revisions were deemed necessary by those who evaluated the simulation, a number of minor problems with language were corrected.

Those interested in obtaining a copy of the simulation should contact the author personally. It should be noted that the simulation requires *HyperCard* version 1.2.5 or later.

### **Implementing the Simulation**

Deciding how to use the simulation in this study was done in cooperation with the Edmonton program instructors. The course was team taught by a male-female pair of instructors with combined experience in excess of twenty years, and they were assisted by both male and female assistant instructors. The simulation and non-simulation groups were taught similarly, with the exception that one group used the computer simulation.

In discussing possible ways of using the simulation, several alternatives were identified: the simulation could be used to introduce the subject of emergency skills, providing a vehicle for generating interest and initiating discussion on various topics in that field; it could be used as a means for teaching out-of-air emergency skills after learning the accompanying theory elsewhere in the course; or one could use the simulation as a means of reinforcing learning after students had learned the skills in the pool. After considering



how each of these options might be implemented, the instructors elected to use the simulation as a complement to their teaching. The primary role of the simulation was defined to be a "laboratory-type" activity session (or sessions) where students could explore the concepts of out-of-air emergency skills. The timing of the sessions was subject to the scuba course schedule, and in order to avoid disrupting the normal schedule, it was decided that a flexible approach would be taken.

A typical course in the Edmonton scuba program looks something like the schedule shown in Figure 4 below. No time scale is given in the schedule, since the duration of the course can range from three days to six weeks, depending on how it is implemented.

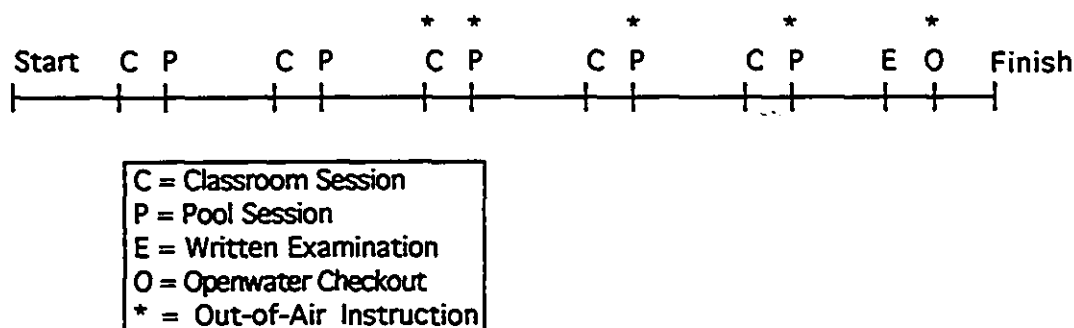


Figure 4. Non-simulation group schedule.

The timing of the pre- and post-assessments, as well as the timing of the simulation activities are shown in Figure 5.

Since only one computer was available to run the simulation, a range of times was made available to allow students greater opportunity to use the simulation. As a result, subjects used the simulation at different times. The common factor among students was that they all used the simulation after initial instruction in out-of-air emergency skills, and before the post-survey, final examination and skills assessment.

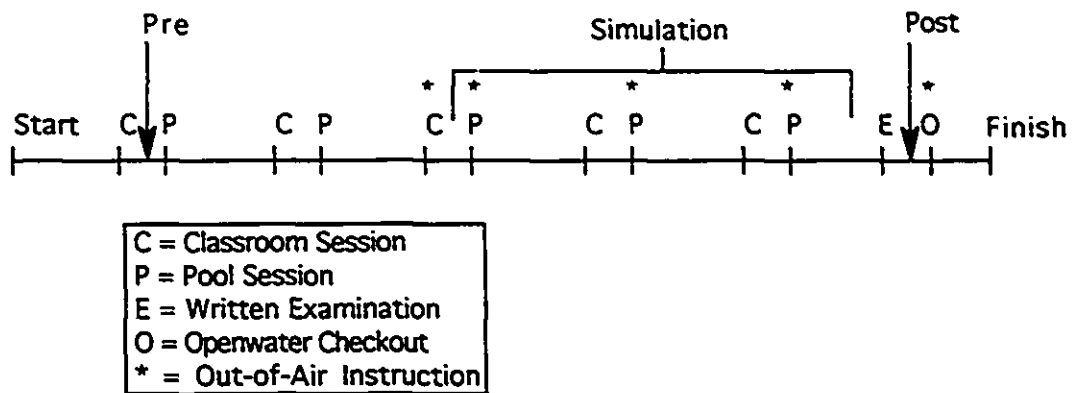


Figure 5. Simulation group schedule.

Students typically used the simulation for approximately one hour per session. All students participated in at least one session, and had the option of using the simulation more often if desired. The maximum number of sessions a student could have participated in was four.

## Measurements

### Experience

Students in a typical scuba course can vary widely with regard to their background and experience, and it was possible that some students may have had previous experience in diving or other related water sports. Varying levels of experience could have yielded a differential effect on students, thereby influencing the results of the study. In order to ensure that this did not happen, students were given a questionnaire to determine the nature of their experience with respect to water sports. It was hoped that simulation and non-simulation groups would be roughly equivalent with respect to this factor, to ensure comparability of the groups.

It was reasonable to expect that the same would apply to students' previous experience with computers. Students were therefore pre-surveyed in this respect as well.

The survey used to measure previous experience with water sports and computers is given in Appendix II.

### Knowledge

Students in the Edmonton program are expected to pass a standard paper-and-pencil test as part of their scuba course. These marks were readily available, and were used as a measure of general diving knowledge. The test was in the form of a 100-item multiple choice examination, and covered all aspects of the scuba course. Diver certifying agencies have determined that these exams are valid with respect to content, and in general, the exams can be relied upon as good indicators of general diving knowledge. Because of liability considerations, certifying agencies also require a high degree of mastery of diving knowledge, somewhere in the range of 80 percent. This standard applied to the classes used in the study.

### Attitudes

Students' attitudes toward diving and computers were measured in the pre- and post-assessments. The attitude survey was divided into two sections corresponding to the above areas, and was administered to students as if it were part of the normal diving course. The computer portion was composed of questions taken verbatim or adapted from a survey developed by Touchings (1989), while the diving portion was locally developed. Both portions of the survey were in the form of a five-point Likert scale, and reliability of both was determined as part of the study.

Field testing of the survey was carried out by having approximately 6 instructors and 40 students from regular scuba classes fill out the survey, and then make suggestions for improvement. No major changes were made as a result of the field testing.

The complete diving/computer attitude survey can be found in Appendix III.

### Behavior

A rating scale for openwater diving skills was constructed, in cooperation with six diving instructors: three from the Edmonton program, and three associated with a different certifying agency. The complete assessment is given in Appendix IV, and is based on performance criteria as specified by the Edmonton scuba course standards. It is specific to out-of-air emergency skills, and incorporates two separate measures: one given by the instructor, and the other given by the student. Each student was rated in a post-water debriefing, with respect to two factors: proficiency in the given skills; and anxiety felt or shown while performing those skills. Instructor ratings for all groups were performed by the most senior instructor of the group. Throughout the study, the same instructor rated all students.

The author served as an independent observer of the course proceedings, but did not participate in the course as an instructor.

### Tracing

While the previously mentioned measures gave a representation of the products of learning, some attention also needed to be paid to the process of learning. It would have been very useful if one could have watched learning in progress, and to a certain degree, one could.

Tracing students' paths through the simulation was seen as a way of providing a tangible record of the decisions made by students while using the simulation. It was hoped that early attempts could be compared with later attempts, in order to show what changes in thinking had occurred in the student. If trends or patterns of response became evident,

some conclusions could possibly be drawn regarding what happened as students gained experience with the simulation.

In addition, tracing students' progress through the simulation provided a basis for interviewing students, to discover what they were thinking at different points in their simulation experience.

With a certain amount of programming, the simulation could feasibly have recorded the students' paths through the simulation, along with some other information. Every time a student went through a scenario, each step the student took within the scenario could have been recorded. Each record would have had a time and date "stamped" onto it, and it would have been recorded onto the computer's hard disk. While this information would have been quite comprehensive, it would have been difficult to analyze because of its sheer mass, and because one would have had to become quite familiar with it in order to draw any significant conclusions. It was felt that this type of analysis, combined with the effort of programming the simulation to record the paths, would have been too burdensome for this study.

An alternative method of tracing student actions was to do so manually as an observer. While this method seemed cumbersome at first, it presented some significant advantages: the observer was instantaneously familiar with the events; certain "golden moments" could be flagged for later discussion; and the observer could be more selective in determining which events would be discussed during interviews later on. Along with these advantages, some disadvantages were also evident: observing students directly may have had an effect on student performance and stress; and using observations as a basis for interviews could have biased interviews. Although every effort was made to prevent problems of these types, there was no way to ensure that they did not arise.

### Interviews

In order to more clearly understand the effects of the simulation, a means for considering situational factors was needed. It was hoped that interviews with a few of the students in the simulation group would help provide some context within which to interpret the results of the study.

Several volunteers participated in informal interviews, at different points during the course, but only after they had used the simulation. During these interviews, students were asked to do the following: identify key factors and pivotal moments or incidents in their learning; provide relevant information regarding what they thought of the simulation; and suggest how they thought the above affected their learning. While the questions were not identical for each interview, they were very similar.

## CHAPTER IV

### RESULTS

#### **Validity and Reliability of the Instruments**

The face validity of all of the scales was established prior to the actual study, in consultation with five different diving instructors and numerous assistant instructors. Instructors examined the instruments, and observed field tests where the instruments were implemented in actual diving courses, in the same way as they would be used in the study. Results of the field tests were compared with the instructors' ratings of students, based on their own observations. In almost all cases, the rating system produced results identical to what instructors had independently produced. Feedback from the instructors was positive, and these experienced specialists were of the opinion that the instruments measured what they purported to measure.

Each of the locally developed instruments was subjected to an item analysis, and a reliability estimate was calculated from the ratings collected during the study. Scores for negatively worded items (see Appendices III and IV) were reversed, and the split-half (odd-even) method was used to arrive at reliability estimates. The results of this analysis are given in Table 1.

| Instrument                   | Reliability | # of Cases |
|------------------------------|-------------|------------|
| Diving Attitude              | .86         | 37         |
| Computer Attitude            | .88         | 15         |
| Out-of-Air Skills Assessment | .93         | 14         |

Table 1. Reliability of locally developed instruments.

No reliability estimate was calculated for the measure of diving knowledge. This was due to two factors. First, item scores were not available for analysis, and second, it was felt that since a standardized certification exam was used, the certification agency must have established content validity and reliability. While no figures were given, a representative of the certifying agency gave assurance that these criteria were met by the instrument.

### Comparability of the Groups on Pre-tests

Factors which were seen as having potential impact on the comparability of the groups were age, previous experience, attitude toward computers, attitude toward diving, and gender. The means and standard deviations of simulation and non-simulation groups with respect to the first four factors are given in Table 2. The statistics reported for the experience and attitude measures are raw scores. Details regarding the measurements are given in the previous chapter.

| Factor              | Simulation Group |                    | Non-simulation Group |                    |
|---------------------|------------------|--------------------|----------------------|--------------------|
|                     | Mean             | Standard Deviation | Mean                 | Standard Deviation |
| Age                 | 17.3             | 1.9                | 16.4                 | 0.9                |
| Previous Experience | 18.8             | 9.1                | 19.4                 | 7.9                |
| Computer Attitude   | 120.7            | 18.7               | 123.8                | 12.1               |
| Diving Attitude     | 122.0            | 16.1               | 122.1                | 11.1               |

Table 2. Comparability of simulation and non-simulation groups.

Box-and-whisker plots follow for each of the experience and attitude variables: Figure 6 shows the comparison of simulation and non-simulation groups with respect to previous experience; Figure 7 shows the same comparison with respect to attitude toward computers; and Figure 8 shows the comparison with respect to attitude toward diving.



The box-and-whisker plots are composed of a box which represents the interval from the 25th to the 75th percentile. Bars, or "whiskers", extend outward from the box to indicate the interval from the 10th to the 90th percentile. The median, or 50th percentile, is also shown, and appears as a horizontal line through the box. Outliers appear as small circles beyond the ends of the whiskers.

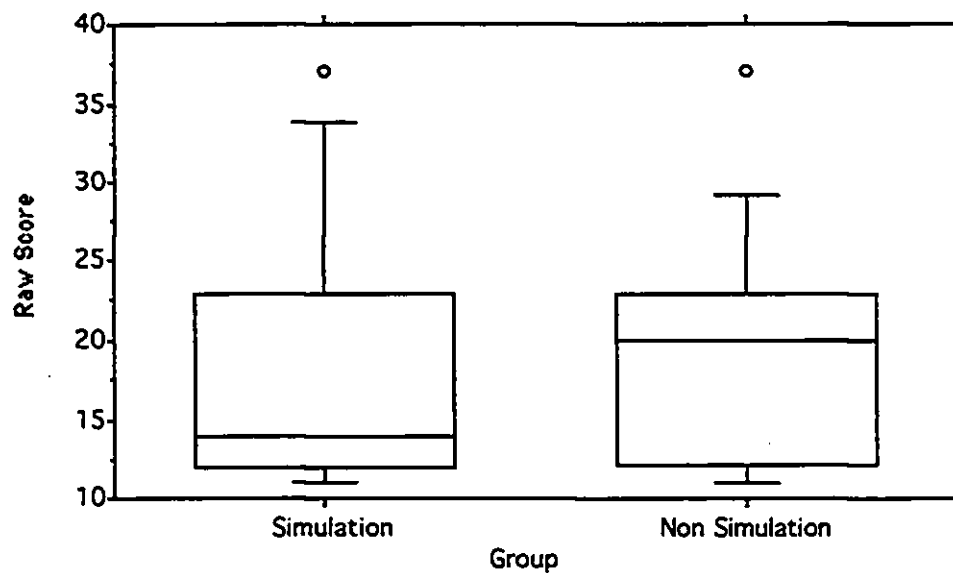


Figure 6. Box-and-whisker comparison with respect to previous experience.

The box-and-whisker plot in Figure 6 shows that the simulation and non-simulation groups were fairly similar with respect to previous experience. The median score for the simulation group was slightly lower, and the simulation group showed more variability in previous experience, but these differences were minor.

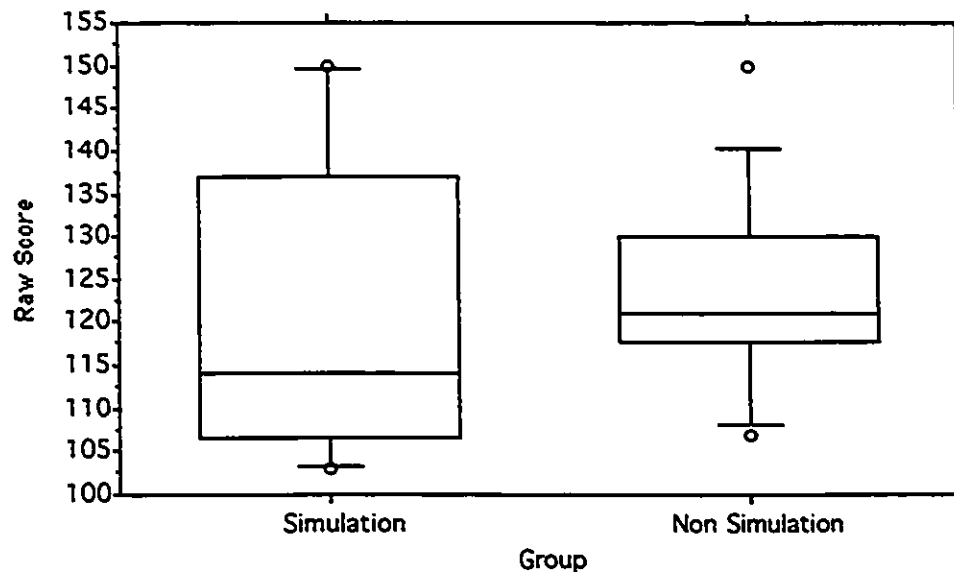


Figure 7. Box-and-whisker comparison with respect to attitude toward computers.

Figure 7 shows how the simulation and non-simulation groups compared with respect to attitude toward computers. The simulation group showed a wider range of scores and greater variability than the non-simulation group. The median for the non-simulation group was higher than for the simulation group, but falls within the range of the box for the simulation group. The overall impression given by the box-and-whisker plot is that the groups were fairly similar with respect to attitude toward computers.

Figure 8 on the following page shows the comparison of simulation and non-simulation groups with respect to attitude toward diving. While the simulation group shows greater variability, the median scores are nearly the same. On the basis of this data, it was concluded that the groups were similar with respect to attitude toward diving.

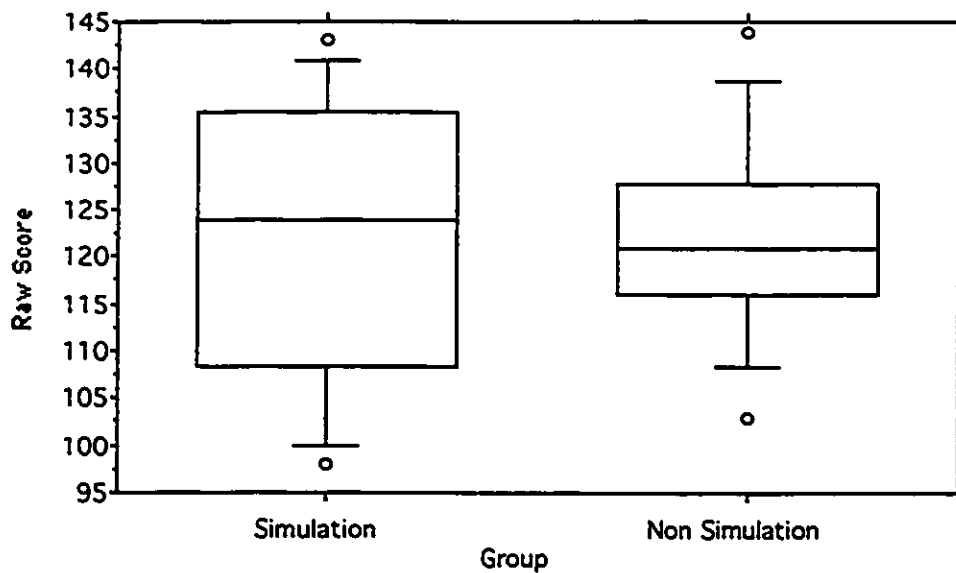


Figure 8. Box-and whisker comparison with respect to attitude toward diving (pretest).

A series of t-tests was performed to provide further support for the statement that the two groups were equivalent at the beginning of the study. Differences between the groups with respect to previous experience, attitude toward computers, and attitude toward diving, were examined for statistical significance. No significant differences could be detected, as shown by the results in Table 3 below.

| Test                | Observed t Value | df | Result * |
|---------------------|------------------|----|----------|
| Previous Experience | -.155            | 18 | ns       |
| Computer Attitude   | -.455            | 18 | ns       |
| Diving Attitude     | -.015            | 17 | ns       |

\*ns = not significant, alpha=0.05

Table 3. t-test comparison of simulation and non-simulation groups on pre-tests.

Composition of the groups with respect to gender was as follows: simulation group, 7 males, 2 females; non-simulation group, 7 males, 4 females. A chi-squared test indicated that the groups were similar in this respect as well. (observed chi-squared=0.04, 1 df, chi-squared<sub>.95</sub>=3.84).

On the basis of the above information, it was concluded that the simulation and non-simulation groups were equivalent at the beginning of the study.

#### **Differences Between the Groups on Post-tests**

The simulation and non-simulation groups were then compared to look for possible differences in learning outcomes. The two groups were compared on post-test scores for: general diving knowledge, attitude toward diving, and out-of-air emergency skill performance. The observed group means and standard deviations for these factors are given in Table 4. All three measures are given as raw scores.

| Test              | Simulation Group |           | Non-simulation Group |           |
|-------------------|------------------|-----------|----------------------|-----------|
|                   | Mean             | Std. Dev. | Mean                 | Std. Dev. |
| Diving Knowledge  | 86.6             | 9.2       | 83.1                 | 17.4      |
| Diving Attitude   | 124.2            | 12.1      | 124.4                | 17.7      |
| Out-of-Air Skills | 98.3             | 12.0      | 94.9                 | 14.9      |

Table 4. Comparison of simulation and non-simulation groups.

Box-and-whisker plots for these three variables follow: Figure 9 shows the comparison of simulation and non-simulation groups with respect to diving knowledge; Figure 10 shows

the same comparison with respect to attitude toward diving; and Figure 11 shows the comparison with respect to out-of-air emergency skills.

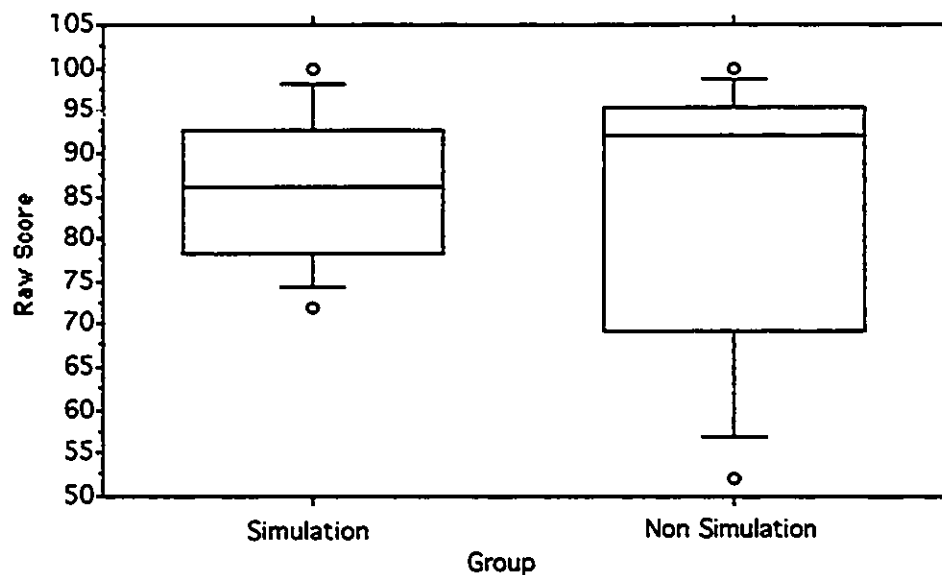


Figure 9. Box-and-whisker comparison with respect to diving knowledge (post-test).

The box-and-whisker plot in Figure 9 shows how the simulation and non-simulation groups compare with respect to diving knowledge at the end of the course. The non-simulation group shows greater variability and a higher median, but the median for the non-simulation group is within the range of the box for the simulation group. From these measurements, it appears that the simulation and non-simulation groups were similar with respect to diving knowledge.

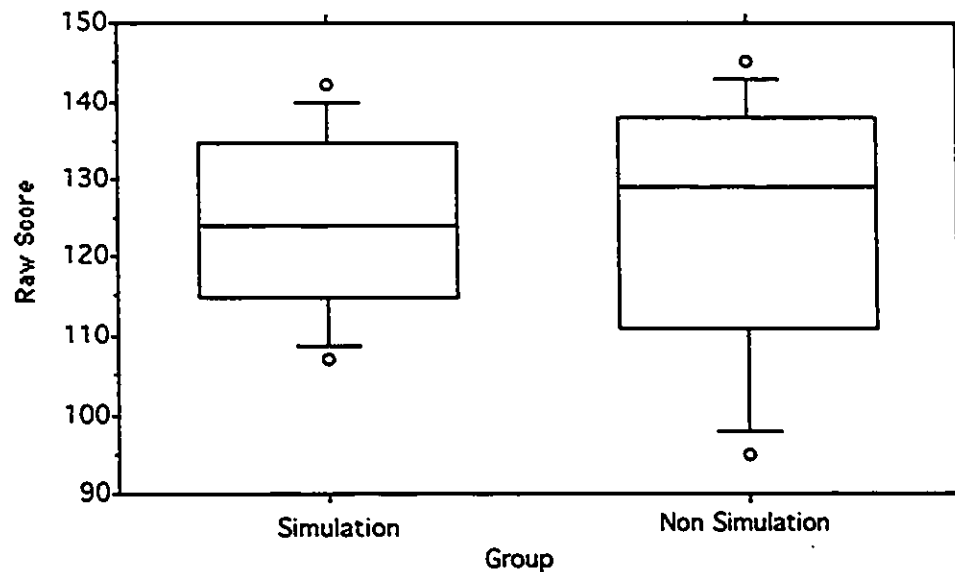


Figure 10. Box-and-whisker comparison with respect to attitude toward diving (post-test).

Figure 10 shows how the simulation and non-simulation groups compared on the diving attitude post-test. The non-simulation group shows greater variability than the simulation group, but the median scores were roughly the same. Differences between the two groups were judged to be minor.

The box-and-whisker plot on the following page (Figure 11) shows the comparison of simulation and non-simulation groups on the out-of-air emergency skills assessment. The variability within groups appears to be similar, and the median scores are very close to the same. On the basis of this information, the groups appear to have scored similarly on the out-of-air skills measure.

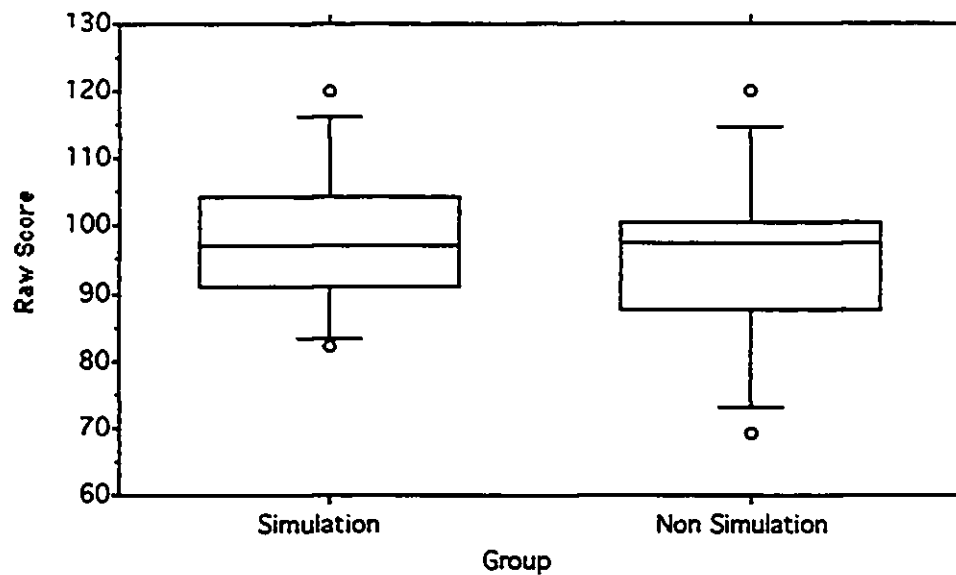


Figure 11. Box-and-whisker comparison with respect to out-of-air emergency skills.

Examination of the above figures suggests that the two groups were fairly similar on all three post-test measures. A series of three t-tests was performed to determine if statistically significant differences existed between the post-test means for the simulation and non-simulation groups with respect to diving knowledge, attitude toward diving or out-of-air emergency skills. No significant differences were noted, as shown in Table 5 below.

| Test              | Observed t Value | df | Result * |
|-------------------|------------------|----|----------|
| Diving Knowledge  | .518             | 15 | ns       |
| Diving Attitude   | -.021            | 15 | ns       |
| Out-of-Air Skills | .499             | 14 | ns       |

\*ns = not significant, alpha=0.05

Table 5. t-test comparison of simulation and non-simulation groups on post-tests.

### **Relationships Between Knowledge, Attitude and Behavior**

The relationships between post-test scores on diving knowledge, attitude toward diving, and out-of-air skills were examined using Pearson's correlation coefficient. The analysis was conducted on the simulation and non-simulation groups separately, and then on the combination of both groups. The three analyses were found to be nearly identical. The results for the combined group are given below in Table 6.

|           | Knowledge | Attitude | Skill  |
|-----------|-----------|----------|--------|
| Knowledge | 1.0000    |          |        |
| Attitude  | 0.1955    | 1.0000   |        |
| Skill     | 0.6937 ** | -0.0179  | 1.0000 |

\*\* Significant at  $p < .01$

Table 6. Pearson's correlation coefficient for the combined (simulation & non-simulation) group.

This analysis indicates a strong relationship between diving knowledge and out-of-air skills, but not between diving knowledge and attitude toward diving, nor between out-of-air skills and attitude toward diving.

### **Tracing**

A method was devised to summarize the information contained in the tracings of paths taken through the simulation. For each attempt made by a student on one of the scenarios, the total number of cards visited was counted. Then a count was taken of the total number of cards visited outside of the "ideal" path. Finally, a ratio was calculated to reflect the ratio of non-ideal cards per total cards visited. This "diversion index" yielded a measure of the degree to which each attempt departed from the model solution for each scenario.



Described mathematically, the index is given as:

$$\text{Diversion Index (DI)} = \frac{\text{\# of non-ideal cards in attempt}}{\text{total \# of cards in attempt}}$$

The index has a range from 0 (total conformity to the ideal path) up to, but excluding 1 (near total departure from the ideal path). Total departure was impossible in all four scenarios, since students began the simulation on the first step of the ideal path, and would thus always have visited at least one card on the ideal path.

The diversion indices for all attempts on scenario one by all students are presented in Table 7. Tables 8, 9, and 10 contain the same information for scenarios two, three and four, respectively.

| Attempt | Student |      |      |      |      |      |      |      |      |
|---------|---------|------|------|------|------|------|------|------|------|
|         | 1       | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| 1       | 0.71    | 0.75 | 0.33 | 0.40 | 0.50 | 0.50 | 0.67 | 0.83 | 0.75 |
| 2       | 0.71    | 0.50 | 0.25 | 0.50 | 0.40 | 0.67 | 0.60 | 0.67 | 0.57 |
| 3       | 0.14    | 0.14 | 0.00 | 0.25 | 0.17 | 0.25 | 0.25 | 0.25 | 0.60 |
| 4       | 0.00    | 0.00 | 0.75 | 0.11 | 0.14 | 0.00 | 0.00 | 0.00 | 0.50 |
| 5       | 0.50    | 0.50 | 0.50 | 0.00 | 0.00 | -    | 0.50 | 0.00 | 0.00 |
| 6       | 0.67    | 0.67 | -    | 0.80 | -    | -    | 0.50 | 0.50 | 0.00 |
| 7       | 0.67    | -    | -    | 0.50 | -    | -    | -    | -    | -    |

Table 7. Diversion indices for attempts on scenario one.

| Attempt | Student |      |      |      |      |      |      |      |      |
|---------|---------|------|------|------|------|------|------|------|------|
|         | 1       | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| 1       | 0.50    | 0.80 | 0.80 | 0.67 | 0.80 | 0.17 | 0.80 | 0.80 | 0.75 |
| 2       | 0.14    | 0.60 | 0.75 | 0.14 | 0.80 | 0.00 | 0.17 | 0.17 | 0.40 |
| 3       | 0.00    | 0.25 | 0.71 | 0.00 | 0.80 | 0.50 | 0.00 | 0.00 | 0.14 |
| 4       | 0.75    | 0.00 | 0.36 | 0.75 | 0.30 | 0.67 | 0.50 | 0.50 | 0.00 |
| 5       | 0.50    | 0.75 | 0.14 | 0.50 | 0.14 | 0.75 | 0.50 | 0.67 | -    |
| 6       | -       | 0.75 | 0.00 | -    | 0.00 | 0.75 | -    | 0.50 | -    |
| 7       | -       | -    | 0.50 | -    | -    | 0.75 | -    | -    | -    |
| 8       | -       | -    | 0.50 | -    | -    | -    | -    | -    | -    |

Table 8. Diversion indices for attempts on scenario two.

| Attempt | Student |      |      |      |      |      |      |      |      |
|---------|---------|------|------|------|------|------|------|------|------|
|         | 1       | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| 1       | 0.50    | 0.43 | 0.50 | 0.00 | 0.20 | 0.67 | 0.50 | 0.67 | 0.20 |
| 2       | 0.40    | 0.57 | 0.17 | 0.00 | 0.00 | 0.60 | 0.00 | 0.75 | 0.00 |
| 3       | 0.00    | 0.17 | 0.00 | 0.67 | 0.00 | 0.50 | 0.00 | 0.29 | 0.00 |
| 4       | 0.00    | 0.00 | 0.00 | 0.67 | 0.83 | 0.00 | 0.67 | 0.50 | 0.67 |
| 5       | -       | -    | 0.67 | 0.75 | 0.88 | 0.00 | 0.67 | 0.00 | 0.67 |
| 6       | -       | -    | 0.75 | -    | -    | 0.67 | 0.67 | 0.00 | 0.83 |
| 7       | -       | -    | 0.67 | -    | -    | -    | 0.75 | 0.67 | 0.67 |
| 8       | -       | -    | -    | -    | -    | -    | 0.83 | 0.80 | -    |
| 9       | -       | -    | -    | -    | -    | -    | -    | 0.75 | -    |

Table 9. Diversion indices for attempts on scenario three.

| Attempt | Student |      |      |      |      |      |      |      |      |
|---------|---------|------|------|------|------|------|------|------|------|
|         | 1       | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| 1       | 0.14    | 0.17 | 0.00 | 0.20 | 0.20 | 0.17 | 0.17 | 0.67 | 0.17 |
| 2       | 0.00    | 0.00 | 0.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 |
| 3       | 0.67    | 0.67 | 0.75 | 0.00 | 0.33 | 0.00 | 0.67 | 0.14 | 0.67 |
| 4       | 0.75    | 0.67 | 0.50 | -    | 0.67 | -    | 0.75 | 0.14 | 0.75 |
| 5       | 0.75    | 0.75 | 0.67 | -    | 0.50 | -    | 0.75 | 0.00 | 0.67 |
| 6       | 0.75    | 0.75 | -    | -    | -    | -    | 0.67 | -    | 0.57 |
| 7       | -       | -    | -    | -    | -    | -    | 0.67 | -    | 0.67 |

Table 10. Diversion indices for attempts on scenario four.

Several patterns can be seen in the information contained in the above tables. Students always arrived at the model solution, as evidenced by the presence of a diversion index of zero in every column of all four of the above tables. Sometimes the zero appears early in relation to the other attempts, sometimes late, and most often in the middle.

Students usually started with an attempt quite different from the model solution, and then gradually drew nearer to the model solution, until they reached it. This is shown by a high diversion index for the first attempt, followed by a gradual decrease in the diversion index over subsequent attempts.

Students did not, in general, terminate their simulation activities upon discovering the model solution. Attempts which follow the model solution generally have a high value for the diversion index, with no distinguishable pattern evident. Anecdotal information indicates that students were "exploring foolish options" during this time: they were trying different courses of action which they knew were wrong.

## **Interviews**

Six students from the simulation group volunteered for informal interviews. Students were initially asked, "What was the most important factor in learning out-of-air emergency skills?" The responses were unanimous: students thought the pool sessions were most critical. When asked, "Why?", they all said it was because the pool was where they had the opportunity to do the things that had been talked about in class.

Students were then asked what they thought of the simulation. All students stated that they liked the simulation and enjoyed using it. Four of the students referred to the simulation as "fun". One student pointed out a few minor technical problems, and then talked about a "shortcoming" of the simulation:

"The simulation doesn't convey the feeling of what the real situation is like. I didn't feel the pressure of the water, or the urge to breathe. It does let you stop and think about things, though."

Students were asked whether they saw any value in the simulation activities. All students indicated that the simulation had some positive value. Students were then asked to identify how the simulation affected their learning. Following are their comments:

"I had the chance to try things that I wouldn't dare do in a real situation. I think that helped me to learn."

"In the pool, I was mostly worried about doing the skills right. I didn't think much about what I was doing. When I used the simulation, it made me think."

"The best thing about the simulation was how it made me work things out in my mind."

"There are two types of learning: "book" learning, and the kind you get from actually doing it - practical learning. The simulation helps with the theory, but not the practical stuff."

"Doing the simulation helps you understand the skills, but it doesn't help you do them any better."

**"It (the simulation) makes you mentally break down a process into parts. In real life many things would be done simultaneously, while the simulation makes you do them one at a time. It lets you stop and think about what you are doing."**

**Students apparently believed that the simulation was valuable in understanding out-of-air emergency skills, but it did not help students directly in learning to perform those skills.**

## **CHAPTER V**

### **DISCUSSION**

#### **Major Findings of the Study**

##### Effects of the Simulation on Learning Outcomes

This study found no significant effects on learning outcomes due to use of the computer simulation. Simulation and non-simulation groups were similar at the beginning of the study, and were similar at the end with respect to general diving knowledge, attitudes toward diving, and skill in performing out-of-air emergency skills. Either the simulation had no effects on learning outcomes, or the effects lay outside the realm of the data collected.

##### Relationships Between Knowledge, Attitudes and Behavior

A significant positive correlation was found between general diving knowledge and proficiency in out-of-air emergency skills. These two measures are the primary means for evaluating students in virtually all introductory scuba courses. Since students usually pay to participate in diving courses, and since they usually participate because of some personal desire to learn to dive, students have an interest in doing well in the course. This may be an important factor in the knowledge-behavior relationship. In contrast, attitudes were not used as a formal means of evaluation in these diving courses, and this may contribute to the lack of significant correlations for knowledge and behavior with attitudes.

##### The Process of Learning

A general pattern was identified in the tracings of students' simulation activities. Students typically started with an attempt which was quite different than the model solution. This attempt was then refined through subsequent attempts, until the model solution was obtained. After arriving at the model solution, students often explored other aspects of the

simulation, trying out courses of action which they knew were incorrect. This pattern of activities has been generalized into the model given below in Figure 12. While variations on the model existed, most of the major elements of the model could be identified in any series of attempts.

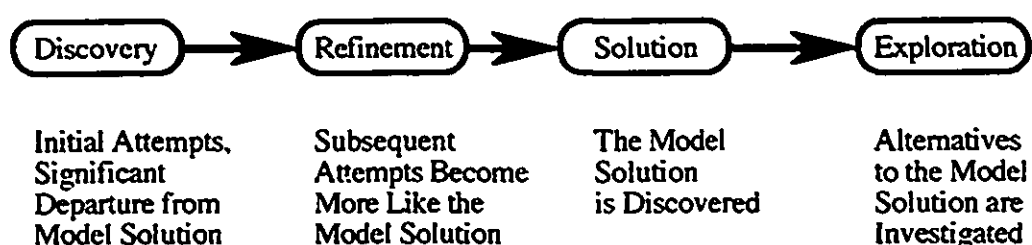


Figure 12. The process of simulation learning.

For convenience, the stages of the above model have been given names. "Discovery" is the first stage, and refers to the initial attempts students made in attempting to solve the problem posed by the scenario. The subsequent attempts, leading up to the model solution, have been termed "Refinement". The transition from discovery to refinement is not marked by any discrete event, but is gradual. "Solution" refers to the discovery of the model solution. "Exploration" refers to the investigations which students undertook following the solution of the problem.

The discovery, refinement and solution stages described above could also be found if one studied pool sessions dealing with out-of-air emergency skills. The last stage, exploration, typically would not be found in pool sessions, because it would be inherently dangerous. Obviously, students could not be allowed to attempt grossly incorrect courses of action in the water, because the result might be injury or death. In a simulation, however, the consequences of such actions can be examined. If the exploration of inappropriate actions

benefits learning, then there would be significant merit to simulation use.

Students' comments indicated the belief that there was value in simulation use. Students stated that the simulation made them think, and that it helped them to develop a thorough understanding of out-of-air emergency skills. While they thought it did not affect their performance of skills, they thought their understanding of the skills was better than if they had not used the simulation. This implies that there may be some benefit to simulation use, outside of the learning outcomes examined in this study. Further studies may help to clarify whether this is really the case.

### **Implications of the Study**

#### **Implications for Research Methodology**

Quantitative data regarding learning outcomes yielded little information about the effects of the computer simulation in this study. It provided some negative information, highlighting what the simulation did not do. Although this information is useful, it is not as valuable as positive information describing what the simulation did. Qualitative methods (tracings and interviews) were more useful in this respect.

In future studies, it would be wise to incorporate both qualitative and quantitative methods. Quantitative methods seem better suited to describing the products of learning, while qualitative methods are more useful in describing the process(es) of learning. Both aspects of learning are important to a complete understanding of educational phenomena. Thus, a combination of approaches is more likely to provide a balanced view of learning. If one had relied solely upon quantitative data in this study, one might have falsely concluded that the simulation was useless. Likewise, paying attention only to the qualitative data might have led one to believe that use of simulations would be of great benefit. By combining approaches, one can see that there are specific areas where simulations are of use, but that



there are other areas where simulations will provide no significant benefits. Educational practitioners are then able to determine whether they should use a simulation, based on their needs and the anticipated benefits of the simulation.

#### Implications for Diver Education

In deciding whether computer simulations are useful in diver education, one's motives must be considered. The main objective of introductory diving courses is to provide basic knowledge and training, to allow students to perform skills safely, so they can dive on their own. In light of the findings of this study, then, one must conclude that computer simulations are not appropriate for introductory diving courses, since students who used the simulation did not perform skills better than those who did not use the simulation.

If the objective were to develop in-depth knowledge and understanding of diving skills, then simulation use could be very valuable. This suggests that computer simulations may be appropriate for advanced diver training. Advanced courses typically concern themselves with developing and expanding the diver's knowledge, with considerably less emphasis on the performance of specific diving skills. The intent is to broaden and lend depth to the student's understanding of diving. If the comments made by students in this study can be relied upon, then the use of computer simulations would be appropriate in advanced courses.

#### Implications for Environmental Education

Environmental education is a very broad field, so making a recommendation in this field is difficult. This study suggests that there may be potential for the use of simulations where the development of thinking skills is concerned. There are certainly areas within environmental education which fit this description, but there are problems with recommending computer simulations as a solution. There is no guarantee that what is true

in diver education will also hold true in environmental education. Environmental education is diverse enough that computer simulations might work in one instance, but not another. Additionally, the issue of how a simulation can best be implemented in this type of setting remains to be solved. Computer simulations may be of benefit to environmental education, but that remains to be proven.

### **Suggestions for Future Research**

This study has identified a number of areas which are worthy of further consideration. First of all, gaps in the literature exist with respect to high school scuba programs. These programs need to be described in detail, so that the philosophy, objectives and methods of this branch of diver education will become explicitly clear. As well, the population of students participating in high school scuba programs needs to be described in detail. There may be peculiarities present in this population, and those factors may have significant bearing on studies of this type. These two types of background information can provide a more solid foundation for future studies in diver education.

Restrictions on time and resources prevented this study from gathering data for large numbers of students. This resulted in statistical analyses which must be considered tentative at best. Repeating the study with larger numbers of subjects would result in more stable, interpretable results. In addition, other analyses might be possible, which were not possible with the small numbers of students in this study.

In analyzing the attitude data in this study, it became apparent that attitudes toward diving might possibly be grouped into several categories. If larger numbers of students were used, a factor analysis of the attitude scale would be possible, and might reveal some interesting groups. These groups might reveal underlying constructs which could then be identified and investigated.

This study was also unable to examine the effects of simulation use on the retention of knowledge. A longer-term study would be worthwhile, to see if students remember out-of-air emergency skills better when they have used a computer simulation. It would also be interesting to follow up how students react to real emergencies after simulation use, but a long-term commitment would be necessary to collect the data. The logistics of keeping track of students after the course, whether they are still actively diving, whether they have experienced an emergency situation, and how they reacted to those situations, would be formidable.

The results of this study suggested that simulation use might be of greatest benefit in advanced diving courses. It would be worthwhile to repeat this study in an advanced course, to test this hypothesis.

There are many ways a simulation could be implemented in diving courses, and this study did not attempt to compare different modes of implementation. Timing of simulation use and the manner of presentation may make a difference to students' learning. This topic would be worth investigation.

There are many other areas in environmental education where simulation use might be appropriate. Teaching the principles of ecology involves exposing students to complex natural systems. Computer simulations might be an effective means for allowing students to explore those systems. Students might benefit from the opportunity to manipulate environmental variables, and to examine the consequences of those changes in natural systems. A good simulation, implemented in an effective manner, might help students appreciably in understanding this and other related topics.

While the simulation used in this study was hypertext-based, it did not make extensive use

of hypermedia resources such as laserdisc video and audio systems. It would be interesting to expand the simulation to include such audio-visual resources, and then to see how students react to this technology. One could expect students to show greater interest and involvement in simulation activities, and there may be significant advantages to the feedback students would get from a simulation of this type.

The development of the computer simulation for this study was a learning experience in itself. Given the appropriate course setting, it would be possible to extend this experience to students in a scuba course. It would be especially appropriate in the framework of an advanced diving course. With the development of hypertext systems, it is now possible to create educational simulations with greater ease than was previously possible. It would be interesting to examine the learning of students who were engaged in the development of their own out-of-air emergency simulation.

### **Conclusion**

The problem posed at the beginning of the study was to determine if a computer simulation can help students overcome the obstacles of transferring out-of-air emergency skills learned in a diving course to openwater situations. Based on the results of the study, one must conclude that the simulation did not help in this area. There is evidence, however, that there may be other benefits to simulation use.

This study raised a number of interesting questions, and identified many areas for further study. In fact, the study raised many more questions than it answered. This should be no surprise, since it is the first study of its kind in the field of diver education. It has been successful as an initial exploration of the effects of computer simulation use in high school scuba education, and has made a significant contribution to the field of diver education by providing information where previously there was none.

There remains considerable research to be done. The findings of this study should serve to guide future research, and will at least provide some basic information regarding the usefulness of computer simulations, and the usefulness of different research methodologies for the study of computer simulation use, in diver education.

Hopefully, future research will take advantage of what has been learned in this study, with the end result of making diver education better in the future. When that has happened, we will be able to say that our real education has begun.

## REFERENCES

## REFERENCES

- Alberta Education. (1990). *Program of Studies: Senior High Schools*. Edmonton: Alberta Education.
- Ambron, S. & Hooper, K. (Eds.). (1990). *Learning with Interactive Multimedia: Developing and Using Multimedia Tools in Education*. Redmond, WA: Microsoft Press.
- Andrews, P. (1990a). Personal communication.
- Andrews, P. (1990b). A new wave: Strategies for marine education. In *Setting the EE Agenda for the '90s*. Troy, OH: North American Association for Environmental Education. 253-256.
- Apple Computer. (1989). *HyperCard Stack Design Guidelines*. Reading, MA: Addison-Wesley.
- Belcher, B. (1989). NAUI History at The University of Toronto. *Sources* 1(1), 67-68.
- Boocock, S. & Schild, E.O. (Eds.). (1968). *Simulation Games in Learning*. Beverly Hills: Sage.
- Bush, V. (1945). As we may think. *Atlantic Monthly* 176(1), 101-108.
- Carlson, J. & Misshauk, M. (1972). *Introduction to Gaming: Management Decision Simulations*. New York: John Wiley.
- Conklin, J. (1987). Hypertext: An introduction and survey. *Computer* 20(9), 17-41.
- Cook, M. (1990). Project OCEAN. In *Setting the EE Agenda for the '90s*. Troy, OH: North American Association for Environmental Education. 274-278.
- Cunningham, B. (1984). Assumptions underlying the use of different types of simulations. *Simulation and Games* 15(2), 213-234.
- Dodge, D. (1980). Domestic politics games and simulations: An evaluation. In C. Horn & A. Cleaves (Eds.) *The Guide to Simulations/Games for Education and Training*. Beverly Hills: Sage. 47-57.
- Eisenstat, G.M. (1976). Teaching defensively. In J.B. Sleeper (Ed.) *Legal Aspects of Underwater Instruction*. Montclair, CA: National Association of Underwater Instructors. 22-25.
- Ellington, H., Addinall, E. & Percival, F. (1981). *Games and Simulations in Science Education*. New York: Nichols.
- Fortner, R.W. & Mayer, V.J. (1989). Marine and aquatic education: A challenge for science educators. *Science Education* 73(2), 135-154.

- Fortner, R.W., Schar, J.F. & Mayer, V.J. (1986). *Effect of Microcomputer Simulations on Computer Awareness and Perception of Environmental Relationships among College Students*. Columbus, OH: Ohio State University. (ERIC document ED 270311).
- Graver, D. (1989). The significance of institutional programs in diving. *Sources* 1(1), 41-43.
- Greenblat, C.S. & Duke, R.D. (1981). *Principles and Practices of Gaming - Simulation*. Beverly Hills: Sage.
- Griffiths, T. (1989). Psychological fitness. In *Advanced Diving: Technology and Techniques*. Montclair, CA: National Association of Underwater Instructors. 66-73.
- Heller, R. (1990). The role of hypermedia in education: A look at the research issues. *Journal of Research on Computing in Education* 22(4), 431-441.
- Hines, J. (1985). *An analysis and synthesis of research on responsible environmental behavior*. Doctoral Dissertation, Southern Illinois University at Carbondale.
- Huber, T.P. & Falkenmayer, K. (1987). Soil erosion study through simulation: An educational tool. *Journal of Environmental Education* 18(3), 23-27.
- Jacobs, R. & Baum, M. (1987). Simulation and games in training and development: Status and concerns about their use. *Simulation and Games* 18(3), 385-394.
- Kaplan, A. (1964). *The Conduct of Inquiry, Methodology for Behavioral Science*. San Francisco: Chandler.
- Krathwohl, D., Bloom, B. & Masia, B. (1964). *Taxonomy of Educational Objectives. Handbook II: Affective Domain*. New York: Longman.
- Lavoie, D.R. & Good, R. (1988). The nature and use of prediction skills in a biological computer simulation. *Journal of Research in Science Teaching* 25(5), 335-360.
- Leahy, R. (1989). Coping with stress through diver education. *Sources* 1(1), 30-34.
- Madro, J. (1989). Personal communication.
- Madro, J. (1982). *Skin & Scuba in Environmental Studies : A Special Report for Alberta Environmental Studies Blue Lake Center*. Edmonton : Underwater Consulting & Contracting Services.
- Marcinkowski, T. (1991). *Responsible Environmental Behavior*. Troy, OH: North American Association for Environmental Education.
- McCormick, S. (1987). Ecodisc - An ecological visual simulation. *Journal of Biological Education* 21(3), 175-180.
- Mills, T.J. (1985). An assessment of water resource education for teachers using interactive computer simulation. *Journal of Environmental Education* 16(4), 25-29.
- Mrazek, R. (1989). Personal communication.



- National Association of Underwater Instructors. (1987). *NAUI Openwater I Scuba Diver Instructor Guide*. Montclair, CA: National Association of Underwater Instructors.
- Nelson, T. (1967). Getting it out of our system. In G. Schechter (Ed.) *Information Retrieval: A Critical Review*. Washington, DC: Thompson Books. 191-210.
- Oren, T. (1990). Cognitive load in hypermedia: Designing for the exploratory learner. In S. Ambron & K. Hooper (Eds.) *Learning with Interactive Multimedia: Developing and Using Multimedia Tools in Education*. Redmond, WA: Microsoft Press. 125-136.
- Orr, D. (1989). Diver education ... it's academic. *Sources* 1(1), 27-29.
- Ortiz, A., Ortiz, E. & Jiménez, L. (1990). Introduction to the marine environment: An integration strategy. In *Setting the EE Agenda for the '90s*. Troy, OH: North American Association for Environmental Education. 318-322.
- Pierce, A. (1985a). Loss of air supply. In *Scuba Life Saving*. Champaign, IL: Leisure Press. 71-84.
- Pierce, A. (1985b). The diver under stress. In *Scuba Life Saving*. Champaign, IL: Leisure Press. 27-33.
- Price, R. (1991). *Computer-Aided Instruction: A Guide for Authors*. Pacific Grove, CA: Brooks/Cole. 246-270.
- Rohwedder, R. (Ed.). (1990). *Computer-Aided Environmental Education*. Troy, OH: North American Association for Environmental Education.
- San Francisco Bay Chapter of the Oceanic Society. (1988). *Project OCEAN*. San Francisco: San Francisco Bay Chapter of the Oceanic Society.
- Scheepers, D. (1991). An introduction to psychological stress and the sport diver. *Sources* 3(1), 42-46.
- Sea World. (1990a). *Sea World of Texas Education Programs*. San Antonio: Sea World of Texas.
- Sea World. (1990b). *Sea World of Texas Outreach Programs*. San Antonio: Sea World of Texas.
- Sea World. (1990c). *Sea World of Texas Curriculum Aid*. San Antonio: Sea World of Texas.
- Sea World. (1990d). *Sea World of Texas Teacher Workshop Schedule*. San Antonio: Sea World of Texas.
- Sea World. (1990e). *Sea World of Texas Summer Education Programs*. San Antonio: Sea World of Texas.
- Selye, H. (1974). *Stress Without Distress*. New York: Signet Books.
- Selye, H. (1976). *The Stress of Life*. New York: McGraw Hill.

- Shrigley, R.L. (1990). Attitude and behavior are correlates. *Journal of Research in Science Teaching* 27(2), 97-113.
- Smith, P. (1987). Simulating the classroom with media and computers. *Simulation and Games* 18(3), 395-413.
- Taylor, J. & Walford, R. (1972). *Simulation in the Classroom*. Baltimore: Penguin Books.
- Toft, M. (1985). Finding high level wellness through outdoor pursuits. *Explore* 22, 9-15.
- Touchings, David. (1989). *Teacher's attitudes toward computers*. M.Ed. Thesis: Memorial University of Newfoundland.
- Widmann, B. (1989). Diving at UCSC - A very personal odyssey. *Sources* 1(1), 61-63.
- Wienke, B.R. (1992). Waterskills in the right measure. *Sources* 4(1), 63-66.
- Willis, J., Hovey, L. & Hovey, K. (1987). *Computer Simulations: A Source Book to Learning in an Electronic Environment*. New York: Garland.

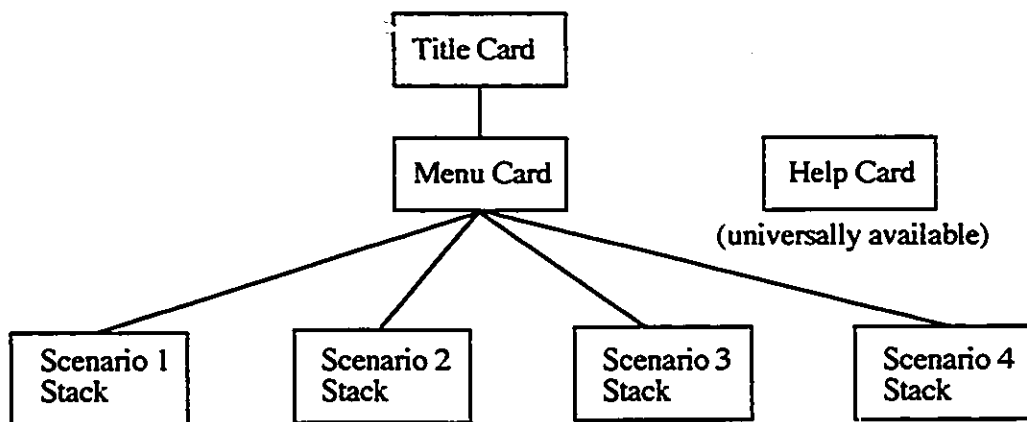
## **APPENDICES**

**APPENDIX I**  
**Map and Description of the Simulation**

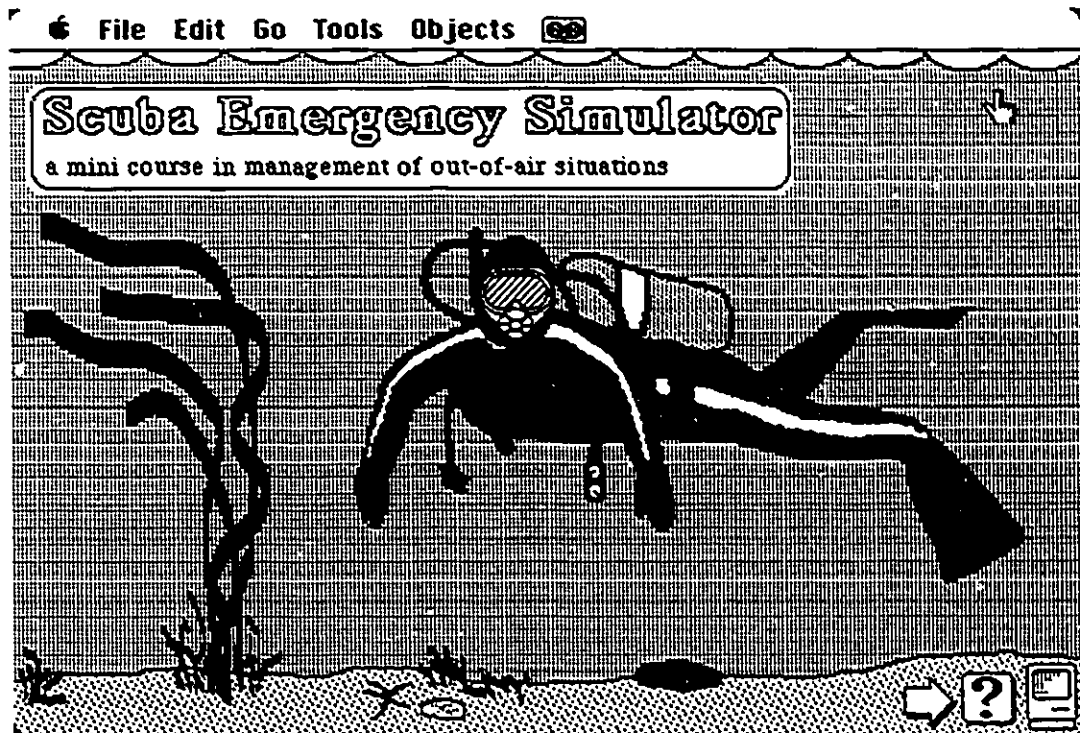
### Overall Structure

The computer simulation used in this study was developed as a tool to assist in instruction of out-of-air emergency skills in introductory scuba diving courses. It is composed of five hypertext "stacks": one for each of the four skills to be taught, and one to manage the activities of the other four. Each stack consists of a number of cards, which contain text, graphics, and "buttons". Buttons are small icons which, when selected, take the user to another card in the simulation. It is the branching structure inherent in these buttons that gives the simulation its interactive quality.

The structure of the main stack is shown in the diagram below, and indicates the relationship of the stacks to each other:

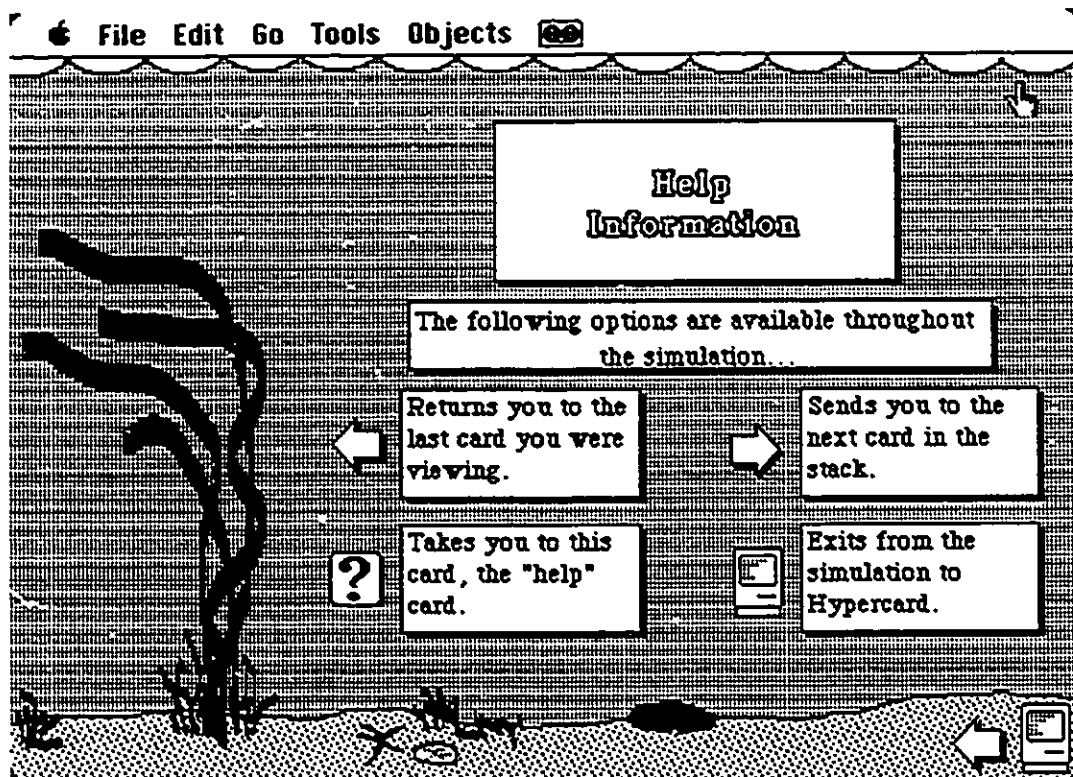


The main stack consists of three cards: the title card; the help card; and the menu card. From the menu card, branches exist to each of the four scenario stacks. The help card is also contained in each of the four scenario stacks, so that it is universally available throughout the simulation.



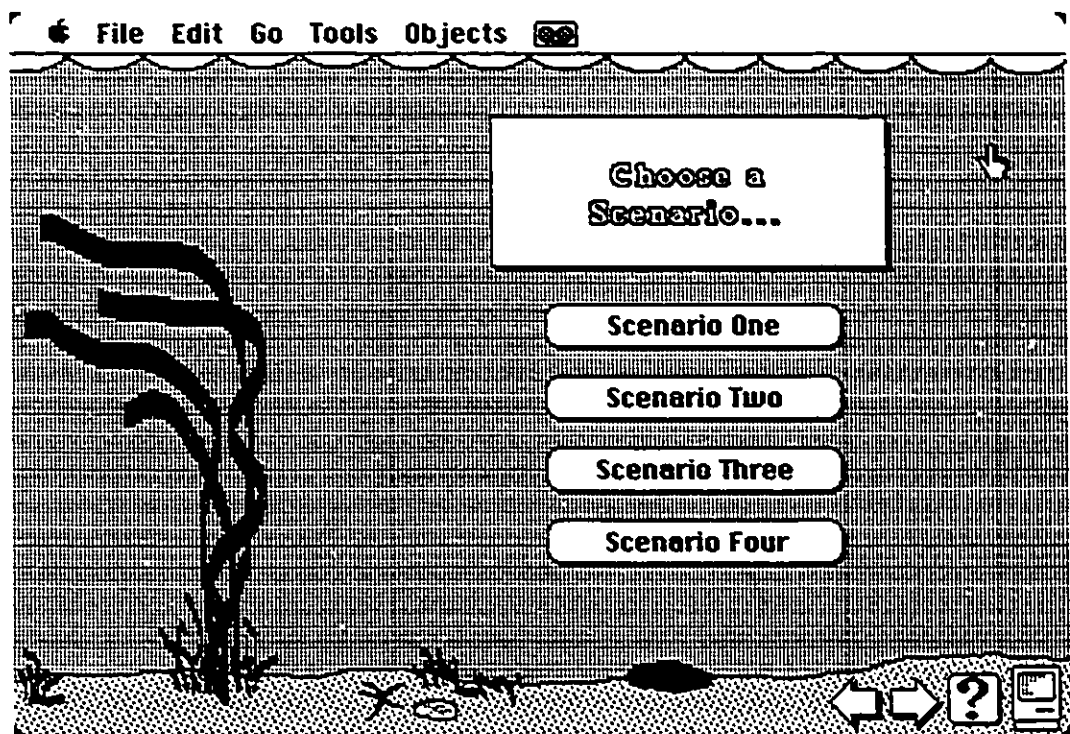
The title card is shown above, and contains some elements of interest. In the upper right hand corner of the card, a small hand is shown. This hand is a pointer, controlled by the user through movements of the mouse. Pointing at something with the hand and clicking the mouse button allows the user to "press" buttons, thereby making choices within the simulation. Buttons available on the title card are in the lower right corner: selecting the right arrow branches to the next card (the menu card); selecting the question mark takes the user to the help card; and selecting the Macintosh icon exits the simulation.

Some buttons are available throughout the simulation, and those buttons are described on the help card (shown on the following page). The left arrow, right arrow, question mark and Macintosh icons have standard meanings through the simulation, as shown by the descriptions on the help card.



The buttons shown on the help card each have a standard meaning throughout the simulation.

The buttons described on the help card are concerned primarily with orienting the user within the simulation. Other buttons on the menu card (shown on the following page) allow the user to select one of the scenarios to work with. By selecting the button "Scenario One", the user is taken to the beginning of scenario one. Selecting the button "Scenario Two" takes the user to the beginning of scenario two, and so on. Once the user has branched to a scenario, it is possible to return to the menu card, and select a different scenario to work with.

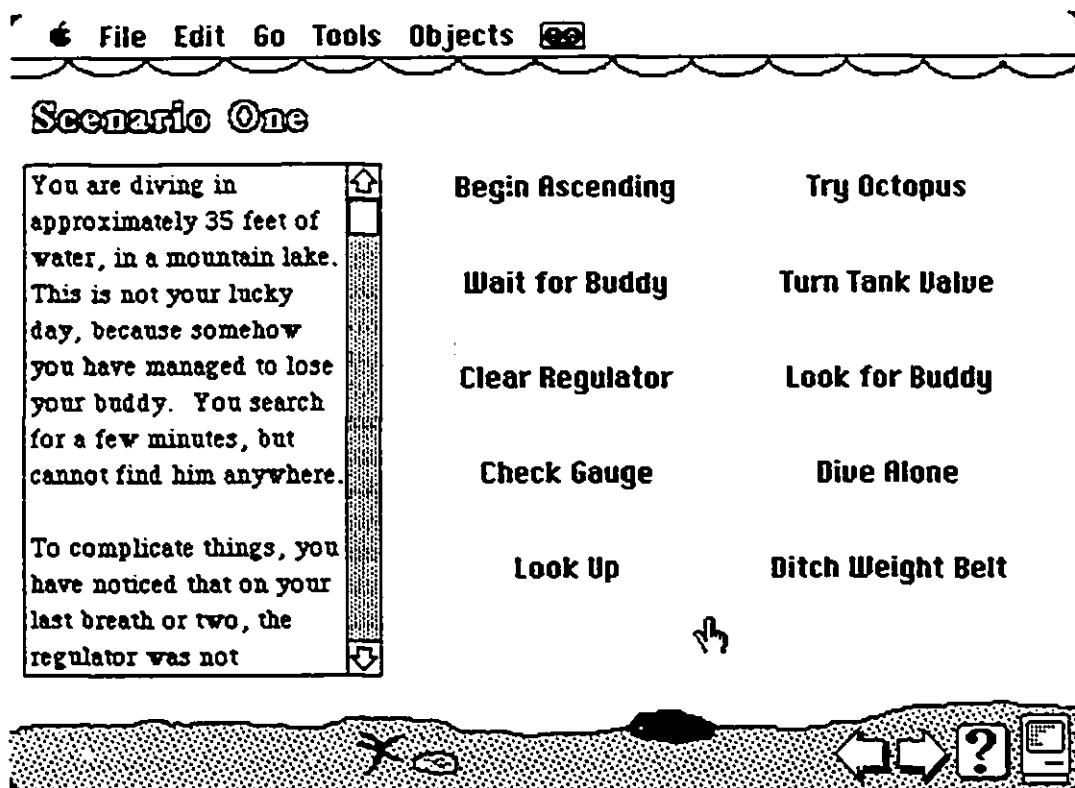


### Scenario One: A Typical Example

The organization of each of the scenario stacks is quite similar in some respects. For simplicity, scenario one will be described here as a typical example, and maps of scenarios two, three and four will be presented afterward.

All of the cards within the scenario are quite similar with respect to the way information is organized (see the following page for the first card in scenario one). In general, a scrolling box appears on the left, through which the student is given information and feedback. On the right are a number of buttons which represent choices which the student can select. In the lower right corner, the familiar help and navigation buttons can be seen. As the student selects different buttons, the simulation branches to different cards, creating the illusion that the information in the scrolling feedback box is changing to reflect the consequences of the choices made. As well, the buttons available to the student appear to change: some





choices may become no longer available, while new options may also appear, depending on the circumstances. Some of the choices given lead the student closer to the model solution, while others lead the student further away from the model solution. Some buttons, when selected, can result in the "injury" or even "death" of the user (simulated, of course).

The cards which are contained in scenario one fall into several categories. Some cards are on the main path of the solution to the problem. If a student makes correct choices at every point in the simulation, this path will be followed through the cards to a successful conclusion, simulating the performance of a controlled emergency swimming ascent.

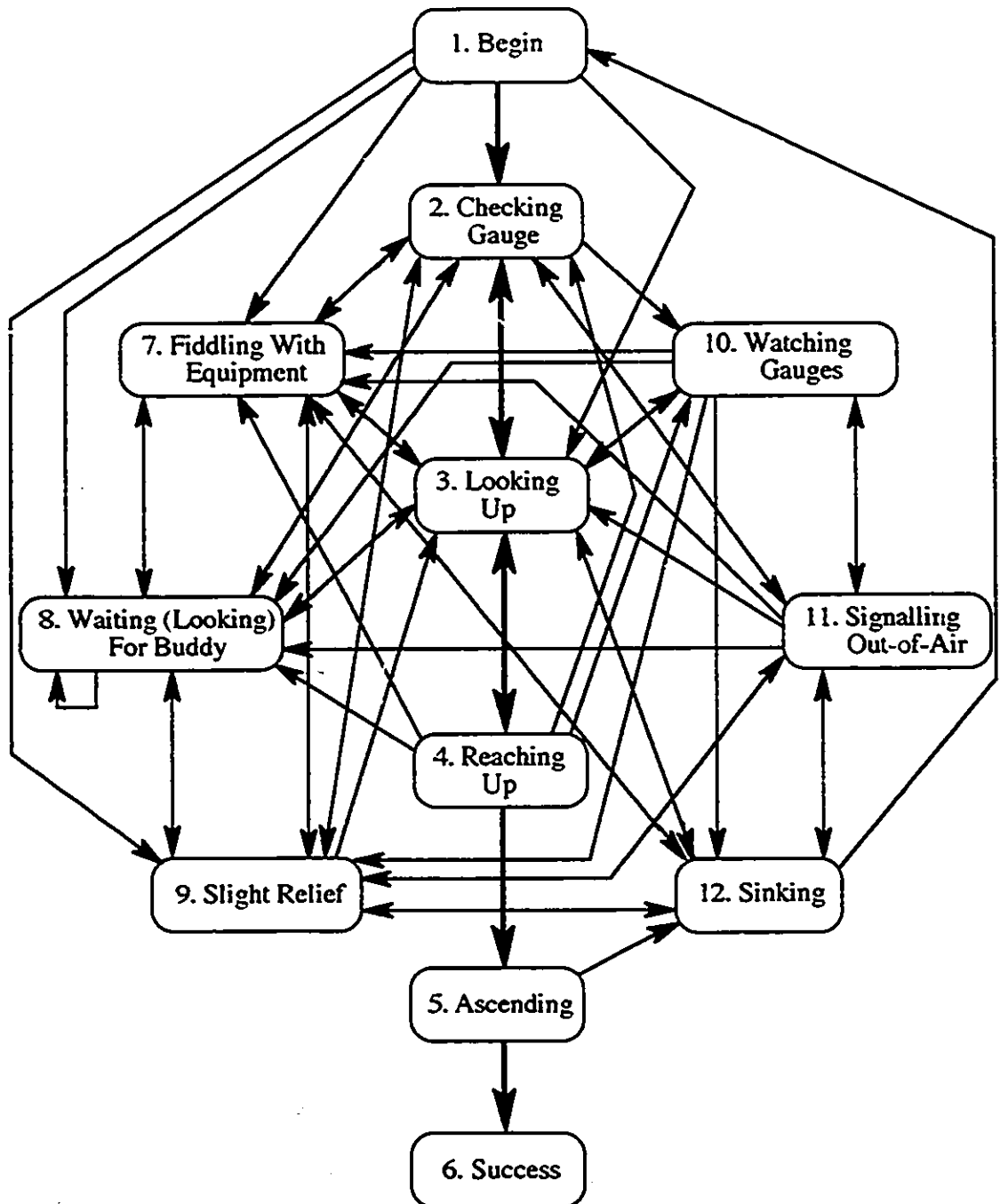
Other cards are arrived at by making an incorrect decision at some point in the simulation.

The seriousness of the consequences is commensurate with the seriousness of the error; some cards represent "death", some represent "injury", while others describe minor difficulties. All these cards can be further subdivided into those which are arrived at through some action (such as ditching a weight belt, or inflating a BC), and those which are arrived at through passive methods (such as waiting, or observing something).

The diagram which appears on the following page shows how the cards are related to each other. Because the possibility of "death" or "injury" exists at every point in the simulation, the structure of the entire simulation is too complex to present in one diagram, and those cards which describe "death" or "injury" have not been shown in the network diagram.

Each card in the diagram is designated by a box, with an arbitrary number assigned to it. Each card also has a title, which in most cases refers to the action which was chosen prior to arriving at that card. Thus, if one is on the first card in the simulation, and then presses the button "Check Gauge", the simulation branches to card two, "Checking Gauge". In this way, one can move along the lines shown in the network diagram. Arrowheads indicate the directionality of links between the cards: some are unidirectional, while others are bidirectional. This models the real-life situation where some actions can be reversed, while others cannot.

The "ideal" path through the simulation is shown with bold lines. This path represents the correct way to perform a controlled emergency swimming ascent, as defined by the course guidelines. The main purpose of the simulation activity is to teach the students to recognize this path, and to eventually be able to use it as a guideline to solve real out-of-air emergency situations. It was expected that students would deviate from this path in the beginning, but would eventually learn to take the ideal path as they gained experience with the simulation.



The pages which follow show the cards represented in the above diagram. The cards from the ideal path (1-6) are shown first, followed by cards 7-12. Finally, the cards representing death and injury are shown.

### Scenario One

You are diving in approximately 35 feet of water, in a mountain lake. This is not your lucky day, because somehow you have managed to lose your buddy. You search for a few minutes, but cannot find him anywhere.

To complicate things, you have noticed that on your last breath or two, the regulator was not

- |                 |                   |
|-----------------|-------------------|
| Begin Ascending | Try Octopus       |
| Wait for Buddy  | Turn Tank Valve   |
| Clear Regulator | Look for Buddy    |
| Check Gauge     | Dive Alone        |
| Look Up         | Ditch Weight Belt |



Card 1. Begin.

### Scenario One

You look at the gauges on your console. One reads between 35 and 40, and the other is in the red range, between 0 and 100.

It is becoming increasingly difficult to breathe.

What do you want to do now?

- |                 |                   |
|-----------------|-------------------|
| Look for Buddy  | Begin Ascending   |
| Wait for Buddy  | Ditch Weight Belt |
| Look Up         | Purge Regulator   |
| Swim Around     | Watch Gauge       |
| Turn Tank Valve | Signal Out-of-Air |



Card 2. Checking Gauge.

Scenario One

Above you, you see an overhanging ledge. You swim out from underneath it, so that it no longer prevents you from swimming to the surface.

What next?

- Watch Gauge
- Begin Ascending
- Wait for Buddy
- Ditch Weight Belt
- Deflate BC
- Look for Buddy
- Check Gauge
- Inflate BC
- Reach Up
- Try Octopus



Card 3. Looking Up.

Scenario One

Your arm is extended toward the surface.

I don't think you're going to get much more air from your regulator.

What will you do next?

- Deflate BC
- Begin Ascending
- Ditch Weight Belt
- Watch Gauge
- Look Up
- Look for Buddy
- Check Gauge
- Try Octopus
- Turn Tank Valve
- Wait for Buddy



Card 4. Reaching Up.

### Scenario One

You start towards the surface.  
  
What now?

- Keep Ascending
- Spit Out Regulator
- Ditch Weight Belt
- Exhale Slowly
- Pull CO2 Cartridge
- Look for Buddy
- Inhale Slowly
- Ascend Rapidly
- Deflate BC
- Inflate BC



Card 5. Ascending.

### Scenario One

A boat passes overhead, but since your arm is above you, you are able to negotiate around it.  
  
You reach the surface, and find your buddy waiting there for you.  
  
Congratulations! You have successfully performed a CONTROLLED EMERGENCY

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 6. Success.

**Scenario One**

No matter how much you fiddle with your equipment, it doesn't seem to make any difference.

Your buddy is still nowhere in sight, and it is getting harder and harder to breathe.

What are you going to do?

- Begin Ascending
- Inflate BC
- Wait for Buddy
- Deflate BC
- Pull CO2 Inflator
- Look for Buddy
- Check Gauge
- Dive Alone
- Look Up
- Ditch Weight Belt



Card 7. Fiddling with Equipment.

**Scenario One**

Your buddy doesn't seem to be around at all.

Don't you think you should be doing something about your air problem?

- Try Octopus
- Begin Ascending
- Wait for Buddy
- Clear Regulator
- Look Up
- Look for Buddy
- Check Gauge
- Swim Around
- Ditch Weight Belt
- Turn Tank Valve



Card 8. Waiting (Looking) for Buddy.

**Scenario One**

You ascend slowly, and notice some slight relief as your regulator delivers a little more air.

As you ascend, you hit your head on a rock overhang which was above you. (Ouch!)

What now?

- |                       |                          |
|-----------------------|--------------------------|
| <b>Descend</b>        | <b>Inflate BC</b>        |
| <b>Wait for Buddy</b> | <b>Turn Tank Valve</b>   |
| <b>Look Up</b>        | <b>Look for Buddy</b>    |
| <b>Check Gauge</b>    | <b>Signal Out-of-Air</b> |
| <b>Deflate BC</b>     | <b>Pull C02 Inflator</b> |



Card 9. Slight Relief.

**Scenario One**

You watch your gauges carefully as you breathe.

The one needle remains stationary at 40, the other continues to drop.

You are finding it extremely difficult to breathe. You should probably do something right away.

- |                          |                          |
|--------------------------|--------------------------|
| <b>Deflate BC</b>        | <b>Ascend Slowly</b>     |
| <b>Wait for Buddy</b>    | <b>Ascend Quickly</b>    |
| <b>Look Up</b>           | <b>Look for Buddy</b>    |
| <b>Signal Out-of-Air</b> | <b>Inflate BC</b>        |
| <b>Turn Tank Valve</b>   | <b>Ditch Weight Belt</b> |



Card 10. Watching Gauges.



**Scenario One**

You carry out a perfect performance of the out-of-air signal, recognized world-wide by all divers.

Unfortunately, there are no divers nearby to acknowledge your signal.

What now?

- |                 |                |
|-----------------|----------------|
| Deflate BC      | Ascend Slowly  |
| Wait for Buddy  | Try Octopus    |
| Look Up         | Look for Buddy |
| Check Gauge     | Inflate BC     |
| Turn Tank Valve | Watch Gauge    |



Card 11. Signalling Out-of-Air.

**Scenario One**

You begin to sink. At the same time, it becomes impossible to breathe.

You feel the pressure of increased depth building rapidly.

- |                   |                   |
|-------------------|-------------------|
| Ditch Weight Belt | Swim For Surface  |
| Inflate BC        | Pull CO2 Inflator |
| Look Up           | Look for Buddy    |
| Signal Out-of-Air | Try Octopus       |
| Turn Tank Valve   | Swim Around       |



Card 12. Sinking.

Scenario One

Perhaps that was not the wisest move you could have made.

Upon ditching your weights, you became positively buoyant, and ascended rather quickly to the surface.

Unfortunately, there was a rock overhang above you, which you hit your head on during the ascent.

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 13. Injured - Ditched Weight Belt.

Scenario One

You ascend slowly, but since you did not extend your hand above you, you failed to detect the boat passing overhead.

The boat's propeller carves your back up like Uncle Herman's electric knife on the Thanksgiving turkey.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 14. Injured - Ascended Without Reaching Up.

### Scenario One

You ascend, and feel a sharp pain in your chest.

When you reach the surface, your buddy is there, and you are coughing up blood.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 15. Injured - Pneumothorax (Ruptured Lung).

### Scenario One

You ascend too quickly, and feel a pain in the knees as you reach the surface.

Your buddy, who is at the surface, politely informs you that you have the bends.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 16. Injured - Decompression Sickness (The Bends).

Scenario One

You look downwards to search for your buddy, but in so doing, you do not notice the boat passing overhead.

The boat's propeller cuts into your arm, and you are bleeding severely.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 17. Injured - Not Looking Up While Ascending.

Scenario One

As you spit out the regulator, you inhale some water and start coughing wildly.

You surface and find your buddy there.

Your buddy laughs uncontrollably at your foolishness, and then hits you in the mouth.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 18. Injured - Spit Out Regulator.

### Scenario One

While diving alone, a giant lake trout came along, wrapped fishing line around you, and tied you securely to a nearby log.

In all the commotion, you panicked, lost your regulator, and inhaled a lungful of icy water.

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 19. Dead - Diving Alone.

### Scenario One

You should have thought before you acted. In ascending, you managed to pin yourself underneath the overhang, where you became trapped.

Your air finally ran out, and Davy Jones' Locker has become your last resting place.

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now

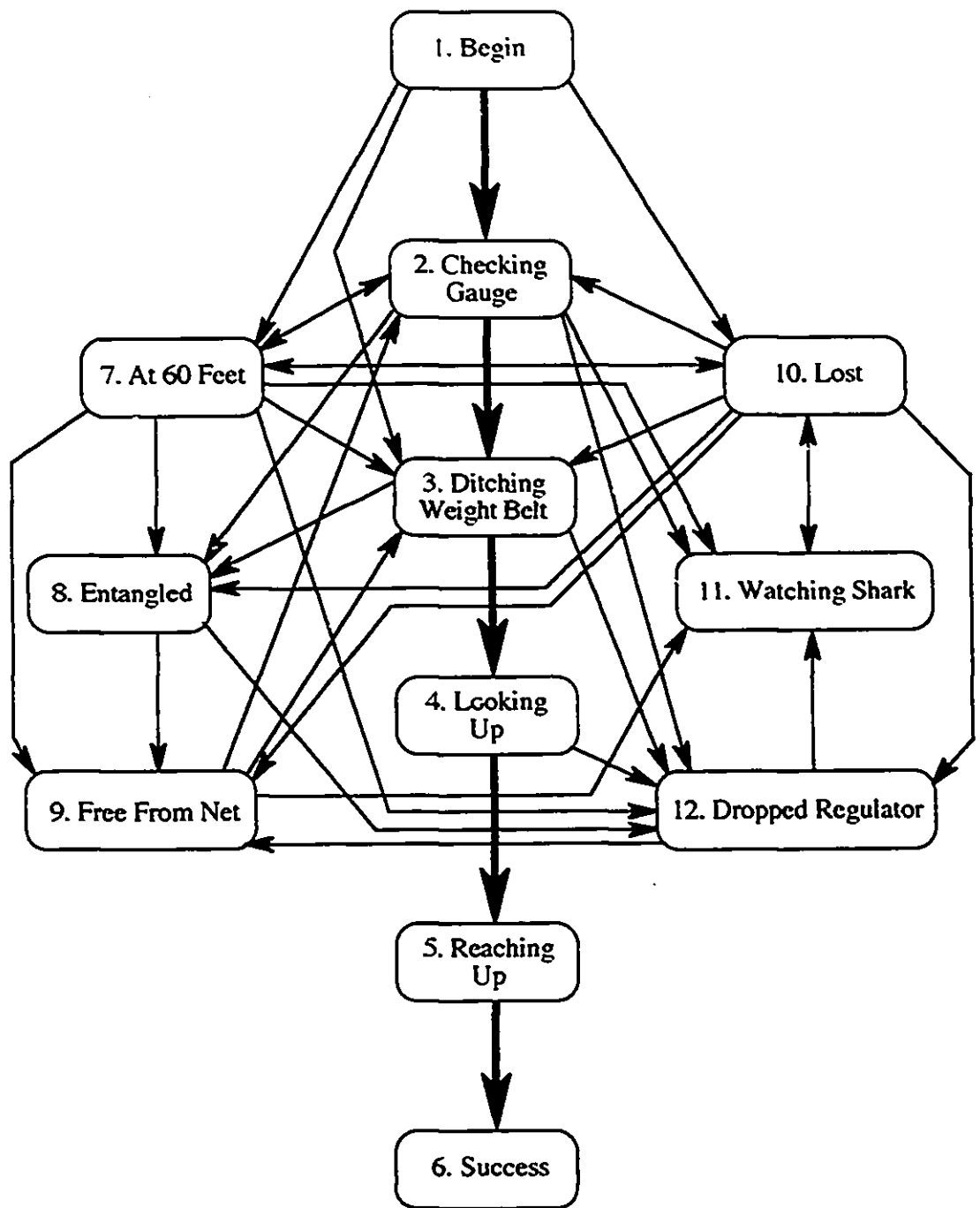


Card 20. Dead - Pulled CO2 Cartridge.

### **Scenarios Two, Three and Four**

The other scenarios in the simulation are similar to scenario one in structure. In scenario two, the solution to the problem posed is a buoyant emergency ascent; in scenario three, the answer is an alternate air source ascent; and the solution in scenario four is a buddy breathing ascent.

The exact content of the cards, and the links between cards, vary between scenarios. The following pages contain the network diagrams and cards for scenarios two, three and four.



Scenario Two

**Scenario Two**

You are diving in tropical waters, in approximately 95 feet of salt water.

While you were photographing some spectacular basket sponges, you managed to lose track of your buddy. Even with the hundred-foot plus visibility, you can't see any sign of her. Quite a distance away, you see the reflections of

- Take More Pictures
- Inflate BC
- Purge Regulator
- Swim To Bubbles
- Keep Looking
- Check Gauge
- Stay Here
- Ditch Weight Belt
- Deflate BC
- Ascend



Card 1. Begin.

**Scenario Two**

One of the gauges reads 100, the other reads 0.

You had to suck quite hard to get your last breath. It was probably the last full breath you will get.

What now?

- Ascend a Little
- Search for Buddy
- Purge Regulator
- Swim To Surface
- Deflate BC
- Try Octopus
- Inflate BC
- Wait Here
- Breathe From BC
- Ditch Weight Belt



Card 2. Checking Gauge.



### Scenario Two

You remove your weight belt, hold it away from you, and drop it.

You begin to rise towards the surface.

What now?

- |                    |                    |
|--------------------|--------------------|
| Continue Ascending | Inflate BC         |
| Deflate BC         | Use Octopus        |
| Watch Gauge        | Look Up            |
| Swim to Surface    | Purge Regulator    |
| Take a Picture     | Spit Out Regulator |



Card 3. Ditching Weight Belt.

### Scenario Two

You look up as you ascend, and steer a bit to one side to avoid a fishing net which has drifted above you.

You feel the urge to inhale.

What do you want to do next?

- |                 |                   |
|-----------------|-------------------|
| Try Octopus     | Breathe From BC   |
| Swim to Surface | Look for Buddy    |
| Watch Gauge     | Pull CO2 Inflator |
| Hold Breath     | Purge Regulator   |
| Reach Up        | Inflate BC        |



Card 4. Looking Up.

### Scenario Two

You are ascending, looking up and reaching up. You have successfully avoided the fishing net.

What now?

- Exhale Steadily
- Breathe From BC
- Look For Buddy
- Inflate BC
- Watch Gauge
- Pull CO2 Inflator
- Try Octopus
- Purge Regulator
- Spit Out Regulator
- Hold Breath



Card 5. Reaching Up.

### Scenario Two

After what seems like an eternity, you break the surface, and find your buddy there, organizing a search party for you.

Everyone is quite relieved that you are all right.

Congratulations! You have successfully performed a BUOYANT EMERGENCY ASCENT.

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 6. Success.

**Scenario Two**

You ascend to approximately 60 feet, and can now breathe a little easier.

You stop to examine an extremely rare find, a rhinoceros nudibranch, which dances elegantly before you.

What will you do?

- |                   |                |
|-------------------|----------------|
| Swim to Surface   | Deflate BC     |
| Check Gauge       | Look Up        |
| Swim Around       | Inflate BC     |
| Watch Nudibranch  | Take a Picture |
| Ditch Weight Belt | Try Octopus    |



Card 7. At 60 Feet.

**Scenario Two**

In your hurry to get to the surface, you neglected to notice that a fisherman's net was drifting above you.

You have become entangled in the net, but you are still getting a trickle of air from your regulator.

What now?

- |                    |                 |
|--------------------|-----------------|
| Wait For Buddy     | Thrash Around   |
| Deflate BC         | Untangle Self   |
| Breathe From BC    | Purge Regulator |
| Cut Net With Knife | Try Octopus     |
| Inflate BC         | Swim to Surface |



Card 8. Entangled.

**Scenario Two**

Above you, there is a fishing net drifting loose. You move out from underneath it.

Your air situation is now desperate.

What will you do?

- |                   |                 |
|-------------------|-----------------|
| Swim to Surface   | Breathe From BC |
| Pull CO2 Inflator | Inflate BC      |
| Ditch Weight Belt | Look for Buddy  |
| Check Gauge       | Wait for Buddy  |
| Try Octopus       | Deflate BC      |



Card 9. Free From Net.

**Scenario Two**

As you look around, everything suddenly becomes strangely unfamiliar. You're not sure where you are.

Your regulator is hardly giving you any air, and you are on the verge of panic.

What will you do?

- |                 |                   |
|-----------------|-------------------|
| Inflate BC      | Ditch Weight Belt |
| Check Gauge     | Start Ascending   |
| Try Octopus     | Pull CO2 Inflator |
| Swim To Surface | Look For Buddy    |
| Deflate BC      | Look Up           |



Card 10. Lost.

File Edit Go Tools Objects





### Scenario Two

You swim into a canyon of coral, and suddenly notice a menacing shark circling overhead, blocking your route to the surface.

You are having great difficulty breathing.

What do you want to do?

|                 |                   |
|-----------------|-------------------|
| Take a Picture  | Swim to Surface   |
| Deflate BC      | Ditch Weight Belt |
| Wait Here       | Breathe From BC   |
| Swim Around     | Pray to Neptune   |
| Purge Regulator | Inflate BC        |

Card 11. Watching Shark.

File Edit Go Tools Objects





### Scenario Two

Just as you remove the regulator from your mouth, a grouper bumps you in the back of the head. You drop the regulator, and can't find it anywhere.

No matter what you try, you can't get any air from your BC or your octopus.

What now?

|                    |                 |
|--------------------|-----------------|
| Photograph Grouper | Hold Breath     |
| Look for Buddy     | Swim to Surface |
| Pull CO2 Inflator  | Deflate BC      |
| Recover Regulator  | Look Up         |
| Inflate BC         | Find Octopus    |

Card 12. Dropped Regulator.

### Scenario Two

As you fumble with your regulator, the purge button sticks, causing you to panic. You inhale some seawater, and then bolt for the surface.

In the process, you manage to give yourself an air embolism. As you reach the surface, you go unconscious, and spend the next three weeks in a coma.

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 13. Injured - Air Embolism.

### Scenario Two

You ascend too rapidly, and feel increasing pain in your knees and elbows as you ascend.

You manage to make it to the surface, where your buddy is waiting for you. She swears never to dive with you again.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 14. Injured - Decompression Sickness (The Bends).

### Scenario Two

You made it past the fishing net, but since you weren't paying attention, you managed to swim right into the dive boat.

The propeller takes a nasty bite out of your shoulder. Consider yourself lucky. It could have been your head.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 15. Injured - Hit By Boat.

### Scenario Two

As you ascend, you feel a pain in your chest. You hit your head on the barnacle-covered keel of the boat, and finally reach the surface, bleeding profusely from the gash in your head, and coughing up red, frothy mucus.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 16. Injured - Head Laceration and Pneumothorax (Ruptured Lung).

### Scenario Two

When your camera is recovered several years later, the authorities are shocked to see the last exposure on the roll.

It is a picture of you, wide-eyed and panic-stricken.

"Serves the fool right", mumbles one of the Coast Guard investigators.

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 17. Dead - Camera Found.

### Scenario Two

Poor choice. You go into an uncontrolled descent, hurtling down the wall you were diving next to.

The last thing you remember is the cold darkness, and then a wonderful feeling as the effects of narcosis set in.

You are never heard from again.

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 18. Dead - Nitrogen Narcosis.



### Scenario Two

Unfortunately, there is not enough air left in your tank. You hold your breath as long as possible, then cough and gasp as the icy seawater fills you lungs.

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 19. Dead - Out Of Air.

### Scenario Two

The shark smiles a fat grin as he sees you rise from among the coral, then arches his fins, and relieves you of your midsection with his razor-sharp teeth.

**\*\* YOU HAVE DIED \*\***

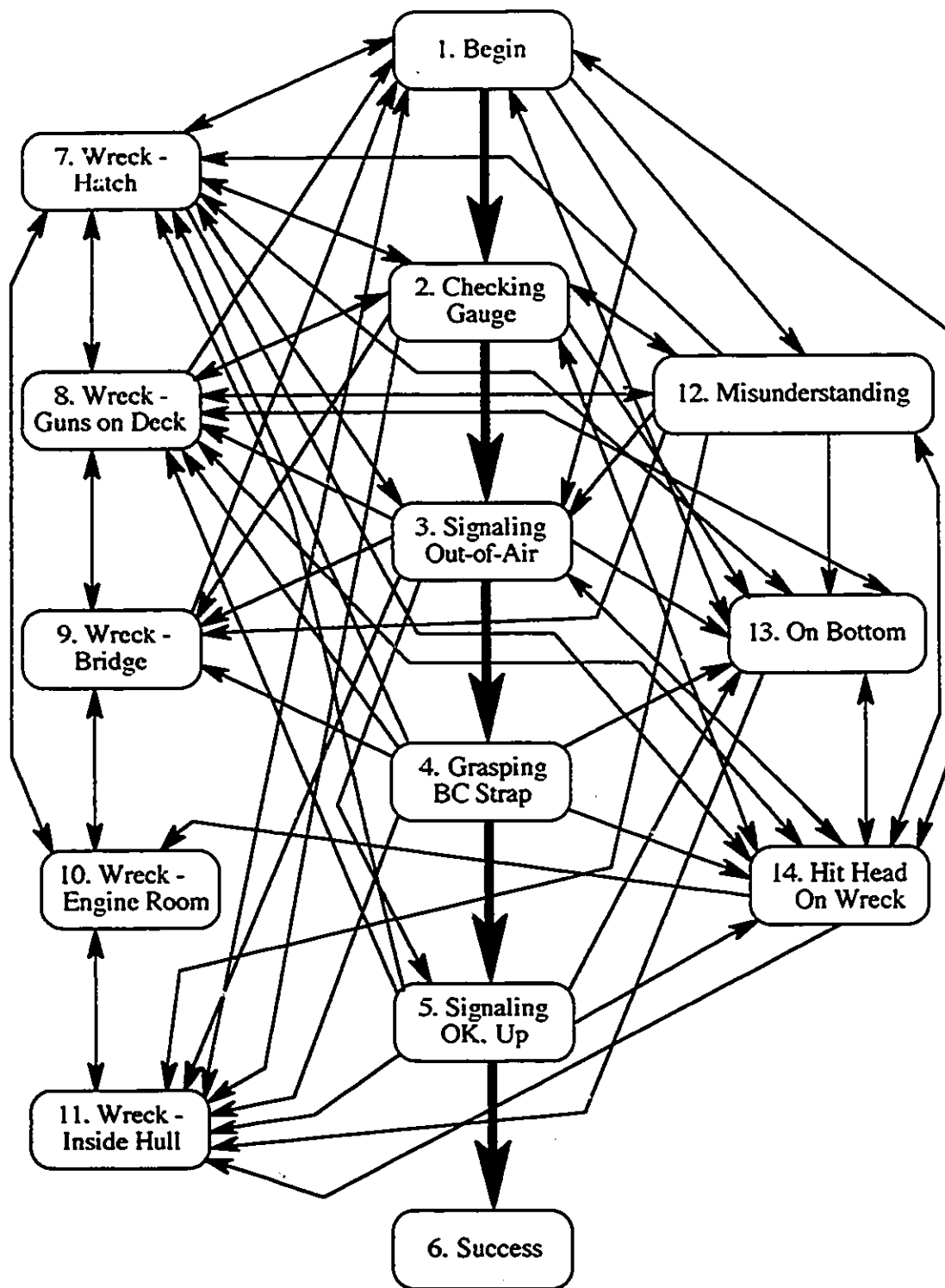
I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 20. Dead - Shark Attack.



Scenario Three

### Scenario Three

You are diving with your buddy on a famous wreck in the Great Lakes region. As you dive alongside the ship's hull, you notice that the regulator is breathing rather hard.

Your buddy does not notice that you are having a problem.

What will you do?

- |                   |                     |
|-------------------|---------------------|
| Enter Wreck       | Inflate BC          |
| Deflate BC        | Check Gauge         |
| Signal Out-of-Air | Ditch Weight Belt   |
| Swim Upward       | Get Buddy's Octopus |
| Pull Buddy's Leg  | Follow Buddy        |



Card 1. Begin.

### Scenario Three

According to your gauge, you are at a depth of approximately 70 feet, and you have about 50 psi of air left.

Your buddy is still oblivious to your problem.

What do you want to do?

- |                     |                   |
|---------------------|-------------------|
| Signal Out-of-Air   | Ditch Weight Belt |
| Ascend Slowly       | Take Buddy's Reg  |
| Get Buddy's Octopus | Enter Wreck       |
| Follow Buddy        | Swim Along Wreck  |
| Deflate BC          | Inflate BC        |



Card 2. Checking Gauge.

File Edit Go Tools Objects



### Scenario Three

Your buddy looks puzzled for a second, then offers you his regulator and starts breathing from his octopus.

You are relieved to have some air again.

What now?

|                   |                  |
|-------------------|------------------|
| Grasp Buddy's BC  | Deflate BC       |
| Signal Ok, Up     | Enter Wreck      |
| Inflate BC        | Swim Downward    |
| Follow Buddy      | Swim Upward      |
| Ditch Weight Belt | Swim Along Wreck |

Card 3. Signaling Out-of-Air.



File Edit Go Tools Objects

### Scenario Three

Your buddy responds by holding on to your BC strap.

Now what?

|                  |                   |
|------------------|-------------------|
| Swim Upward      | Deflate BC        |
| Swim Downward    | Signal OK, Up     |
| Follow Buddy     | Inflate BC        |
| Enter Wreck      | Continue Diving   |
| Swim Along Wreck | Ditch Weight Belt |

Card 4. Grasping BC Strap.

### Scenario Three

Your buddy returns the 'OK' and 'Up' signals.

He looks at you as if he were waiting for something.

What will you do?

- Inflate BC
- Deflate BC
- Follow Buddy
- Enter Wreck
- Descend Slowly
- Ditch Weight Belt
- Swim Along Wreck
- Swim Upward
- Swim Downward
- Ascend Slowly



Card 5. Signaling OK, Up.

### Scenario Three

You and your buddy arrive together at the surface. You feel good knowing that you were able to handle an out-of-air situation.

Congratulations! You have satisfactorily performed an **ALTERNATE AIR SOURCE ASCENT.**

The important points are:

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 6. Success.

### Scenario Three

You ascend a little, and then pause as you come to a hatch in the hull of the ship. Your buddy follows you, although he looks somewhat annoyed.

What now?

- Enter Hatch
- Move Fore
- Move Aft
- Move Port
- Move Starboard
- Deflate BC
- Inflate BC
- Check Gauge
- Signal Out-of-Air
- Ditch Weight Belt



Card 7. Wreck - Hatch.

### Scenario Three

You come to a section of the ship where there are large guns on deck. Your buddy sits on one of the guns as if he were riding a horse.

Your regulator emits a startling honk as it delivers its last breath of air.

What now?

- Ride Cannon
- Move Fore
- Move Aft
- Move Port
- Move Starboard
- Deflate BC
- Inflate BC
- Check Gauge
- Get Buddy's Octopus
- Ditch Weight Belt



Card 8. Wreck - Guns on Deck.

**Scenario Three**

You find yourself on the bridge, with views to the fore, port and starboard.

Your buddy is pretending that he is the captain of the vessel.

There is a hatch to the aft.

What will you do?

- Enter Hatch
- Move Fore
- Move Aft
- Move Port
- Move Starboard
- Swim Along Wreck
- Swim Downward
- Swim Upward
- Pull C02 Inflator
- Ditch Weight Belt



Card 9. Wreck - Bridge.

**Scenario Three**

You are in the engine room. There is an opening to the fore, a dark hole to the aft, a hatch to the starboard, and another room to the port.

What will you do?

- Exit Wreck
- Move Fore
- Move Aft
- Move Port
- Move Starboard
- Swim Upward
- Swim Downward
- Inflate BC
- Deflate BC
- Pull C02 Inflator



Card 10. Wreck - Engine Room.

File Edit Go Tools Objects



### Scenario Three

You are inside the deteriorating wreck. It is dark here, and you cannot see.

You hear the wreck moan and creak as it rocks under the waves.

What will you do?

- Exit Wreck
- Swim Up
- Move Fore
- Swim Down
- Move Aft
- Inflate BC
- Move Port
- Deflate BC
- Move Starboard
- Ditch Weight Belt

Card 11. Wreck - Inside Hull.



File Edit Go Tools Objects

### Scenario Three

Your buddy misinterprets your actions, and pushes away from you. He scolds you silently, then turns and continues diving on the wreck.

What now?

- Check Gauge
- Enter Wreck
- Follow Buddy
- Deflate BC
- Inflate BC
- Signal Out-of-Air
- Swim to Surface
- Ditch Weight Belt
- Swim Along Wreck
- Pull CO2 Inflator

Card 12. Misunderstanding.



**Scenario Three**

You sink a little way, and come to rest on the bottom. There is a huge brass bell here, which you know is previously undiscovered.

You have lost track of your buddy, and it is getting very difficult to breathe.

What do you want to do?

- Inflate BC
- Deflate BC
- Retrieve Bell
- Look for Buddy
- Look at Bell
- Ditch Weight Belt
- Enter Wreck
- Swim Along Wreck
- Swim Upward
- Swim Downward



Card 13. On Bottom.

**Scenario Three**

You begin ascending rapidly, then hit your head hard on the wreck.

You manage to hang on to a large cleat long enough for your buddy to retrieve your weight belt. You struggle for a while, then finally manage to get it back on.

Your buddy is not happy with you at all.

- Enter Wreck
- Check Gauge
- Swim Downward
- Swim Upward
- Signal Out-of-Air
- Get Buddy's Octopus
- Inflate BC
- Deflate BC
- Swim Along Wreck
- Follow Buddy



Card 14. Hit Head On Wreck.

### Scenario Three

You can't go that way.

As you bump into the wreck, a beam falls, hits you on the head and knocks you unconscious.

Your buddy manages to rescue you, but just barely.

**\*\* YOU ARE INJURED \*\***

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 15. Injured - Concussion.

### Scenario Three

You lift the bell toward the surface, and get about halfway before you manage to drop it. The bell hits your buddy below you, killing him instantly, and you shoot up to the surface, acquiring an air embolism in the process.

**\*\* YOU ARE INJURED \*\***

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 16. Injured - Air Embolism.

### Scenario Three

There is an inscription on the bell, and as you begin to read it, your regulator stops delivering air altogether.

You bolt for the surface, and give yourself the bends as you ascend too rapidly.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 17. Injured - Decompression Sickness (The Bends).

### Scenario Three

You ascend too rapidly, and feel pain in your joints as you ascend.

When you reach the surface, the divemaster curses, and then reaches for the radio to call for an ambulance.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 18. Injured - Decompression Sickness (The Bends).

### Scenario Three

You enter a dark room where, unknown to you, there resides a rather repulsive sea monster.

The last thing you feel is the sea monster's fangs biting into the back of your neck.

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 19. Dead - Sea Monster.

### Scenario Three

You enter a room which appears to have been a storage area for tools. As your buddy enters behind you, you hear a loud groan as the wreck settles, pinning both of you in the process. You hold your breath until finally, you cannot resist gasping for air (of which there is no more).

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 20. Dead - Pinned In Wreck.

Scenario Three

That is a definite no-no when inside a wreck. Your positive buoyancy pins you to the ceiling, and though your buddy struggles to save you, he is forced to watch helplessly while you expire your last precious breath of air.

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 21. Dead - Pinned to Ceiling.

Scenario Three

That was quite foolish, I must say. As you mount the cannon, a section of the hull collapses, and you fall into the gaping hole below. A moment later, the cannon shifts and falls on top of you, pinning you underneath it.

You hold out as long as you can, but finally cannot resist the urge to inhale. Your lungs fill

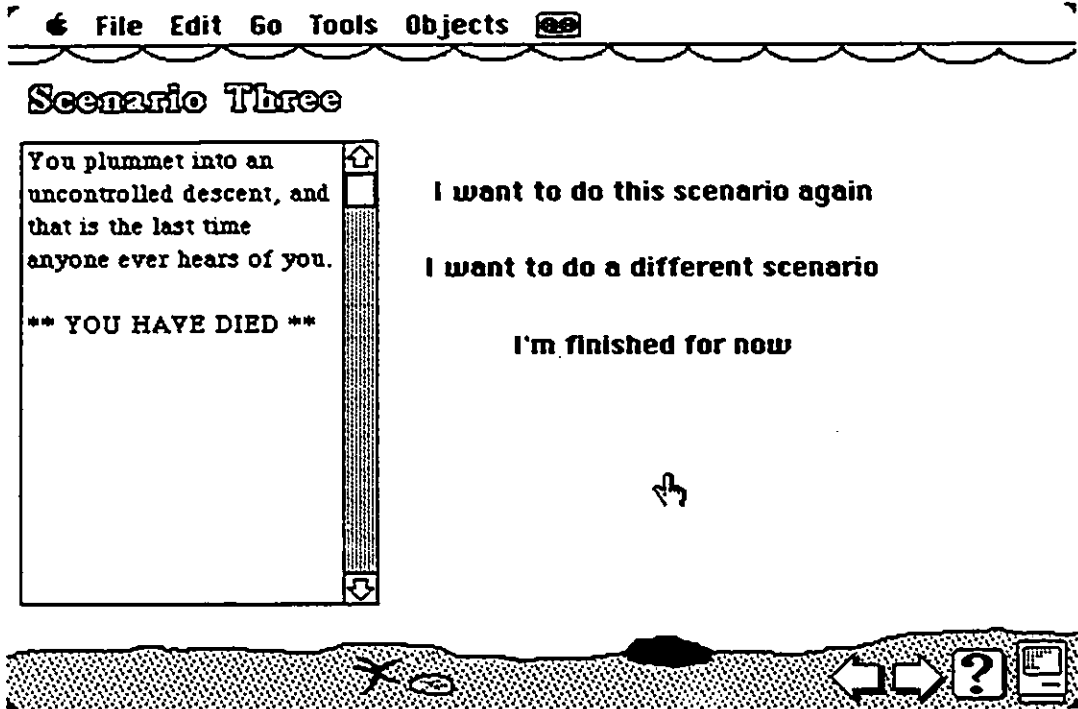
I want to do this scenario again

I want to do a different scenario

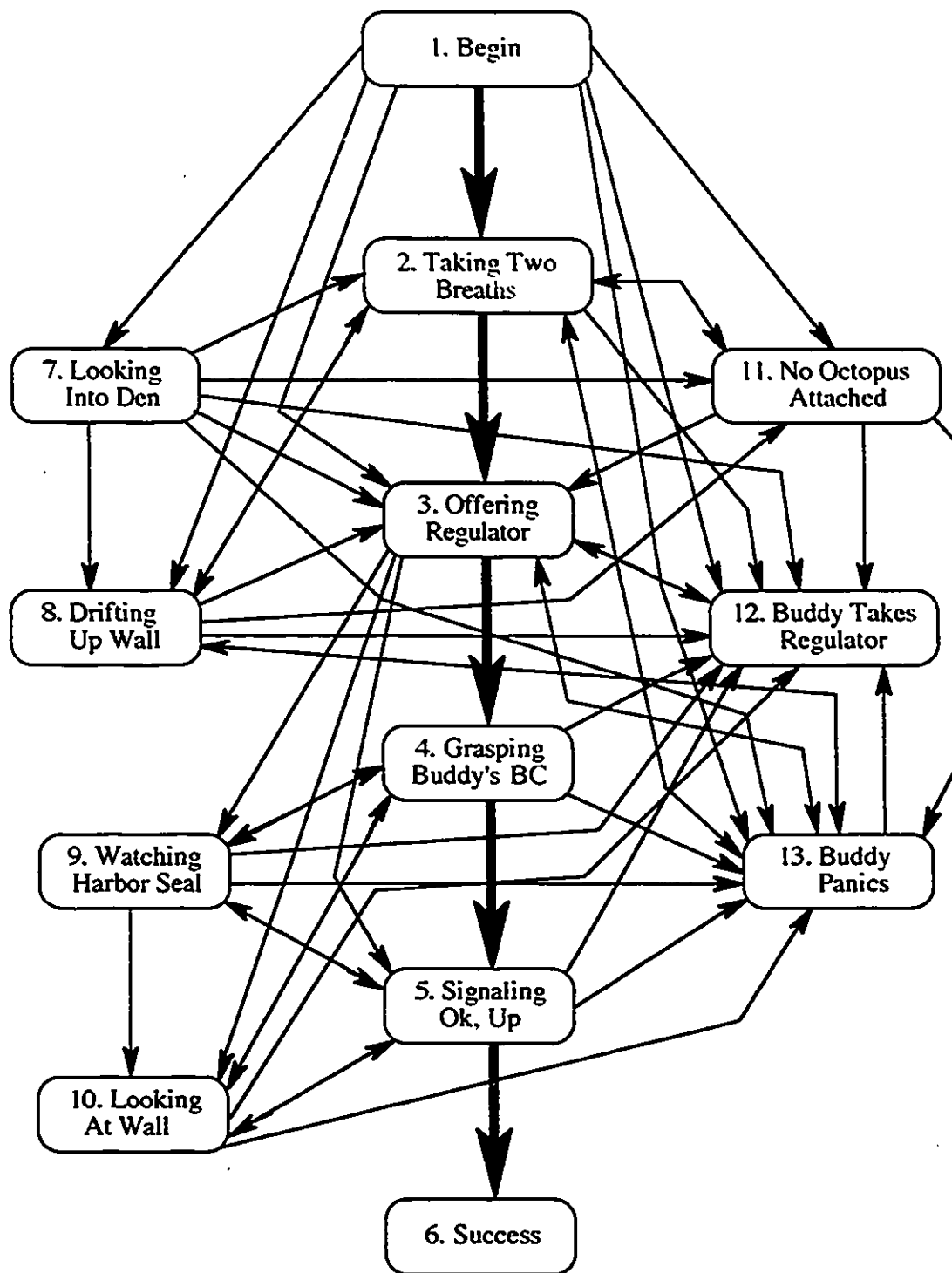
I'm finished for now



Card 22. Dead - Pinned By Cannon.



Card 23. Dead - Uncontrolled Descent.



Scenario Four

**Scenario Four**

You are diving in the cold waters of the Pacific Northwest. You and your buddy have been having a very enjoyable dive, playing with an octopus you found outside of his den.

You have managed to lose track of time, and suddenly your buddy looks at her gauge and gives you the 'Out-of-Air'

- Look into Den
- Inflate BC
- Take Two Breaths
- Deflate BC
- Check Buddy's Gauge
- Offer Regulator
- Descend Slowly
- Offer Octopus
- Ascend Slowly
- Signal OK, Up



Card 1. Begin.

**Scenario Four**

Your buddy waits patiently while you take two breaths. She is eyeing your regulator intently.

What do you want to do?

- Inflate BC
- Swim Upward
- Deflate BC
- Swim Downward
- Inflate Buddy's BC
- Get Buddy's Reg
- Offer Octopus
- Ditch Her Weights
- Offer Regulator
- Check Buddy's Gauge



Card 2. Taking Two Breaths.



**Scenario Four**

Your buddy gratefully receives the regulator, takes two breaths, and then offers it back to you. She blows tiny bubbles while she waits for you to take your turn.

Both of you are careful to hold on to the regulator without covering the purge button. Together, you establish the familiar cycle of buddy breathing.

- Swim Around
- Ascend Slowly
- Descend Slowly
- Follow Buddy
- Signal OK, Up
- Grasp Buddy's BC
- Inflate Buddy's BC
- Deflate Buddy's BC
- Check Buddy's Gauge
- Set Buddy's Reg



Card 3. Offering Regulator.

**Scenario Four**

With your left hand, you grasp your buddy's right BC shoulder strap. She responds by doing the same to you.

The buddy breathing cycle continues.

Now what?

- Continue Dive
- Ditch Her Weights
- Signal Ok, Up
- Check Buddy's Gauge
- Follow Buddy
- Inflate BC
- Deflate BC
- Ascend Slowly
- Descend Slowly
- Pull CO2 Inflator



Card 4. Grasping Buddy's BC.

### Scenario Four

Your buddy returns the 'OK' and 'Up' signals, and watches to see what you will do next.

What will you do?

- Inflate BC
- Ascend Slowly
- Deflate BC
- Descend Slowly
- Follow Buddy
- Check Gauge
- Pull C02 Inflator
- Purge Regulator
- Ditch Weight Belt
- Check Buddy's Gauge



Card 5. Signaling Ok. Up.

### Scenario Four

You ascend together slowly, continuing the buddy breathing cycle. When you reach the surface, your buddy thanks you profusely, and extols the virtues of your diving skill to the dive boat's skipper. The Skipper promptly offers you a job as divemaster aboard the HMS Scumbucket. You are flattered, but graciously

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 6. Success.

File Edit Go Tools Objects


### Scenario Four

You look into the den and find that it belongs to a Wolf Eel, not the Octopus.

Your buddy gives you the 'Out-of-Air' signal again, this time a little more frantically.

What now?

|                  |                   |
|------------------|-------------------|
| Feed Wolf Eel    | Offer Regulator   |
| Take Two Breaths | Offer Octopus     |
| Inflate BC       | Swim Upward       |
| Deflate BC       | Swim Downward     |
| Watch Wolf Eel   | Pull CO2 Inflator |



Card 7. Looking Into Den.

File Edit Go Tools Objects


### Scenario Four

You drift slowly up a wall, plastered with plumose anemones.

Your buddy follows, then starts tugging at your leg. She looks quite disturbed.

What now?

|                 |                    |
|-----------------|--------------------|
| Inflate BC      | Ditch Her Weights  |
| Deflate BC      | Inflate Buddy's BC |
| Look at Anemone | Deflate Buddy's BC |
| Offer Octopus   | Pull CO2 Inflator  |
| Offer Regulator | Take Two Breaths   |



Card 8. Drifting Up Wall.

**Scenario Four**

As you tour the area, a harbor seal takes a liking to you and your buddy.

He begins darting toward you, veering away only inches from your mask.

What will you do?

- |             |                  |
|-------------|------------------|
| Inflate BC  | Grasp Buddy's BC |
| Deflate BC  | Signal OK, Up    |
| Watch Seal  | Ascend Slowly    |
| Feed Seal   | Descend Slowly   |
| Follow Seal | Follow Buddy     |



Card 9. Watching Harbor Seal.

**Scenario Four**

You wonder at the beauty of the sunlight filtering through the arms of the thousands of anemones which cover the wall next to you.

Your buddy is having difficulty staying next to you, and keeps pulling on the regulator hose.

What will you do?

- |                  |                   |
|------------------|-------------------|
| Signal OK, Up    | Pull CO2 Inflator |
| Deflate BC       | Look At Anemone   |
| Inflate BC       | Signal Out-of-Air |
| Grasp Buddy's BC | Descend Slowly    |
| Purge Regulator  | Ditch Weight Belt |



Card 10. Looking At Wall.

**Scenario Four**

Unfortunately, your regulator does not have an octopus attached.

Your buddy has a crazed look in her eyes.

What now?

- |                  |                     |
|------------------|---------------------|
| Inflate BC       | Inflate Buddy's BC  |
| Deflate BC       | Deflate Buddy's BC  |
| Take Two Breaths | Swim Upward         |
| Offer Regulator  | Turn Her Tank Valve |
| Purge Regulator  | Ditch Weight Belt   |



Card 11. No Octopus Attached.

**Scenario Four**

Your buddy panics, and before you can react, she manages to rip the regulator out of your mouth.

Your buddy is breathing from your regulator.

What now?

- |                      |                    |
|----------------------|--------------------|
| Take Regulator       | Purge Regulator    |
| Signal Buddy Breathe | Swim Downward      |
| Hit Your Buddy       | Inflate BC         |
| Stab Buddy's BC      | Deflate BC         |
| Ditch His Weights    | Ditch Your Weights |



Card 12. Buddy Takes Regulator.

### Scenario Four

Your buddy begins to panic, and starts grabbing at your face.

You manage to bring your foot up and give her a gentle kick in the chest, pushing her away.

She looks as if she is about to come after you again.

What do you want to do?

- Purge Regulator
- Take Two Breaths
- Turn Tank Valve
- Ditch Her Weights
- Ditch Your Weights
- Offer Regulator
- Inflate Her BC
- Deflate Her BC
- Inflate Your BC
- Deflate Your BC



Card 13. Buddy Panics.

### Scenario Four

Your buddy panics and bolts for the surface. In the process, she ruptures a lung, and is hauled aboard the dive boat in excruciating pain.

When she explains to the crew what happened, the skipper harpoons you.

**\*\* YOU ARE INJURED \*\***

- I want to do this scenario again
- I want to do a different scenario
- I'm finished for now



Card 14. Injured - Buddy Panics.

### Scenario Four

Your buddy holds on to you, and together you zoom toward the surface.

Both of you arrive at the surface with a case of the bends. Your buddy musters enough strength to give you a black eye.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 15. Injured - Decompression Sickness (The Bends).

### Scenario Four

You push the button, and the regulator begins to free flow. Your buddy socks you a good one in the nose, breaking it.

Both of you manage to get to the surface, where your buddy makes sure that your nose is broken in several places, not just one.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 16. Injured - Free Flow and Broken Nose.

### Scenario Four

You watch the seal as it becomes more and more daring with each pass.

Finally, it knocks your mask off, and the sting of the salt water in your eyes causes you to panic.

You rush to the surface, giving yourself a mild case of the bends.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 17. Injured - Lost Mask and Panic.

### Scenario Four

You nab a nearby scallop, crack it open, and offer the meat inside, only to have your hand bitten badly.

Your hand bleeds profusely, and it hurts like \*&%\$#%.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 18. Injured - Wolf Eel Bite.



### Scenario Four

You inadvertently shut your buddy's air completely off. She thinks you are trying to drown her, and in her panic, pulls her dive knife and gives you a gash in the torso.

**\*\* YOU ARE INJURED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 19. Injured - Stabbed By Buddy.

### Scenario Four

Your buddy retaliates by jabbing a hole in your BC with her dive knife.

You sink to the bottom and are never seen again, while she is left to spin a fantastic yarn about how you were attacked by a killer harbor seal.

**\*\* YOU HAVE DIED \*\***

I want to do this scenario again

I want to do a different scenario

I'm finished for now



Card 20. Dead - Attacked By Buddy.

**APPENDIX II**  
**Experience Survey**

## Experience Survey

**PART I :** Please provide some background about your previous experience in diving / water sports.

1. Do you have previous experience in SCUBA diving? Yes No
2. How many years' experience do you have? \_\_\_\_\_
3. How many times did you SCUBA dive in the past year?  
\_\_\_\_\_ 0  
\_\_\_\_\_ 1-5  
\_\_\_\_\_ 6-10  
\_\_\_\_\_ 11-15  
\_\_\_\_\_ 16 +
4. Estimate the average depth ( in feet ) of the dives you have made in the past year. \_\_\_\_\_
5. Do you have previous experience in other water sports? (swimming, windsurfing, snorkeling, canoeing, kayaking, waterskiing, etc.) Yes No
6. If you answered yes to #5 above, list the three water sports which you participate in most often.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. Describe briefly your reasons for taking this course:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**PART II : Please provide some background about your previous experience with computers.**

1. Do you have access to a computer? Yes    No
2. How many years' experience do you have? \_\_\_\_\_
3. Estimate how often you use a computer. \_\_\_\_\_ daily  
\_\_\_\_\_ several times / week  
\_\_\_\_\_ once per week  
\_\_\_\_\_ several times per month  
\_\_\_\_\_ once per month or less
4. Do you have a computer at home? Yes    No
5. What three software items do you use most frequently? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. Can you write computer programs? Yes    No
7. What computer languages, if any have you programmed in?
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**PART III : Please provide the following personal information:**

1. Name: \_\_\_\_\_
2. Sex:        Male                  Female
3. Age in years: \_\_\_\_\_

**APPENDIX III**  
**Attitude Survey**

## Attitude Survey

**PART I :** Please indicate your opinion about the following statements by circling the appropriate number.

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neutral
- 4 = Agree
- 5 = Strongly Agree

|  | SD | D | N | A | SA |
|--|----|---|---|---|----|
| 1. Diving is fun.  | 1  | 2 | 3 | 4 | 5  |
| 2. The idea of breathing underwater makes me nervous.  | 1  | 2 | 3 | 4 | 5  |
| 3. Everyone can learn to dive safely.  | 1  | 2 | 3 | 4 | 5  |
| 4. Diving should be reserved for those who are physically fit.                                       | 1  | 2 | 3 | 4 | 5  |
| 5. Diving is a very strenuous activity.  | 1  | 2 | 3 | 4 | 5  |
| 6. I enjoy the thrill of exploring underwater.   | 1  | 2 | 3 | 4 | 5  |
| 7. It scares me to think of what I might encounter while diving.                                     | 1  | 2 | 3 | 4 | 5  |
| 8. It is not important to understand the underwater environment.                                     | 1  | 2 | 3 | 4 | 5  |
| 9. It is imperative that we do not spoil or waste nature's underwater resources.                     | 1  | 2 | 3 | 4 | 5  |
| 10. Divers should be conservation-minded.  | 1  | 2 | 3 | 4 | 5  |
| 11. I do not feel capable of handling minor diving emergencies.                                      | 1  | 2 | 3 | 4 | 5  |
| 12. I would feel comfortable diving underwater.  | 1  | 2 | 3 | 4 | 5  |
| 13. I am an asset to my diving partners.   | 1  | 2 | 3 | 4 | 5  |
| 14. As our society's demands increase, we will become more dependent on the ocean and its resources. | 1  | 2 | 3 | 4 | 5  |
| 15. Technology has had little impact on the diving industry.   | 1  | 2 | 3 | 4 | 5  |
| 16. If I ran out of air underwater, I would not know what to do.                                     | 1  | 2 | 3 | 4 | 5  |

|   | SD | D | N | A | SA |
|---|----|---|---|---|----|
| 17. Diving enriches other areas of my life.                                 | 1  | 2 | 3 | 4 | 5  |
| 18. In a diving emergency, I would most likely panic.                       | 1  | 2 | 3 | 4 | 5  |
| 19. I hope to continue diving for many years.                               | 1  | 2 | 3 | 4 | 5  |
| 20. Diving provides me with rich, rewarding experiences.                    | 1  | 2 | 3 | 4 | 5  |
| 21. Divers are rugged individualists.                                       | 1  | 2 | 3 | 4 | 5  |
| 22. I could not have learned to dive without this course.                   | 1  | 2 | 3 | 4 | 5  |
| 23. The underwater environment is dangerous.                                | 1  | 2 | 3 | 4 | 5  |
| 24. Not everyone should try diving.   | 1  | 2 | 3 | 4 | 5  |
| 25. Learning to dive teaches one to act responsibly.                        | 1  | 2 | 3 | 4 | 5  |
| 26. I am not interested in learning more about the ocean.                   | 1  | 2 | 3 | 4 | 5  |
| 27. As a diver, I am responsible for the safety of my diving partners.      | 1  | 2 | 3 | 4 | 5  |
| 28. Underwater parks and marine reserves are not a good idea.               | 1  | 2 | 3 | 4 | 5  |
| 29. It would bother me to be far beneath the water's surface.               | 1  | 2 | 3 | 4 | 5  |
| 30. I don't like the idea of being dependent on diving equipment for air.   | 1  | 2 | 3 | 4 | 5  |
| 31. I am confident that I can learn to handle almost any problem in diving. | 1  | 2 | 3 | 4 | 5  |
| 32. I am not interested in gaining more diving experience.                  | 1  | 2 | 3 | 4 | 5  |
| 33. A diver must know his/her personal limits.                              | 1  | 2 | 3 | 4 | 5  |
| 34. Diving plays an important role in many other industries.                | 1  | 2 | 3 | 4 | 5  |
| 35. Learning to dive has taught me many scientific principles.              | 1  | 2 | 3 | 4 | 5  |

PART II : Please indicate your opinion about the following statements by circling the appropriate number.

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neutral
- 4 = Agree
- 5 = Strongly Agree

|   | SD | D | N | A | SA |
|---|----|---|---|---|----|
| 1. I would feel comfortable working with a computer.  | 1  | 2 | 3 | 4 | 5  |
| 2. Computers will improve our society.  | 1  | 2 | 3 | 4 | 5  |
| 3. Computers are not very important to me in my work.   | 1  | 2 | 3 | 4 | 5  |
| 4. The idea of using a computer makes me shudder.   | 1  | 2 | 3 | 4 | 5  |
| 5. As jobs become increasingly oriented toward the use of information, society demands and rewards those who know how to use computers. | 1  | 2 | 3 | 4 | 5  |
| 6. Computer literacy is important if an individual is to succeed in today's world.  | 1  | 2 | 3 | 4 | 5  |
| 7. I get nervous whenever I have to operate new technology.   | 1  | 2 | 3 | 4 | 5  |
| 8. Personal choice and freedom in some areas of life are restricted by computers.   | 1  | 2 | 3 | 4 | 5  |
| 9. If there was a computer terminal in my classroom it would help me to be a better student.  | 1  | 2 | 3 | 4 | 5  |
| 10. Computer users have an unemotional view of life.  | 1  | 2 | 3 | 4 | 5  |
| 11. I will never feel comfortable if ever I have to use a computer in my work or career.  | 1  | 2 | 3 | 4 | 5  |
| 12. Computers have raised the quality of life in my province.   | 1  | 2 | 3 | 4 | 5  |
| 13. Computers are extremely frustrating machines.   | 1  | 2 | 3 | 4 | 5  |
| 14. Computers concentrate too much power in the hands of experts.   | 1  | 2 | 3 | 4 | 5  |
| 15. Increased use of computers would relieve people of routine duties and help them to make fuller use of their capabilities.           | 1  | 2 | 3 | 4 | 5  |



|   | SD | D | N | A | SA |
|---|----|---|---|---|----|
| 16. Computers will make it harder for people to find jobs.  | 1  | 2 | 3 | 4 | 5  |
| 17. The ability to use computers is as basic and necessary to a person's formal education as reading, writing and arithmetic.                   | 1  | 2 | 3 | 4 | 5  |
| 18. I am very contented when I am working on a computer.  | 1  | 2 | 3 | 4 | 5  |
| 19. Computers are not very important to most people.  | 1  | 2 | 3 | 4 | 5  |
| 20. Material which is otherwise boring would be interesting when presented using a microcomputer.   | 1  | 2 | 3 | 4 | 5  |
| 21. Computers are eliminating jobs.   | 1  | 2 | 3 | 4 | 5  |
| 22. Everyone should be computer literate, i.e. aware of the basic operation of a computer.  | 1  | 2 | 3 | 4 | 5  |
| 23. Computer users are insensitive people.  | 1  | 2 | 3 | 4 | 5  |
| 24. Computers are beyond the understanding of the average person.   | 1  | 2 | 3 | 4 | 5  |
| 25. In general, if computers and computer output are used to help make decisions, human judgement will be improved.                             | 1  | 2 | 3 | 4 | 5  |
| 26. Over the next decade, sweeping economic and technological transformations will alter the jobs people do and the ways in which they do them. | 1  | 2 | 3 | 4 | 5  |
| 27. Computers are mainly for people who are good at Math and Science.   | 1  | 2 | 3 | 4 | 5  |
| 28. Computers will be important for Canadians in their future work and jobs.  | 1  | 2 | 3 | 4 | 5  |
| 29. In my school, computer assisted instruction should be used by all teachers.   | 1  | 2 | 3 | 4 | 5  |
| 30. It's only a matter of time before computers put people out of work.   | 1  | 2 | 3 | 4 | 5  |
| 31. Computers are a tool, just like a hammer or a saw.  | 1  | 2 | 3 | 4 | 5  |
| 32. Computers dehumanize society by treating everyone like a number.  | 1  | 2 | 3 | 4 | 5  |

- |  | SD | D | N | A | SA |
|--|----|---|---|---|----|
| 33. Computer assisted instruction will help students become more responsible people.   | 1  | 2 | 3 | 4 | 5  |
| 34. If technology continues to develop at its present pace, soon we will be out of work and computers will have taken our place. | 1  | 2 | 3 | 4 | 5  |
| 35. Computer use can bring out human creativity and self-expression.   | 1  | 2 | 3 | 4 | 5  |

**PART III : Please provide the following personal information:**

1. Name: \_\_\_\_\_
2. Sex:        Male                      Female
3. Age in years: \_\_\_\_\_

Item Polarity

Part I

- 1. +
- 2. -
- 3. +
- 4. -
- 5. -
- 6. +
- 7. -
- 8. -
- 9. +
- 10. +
- 11. -
- 12. +
- 13. +
- 14. +
- 15. -
- 16. -
- 17. +
- 18. -
- 19. +
- 20. +
- 21. -
- 22. +
- 23. -
- 24. -
- 25. +
- 26. -
- 27. +
- 28. -
- 29. -
- 30. -
- 31. +
- 32. -
- 33. +
- 34. +
- 35. +

**TOTALS**

18 Items Positively Worded  
17 Items Negatively Worded

Part II

- 1. +
- 2. +
- 3. -
- 4. -
- 5. +
- 6. +
- 7. -
- 8. -
- 9. +
- 10. -
- 11. -
- 12. +
- 13. -
- 14. -
- 15. +
- 16. -
- 17. +
- 18. +
- 19. -
- 20. +
- 21. -
- 22. +
- 23. -
- 24. -
- 25. +
- 26. +
- 27. -
- 28. +
- 29. +
- 30. -
- 31. +
- 32. -
- 33. +
- 34. -
- 35. +

18 Items Positively Worded  
17 Items Negatively Worded

## References

Touchings, David. (1989). *Teacher's Attitudes Toward Computers*. M.A. Thesis : Memorial University of Newfoundland.

**APPENDIX IV**  
**Out-of-Air Emergency Skills Assessment**

## Out-Of-Air Emergency Skills Assessment

The following rating scale is designed to assess the student's performance of out-of-air emergency skills. The six skills to be evaluated are:

1. Controlled Emergency Swimming Ascent.
2. Alternate Air Source - Donor.
3. Alternate Air Source - Recipient.
4. Buddy Breathing - Donor.
5. Buddy Breathing - Recipient.
6. Buoyant Emergency Ascent.

### Instructions :

It is important for the ratings to be accurate. Please ensure that the rating scale is filled out during or immediately after the performance of each skill.

**PART I :** Part one of each skill assessment consists of a checklist of critical subskills. The instructor should complete PART I by checking off only those subskills which were adequately performed by the student.

**PART II :** Part two asks the instructor to rate the student's anxiety and proficiency levels. For the purposes of this assessment, the following definitions should be used:

**Anxiety:** The amount of psychological stress indicated by the student. Signs of anxiety include rapid breathing, wide eyes, and constant exertion. The level of anxiety is indicated by the frequency, duration and intensity of the symptoms observed.

**Proficiency:** The degree of expertise demonstrated by the student in performing the skill. A high level of proficiency is indicated by smooth, controlled performance of the skill, while a low level is indicated by erratic performance and lack of control.

**PART III :** Part three asks the student to rate the his/her own anxiety and proficiency levels. The same definitions apply as for PART II.

**Skill 1 : Controlled Emergency Swimming Ascent**

**PART I : Checklist of critical subskills.**

- Gives "out-of-air" and "up" signals.
- Leaves regulator in mouth.
- Swims slowly toward the surface.
- Exhales continuously.
- Maintains lungs about half full of air.

**PART II : Instructor's Perception of Performance.**

The instructor should answer the following questions:

1. What level of anxiety did you observe in the student while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How would you rate the student's overall proficiency in this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Good | Very<br>Good |
|--------------|------|---------|------|--------------|

**PART III : Student's Perception of Performance.**

The student should answer the following questions:

1. What level of anxiety did you feel while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How well did you perform this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Well | Very<br>Well |
|--------------|------|---------|------|--------------|

**Skill 2 : Alternate Air Source - Donor**

**PART I : Checklist of critical subskills.**

- \_\_\_ Recognizes "out-of-air" signal.
- \_\_\_ Grasps recipient's right forearm with right hand.
- \_\_\_ Removes regulator from mouth and offers it to recipient.
- \_\_\_ Begins breathing from octopus regulator.
- \_\_\_ Signals "ok" and "up" to recipient, ascends with recipient.

**PART II : Instructor's Perception of Performance.**

The instructor should answer the following questions:

1. What level of anxiety did you observe in the student while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How would you rate the student's overall proficiency in this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Good | Very<br>Good |
|--------------|------|---------|------|--------------|

**PART III : Student's Perception of Performance.**

The student should answer the following questions:

1. What level of anxiety did you feel while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How well did you perform this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Well | Very<br>Well |
|--------------|------|---------|------|--------------|



**Skill 3 : Alternate Air Source - Recipient**

**PART I : Checklist of critical subskills.**

- Gives "out-of-air" signal to donor.
- Grasps donor's right forearm with right hand.
- Receives regulator from donor.
- Begins breathing from donor's regulator.
- Recognizes "ok" and "up" signals, ascends with donor.

**PART II : Instructor's Perception of Performance.**

The instructor should answer the following questions:

1. What level of anxiety did you observe in the student while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How would you rate the student's overall proficiency in this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Good | Very<br>Good |
|--------------|------|---------|------|--------------|

**PART III : Student's Perception of Performance.**

The student should answer the following questions:

1. What level of anxiety did you feel while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How well did you perform this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Well | Very<br>Well |
|--------------|------|---------|------|--------------|

**Skill 4 : Buddy Breathing - Donor**

**PART I : Checklist of critical subskills.**

- \_\_\_ Recognizes "out-of-air" signal.
- \_\_\_ Grasps recipient's right shoulder with left hand.
- \_\_\_ Breathes twice, then offers regulator to recipient (repeats cycle).
- \_\_\_ Maintains control of regulator with right hand, exhales tiny bubbles while recipient breathes.
- \_\_\_ Signals "ok" and "up" to recipient, ascends with recipient.

**PART II : Instructor's Perception of Performance.**

The instructor should answer the following questions:

1. What level of anxiety did you observe in the student while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How would you rate the student's overall proficiency in this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Good | Very<br>Good |
|--------------|------|---------|------|--------------|

**PART III : Student's Perception of Performance.**

The student should answer the following questions:

1. What level of anxiety did you feel while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How well did you perform this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Well | Very<br>Well |
|--------------|------|---------|------|--------------|

**Skill 5 : Buddy Breathing - Recipient**

**PART I : Checklist of critical subskills.**

- Gives "out-of-air" signal to donor.
- Grasps donor's left shoulder with right hand.
- Receives regulator from donor, breathes twice (repeats cycle).
- Holds donor's right wrist with left hand, exhales tiny bubbles while donor breathes.
- Recognizes "ok" and "up" signals, ascends with donor.

**PART II : Instructor's Perception of Performance.**

The instructor should answer the following questions:

1. What level of anxiety did you observe in the student while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How would you rate the student's overall proficiency in this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Good | Very<br>Good |
|--------------|------|---------|------|--------------|

**PART III : Student's Perception of Performance.**

The student should answer the following questions:

1. What level of anxiety did you feel while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How well did you perform this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Well | Very<br>Well |
|--------------|------|---------|------|--------------|

**Skill 6 : Buoyant Emergency Ascent**

**PART I : Checklist of critical subskills.**

- \_\_\_ Checks gauge to verify out-of-air situation.
- \_\_\_ Gives "out-of-air" and "up" signals.
- \_\_\_ Locates weights and weight belt buckle, releases buckle using both hands.
- \_\_\_ Holds weights clear and drops them.
- \_\_\_ Swims to the surface, exhaling continuously.

**PART II : Instructor's Perception of Performance.**

The instructor should answer the following questions:

1. What level of anxiety did you observe in the student while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How would you rate the student's overall proficiency in this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Good | Very<br>Good |
|--------------|------|---------|------|--------------|

**PART III : Student's Perception of Performance.**

The student should answer the following questions:

1. What level of anxiety did you feel while performing this skill?

|             |     |          |      |              |
|-------------|-----|----------|------|--------------|
| Very<br>Low | Low | Moderate | High | Very<br>High |
|-------------|-----|----------|------|--------------|

2. How well did you perform this skill?

|              |      |         |      |              |
|--------------|------|---------|------|--------------|
| Very<br>Poor | Poor | Average | Well | Very<br>Well |
|--------------|------|---------|------|--------------|

### References

National Association of Underwater Instructors. (1985). *The NAUI Textbook*. Montclair, CA : National Association of Underwater Instructors.

National Association of Underwater Instructors. (1987). *NAUI Openwater I Scuba Diver Instructor Guide*. Montclair, CA : National Association of Underwater Instructors.

**APPENDIX V**  
**Letters of Consent**

Box 1145  
Raymond, AB  
T0K 2S0  
10 January 1990

Jack Madro  
Subsea Experience  
6928 - 104 Street  
Edmonton, AB  
T6E 2L7

Dear Jack:

As part of the requirements for a Master of Education degree at the University of Lethbridge, I am conducting research into the effects of a computer simulation in SCUBA instruction. A portion of this research involves comparing two groups of students enrolled in a SCUBA program, one which uses the simulation as part of their instruction, and one which does not. Students are surveyed with respect to their knowledge, skills and attitudes, and may be interviewed to determine their views on the computer simulation.

It has come to my attention through Rick Mrazek that you are carrying out a SCUBA program in Edmonton, and may be willing to participate in this research. Your part in the study would involve integrating the simulation into some of your classes, rating the students with respect to out-of-air emergency skills, and making certification exam marks available to me. I plan to conduct the study during the period January - April 1991, and I would be happy to have the opportunity to work together with you on this study.

Enclosed find a copy of the simulation and the surveys I plan to use. As well, I have included a sample letter of consent which will be distributed to all participants.

If you have any concerns or questions, feel free to contact me personally at 329-2176, or you can contact either of the following people at the University of Lethbridge:

|                    |  |          |
|--------------------|--|----------|
| Dr. Rick Mrazek    | Faculty Supervisor                       | 329-2452 |
| Dr. David Townsend | Chair, Faculty Research Ethics Committee | 329-2731 |

Thank you in advance for your assistance with my research project.

Sincerely,

R. Scott Erickson

Box 1145  
Raymond, AB  
T0K 2S0

Dear Participant:

As part of the requirements for a Master of Education degree at the University of Lethbridge, I am conducting research into the effects of a computer simulation in SCUBA instruction. The purpose of this study is to evaluate the potential of using computers and computer simulations in diving instruction. I anticipate that you and others will benefit from participation in this study by having the opportunity to participate in a novel learning activity which has demonstrated great potential to date. As well, it will be of assistance to the diving industry in finding better ways to teach diving. I would like your permission for you to participate in this study.

As part of this research, you will be asked to fill out surveys relating to previous experience with diving / water sports / computers, and attitude towards diving and the underwater environment. You will also be evaluated with respect to some of your diving skills and knowledge. (This is done in almost every SCUBA course anyway. I am requesting access to that information, as the instructor cannot provide it to me without your consent.) In addition, some of the participants will be asked to use a computer simulation as part of their instruction.

Please note that all information will be handled in a confidential and professional manner. When responses are released, they will be reported in summary form only. Further, all names and other identifying information will NOT be included in any discussion of the results. You also have the right to withdraw from the study without prejudice at any time. If you choose to do so, please indicate your willingness to participate by signing this letter in the space provided below, and return the letter.

I very much appreciate your assistance in this study. If you have any concerns or questions, feel free to contact me personally at 329-2176, or you can contact any of the following people:

|                    |  |          |
|--------------------|--|----------|
| Dr. Rick Mrazek    | U of L Faculty Supervisor                | 329-2452 |
| Dr. David Townsend | Chair, Faculty Research Ethics Committee | 329-2731 |
| Mr. Jack Madro     | SCUBA Instructor, Subsea Experience      | 434-1433 |

Thank you in advance for your assistance in this research.

Sincerely,

R. Scott Erickson, Graduate Student  
University of Lethbridge

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Effects of a Computer Simulation in Diving Instruction

I, \_\_\_\_\_, agree to participate in this study.

Signature \_\_\_\_\_ Date \_\_\_\_\_

Signature of Parent \_\_\_\_\_ (if under 18)