THE PADI APPROACH TO DIVER RESCUE TRAINING

Drew Richardson and Karl Shreeves

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Abstract

Designing instruction for rescue skill training in recreational divers must address the question of what to teach (content), and when to teach it (sequence amid the development of prerequisite cognitive and motor abilities). The "old school" of diver training attempted to teach all aspects of rescue to the beginner diver. This has given way to training rescue skills by building basic skills in steps to assure prerequisite learning and psychological preparedness.

Teaching rescue skills content is a question of sequence. Examining rescue skills and student characteristics against the doctrines of instructional system design theory (ISDT), learning theory and cognitive psychology shows that premature rescue skill training has several potential pitfalls. Among these are potential failure to perform, failure to assimilate, failure to retain, and failure to transfer skills to rescue situations after training. Students may not recognise these failures in themselves and therefore have unrealistic estimations of their rescue abilities. The potential for these problems, despite otherwise appropriate teaching methodologies, arises, among other reasons, because of limitations in human attentional resources, and the absence of experienced-based mental frameworks and related domain-specific prerequisite intellectual skills. The preferred timing of practice sessions may also be an issue.

Sequence is also content related. There is a potential for increasing the complexity of a rescue when rescuers learn techniques as isolated skills. Both patient and rescuer benefit when the content integrates rescue and first aid in a priority hierarchy that parallels emergency medical care, though at the lay level. Adapting to local emergency medical protocols enhances this approach to content yet further.

The PADI system of diver education presents diver rescue training in a content based on established medical and rescue protocols and sequence based on ISDT, cognitive psychology and motor learning theory. This approach minimises or eliminates the problems associated with "old school" recreational rescue diver skill training to assure the assimilation, retention and application of appropriate rescue techniques and philosophies.

Introduction

This paper covers the application of instructional theory and cognitive psychology to diver rescue skills assimilation, retention and transfer. It is a summary of the PADI system's educational approach.

Since the birth of recreational scuba diving, training rescue techniques has been associated with training divers. Scuba training texts from the 1950s into the 1970s reflect an approach that wrapped rescue among many other topics in a single course that was intended to teach all aspects of diving, including the broad range of rescue skills, first aid and rescue breathing. The approach of the "old school" was often to combine rescue procedures with discussions on human physiology; specific first aid for specific pathophysiologies was provided, but the broader topics and techniques of preparation, management, and the rescue itself were largely ignored.[1-4]

Diver training matured with adoption of educational principles derived from Instructional System Design Theory (ISDT), cognitive and educational psychology, and other theories of human learning. Training moved away from the invalid one-course-teaches-all concept and evolved into training in stages, mirroring mainstream education. This for allowed more attention to specific topics, including rescue training, which then became a large part of advanced diver programs in the late 1970s and early 1980s.[5] By 1985, in the PADI system of diver education, the training of rescue techniques had evolved into a distinct and separate program, with the beginner diver taught fundamental self-rescue and assisting skills which were built upon during subsequent training.[6] Though PADI courses have been revised since then to keep pace with change, the instructional hierarchy remains essentially the same, as reflected in current PADI materials.[7] Today, before rescue training, the student completes the PADI Open Water Diver course, the PADI Advanced Open Water course and then does the PADI Rescue Diver course, with CPR and first aid training a required component.[8]

A brief look at ISDT, cognitive psychology and other human learning principles as they relate to rescue training reveals why PADI's approach to rescue training has endured and been successful, while the "old school" approach of presenting novices with virtually all rescue techniques has declined. We can follow this with a brief look at the sources of training content, particularly emergency oxygen and CPR protocols.

Instructional system design theory

ISDT is concerned with what the student must be able to do after being taught and in reaching that goal, analysing what to teach when. The design of instruction calls for a task analysis of the educational goal that looks at

both sequence and the information processing characteristics of learners.[9,10] Improper sequencing of material can hinder education because a student may lack prerequisite skills or knowledge for the task being learnt. However, instruction must also be sequenced and timed considering the student's psychological and physical preparedness to learn at a given time as well as the sequence called for by the information.[10,11] It is the question of psychological preparedness that leads to the inadequacy of teaching the full spectrum of rescue techniques to beginner divers.

Attentional resources

The human mind has a limited capacity to pay attention to stimuli. There are various models that address attentional resources, but most relevant to training divers in rescue skills are the effects of controlled processes compared with automatic processes.

Controlled processes are those that require conscious thought. Controlled processes require mental effort, consume attentional resources and are performed step-by-step. The individual must focus on the task to accomplish it. However, with repetition over time, a controlled process may become an automatic process. Automatic processes require little or no mental effort, consume few attentional resources and are performed in parallel with other tasks.[12] The automatic process level is called automacity, particularly where motor skills are involved.[11,13]

To teach complex motor skills (which includes diver rescue skills) instruction must be sequenced so that automacity is first attained in sub-skills. This frees the mind to concentrate on the aspects of the new motor skill, or new aspects of the same skill. Otherwise the skill may be too complex for the student's attentional resources. Beginner instruction must first develop those sub-skills that must be performed automatically.[13] (Magill 1993, 169-171)

The novice diver who has just learned basic diving skills, which are prerequisite to rescue skills, operates primarily at the controlled process level. The diver may have attained mastery and performs the skill competently, but must pay attention to the steps. The "old school" of diver training disregarded this, expecting novices to learn complex rescue skills while still in the controlled process stage with prerequisite skills.

It is not psychologically valid to expect the novice to learn complex rescue skills such as in-water artificial respiration when the student must still consciously think about needed skills such as buoyancy control or air way control. On the other hand, simple skills such as a tired diver tow or removing a cramp, are not particularly complex and are reasonable to teach at the novice level.

Because the novice operates on the controlled process level, the novice is self-focused. Therefore, at the novice level, the PADI system's philosophy is to emphasise simple rescue skills and problem management, such as cramp removals, tired diver tows, establishing buoyancy and other self rescue skills. The novice masters prevention, which is the most important rescue skill, and develops automacity with basic diving skills. Also, though novices are not ready to develop complex motor skills, they are ready to learn some of the concepts behind them. Therefore, novice divers in the PADI system are introduced to the basic concepts behind rescue procedures, including complex ones.[14,15]

The PADI Rescue Diver course follows both the novice course and the PADI Advanced Open Water program, which emphasises diving in different environments and while engaged in specialised activities. This sequence is consistent with the need for automacity because it ensures that the student has a minimum of nine dives, compared with no dives in the old school methodology when complex rescue training began in the pool. After nine actual dives, it can be expected that a diver's basic skills will be completely, or nearly completely, under automatic processes.

Domain specific experience and schemata

As mentioned, novice divers are initially self-oriented. As their controlled processes become automatic processes, the demand on their attentional resources drops. This allows them to focus beyond their basic diving skills and become more task oriented. In keeping with this psychological change the Advanced Open Water program trains the diver to accomplish task specific learning objectives ranging from deep-diving and navigation knowledge and skills, to underwater photography and studying nature.[15,16]

From an ISDT perspective, the Advanced Open Water has a function in training divers to handle rescues. The program, along with the initial open water training, creates a structured environment in which students develop experience (increased automatic processing) and schemata. A schema is cognitive framework the mind uses to organise interrelated concepts in a way that permits access to those concepts and their relationships. The mind uses these for semantic memory, problem solving, and both inductive and deductive reasoning. Specialised schema organise and activate motor skills.[11,12,13]

The "old school" of training divers in rescue neglected the development of experience and schemata, whereas the PADI system is particularly concerned with these. The minimum of nine dives, plus task-focused training, assures that students entering the rescue diver program have several well-established schemata. It is reasonable to expect these divers to have experience and

schemata relating to basic problem solving and self-rescue skills (which the Rescue Diver course builds upon), nuances of equipment configurations, environmental conditions, diver personalities and other topics that all affect handling a rescue. Among the many ways schemata and experiences relate to rescue training, two that stand out in particular are problem solving and the development of mental scripts and procedures for rescue.

Problem solving

Besides basic techniques for specific emergencies, such as mouth-to-pocket mask rescue breathing for an unresponsive, non-breathing victim, diver rescue is a problem-solving skill because there is no way to know in advance the specifics of the situation. Problem solving is a higher-level cognitive skill; good problem solvers in a given field have, among other attributes, well developed schemata that they access in solving a problem. This has been demonstrated by many studies.[10-12]

These show that better problem solvers do not necessarily have better problem solving abilities per se, but have better organised knowledge (schemata) about the problem subject. Those with better schemata and experience more readily identify problem components. They have previously encountered more sub-steps in the problem and may therefore deal with these sub-steps through automatic processes, freeing attentional resources to work on the novel aspects of the problem. Well developed schemata and experience are associated with greater problem solving efficiency and these problem solvers have greater accuracy in assessing their own progress as they attack the problem. In short, experience and schemata allow the solver to apply more mental resources to finding the solution.[11,12] The PADI system approach to rescue training accommodates the development of basic schemata and experience that student will apply at the Rescue Diver level.

Mental scripts and procedures.

Scripts are components of a schema that the mind uses to sequence action. These range from what to expect, such as what happens when visiting the dentist, to procedures to follow in a particular situation, such as, first you check in with the receptionist at the dentist's office, then you wait, etc. Scripts do not handle problems (i.e. situations never previously encountered), but help the problem solving process by letting the mind assign probable roles to elements in a given situation.[11,12]

Procedures are rules for doing something; complex procedures have variables that call for judgment and require combining simpler rules into the proper sequence.[27,28] Much of rescue training falls into these categories.

The "old school" of rescue training neglected the roles of scripts and higher-order rule development. The tendency was to teach rescue as a set of isolated procedures that were not well integrated. First aid and rescue breathing were treated separately.[17,18]

The problem with this approach is that the student may not be able to integrate these skills when faced, for example, with a non-breathing victim in the water who is bleeding profusely and who is negatively buoyant. What does the rescuer do first? Without training that integrates the skills, determining the basic steps is a problem solving situation that demands significant attentional resources.

The PADI system accomplishes rescue training through an approach that not only provides for the development of schemata, but that also integrates rescue skills with each other and Basic Life Support (BLS). The BLS approach itself integrates CPR and first aid according to the protocols followed by emergency medical personnel, but at the lay level.[7,19] This is one reason why CPR/first aid certification is required prior to certification as a PADI Rescue Diver.

It should be noted that the preferred CPR/first aid BLS course for the PADI Rescue Diver course is the Medic First Aid (MFA) course, which was developed by Emergency Medical Planning, Inc. MFA was the first lay person level course to integrate CPR and first aid along emergency medical technician (EMT) protocols.[20,21] With a field record of more than 15 years, the MFA system has proved itself effective not only in initial training, but in the willingness of students to render aid when needed. Surveys show that more than 85% of MFA trainees have offered to use their skills when faced with an actual emergency, which is a far greater proportion than trainees from conventional, non integrated CPR/first aid courses.[20] The philosophy of integrated training in the MFA program parallels, and integrates with, that in the PADI Rescue Diver course.

In the example of the negatively buoyant, non-breathing, bleeding victim, through the integrated approach, the rescuer knows that the priorities are to make the victim buoyant and begin artificial ventilation, handling the bleeding as soon as possible. This aspect of the rescue follows a developed script and higher order rules (procedures) that enact the component rescue skills largely under automatic control, leaving the rescuer's attentional resources free to address the unique aspects of the situation, such as distance to the boat, etc.

In an actual rescue situation, integration is important because it reduces the number of stimulus-response choices by automating decisions where appropriate. Hick's Law states that reaction time increases logarithmically with the number of stimulus-response choices. Therefore, reducing choices reduces reaction time.[13,22]

Mass practice versus distributed practice

In the development of motor skills, one area of conflict is whether learning benefits more from massed practice, with relatively short intervals between practicing, or from distributed practice, with longer intervals. What constitutes "short" or "long" depends on the skill in question, which has contributed to some of the debate as to which is better.[13]

Research in the 1930s, 1940s and 1950s suggested that distributed practice made for more efficient learning, but with more recent research that view is no longer valid. Based on current research, the prevailing view is that distributed practice is better for continuous motor skills, repetitious skills with arbitrary beginning and end points, but only marginally. Mass practice is better for discrete motor skills, those with clearly defined beginning and end points, especially with respect to short term retention. Students show about the same long term retention of discrete motor skills after mass practice or distributed practice; therefore, mass practice is preferred for the short term advantage.[13]

Dive and rescue skills include both continuous and discrete motor skills. Continuous motor skills include swimming with fins, scuba breathing and buoyancy control. Discrete motor skills include dropping a weight belt, removing equipment from the rescuer and victim, and approaching a panicked diver. Discrete motor skills that are performed in series are called serial motor skills.[13] These would include buddy breathing, alternate air source breathing, exiting the water, and in water artificial respiration (which has a continuous sub-skill, swimming with fins).

The PADI system accommodates the differences in preferred practice for continuous and discrete motor skills. Most of the continuous motor skills are basic diving skills. The novice learns these during the Open Water Diver course, which has at least five sessions and fits the description of distributed practice.[23] By the time the student reaches the Rescue Diver course, the continuous basic skills that are sub-skills to rescue skills have been practiced over at least nine dives, which is also distributed practice. Further, the continuous components are usually at the automatic process level by the time the diver reaches the Rescue Diver stage, so that learning them is no longer an issue because they have already been learnt.

At the Rescue Diver level in particular, students begin to develop most of the discrete motor skills related to rescue. The common format is a two day program with closely spaced, increasing-complexity, skill training and practice. This creates practice conditions that most conform with the preferred, mass practice conditions.

Learning transfer

ISDT is not just concerned with learning, but learning transfer, the student's use of the learned skill or knowledge in the actual situation for which it was intended. In rescue training, the question is whether the student, having performed rescue skills in class, will use the skills when faced with an actual rescue situation.

Transfer is encouraged by embedding the new skill(s) in a schema, and more importantly, by having a variety of practice.[11] Assuring that students have rescue-related schemata is well addressed by the PADI system. In addition, the PADI Rescue Diver course consists of multiple scenarios where students repeatedly apply their skills in varied situations with increasing complexity.[23] This contrasts with the "old school" approach, which not only presented skills in an isolated, unintegrated context, but which did not typically include variety of practice in the training.

Students who are practicing a complex procedure, or problem solving skill, without the prerequisite establishment of automated processes and schema will be thinking hard. This may be exacerbated by having to listen to and process instruction being provided. The result may be that the students solve the problem (complete the rescue), but have not actually learned much.[11] We are concerned that these students may believe they have mastered the rescue skills. Perhaps such a belief would dissuade students from continuing their diving training to include rescue, or they might put themselves in situations they would otherwise avoid due to their skill limitations.

Emergency protocols

Apart from applying ISDT methodologies, an issue is deciding what emergency medical protocols to include in a course. PADI's expertise in this area lies in instructional design, not in medicine. Therefore, the PADI system relies on those with relevant expertise for the specific protocols. Rescue-related training, such as BLS protocols, providing emergency oxygen, whether or not to incline a patient with decompression illness (DCI) head down, etc. draws upon the current protocol of the American Heart Association,[24] from the Divers Alert Network, the hyperbaric medical community including the South Pacific Undersea Medicine Society, Undersea and Hyperbaric Medical Society, European Underwater and Baromedical Society, and other expert sources internationally.

PADI Instructors follow these protocols, but adapt them to their local area to mesh with local emergency medical services (EMS) and local protocols.[7] The intent is two fold. First, to assure that students are trained in rescue protocols that include the steps needed to get the victim/patient into local emergency care, and second, to follow any

local laws that may apply. Therefore, rescue techniques taught under the PADI system follow established and accepted protocols, but with adaptations suited to the area.

Some rescue issues have no clear cut protocols. One example is how to handle a diver convulsing due to oxygen toxicity. In seeking advice, PADI was given two possible protocols. After assessing the protocols, the more widely recommended one, get the diver to the surface, was presented first. However, the second protocol, hold a breathing diver at depth until after the convulsion, was also presented.[25] When a single, clear protocol for this is presented by the hyperbaric medical community, then PADI materials will reflect that single protocol. Such a protocol appears to be evolving.

The PADI approach to rescue training

The PADI system applies ISDT, cognitive and educational psychology principles and other tenets of learning theory to train divers in rescue. Due to the need to develop automatic process in cognitive skills and motor skills, the need for experience and schemata, the benefits of appropriate practice intervals and the importance of assuring learning transfer, such training cannot be a single step. Rather, it is an ongoing process that begins at the novice PADI Open Water Diver level and continues through the PADI Rescue Diver level. Each training level has an important role.

PADI Open Water Diver. The student is self-oriented and most skills are consciously controlled. Students learn primary self-rescue skills and practice low complexity assists. Students begin to develop automacity in their motor skills and general diving schemata. Course materials establish basic concepts for a rescue-related schema, including problem recognition, basic assisting procedures, first aid for decompression illness and the basic steps for rescuing an unresponsive diver. Motor skills learned in this course directly related to rescue include:

entries and exits
swimming with fins
cramp removal
weight system removal at the surface and underwater
tired diver tow
buoyancy control at the surface and underwater
alternate air source use
free flow regulator breathing
controlled emergency swimming ascent
no-mask swimming
buddy breathing (optional)
scuba unit removal at the surface
basic compass use and navigation

PADI Advanced Open Water program. The student is less self-oriented; skills are increasingly under automatic control. Students gain experience in a variety of diving situations, broadening the diving schemata that they will use in rescue problem solving. By the end of the course, primary diving skills are generally automatically controlled, which frees attentional resources for new skill acquisition and problem solving at the next stage. Any additional specialty training, and/or non-training dives, contribute to the experience and schemata as well. Besides the crucial development schemata, the core deep dive includes more detail and review of first aid and treatment for DCI. Motor skills directly related to rescue include:

compass use, patterns and navigation
night navigation

PADI Rescue Diver course. The student is more externally-oriented and primary dive skills are under automatic control; the student has a basic rescue schema, as well as general diving experience and schemata to draw on as resources. Students learn the concepts and principles behind diving related first aid, stress and stress management, emergency management, emergency oxygen and how equipment can contribute to emergency situations. Other topics include the pathophysiology of lung expansion injuries and decompression sickness. Students practice rescue skills in a sequence that emphasises skill and concept integration, rising complexity, problem solving and variety of practice. These assure rescue skill mastery at the higher-order rule level, as well as learning transfer after the course. Motor skills learned include:

evaluating a victim's mental state (panicked or not)
approach, rescue and assistance of tired diver
tired diver tows
approach, rescue and assistance of panicked diver
underwater and surface contacts
non-swimming assists
exits with a responsive victim
post rescue attendance
search patterns and search for a missing diver
surfacing the unresponsive diver
in water rescue breathing
equipment removal of rescuer and victim while rescue breathing in water
exits with an unresponsive victim
first aid for DCI
responding to an accident from a boat or shore

After initial mastery in multiple practice sessions, these are practiced again in two fully integrated accident scenarios.

The PADI Divemaster course. The PADI Divemaster course is the first leadership level program and was not mentioned in previous discussions because it is beyond the

scope of this paper's topic. However, it is appropriate to note that as students enter this program, they enter a leadership orientation. Rescue training continues at this level, first to refresh skills and foster retention and second, to develop skills to the demonstration quality level. The skills acquired in the previous three levels continue to be refined with the goal of providing role model demonstrations for lower level students in training. Divemaster students also learn more about managing other divers (rescue and non-rescue scenarios), and the physics and physiology of diving, include rescue-related pathophysiology.[26]

Throughout these programs, the PADI system applies protocols derived from the emergency medical care and hyperbaric medical communities. The course adapts these protocols to the specifics of local protocols and emergency medical care.

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The references have been rearranged to consolidate multiple references to one work so that the page numbers, separated by commas, are in the order that the references refer to them. This has reduced the number of references from 44 to 26.

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Drew Richardson is Vice-President, Training, Education and Memberships of PADI Worldwide and President, Diving Science and Technology, Inc. His address is PADI International, 1251 East Dyer Road #100, Santa Ana, California 92705-5605, USA. Phone + 1-714-540-7234. Fax + 1-714-540-2609. E-mail 748-3543@mcimail.com .

Karl Shreeves is Vice-President, Technical Development, Diving Science and Technology, Inc. His address is PADI International, 1251 East Dyer Road #100, Santa Ana, California 92705-5605, USA. Phone + 1-714-540-7234. Fax + 1-714-540-2609. E-mail 205-2396@mcimail.com