Bridge Resource Management, Simulation and Experiential Learning "A Loaded Gun"

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The principals of using simulators to teach Bridge Resource Management are examined in the context of the experiential learning process. A direct link is established between components of well designed Bridge Resource Management courses and the components of the experiential learning cycle. The advantages of using simulation as the primary teaching tool in meeting the objectives of these courses by creating situations where the students learn from direct experience are discussed. It is noted that there is a misconception that experiential learning is free choice or learning by chance that focuses solely on the student and the role of the instructor is minimized or totally eliminated. The danger of teaching bad practice, unacceptable risk taking, developing overconfidence, destroying confidence and creation of "mis-educative experiences" are explained. The importance of the instructor in preventing undesired teaching results is discussed.

Bridge Resource Management

The concept of Bridge Resource Management as we know it today evolved in the mid 1970's when several maritime causalities occurred involving well founded ships, manned by competent well trained crews. (1) In 1976 the International Chamber of Shipping issued Casualty Report No 15 stating that one of the principal factors causing navigation casualties was a weakness in bridge organization. (2) In response to these casualties vessel operators began to review and revise ship operations manuals and directives.
The international maritime community also began to initiate discussion on the role of bridge management in safe navigation. In 1978 the Oil Companies International Marine Forum (OCIMF) held a "Safe navigation Symposium" in Washington D.C. The findings of this conference also indicated that groundings and collisions are attributed to human error despite properly trained and competent personnel on well equipped ships. Also in 1978 the International Convention on Standards of Training, certification and watchstanding for seafarers, 1978(STCW) was adopted by The International Maritime Organization (IMO). Resolution 1 of these standards, "Recommendation on Operational Guidance for Officers in Charge of a Navigational Watch" and Regulation II/1 "Basic Principles to be Observed in Keeping a Safe Navigation Watch" spelled out best practice and procedures for standing a safe navigation watch but fell short of addressing the interaction between the conning officer with equipment and other individuals on the bridge. (3) The first attempt to address the problem head on was in that same year when in the United Kingdom the Board of Trade issued recommendations

for the Appraisal, Planning, Monitoring and Execution of passages in their Marine Notice M854. The Board of Trade also included questions on bridge organization for all deck officer competency exams. (1) The basic principals for bridge resource management that we still use today were established.

Maritime Simulator Training and Bridge Resource Management

Concurrently with the recognition the lack of bridge organization as a major contributor to marine causalities marine simulators started to appear at training institutions and research facilities around the world. In the United States the first marine simulator to be used, Computer Aided Operations Research Facility (CAORF) was sponsored by the Maritime Administration in the mid 1970s. Marine Safety International built and operated the first simulator for training of mariners in the United States in the late 1970s. With the development of maritime simulators around the world came international dialog, collaboration and sharing of information on their development and use. The first International Conference on Maritime Simulation (MARSIM) was held at the College of Nautical Studies, Southampton, UK in 1978 and in 1980 the first International RADAR Simulation Training Workshop (IRSTW), the predecessor of the International Navigation Simulator Lectures Conference (INSLC), was held in Liverpool, UK. INSLC was devoted to promoting the best practice in the use of navigation simulators for training and use in research and delegates were primarily practitioners of maritime training. At this time there was a concentration on simulator development and fidelity. Most simulators were primarily used for research and skill development. They were commonly referred to as Shiphandling Simulators, a name that persisted for years even though their usage was broadened beyond skill development into aspects of human factors. Shell Tankers (UK) Limited and their parent Shell International Marine Ltd. saw a need for "Bridge Team Training" as a result several serious mishaps all of which were classified as avoidable and human error accidents. Of primary concern was that without exception the ships involved were well founded, well equipped and commanded by Masters that had long unblemished records and enjoyed the full confidence of Shell's managers. Shell identified the root cause of these casualties as a lack of Bridge Teamwork and worked with the faculty and staff of Southampton Institute, Warsash Campus, UK to develop a course in "Bridge Team Training" using marine simulation. This course was the first Bridge Team training that utilized a marine simulator as the primary teaching tool. It addressed the lack of detailed passage planning and the lack of understanding of how to organize the duties and pattern of communications needed by a bridge team so that a plan, once made, would be executed properly. It also focused on proper monitoring and error trapping. These course essentials remain the basis for most Bridge Resource (BRM) courses offered today. (4) These simulator based BRM courses have four major elements, briefing, planning, execution and debriefing. Over time it was realized that the safe operation and navigation on the bridge of a ship was not limited to refining team skills but included the management all of

people and equipment that was located on the bridge. As a result these courses became known as "Bridge Resource Management" courses focusing on management, teamwork and human factor concepts. They are commonly referred to as capstone courses where the students taking them had previously gained the basic knowledge and understanding of navigation concepts and equipment operation and are expected to "transfer" this knowledge and understanding to real life situations in a simulated ship bridge environment.

Experiential Learning

The concept of learning by experience is a powerful teaching method has long been recognized. Aristotle has been quoted with saying "For things we have to learn before we can do them we learn by doing them." Confucius stated; "Tell me, and I will forget. Show me, and I may remember. Involve me, I will understand." Thomas Jefferson; stated "What we learn to do we learn by doing." According to Diem "experiential learning satisfies the fact that we remember 90% of what we see, hear, discuss, and practice. Sight, hearing, and discussing account for about 30% of the learning process, but when combined with actual practice true learning has occurred." (5) John Dewey an education psychologist wrote extensively about the relationship between experience and modern education practice. He stated "…there is an intimate and necessary relationship between the processes of actual experience and education." Dewey's theory is that one's present experience is a function of the interaction between one's past experience and the present situation. He states that it is the teacher's responsibility to structure and organize a series of experiences which will positively influence each individual's future experiences. Dewey also warns against adopting a progressive education (free education) approach for the sake of change only. Many times educators can become too reactionary towards traditional or structured education and take on a free approach to education without knowing why freedom can be most useful. (6) James Neill concludes that people can learn very effectively through direct hands on experience as long as these experiences are well designed and facilitated. The experiences need to be guided via structured planning and reviewing process. (7) Numerous educators have expanded on the basic learning theory of Dewey and created stages of learning developing "experiential learning cycles". The simplest cycle, one stage model, is simply that experience alone is sufficient for learning. For years this has been the bases for the allowing individuals to sit for original licenses based on experience as an unlicensed seafarer only. The two stage model adopted by the Outward Bound program combines experience with refection. Neill states that reflection on ones experience is an important component of the experiential learning process. (7) Greenway expanded the learning cycle by adding a planning stage. This added step focuses on taking what has been learned in the reflection stage and using it to plan for the next experience. In other words it is applying what has been learned to future events. This approach includes the original concept by Dewey that ones present experience can have a positive effect on future experiences. It stresses continuity from one experience to another. (8) Fig 1.

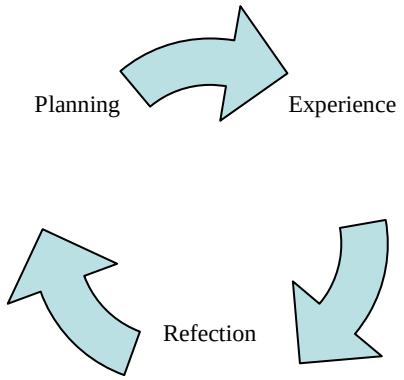

Fig. 1 Three Stage Learning Cycle Greenway

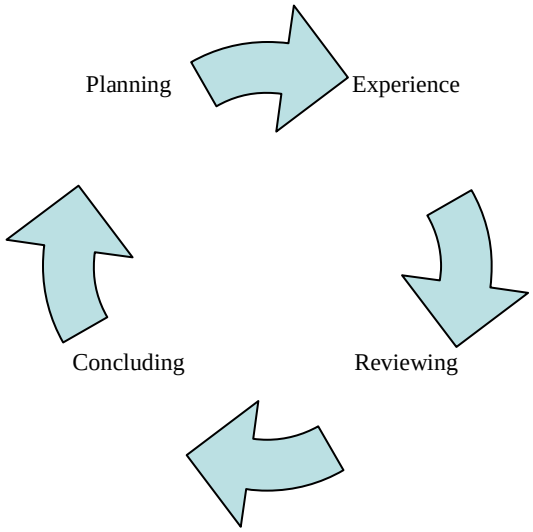

Fig. 2 Four Stage Learning Cycle Kolb

David Kolb took this three stage model and refined it further by dividing the reflection stage into a reviewing and concluding stages. (9) Fig. 2 In this model the reviewing stage concentrates on trying to explain what has happened and clearing up misconceptions by asking questions about the past experience. The concluding phase focuses on answering the questions raised during the reviewing stage using knowledge and logic. Despite the adequacy of the three stage model and the creation of more complex five through nine stage models the four learning cycle remains the most popular. Bert Juch has collected and listed seventeen four stage 'learning process cycles' that are variations of the Kolb model. (10)

The one common feature in all the models is the emphasis placed on developing structured experiences that have continuity and the absolute necessity and importance of the refection stage.

Experiential Learning and Bridge Resource Management (BRM)

The Bridge Resource Management course offered at the United States Merchant Marine Academy at Kings Point was developed based on the course developed at the Southampton Institute, Warsash Campus by Captain Meurn with input from Richard Beadon who previously taught at Warsash. The learning cycle developed for the course can be seen in Fig.3.

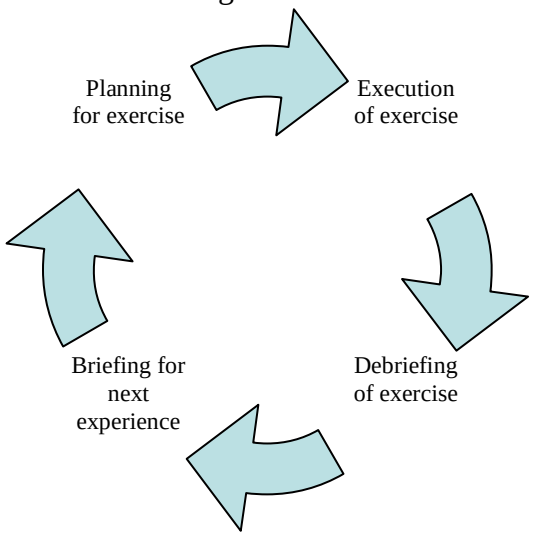

Fig 3 Bridge Resource Management Learning Cycle

The principal task of the course is to create structured experiences that are recognized as relevant to real life bridge operation in order to prepare midshipmen to use knowledge obtained in previous nautical science courses and gained from their experience as cadets during their sea year to solve problems without the aid of the instructor or other expert when they arise. Sea experience as a cadet (apprentice) allows the students the opportunity to learn by observation and the simulator allows them to imitate the experts they have observed during their sea experience. Unfortunately, they often don't know what the seasoned mariner (expert) is thinking or why they came to a particular conclusion since most times at sea the mariner does not debrief the cadets after an evolution. CAPT. Daniel MacCalrevy, author of *Shiphanding for the Mariner* has stated "the hardest part to learn (in standing a bridge watch) is the complexity of decision making; the prioritization of conflicting problems and the resolution of competing (and sometimes contradictory) information." The course is designed to directly address these issues.

In addition "Best Practice" is stressed throughout the course. Best Practice is defined as exceeding industry acceptable standards by the United Kingdom Maritime and Coastguard Agency (MCA).

Using the BRM Learning Cycle as a guide the first step is the briefing. During this stage the instructor must clearly define the objective of the exercise, set the scene for the exercise, define roles of the midshipmen, explain the rules of the exercise, and provide material necessary to plan and execute the scenario. For exercises towards the end of the term it may even be appropriate to include non relevant or misleading material designed to force the team to trap errors, clarify (call the Captain) and correct the material. It is important that during this stage the instructor only gives guidance and does not tell the midshipmen how to accomplish the exercise. They must figure that out by themselves drawing on their previously gained knowledge and experience. Many times this leads to experimenting with procedures and organization by midshipmen which in itself is a powerful learning experience. Although coaching is acceptable in lower level skill development simulator courses centered on psychomotor development it should be avoided in BRM exercises. The goal is to have the midshipmen learn from their own experience.

The second phase is the planning stage. Working as team midshipmen must complete a passage plan which includes detailed chart work, a written plan, contingency plans, (emergency and operational) and a conning notebook when applicable. Again it is important for the instructor to give only general guidance, suggestions, and not critique the plan prior to the execution stage. For some instructors the temptation to explain and correct poor plans prior to the execution is almost overwhelming. Best Practice is stressed in planning and in many cases it is not readily accepted by the students as they may not have seen plans made to that level during their sea experience. It has been my experience that during a term the first passage plans are poorly done and as the term progresses they become more and more detailed as the students discover, for themselves, that there is a direct relationship between proper planning and good performance.

Execution is the third stage in the BRM Learning Cycle and it is here where the midshipmen complete the passage or evolution that they have planned for. The instructor has two primary roles in this stage. First is to guide the exercise to accomplish the stated learning objectives. The exercise must stay relevant and realistic. Common errors made by instructors are to make the exercise too complicated where the original learning objectives are lost in a maze of non relevant activity. Sometimes there is a temptation to continuously add in distractions that prevent students from accomplishing the tasks that the exercise was designed to address. Scenarios should have a "quite period", where teams appear to watching the grass grow. After all most shipboard situations are normal. Normalcy should be one of the instructor's goals and it allows the instructor to create a system of error chains that the teams must identify and trap. The degree of monitoring and vigilance usually falls off in these situations and complacency sets in. As complacency is one of the leading causes in maritime casualties it must be addressed in one or more exercises. The instructor can never predict precisely what is going to happen during a scenario, what actions or reactions midshipmen will have at a given time or if in fact the problems presented in the exercise will be solved. The instructor must be prepared to deal with unexpected outcomes. After 18 years of teaching BRM courses on the simulator the most common phrase I utter during an exercise is "I have never seen that one before". I also learn from my students. Sometimes their solutions to a situation are innovative and not the way I would have done it but acceptable.

The second role of the instructor is to document and monitor the bridge team closely. **Monitor! Monitor! Monitor!** Teams will finish an exercise with perceptions of what happened during a particular scenario. Many times these perceptions are in error, there may even be different options of what actually happened between team members. It will be important during the debrief stage for the different members of the team to express their perceptions and sometimes debate the facts but in the end the instructor must be prepared to document what actually happened. This can be done by printouts, hand written notes or in some cases play backs. Observation and documentation of actions of team members extremely important, even if the actions had little effect on the outcome.

The last and perhaps the most important stage of the BRM learning cycle is the debrief. Unfortunately there are some simulator instructors that underestimate the importance of the debrief. Time management is very important as enough time needs to be provided to allow students to thoroughly review and reflect on the exercise. I have found that debriefs take as long as or longer than the exercise itself. This phase of the cycle is where the learning really takes place. Warrick has stated "the objectives of an experiential learning exercise are not easily achieved. Much of the responsibility for reaching the desired objectives rest with the debriefing phase of the exercise. The major responsibility for conducting successful experiential learning exercises is a properly conducted debrief."(11) For best results is necessary that the debrief be student centered. The role of the instructor is to see that every member of the watch team participates. The instructor should ask

questions, drawing out information and encouraging discussion from team members. He or she should provide expertise, experience and suggestions to the debrief. The answers to questions should come from the midshipmen. Don't tell them, let them speculate, agree and disagree and force them to take a position and defend it. The instructor should only provide the answer if the team can not arrive at the correct solution themselves. This happens in some cases due to time restraints.

The watch team, and some instructors, will want to go directly to the "what happened" phase of the debrief, especially if a casualty or near miss has occurred. This should be avoided. Almost all casualties are caused by an error chain and many times the first error in the chain takes place in the planning phase. I always start my debrief by having the team explain their passage plan in detail, covering the reasons and rational for the plan. If an error or omission in the plan was made contributing to a negative outcome I do not jump ahead by pointing it out. When we get to reviewing the outcome I have the teams reflect back to the plan and discover the role the error or omission played. During this phase the instructor will also be able to determine the amount of effort each member of the team contributed to the creation of the plan.

The next phase of the debrief is the "what happened?" phase. The instructor should ask the midshipmen at this point "what happened?". It is the instructor's role to identify different perceptions and attitudes of what has occurred. This will also give the instructor a good measure of the level of situation awareness by individual team members and the team as a whole. Again the students should be allowed to discuss and debate their perceptions prior to the instructor showing them what actually happened. When going over the senerio the instructor should be asking questions such as "were their other alternative?", "was there a better way of doing it?", "now that you have done it once would you do it differently the next time? If so how and why?". The debrief ends with a summary that focuses on alternatives, how to do it right, best practice, and not dwelling on what the team did poorly. It is important that each member of the team receive feedback their performance, on the level and nature of their involvement and attitude during the exercise. If the team leaves the debrief still debating their actions it is OK. In fact it is good. Continuous reflection on the experience is an important part of the experiential learning process. The instructor need not feel the need answer every question. If the debrief is conducted properly the students will internalize the experience independent of the team, processing lessons learned and developing and refining their method of managing information, problem solving, leadership and decision making.

Competency Based Training and Experiential Learning

Experiential Learning is interpreted by some as student centered. The students take charge of their own learning and are self regulated. They de-emphasize or minimize the role of the instructor and focus on the subjective nature of the experience. The focus is placed on the affective learning domain as defined by Krathwohl. (12) Students are allowed to determine their own learning objectives in a completely free unstructured and permissive learning environment. The

practice of placing students on a bridge simulator with very little basic nautical knowledge, guidance, in unstructured simulated situations with the attitude that they will learn something from the experience can be dangerous. This especially true if it is part of part of a competency based training program. It is the prime responsibilities of a maritime educator to assure that their students are competent at the end of their training.

Competency has been defined as an individual's demonstrated knowledge, skills and abilities (KSAs) performed to a specific standard. It is usually very structured and is objective in nature and focuses on the cognitive and psychomotor domains. (13)

These contrasting views lead to possible pitfalls when integrating experiential learning methods (simulator) into a BRM course that has developing and assessing competence as one of its major objectives. A large portion of bridge resource management deals with human factors such as leadership, team building, error trapping, complacency, fatigue, communications etc. All of these factors reside in the affective domain. Navigation, collision, avoidance, shiphandling use of electronic equipment resides in the cognitive domain. Therefore the course should be a combination of both domains plus the psychomotor domain. The formula developed for competence in conjunction with the BRM course is:

C = (K + S) A

C = Competence

K = Knowledge – cognitive domain

S = Skill - psychomotor domain

A = Attitude – affective domain

Attitude is the multiplier in the equation as students entering the capstone BRM course already have demonstrated an acceptable level of knowledge and skill in lower level courses. Therefore the BRM course focuses on human factors. Knowledge and skills in several different nautical science areas must be blended together and applied in a real life situation. The attitude towards the acceptance of BRM techniques presented is also an important factor.

Dangers

Simulation is a powerful teaching tool. It was documented earlier in this paper that the retention of knowledge is dramatically increased when individuals learn by doing. I am constantly amazed when graduates return to the Academy and recount in great detail specific simulations that took place many years before. Knowing the effectiveness of this type of training instructors must be constituently vigilant in its use.

- Scenarios must be well planned, relevant and realistic with specific learning objectives that are made known to the students. Otherwise they will consider simulation a game and the transfer of learning to real life situations will be reduced.
- Instructors must insist on "Best Practice" during exercises. Poor practice must be identified even if it did not have a negative effect on the outcome. The instructor must make suggestions for better methods. (Best Practice) If this is not done students will assume their action was acceptable. The instructor will have inadvertently taught and reinforced "Bad Practice".
- Students must not be allowed to "get underway" without a passage plan. The plan is best created by the students

themselves but may be formulated by the instructor under certain circumstances. Getting underway without a plan sends the message that passage planning is not important.

- Exercises must be supervised. Allowing midshipmen to "practice" without instructor supervision can lead to the students taking risks that would not be acceptable in real life. Skill development, learning equipment operation such as RADAR or ECDIS is an exception.
- Students must not be placed in situations where there are no possible solutions. Setting them up for failure can destroy their confidence.
- Nothing breeds success like success. Students must be given exercises that are at a level of difficulty that allows successful outcomes. However they must be challenged as well. Exercises that are artificially easy will lead to overconfidence.
- The use of simulators for BRM courses where the monitoring of the bridge team is poor or non existent is not advisable. One of the most important roles of the instructor is to monitor the execution of the exercises closely so that proper feedback can be provided during debrief.

Conclusions

BRM simulator courses utilize the experiential learning process and the experiential learning cycle is easily adapted.

Although experiential learning is student focused instructors play the key role in the process, but not in the traditional manner. Instructors design and provide structured exercises and act as facilitator during debriefs. An effective BRM instructor is one who is passionate about the seagoing profession, about his or her work as a simulator instructor and is able to immerse cadets totally in the learning situation, allowing them to gain knowledge, skills and a proper attitude from the simulated environment. They bring their own experience and perspective to the course. I have found that teaching BRM is a lot harder than teaching a standard lecture based course. Having said that I will end with the statement that I usually make at the end of a simulation demonstration where I have the opportunity to express my teaching philosophy. "For gods sake do not tell the Dean how much fun I have, or he will want to cut my pay."

Author

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