Rules of Engagement: Fostering Active Learning for Performance Improvement

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ABSTRACT

The new millennium has seen significant changes in the operational environment and in the nature of the enemy. Training must likewise change to prepare our military to meet the challenges associated with this new paradigm. One of the current Department of Defense initiatives in education and training is the move to convert instructor-led courses to distributed learning. However, creating distributed learning involves more than the mere migration of content to online delivery. Effective distributed learning engages learners through study and investigation within authentic contexts; it encourages the growth of learner responsibility, initiative, decision making, and intentional learning. This is active learning, which has its roots in constructivist theory.

This paper discusses what makes learning *active* and provides strategies for fostering active learning in an asynchronous distributed learning situation. These strategies, based on research and the author's own considerable experience in designing online instruction, provide for individual and collaborative engagement while the learner practices the skills needed to develop expertise in solving problems and in performing tasks in the learning domain. They also include strategies for learner support and feedback to ensure that the active learning process results in appropriate and accurate knowledge construction for performance in the operational environment—in air, on land, and at sea.

Integrating active learning facilitated by collaborative interactions and expert guidance will result in curriculum that promotes individual development as well as teamwork, providing the unique cognitive skills necessary to meet the challenges of a rapidly changing and increasingly complex joint operational environment. It is a strategic approach to education and training that will enable the military to realize the goal of *One Team, One Fight, One Training Futur*e.

ABOUT THE AUTHOR

Jo MacDonald is a senior instructional designer for Intelligent Decision Systems, Inc., with 17 years of experience in all aspects of instructional systems design, including analysis, design, development, implementation, and evaluation. Her experience in technology applications for education and training include the design and development of PC-based simulations, Web-based instruction and training (WBI/WBT), interactive media instruction (IMI), computer-aided instruction (CAI), educational videos, interactive videodiscs (IVD), and standardized tests. Her primary client throughout her career in instructional technology has been the U.S. Navy, and she experienced firsthand the growth pains associated with the dramatic paradigm shift from instructor-led courses to self-paced distance learning. Ms. MacDonald is passionate in her dedication to excellence in education and training and committed to ensuring that the focus of technology is always on maximizing learning. Ms. MacDonald is currently pursuing her Ed.D. in Curriculum and Instruction, with a specialization in Instructional and Performance Technology and a sub-specialization in Distance Education, at the University of West Florida in Pensacola, Florida.

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INTRODUCTION

As the new millennium unfolds, one thing is apparent: the rules of war have changed. The enemy is not a single, clearly identifiable regime with expansionist objectives but rather a covert, transnational enemy that perpetrates premeditated, politically-motivated acts of violence against innocents. This new enemy is highly mobile and extremely adaptable, requiring a defensive organization that is equally mobile and adaptable. Events from Operations Enduring Freedom and Iraqi Freedom have demonstrated that "a single Joint system of maneuver and strike, supported by interagency and coalition partners, created advantages over the enemy by reducing the time from sensing-to-decision-to-engagement" (U.S. Department of the Army, 2003, p. 2). To prepare our Soldiers, Sailors, Marines, Airmen, and Coast Guardsmen to be a part of this joint, interagency, multinational (JIM) team, training must also change: *one team, one fight, one training future*.

One of the current cross-services initiatives in training to meet these challenges is to migrate instruction to a distributed learning environment. This initiative has produced countless online courses providing multiple advantages: greater accessibility to training when and where needed, reduction in total time to train, instruction tailored to the needs of the individual, lower costs, and easier course maintenance. However, much of it falls short of what is needed to increase readiness and to improve performance in a proactive, anticipatory operational environment. As members of a JIM defense team, the men and women in today's military need to be able to think critically, solve problems as they arise, move easily from one task to another, work efficiently and effectively in team situations, and constantly adjust their understanding and grow their knowledge and skills to meet emerging needs. This requires that courseware designers think beyond the mere migration of content to online delivery. Effective distributed learning engages learners through study and investigation within authentic contexts; it encourages the growth of learner responsibility, initiative, and intentional learning; and it promotes the development of critical thinking, problem solving, and decision making. This is active learning, which has its roots in constructivist theory, as espoused by Piaget, Bruner, Vygotsky, and others. It is an approach that can be applied to any learning situation to help learners acquire necessary skills and knowledge more effectively with greater transfer. It also provides learners with problem-solving skills, metacognitive skills, and a commitment to learning that transmute into improved performance in the field.

WHAT IS ACTIVE LEARNING?

To understand active learning, one must first understand *how* we learn.

Information-Processing Theory

The information-processing theory grew out of the work of a group of cognitive learning theorists in the 1960s. The simple model below, based on Ormrod's model of memory (Ormrod, 1999, p. 178), illustrates the basic concept.

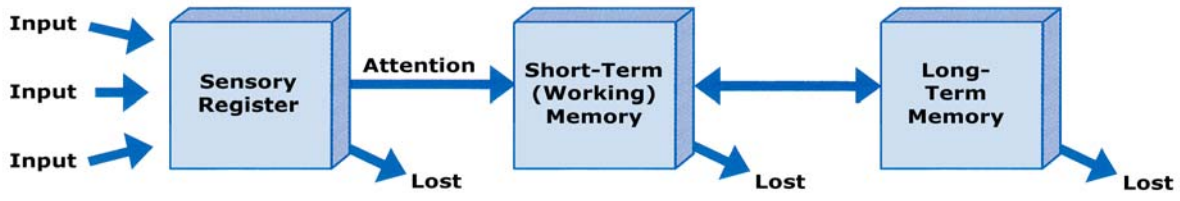

Figure 1. Information-Processing Model

We are constantly bombarded by sensory inputs. In the first stage of information processing, these inputs pass through the sensory register (Ormrod, 1999). Those inputs that we perceive as worthy of our attention are transformed (processed) into usable information and passed on to short-term memory. All other inputs are lost. This very necessary process prevents sensory overload.

Short-term memory is often referred to as working memory because information is retained only 5 to 10 seconds unless the learner *actively* works with it, trying to make sense out of it in terms of what is already known. Understanding this limitation is critical because it is in short-term memory that learning takes place. *Learning* may be defined as the transformation of sensory inputs to usable information for storage in long-term memory.

Our long-term memory has limitless capacity for storage. However, we know from experience that we cannot always access everything we store in our long-term memory. Why? Research has shown that the way information is stored affects how easily it can be retrieved. If it is stored as an isolated fact, unrelated to other information—for instance, when we memorize through repetition—then it is hard to recall. The more associations built around stored information, the more ways there are to access it when needed. How frequently we use information also affects recall. If stored information is not used, the physiological connections will tend to fade over time, and the ability to recall the information will be lost (Ormrod, 1999).

Development of Active Learning Theory

Constructivists built on the theory of information processing by focusing on learners' motivation to learn and their ability to transfer what they learned to new situations. They proposed that people learn best by reflecting on their experiences, looking for inter-relationships, and generating *mental models* to make sense out of what they have experienced in light of what they already know. Mental models are self-created, internal representations of reality. Each new experience is an opportunity to re-evaluate these mental models, to validate them or to adjust them as the individual achieves deeper understanding of complex ideas—in essence, to construct knowledge.

The concept of active learning stems from some of the fundamental precepts of constructivism:

- The developmental psychologist Jean Piaget said that learners actively construct knowledge when their exploration of their environment uncovers inconsistencies between what they know and what they are experiencing (Roblyer, 2004).

- Jerome Bruner, a leading constructivist theorist, states that "learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge" (cited in O'Malley et al., 2003, p. 15).

- Lev Vygotsky, a Russian developmental psychologist, felt that learning takes place in a social context and that interaction with others is an important part of the learning process (Roblyer, 2004).

- According to the tenets of situated cognition, knowledge is "a product of the activity, context, and culture in which it is developed and used" (Brown, Collins, and Duguid, 1989, p. 1).

- The Cognition and Technology Group at Vanderbilt (CTGV) proposed that learning should be anchored in real-life experiences in order to prevent inert knowledge, knowledge that cannot be used because the learner does not see its relationship to problems encountered in real life (Roblyer, 2004).

- Later theorists proposed that learners are active participants in the construction of knowledge through discussion and collaborative resolution of authentic, relevant problems, thus giving rise to case-based learning (Kolodner and Guzdial, 2000) and problem-based learning (Koschmann, 1996). In both case- and problem-based learning, learners assume the major responsibility for learning.

Active Learning Definition

Briefly stated, active learning is a process whereby learners are actively engaged in constructing knowledge in a meaningful, realistic context through exploration, reflection, and social discourse with others, rather than passively receiving information. It is a spiral process in which learners are given increasingly difficult problems and the resources necessary to solve them. Learners select information from available resources and then use cognitive strategies such as organization, elaboration, and

scaffolding to transform it into new, personal meaning (Campbell, 1998). Dodge (1996) simplifies this process into three domains for instructional design: inputs (information resources), transformations (knowledge construction), and outputs (applied knowledge). The diagram below illustrates the fact that these three domains are inextricably linked within a fourth domain: an authentic contextual framework that provides the reason and motivation for learning.

Figure 2. Domains for Design of Active Learning

FOSTERING ACTIVE LEARNING

Fostering active learning in asynchronous online instruction requires consideration of each of the four domains. Designers must provide, suggest, or enable various inputs within an authentic context, design contextually relevant activities that will promote transformation while providing any necessary support for performing these activities, and call for contextually relevant outputs that demonstrate the learner's new knowledge.

Authentic Contexts

The concept of anchoring instruction in authentic contexts arose from the hypothesis that teaching without a direct relationship to learners' personal experiences often results in their acquiring inert knowledge, knowledge that cannot be used (Dunlap, 1999). In all branches of service, those who are involved in training—as instructors, as learners, or as seasoned warriors trying to bring a new graduate from one of the schools *up to speed*—know how difficult it is for learners to transfer knowledge from one situation to another. Learners pass a test, demonstrating that they have acquired the requisite knowledge, and then are unable to apply what they learned on the job. Research indicates that inert knowledge results from presenting information stripped of the contextual clues that would give it meaning (Choi and Hannafin, 1995). "Learning becomes the memorization of seemingly abstract, self-contained entities, not useful tools for understanding and interacting with the world" (Barab, Hay, and Duffy, 2000, p. 4). For learning to be meaningful, better understood, and more likely to transfer to new situations, it should be anchored in an authentic context, one that involves practical application of knowledge (outputs) in a real-life situation and that allows examination of the information from multiple perspectives.

One method for doing so is to use what CTGV terms *macrocontexts*. A macrocontext embeds a higher-order problem in a semantically rich, open-ended environment to provide an authentic context for understanding and solving the problem. Although the CTGV proposed using video to provide the context, computer-simulated environments, case studies, or scenarios may also be used. This top-down, big-picture approach encourages learners to generate the necessary sub-goals to solve the problem. Learners learn necessary lower-level facts and skills in the context of the higher-order problem and in doing so gain insights into the relationships between what they are learning and opportunities for using the learned information (Barab et al., 2000).

An example of this type of instruction is a computerized lesson that was developed to study the power of anchored instruction. In the lesson, a one-minute video clip provides the context and the problem. Rocky, a monkey, is dying of Simian AIDS. A potential cure was discovered by a scientist in the Brazilian rain forest, but the research data were destroyed in a fire. Fortunately, the scientist wrote a letter to a colleague that provides clues to the cure. The students are to follow these clues to discover the cure and save Rocky.

Students immediately took control of their learning as they decided what information to explore. They gathered information from a variety of inputs, including text, graphics, and videos, and in so doing learned about viruses, immunizations, AIDS, customs, international laws, exchange rates, deforestation, plants and animals of the rain forest, ethics, and chemical interactions. The difference is that students learned these concepts as part of the task, not as isolated objective facts to be memorized. Researchers noted the following:

> Students learning the content to address the anchor problem scored higher on achievement questions and evidenced more transfer than did students who studied the information without the anchor. More importantly, students learning in the context of an engaging anchor made connections among the various disciplinary concepts, even seeing relations between the computerized lesson and other lessons, and between the lesson and personal experiences. (Barab et al., 2000, p. 6)

These observations show that learners, when constructing knowledge in an authentic context, are more likely to be able to transfer what they learned to new situations.

Experiential simulations are a way to provide a rich context for learning. An experiential simulation "establishes a certain psychological reality, and places the participants in defined roles in that reality" (Gredler, as cited in Barab et al., 2000, p. 6). As participants in the simulation, learners are situated within the context in which the content being learned is applied (2000). They do not study a particular domain but instead become part of the scenario, thus stimulating interest and motivation, and are able to interact with and explore complex ideas within such spaces (Rieber, as cited in Amory and Seagram, 2003).

Intelligent Decision Systems and Horizons Unlimited created three experiential simulations for the Navy, one for supply officers, one for yeomen, and one for religious program specialists. In each of these, learners are given a simulated office environment and are required to perform tasks similar to those that they would perform on the job. Inputs for the tasks are similar to those they would receive on the job—a person coming to the door with a tasker, a phone call, an e-mail, or a computer reminder for a routine task. In addition, learners have access to standard office tools and resources: job aids, publications, log books, a word-processing program, a check book, and deposit slips. In Sea Trials, the simulation developed for supply officers, learners work in a team just as they would aboard a ship. These simulations provide authentic learning and practice opportunities, teach problem-solving skills, and also develop knowledge of teamwork, work ethics, and job responsibilities.

Inputs

In a traditional instructor-led class, the instructor may be the only source of information input. Learners are conditioned to accept that the information an instructor gives them regarding a given content area is important, and so they attempt to remember it. However, in real life we assimilate information from a multitude of sources: books, magazines, television, newspapers, and other people. This requires us to evaluate the usefulness of the information we receive, thus encouraging active learning.

In an online learning environment, there are many input options. Consider, for example, the office simulations described above. The learner receives input from several sources, including phone calls, documents, e-mails, and publications. This list could be expanded to include information that the learner has to find on the Internet or from other sources, visuals that can be accessed and manipulated by clicking on an object in the interface, and intelligent agents. Intelligent agents are animated characters (in this case, characters representing other shipboard personnel) who may provide context-sensitive information, coach the learner by making suggestions or providing feedback on learner actions, or model inquiry skills by asking thought-provoking questions.

One of the most critical types of input is the collaborative input provided by other learners. Whether these other learners play a pre-assigned role or are merely part of a learning community, they provide additional insights, different perspectives, and alternative solutions. Tools for collaborative input include discussion boards, synchronous chat, e-mail, and text messaging. Communication and collaboration using these ubiquitous tools are so much a part of everyday life that to ignore them in a learning situation supposedly based on an operational reality is to undermine the authenticity of the situation.

Some inputs will be more valuable than others. As in the real world, some may prove to be of little use to the learner—but the learner must make that determination. What is essential is providing the learner multiple representations of the information and multiple sources to encourage thoughtful consideration of the information.

Transformation and Output

As discussed before, transformation results when learners work with the information in short-term memory to create the cognitive associations necessary to move it into long-term memory. Working with information may involve a variety of mental processes:

- *Relating new information to previous knowledge.* Is the new information consistent with what is already known? Does it provide more detail? Or does it provide a bigger picture, enabling the learner to relate concepts or ideas that previously had no connection for the learner?

- *Evaluating information.* If instruction does not overtly tell a learner what is important, the learner must make this determination based on previous knowledge and an assessment of the needs of the situation. This is another reason why context is so critical to active learning.

- *Elaborating on information.* Elaboration is the process of making assumptions about or drawing inferences from new information. These assumptions and inferences are then *learned* along with the actual input (Ormrod, 1999). The elaboration process is important because it helps build mental models. Initially, these mental models may have distortions or errors. However, by integrating new information, the learner refines the mental model over time.

- *Organizing information*. When information comes from various sources, the learner is responsible for organizing it. Information must first be analyzed to discover commonalities and then organized according to any of countless schemas—for example, hierarchy, similarity, location, time, or sequence.

- *Synthesizing information*. Providing multiple representations and multiple sources of information also requires learners to synthesize disparate but related pieces of information into a single idea or concept.

Transformation and Output Strategies

Strategies that promote transformation and output involve an authentic problem to be solved or a case to be analyzed in order to encourage exploration and discovery. They are contextually relevant and "are designed to encourage students [to] think creatively, critically or in a decision-making or problem solving manner . . ." (Li and Gunn, 2003, pp. 2–3).

One of the best strategies for promoting active learning is to give learners a somewhat ill-defined problem, one in which learners must decide the essential nature of the problem and then determine the best approach to solving it. This type of problem encourages them to seek the knowledge or skills needed to solve the problem and to actively work with the information inputs they receive using the transformational cognitive processes listed above.

Consider for a moment the nature of learning activities in a traditional military classroom, where learners complete tasks using job sheets that list the equipment and references needed and provide a detailed list of steps to perform the task. Contrast this with the following scenario from The Armor Captain Career Course, an asynchronous distance-learning course developed by Northrop Grumman to train tank commanders in an armor/cavalry unit. In this particular scenario, the learner is placed in the role of a commander given an operations order (OPORD) to conduct a tactical road march. The learner must devise a tactical plan employing the techniques and formations that will allow the unit to maintain the correct balance of speed and security to accomplish the mission. Then, as part of the mission, the learner must dispatch a unit quartering party; refine the tactical plan, if necessary, based on the information obtained from the quartering party; direct the unit's movement; and direct and supervise unscheduled halts. Throughout the activity the learner is involved in receiving and processing information from a variety of sources, including maps, overlays, and various intelligence sources, including simulated radio. As situations develop, learners are asked to use the information to make the best tactical decision and are then provided feedback on that decision.

Another strategy to spur transformational information processing involves the use of interactive, model-based simulations to provide phenomena for active exploration. Although the military is increasingly using model-based simulations to provide practice, additional consideration should be given to using them for active learning. Instead of reading about a concept and then seeing an animation illustrating it, learners would create hypotheses and then manipulate variables and observe and reflect on the results in order to discover the underlying concept (Barab et al., 2000).

There are several strategies that can be used on a more micro scale to promote active learning:

- Use advance organizers to provide a framework for content so that as learners grapple with new information they can consider how it fits into the big picture.

- Provide learners multiple solutions to a problem, and then ask them to select the best one and to defend their answer (Li and Gunn, 2003).

- Encourage learners to create concept maps to show relationships between ideas.

- Ask open-ended questions that stimulate critical thinking—for instance, ask learners to describe a relationship, to generate a principle, or to predict an outcome.

- Have learners develop their own performance support system (Dunlap, 1999).

Learner Support and Expert Guidance

Because of the individual freedom involved in active learning, it is always necessary to provide support to forestall frustration (Dunlap, 1999). Support can be provided through learner-controlled, context-sensitive help pop-ups that explain functionality or provide considerations to help jump-start the learner's thought processes. It can also be provided by access to a subject matter expert who functions as a learning guide and is available via e-mail, discussion board, or scheduled chat times to answer questions and to help learners get back on track. In lieu of a live learning guide, a computer-based intelligent agent can be used to provide context-sensitive guidance. For example, in the Army example above, questions, feedback, and expert advice could have been supplied by an intelligent agent who is part of the scenario, a seasoned combat veteran who is traveling with the unit to relieve a commander who was killed in action.

Collaboration

Collaboration with other learners is one of the tenets of active learning because it enables the social negotiation of meaning. "In collaborative work, group members draw out, confront, and discuss both misconceptions and ineffective strategies. Through collaborative participation, students also refine their knowledge through argumentation, structured controversy, and the sharing and testing of ideas and perspectives" (Grabinger and Dunlap, 2002, p. 3).

Although collaborative problem-solving scenarios are difficult to coordinate in an asynchronous military distance learning environment, it is still possible to promote a sense of community using any of a multitude of communication tools. For example, ConnexionWare, a collaboration tool by Regional Internet Media, Inc., provides a photo directory of all current course participants, the ability to share documents, and tools for engaging in synchronous chat and threaded discussions.

Even informal collaborative activities can reap major benefits in terms of learning. Discussion among learners exposes them to multiple viewpoints, which can help them "acquire a more accurate and complete understanding of a topic, especially for more complex or controversial issues" (Li and Gunn, 2003, p. 3). Participating in discussion boards encourages critical reflection as learners post questions and respond to others' postings.

RELATIONSHIP OF ACTIVE LEARNING TO PERFORMANCE

The relationship of active learning to performance has not been proven definitively. However, there is an incontrovertible parallel between the cognitive skills and attitudes that learners develop in an active-learning environment and the skills and attitudes required to meet the demands of the new operational environment.

Increased Problem-Solving Skills

One of the critical needs for any service member is the ability to solve problems as they arise. Active learning, with its emphasis on authentic problems anchored in a realistic context, encourages the growth of problem-solving skills. Whether learners are participants in an experiential simulation or are given a problem couched in a case study, they are learning to analyze a problem, hypothesize about the solution, seek relevant knowledge, actively work with the inputs they receive, and apply what they learn to the situation. They "become reflective practitioners . . . , engaging in critical thinking during the process of working on the problem and reflecting on both the process and the content learning that occurred through working on the scenario" (Barab et al., 2000, pp. 6–7).

Increased Metacognitive Skills

One of the skills desired in today's military is the ability to critically examine new information and to adjust one's understandings accordingly. Through active learning, in which learners have to make sense of multiple inputs with differing representations and perspectives, learners acquire the metacognitive skills to make these adjustments, sorting through and evaluating new information for relevance and consistencies/inconsistencies with what they already know, and then making adjustments to their mental models based on their new understanding.

Commitment to Life-Long Learning

Service members today are also expected to make a commitment to life-long learning, to seek learning opportunities and to grow their knowledge and skills to meet emerging needs. This is also the goal of active learning. Learners are encouraged to seek the knowledge or skills needed to solve a problem, to assess their progress and the effectiveness of their choices, and to determine what still needs to be

completed to reach their goal. This is the essence of performance improvement—not a prescribed plan of learning imposed by the organization but rather a quest for knowledge arising from the individual's ability to recognize his or her own limitations related to job performance, to pursue the knowledge and skills to overcome those limitations, and to assess progress and modify learning strategies accordingly.

CONCLUSION

The military has embraced distributed learning as a means of providing anywhere/anytime instruction to all service members. However, it is not enough merely to convert existing courseware to a distributed format; the key to providing *effective* distributed learning is to incorporate active learning strategies that will help learners grow the necessary knowledge and skills to meet the challenges of today's operational environment.

The integration of active learning strategies into self-paced distributed learning fosters the development of leaders with highly developed problem-solving abilities and strategic thinking skills, leaders who are committed to personal and professional excellence. Integrating active learning, facilitated by collaborative interactions and expert guidance, will result in distance learning that promotes individual development and provides the unique cognitive skills necessary to meet the challenges of a rapidly changing and increasingly complex joint operational environment. It is a strategic approach to education and training that will enable the military to realize its goal of *One Team, One Fight, One Training Future*.

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