



A simulated improvised explosive device detonates during a realistic training scenario 1 May 2008 at the National Training Center, Fort Irwin, California. The soldiers are from 2nd Brigade Combat Team, 4th Infantry Division, based at Fort Carson, Colorado. Training events like this can be further enhanced by applying the science of learning and instructional design. (Photo by Staff Sgt. Brian Ferguson, U.S. Air Force)

# Transforming Unit Training with the Science of Learning



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**T**he Army is currently in the midst of a multiyear effort to optimize training and education across the force to ensure it is ready for any future conflicts. The U.S. Army Operating Concept forecasts future conflicts as complex endeavors, requiring agile and adaptive leaders and organizations to address hybrid threats and complex environments.<sup>1</sup> To prepare for these challenges, the Army sees education as its primary tool. In a July-August 2015 article in *Military Review*, Lt.

Gen. Robert Brown, then commanding general of the U.S. Army Combined Arms Center (CAC), states that enabling education “is the most reliable strategic hedge in investment that the Army can make in the face of an uncertain future.”<sup>2</sup> Brown further describes the status of the Army’s educational system as “inadequate for addressing the growing complexity, volatility, and uncertainty of the twenty-first century security environment.”<sup>3</sup> To address this shortfall, there are several ongoing efforts to improve

the Army's formal professional military education (PME) system, primarily through the establishment of the Army University, which is expected to increase rigor and effectiveness in all Army courses.<sup>4</sup> Regardless of these efforts, PME's scope



and duration are insufficient to effectively transfer all knowledge necessary for professional soldiers and leaders.

Operating in our complex modern world requires our leaders and formations to be agile and adaptive, but we currently do not have a system in place to give them all the skill sets and capabilities necessary to win. The overarching problem is that training is not treated as learning, especially in the operating force. Unit commanders often expect soldiers and leaders to arrive at their units following PME with all the necessary knowledge to perform as a part of the team.<sup>5</sup> Without significant expansion of PME, however, this expectation is unrealistic. Compounding this problem, Army operational training doctrine such as Army Doctrine Publication 7-0, *Training Units and Developing Leaders*, does not provide sufficient guidance or direction to plan effective learning experiences. Many in the operating force view the training they conduct more as rehearsals of skills rather than deliberate experiences to learn new skills or knowledge.<sup>6</sup> Where PME is embracing evidence-based learning practices from academia, doctrine for training does not take advantage of the advances in the learning sciences. To prepare its leaders and formations to win in a complex world, the Army must get more educational value from training conducted in the operating force. The Army can accomplish this by applying the science of learning

25th Infantry Division soldiers view video feed from a Phantom 4 Quadcopter unmanned aerial system during the Pacific Manned-Unmanned Initiative 22 July 2016 at Marine Corps Training Area Bellows, Hawaii. The exercise provided an opportunity for soldiers, partnered with organizations and agencies such as the Maneuver Center of Excellence and the U.S. Army Tank Automotive Research Development and Engineering Center to test and learn from new technology in the field. (Photo by Staff Sgt. Christopher Hubenthal, U.S. Air Force)

and instructional design to create training events that not only are realistic but also transfer necessary knowledge and provide sufficient motivation. The Army must develop doctrine and guidance based on a constructivist philosophy of cognitive learning theory and provide commanders with tools to design training as deliberate learning experiences.

## Defining the Problem

To manage the development of its leaders, the Army uses a structure of domains in which training and education occur: institutional, operational, and self-development.<sup>7</sup> According to doctrine, training and education occur in each of these three domains, but to varying degrees. The operational domain is characterized by an emphasis on training, particularly as a member of an operational unit but also through broadening experiences.

The institutional domain, though, is where education takes primacy. The Army University, a part of the institutional domain, has recently begun sweeping changes to ensure courses across the Army are using evidence-based practices for instruction and activities. However, these changes can only be expected to have a small effect on a leader's development over the course of a career. For example, an armor officer taking command of a battalion has spent as few as twenty months in resident PME over the course of the officer's career up until that point (4.5 months in the Armor Basic Officer Leadership Course [BOLC], 5.5 months in the Maneuver Captain's Career Course [MCCC], and ten months in the Command and General Staff Officers' Course).<sup>8</sup> With less than two out of seventeen years spent in PME, this institutional education can hardly be expected to provide all necessary knowledge for a battalion commander to win in the complex world described in the *Army Operating Concept*.

The majority of an officer's career is spent in the operational domain, so to have significant, meaningful change in a person, a greater amount of education must occur within this domain. The Army has devoted significant time and energy into creating doctrine on training and education; however, none of the doctrinal or related training or administrative publications addresses how training in the operating force is to be designed.<sup>9</sup> Several tools are available for commanders to use as they create training events, but almost all of them, to include the Eight-Step Training Model, are focused primarily on the resourcing of training, and they provide little guidance or direction on the content.<sup>10</sup> The U.S. Army CAC has recognized this problem, and published a white paper titled "Enhancing Realistic Training." The purpose of the paper is to present an operational design for the development and integration of efforts to enhance realistic training.<sup>11</sup> The white paper is a very useful document in describing what future training should consist of, especially as it relates to the inclusion of all the complexities expected on a future battlefield. What the paper is missing is a description of how the training is to be designed. Taken at face value, commanders could assume that when creating a training event, they are expected to include all possible complexities into the scenario because they will be expected to operate eventually in a complex world. Though the Army also professes the "crawl, walk, run" model of incrementally increasing the difficulty and complexity of training, there is no doctrine to help a commander

create the conditions for a unit to progress in the complex tasks described in the CAC white paper.<sup>12</sup> Additionally, the white paper references other joint and Army publications (such as doctrine, guidance, regulations, and white papers) but does not include any academic work or research in training and education. If the Army wants to continue to develop soldiers and leaders in the operational domain while also preparing organizations to operate in a complex world, it must use evidence-based practices of the learning sciences to design training.

## The Science of Learning

The science of learning is based on an understanding of how individuals and groups learn.<sup>13</sup> The field is now over one hundred years old, and it has gone through several major shifts in that time. For the purposes of this paper, the definition of learning used is from Richard E. Mayer, a psychologist from the University of Santa Barbara:

Learning is the relatively permanent change in a person's knowledge or behavior due to experience. This definition has three components: (1) the duration of the change is long-term rather than short-term; (2) the locus of the change is the content and structure of knowledge in memory or the behavior of the learner; (3) the cause of the change is the learner's experience in the environment rather than fatigue, motivation, drugs, physical condition, or psychological intervention.<sup>14</sup>

This definition allows us to apply it to both individual and organizational outcomes. Whenever we train, we expect that trainees will come out of the event changed (hopefully for the better), that the change

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will be long-lasting, that trainees will behave differently given a certain set of circumstances, that the change will be repeatable, and that it will occur regardless of varying conditions. This is where differences between Army and academic understanding of training and education become apparent. The Army distinguishes the primary difference between training and education as the focus on the known versus the unknown. The Army definition of training is “a structured process designed to increase the capability of individuals or units to perform specified tasks or skills in known situations,”<sup>15</sup> but the definition of education is focused on “an individual’s ability to perform in unknown situations.”<sup>16</sup> In the learning sciences, training is a subset of education, with learning occurring in both. The term “training” in academia refers to those instructional experiences that are focused on individuals acquiring specific skills that they will apply almost immediately, but it is recognized that similar actions occur in both training and education.<sup>17</sup> To improve training, the Army must embrace the idea of training as learning, as opposed to training as experience.

To use the science of learning in training design and development, it is important to understand the philosophies and theories that guide the science of learning. Learning philosophies and theories describe *why* learning occurs in individuals and organizations.<sup>18</sup> The learning sciences have developed these ideas that are not just based upon experiences of what works, but have been substantiated and modified based on empirical research. By codifying a philosophy and theory in doctrine, it would support commanders by giving them evidence-based tools and guidance to design better training.

“Constructivism” is the most recently popular philosophy within many educational communities, and is nested within the larger category of general philosophies that are described as “rationalism.”<sup>19</sup> This philosophy is characterized by the belief that reason is the primary source of knowledge, and that individuals construct knowledge, rather than discover it.<sup>20</sup> To understand what this looks like in practice, it is built on three subgroupings: individual constructivism, social constructivism, and contextualism. Individual constructivism is the idea that knowledge is constructed from an individual’s experiences. Learning results from a personal interpretation of knowledge and is an active process in which an individual constructs meaning based on experience. Social constructivism adds the assumption that learning can be collaborative with

meaning or knowledge being negotiated from multiple perspectives (such as a dialog between an instructor and a student or between multiple students within a classroom). Finally, contextualism implies that learning should occur in realistic settings and assessments should be integrated into the learning task, not be a separate activity.<sup>21</sup> While this last point is already a goal of Army training, the constructivism aspect is missing from the vast majority of Army training. While the Army University and the U.S. Army Training and Doctrine Command (with its Army learning model) have committed to a constructivist philosophy for PME, the doctrine for training operating forces has not been altered accordingly.<sup>22</sup>

The vast majority of Army training is based on the philosophy of behaviorism, which was the predominant school of thought for the first half of the twentieth century. While doctrine does not explicitly state the underlying philosophy, the ideas of behaviorism can be found in training doctrine and training guidance throughout the force. According to behaviorism, learning has occurred when learners display the appropriate response to a particular stimulus.<sup>23</sup> This philosophy emphasizes the influence of the environment on learning and prioritizes the necessity of learners receiving appropriate reinforcement (both positive and negative) for their responses to particular stimulus. This philosophy reached its peak in the 1940s and 1950s with B. F. Skinner’s work on “operant conditioning,” but soon it fell out of favor in the educational world as science was beginning to unlock mysteries behind how the brain functioned, which led educators to focus more on cognitive processes than displayed behaviors.<sup>24</sup>

## Applying the Science

The differences between constructivism and behaviorism as philosophies may seem trivial, but understanding them and using them appropriately could greatly improve how the Army trains. For example, compare the behaviorist and constructivist responses to a typical small-unit training problem: failure to bound across an objective. In March 2016, this problem was so prevalent that the XVIII Airborne Corps commander wrote an e-mail about it to his entire command.<sup>25</sup> Soldiers were simply not bounding, by individual or by teams, across an objective as they cleared. For those not familiar, during a squad live-fire exercise, as the unit reaches the objective, they are expected to maneuver



The behaviorist would identify the lack of bounding as a behavior that needs correction and would create conditions for the soldiers to bound more often to build a habit of bounding. A constructivist would identify why the soldiers were not bounding and use education to modify the decision making the soldiers used so that they

Sgt. Victor Garciamoros, an observer/controller/trainer from 1st Battalion, 361st Engineer Regiment, Task Force Redhawk, 5th Armored Brigade, gives feedback to soldiers of the 485th Military Police Company, Nevada Army National Guard, 15 September 2011 during fundamentals of patrolling training at McGregor Range, New Mexico. (Photo by Sgt. 1st Class Alejandro Sias, 5th Armored Brigade, First Army, Division West, Public Affairs)

across the objective with personnel alternating between stationary and moving. Those moving do so rapidly while exposing themselves as little as possible, and those stationary are presenting as little of themselves as possible while providing direct covering fire as necessary. The problem is that this rarely happens. Often, units will clear the objective all at once with no stationary element providing supporting fires. And, in the worst cases, those moving personnel will walk across the objective with no consideration of cover or concealment, presenting themselves as the largest targets possible to the enemy. A behaviorist would look at this problem and prescribe more repetitions.

would choose to bound under similar situations in the future. The constructivist would be more focused on the cognitive processes used by the soldiers because research shows students' actions are rational given the way that they perceive the conditions.<sup>26</sup> Soldiers do not fail to bound because of lack of knowledge of how to bound; they fail to bound because, in their "reality," they do not perceive a need. Perhaps this is because the soldiers never had to bound in the video games they played, neither in commercial games nor in Army virtual battlespace simulations. Or, possibly, their previous experiences may tell them that there is no threat, because they have never received fire while clearing an objective. Or, if their reflexive-fire training was always conducted from the standing position, they may be more comfortable firing from that position. All of these could be valid assumptions, and all could result in different prescriptions for how to address the problem. Though both the behaviorist and the constructivist may have arrived at similar conclusions regarding the problem, the constructivist analysis allows

for a greater number of solutions. If the Army embraces a constructivist philosophy for training, commanders will transition from managing training to designing training, which will achieve greater results.

With constructivism as the philosophy on which Army training is built, we can use a more cognitive learning theory to design training events and scenarios. Cognitive learning theory is the dominant theoretical influence on instructional design in the educational world.<sup>27</sup> This theory places emphasis on factors within the learner, as opposed to factors within the environment (which would fall more within the behaviorist model).<sup>28</sup> Cognitive psychology is the basis for cognitive learning, and has influenced instructional design primarily through the understanding that (1) learning is an active process where high-level cognitive processes occur, (2) learning is cumulative in that prior knowledge is always a factor, (3) the brain represents and organizes knowledge in a certain way as memory, and (4) learning is itself a specific and deliberate cognitive process.<sup>29</sup> In this theory, the learner constructs meaning from instruction rather than being a recipient of meaning.<sup>30</sup> Commanders that incorporate cognitive learning theory into their training design will be more concerned with why their units performed a certain way than with how they performed. While the desired training outcomes may be very similar to those used in past training, the purpose will be to observe an action as evidence of the individual or group performing the desired cognitive process.<sup>31</sup> Many good commanders intuitively do this, but codifying this approach in doctrine will support training that is more effective across the operating force.

Through a cognitive learning theory, training and education can be developed to specifically target desired outcomes. While there is significant research on different ways of developing and assessing learning, Ellen Gagné's system of categorization is widely used.<sup>32</sup> Constructivists agree that there are different types of learning outcomes, and each type of outcome requires a different type of instruction (or condition) for it to be transferred to a learner.<sup>33</sup> Gagné establishes five large categories or "domains": declarative knowledge, intellectual skills, cognitive strategies, attitudes, and psychomotor skills.<sup>34</sup> Additionally, intellectual skills can be further refined into concepts, procedures, and problem solving—all of which have different requirements for learning. Though these differences may seem either obvious or trivial, they could

significantly affect the way the Army trains. Obviously, no one will train troop-leading procedures (TLP) exactly the same way he or she trains land navigation, but there can also be a difference in training TLP as processes, as opposed to problem solving. In PME, the two maneuver BOLCs train TLP as processes, as it is often the officers' first experience with thorough TLP, but the MCCC trains them as problem solving. This allows the MCCC to present different and challenging opportunities to its students. This idea of categories of learning is used in PME, but not in the operating force.

## **Instructional Design as a Solution**

Currently there is no guide for operating-force commanders to determine how to best train a task other than the objective of accomplishing the task. Incorporating the academic process of instructional design into training development is how the Army could apply the science of learning and constructivism in the operating force. The term "instructional design" refers to an academic process of systematically translating the theories and principles of learning into plans for instructional materials, activities, resources, and evaluation.<sup>35</sup> Though some may not think of unit training as instruction, it actually shares many characteristics: it is the intentional arrangement of experiences leading to soldiers (or other learners) acquiring particular capabilities or skills. Quality instructional design based on the constructivist philosophy and cognitive learning theory promotes cognitive processes that lead to learning.<sup>36</sup> Using an established doctrinal system is important to design instruction so that the goals (learning or training outcomes), instructional strategy (the "how"), and evaluation (or assessment of the instruction and the learners) all match. The academic world has been using instructional-design processes for years, and the Army has been using instructional design for PME courses; however, to prepare our formations to operate in a complex world, we must begin to use it for training design in the operating force as well.

The Army could dramatically improve training across the force by creating a doctrinal construct for training design that incorporates learning science philosophy and theory with evidence-based instructional-design principles and processes. PME can only provide so much education in the brief time a student participates, and current Army unit training based on behaviorism is insufficient at bridging the gap to prepare soldiers and

leaders to operate in a complex world. Commanders must become more than training managers; they must become training designers. They must understand and apply evidence-based practices to develop their formations. Through this approach, the Army will no longer rely just on the institutional Army (also known as the

generating force) for education, as the training conducted in the operating force will allow for greater development of knowledge and understanding in all its soldiers and leaders. Thinking of unit training as more than just rehearsals will improve soldier and leader education throughout their careers. ■

## Notes

1. U.S. Army Training and Doctrine Command (TRADOC) Pamphlet (TP) 525-3-1, *The U.S. Army Operating Concept, Win in a Complex World, 2020-2040* (Fort Eustis, VA: TRADOC, 2014).
2. Robert B. Brown, "The Army University: Educating Leaders to Win in a Complex World," *Military Review* 95, no. 4 (July-August 2015), 22.
3. *Ibid.*, 19.
4. *Ibid.*, 19–22.
5. This is certainly not a doctrinal statement, but commanders' expectations that soldiers will arrive from professional military education (PME) knowing all they need to know have been evident over the past few years. An example is recent interactions between the Infantry School and operating force leadership from Stryker brigade combat teams. In several formal meetings and briefings, the operating force leadership has asked the school to provide more and better opportunities for individuals to learn the Stryker system before arriving to their unit. While this may be possible, it would require additional PME expansion, which may not be feasible.
6. Again, this perspective regarding soldiers viewing training merely as rehearsing is not doctrinal, but is based on personal experience during interactions between the institutional force (the Maneuver Center of Excellence) and leaders from the operational force. There was an expectation amongst operational leaders that had all the skills necessary to perform in follow-on operational-force assignments with little to no additional development necessary. Those leaders saw unit training as "exercising" or "practicing" skills that individuals gained through PME.
7. While the training domains are a doctrinal construct, the U.S. Army Human Resources Command also has several publications covering this topic, specifically in how it relates to career progression.
8. These time figures for PME are based on a chart developed by Armor Branch at Human Resources Command to depict career timelines. The information was presented to Maneuver Captain's Career Course students in fall of 2015.
9. There are several training-related publications, but I would specifically like to point the reader to Army Doctrine Publication (ADP) 7-0, *Training Units and Developing Leaders* (Washington, DC: U.S. Government Printing Office [GPO], 2012) and its related series of manuals.
10. "8 Step Training Model," Fort Benning graphic, accessed 6 September 2016, <http://www.benning.army.mil/armor/ocoa/content/References%20and%20Guides/8%20Step%20Training%20Model.pdf>.
11. U.S. Army Combined Arms Center (CAC), "Enhancing Realistic Training White Paper: Delivering Training Capabilities for Operations in a Complex World" (white paper, U.S. Army CAC, Fort Leavenworth, KS, 26 January 2016), accessed 21 September 2016, [http://usacac.army.mil/sites/default/files/documents/cact/ERT%20White%20Paper%20-%20Signed%20\(26%20JAN%202016\).pdf](http://usacac.army.mil/sites/default/files/documents/cact/ERT%20White%20Paper%20-%20Signed%20(26%20JAN%202016).pdf).
12. It is difficult to cite a lack of something. Though "crawl, walk, run" is discussed throughout training doctrine, there is little else to shape training design in many of the doctrinal publications available for operating force commanders.
13. Richard E. Mayer, *Applying the Science of Learning* (Boston: Pearson Education, Inc., 2011), 18.
14. Richard E. Mayer, "Learning," in *Encyclopedia of Educational Research* (New York: The Free Press, 1982), 1040–58.
15. Army Regulation 350-1, *Army Training and Leader Development* (Washington, DC: U.S. GPO, 2014), 239.
16. *Ibid.*, 229.
17. Patricia L. Smith and Tillman J. Ragan, *Instructional Design* (Hoboken, NJ: John Wiley & Sons, 2005), 5.
18. *Ibid.*, 26.
19. *Ibid.*, 19.
20. *Ibid.*
21. *Ibid.*
22. TP 525-8-2, *The U.S. Army Learning Concept for 2015* (Fort Eustis, VA: TRADOC, 20 January 2011).
23. Smith and Ragan, *Instructional Design*, 25.
24. Wallace Hannum, "B. F. Skinner's Theory," Learning Theory Fundamentals website, accessed 6 September 2016, <http://www.theoryfundamentals.com/skinner.htm>.
25. E-mail from Lt. Gen. Stephen Townsend to the XVIII Airborne Corps leadership and the Infantry School at Fort Benning, Georgia, 1 March 2016.
26. Paul Cobb, "Constructivism and Learning," in *International Encyclopedia of Educational Technology*, 2nd ed., eds. Tjeerd Plomp and Donald P. Ely (Tarrytown, NY: Elsevier Science, 1996), 56–59.
27. Smith and Ragan, *Instructional Design*, 26.
28. *Ibid.*, 25.
29. T. J. Schuell, "Cognitive Conceptions of Learning," *Review of Educational Research* 56 (1986): 415.
30. Smith and Ragan, *Instructional Design*, 11.
31. *Ibid.*, 26.
32. *Ibid.*, 79.
33. *Ibid.*, 80–81.
34. Ellen D. Gagné, Carol Walker Yekovich, and Frank R. Yekovich, *The Cognitive Psychology of School Learning* (Boston: Little & Brown, 1985).
35. Smith and Ragan, *Instructional Design*, 5.
36. *Ibid.*, 9.