Higher Order mLearning: Critical Thinking in Mobile Learning

Shawn McCann
Train the Trainer Schools
Camp Pendleton, CA
Shawn.McCann@usmc.mil

ABSTRACT

This paper explores the literature regarding the development of higher order learning through student participation in technology enhanced environments, specifically, the use of mobile devices in the practice of critical thinking by leveraging inherent elements and affordances of temporality, space, and connectedness that mobile devices provide. The literature on mobile learning only recently began to explore critical thinking and remains focused on content delivery. However, the collaboration, just-in-time, and learning-on-the-go capabilities of mobile learning hold potential for deeper discourse within the context of higher order learning. This paper argues that carefully designed learning spaces, accessible by technology in hand, create beneficial opportunities for reflection and critical thinking that drive academia, business, and military organizations. However, poor definitions of critical thinking compromise its effective development and evaluation. Through an inquiry of higher order learning, critical thinking, mobile learning, and technology enhanced learning, the author defines and recognizes reflection as an essential component of critical thinking, identifies gaps in research associated with higher order mobile learning, and establishes the importance of critical thinking in mobile learning.

ABOUT THE AUTHOR

Shawn McCann serves as the officer in charge of United States Marine Corps Train the Trainer Schools West where he trains, educates, and certifies instructors, curriculum developers, and formal school managers. Shawn enlisted in the Marine Corps in May of 1996 and served multiple tours as an instructor and instructor trainer within Training Command. He earned a commission as a second lieutenant in May of 2004, and as an infantry officer, deployed for two combat tours before he returned to Training and Education Command. There he served as a scheduling and program of instruction officer for the Recruit Training Regiment and as the company commander of Instructional Training Company. He was then selected for, and designated an Education Officer, to meet the requirements of his current position. Shawn holds a Masters of Arts, and is pursuing a doctorate in Adult Learning and Leadership from Teachers College, Columbia University in the City of New York.

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MOBILE LEARNERS

The current trend of mobile device usage in personal and professional life is exponentially increasing (Brink, 2011). People access their mobile phones upwards of 1,500 times each week (Woollaston, 2014), filling their idle time with games, music, movies, social media, and studies. This anytime, anywhere feature of mobile devices makes space for learners to take advantage of an increasing number of learning opportunities.

Due to complexity encroaching into personal and professional lives (Stacey, 1996), individuals are required to discern the quality of information constantly available on mobile devices before they can communicate effectively and make ethical decisions. In this context, mobile device screens become more than an interface to the hardware: They create the time, space, and connectedness necessary to engage in critical thinking. In essence, mobile technology design can engage users in the "systematic and sustained critical discourse where dissonance and problems are resolved through exploration, integration, and testing. . . . [including] interactions between the public shared world and the private reflective world" (Garrison, Anderson, & Archer, 2001, p. 21). More specifically, technology enriches individuals' experiences by supporting the reflection required for critical thinking and effective communication across academic, business, and military communities.

Mobile Experience

Using mobile technology, individuals connect with data, colleagues, and customers anytime, anywhere. Most people rely so heavily on their mobile device that they will not leave home without it. In fact, mobile devices may simultaneously overtake and render keys and wallets redundant. Mobile devices already act as keys opening locks, and starting cars. A mobile device can replace the wallet, already storing family photographs, organizing business cards, maintaining receipts, securing credit information, and transferring currency and credit information to make purchases.

Moving beyond a tool for convenient knowledge delivery and retention, mobile learning may also provide the space to individually or collectively participate in critical thinking. Mobile learning "can create a learning experience that transcends time and place, allowing for continued exposure to peer experience with support and collaboration that moves beyond physical classroom walls" (Shippee and Keengwe, 2014). The learning-on-the-go and just-in-time capabilities mobile learning provides may create opportunities for something more than knowledge delivery. Mobile learning allows timely consultation from leaders, professors, coaches, and mentors in the context of the learner's challenge.

Research on mobile learning mostly focuses on content delivery, which accounts for only a small segment of the capabilities that the just-in-time and learning-on-the-go components of mobile learning hold. Existing research demonstrates the ability for higher order learning, such as critical thinking, to occur via technology enhanced learning also known as distance learning, eLearning, and blended learning (Conrad & Donaldson, 2004; Glowacki-Dudka & Barnett, 2007; Garrison, Anderson, & Archer, 2001; Astleitner, 2002).

One cannot separate mobile learning from other types of educational activities, as many aspects of learning are fundamentally mobile (Sharples, Taylor, & Vavoula, 2007). The transfer of knowledge and skills across contexts and life transitions (Sharples, Taylor, & Vavoula, 2007) becomes possible through the integration of technologies and well-designed educational activities. Merging higher order learning outcomes with the affordances of mobile learning temporality, space, and connectedness may enable learners manage complexity, or even stay ahead of it.

PROBLEM STATEMENT

As mobile device capabilities continue to expand, so do the possibilities for including the devices in higher order learning interventions. Recently these devices received an increase in usage as a tool for learning in classrooms and workplaces as evidenced by mobile friendly websites and applications with educational objectives. These devices, however, are more than just smaller computers or hip pocket resources. A review of the current literature on technology enhanced learning and critical thinking demonstrates the ability for facilitators to replicate their learning outcomes using technology in physical and virtual classrooms.

There is a movement of Chief Executive Officers (CEOs) unplugging from their desktop computers and using mobile devices such as tablets (Norton, 2014). This resurgence of President Lincoln's leadership by walking around indicates a greater need to apply critical thinking, effective communication, and ethical reasoning while using mobile devices. This is a lofty goal when the current tendency of virtual collaboration leans towards agreement and grasping for commonalities (Garrison, Anderson, & Archer, 2001). Leaders require the frank, honest, and accurate data that is often difficult to communicate in a 140-character tweet. Mobile technology complements mobile leadership well, but direct reports must also adapt their ability to communicate effectively up to the C-Suite and across functions.

Rossing (2012) likens mobile technology to a violin where an educator would not expect a student to navigate the fingerboard expertly at their first lesson. Likewise, leaders should not assume that learners would become critical thinkers and effective communicators upon the receipt of an iPad. Academia and talent development departments should incorporate mobile learning and reflect on its usage. Formal schools should facilitate lessons on how to learn when confronted with new technology; not simply teach mobile device operation as a job skill (Rossing, 2012). The same universities and talent development departments should also fully explore the potential of mobile learning, and not just digitize current content and methodology (Rossing, 2012).

Critical Need

Our nation needs contributors to our democratic society, citizens who can apply critical thinking, or the "skills of interpretation, analysis, evaluation, inference, explanation, and self-regulation" (Facione, 2006, p. 17). This criticality allows citizens to make better decisions that directly affect strategic aims of business, academia, and the military. Thinking critically for the betterment of one's own career, achieving high academic marks, or earning a promotion leads to the advancement of the whole as the individual contributes to society. This is also the aim of a liberal education, a philosophy that prizes rational thought (Siegel, 1987). Facione (2006) describes a liberal education as:

> Learning to learn, to think for yourself, on your own and in collaboration with others. Liberal education leads us away from naive acceptance of authority, above self-defeating relativism, and beyond ambiguous contextualism. It culminates in principled reflective judgment. Learning critical thinking, cultivating the critical spirit, is not just a means to this end, it is part of the goal itself. People who are poor critical thinkers, who lack the dispositions and skills described, cannot be said to be liberally educated, regardless of the academic degrees they may hold. (p. 18)

Developing this type of thinking helps individuals learn about themselves and the *other*, allowing the workplace to reap the rewards of diversity. Research shows that workplace diversity directly impacts institutional innovation (Parrotta, Pozzoli & Pytlikova, 2014). Often, the workplace tolerates diversity and rarely moves through the difficulties associated with dissimilar meaning making schemes inherent to various cultural backgrounds. As cited in Parrotta et. al (2014), "ethnic diversity may create communication barriers, reduce the workforce cohesion, and prevent cooperative participation in research activities, bringing high costs of 'crosscultural dealing' (Williams and O'Reilly 1998; Zajac et al. 1991; Lazear 1999)." (p. 3). Critical thinking enables people to apply empathy to move beyond the friction and barriers that impede collaboration required for innovation. Servicemembers can also benefit from innovation stemming from critical thinking and diversity when integrating with foreign military units. They may employ empathy at the tactical level within the battlespace to assess intent appropriately, and at the strategic level where planners require a deeper understanding of the people and context to win the hearts and minds (Cutright, 2013).

CRITICAL THINKING AS HIGHER ORDER LEARNING

Many frequently use the term critical thinking even though the practice is often underutilized in academic, military, and business institutions. These same entities espouse the virtues of, and claim to develop, critical thinkers, but fail to thoughtfully define and evaluate critical thinking. Critical thinking transcends standard learning, and does not lend itself for easy evaluation. Evidence of higher order learning does not surface through generating right answers on a multiple-choice test, reciting doctrine, or delivering good news. Critical thinking often stands in contrast to these valued student and direct report traits. It requires the questioning of longstanding individual and institutional beliefs that often creates discomfort for learners and leaders.

A contributing factor to the unsparing use of the term, and lack of its application, may derive from the complications that arise while trying to define it. In an attempt to define the concept, one must first understand that five intellectual traditions significantly influenced the term and created distinct brands of critical thinking. Critical theory, analytic philosophy and logic, natural science, pragmatism, and psychoanalysis (Brookfield, 2011) utilize distinct criteria to shape the idea of critical thinking in each of their fields. The following section will briefly highlight their similarities, shared ideas, and usage of the concept—the *interfield commonalities*.

Although each of these intellectual traditions views the idea of critical thinking in a slightly different manner, a 1990 study by the American Philosophical Association captures the interfield commonalities. The clarified definition establishes critical thinking as "the process of purposeful, self-regulatory judgment that results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (Facione, 1990, p. 6). This agreed upon explanation demonstrates a slowing down of the action that critical thinking requires by starting with the words *process* and *purposeful*. Such words frame critical thinking as a tool to apply or a method of thinking. Using the term *self-regulatory* also situates the thinker as the tool requiring continuous central calibration as they render *judgment*. The terms *interpretation, analysis, evaluation,* and *inference* crafted into the definition exhibit the interfield commonality of privileging academic thought. This leaves room for each intellectual tradition to determine how their practitioner goes about actioning them relative to *evidential, conceptual, methodological, criteriological,* or *contextual considerations*.

Intellectual Traditions of Critical Thinking

The critical theory view of critical thinking requires that one reflect on their own assumptions as they relate to flawed societal norms. These societal norms privilege the hegemony, and oppress others through often invisible and subversive means. In this intellectual tradition, those who fail to critically reflect on the state or public aims often passively participate in their own oppression (Pietrykowski, 1996; Habermas, 1991; Brookfield, 2005). Brookfield's (2011) definition of critical thinking asserts that assumptions frame thinking and determine actions. The criticality of the thinking emerges through an assessment of the validity of existing assumptions, and the utilization of multiple perspectives prior to taking action (Brookfield, 2011). This condensed critical theory based view of critical thinking requires an application of self-criticality and an ability to recognize what the field establishes as legitimate knowledge.

Paul (1993), of the analytic philosophy and logic tradition, situates critical thinking as purposeful, systematic, and habitual application of criteria and intellectual standards. The critical thinker, according to Paul's (1993) definition, takes charge of the thinking, constructs it in accordance with the established standards, and assesses its effectiveness using the purpose, the criteria, and the standards. Reflection in this domain requires the critical thinker to use their thinking to control their feeling and wanting. Elder and Paul (2011) believe that changing one's thinking can change one's emotions, and this allows one to access their rational mind and appropriately apply the process, standards, and elements of critical thinking. This academic tradition also requires critical thinkers to critically reflect ensuring that their inferences emerged from valid assumptions (Paul & Elder, 2001).

The natural science tradition of critical thinking stresses the use of scientific reasoning, and relies on observation and evidence gathering to prove a hypothesis or falsify a theorem (Brookfield, 2011). Natural science qualities of critical thinking also require the careful collection of evidence and the continuous checking of assumptions. The definition and standard of scientific method varies little from the field's view of critical thinking. The scientific

method may generally be defined as defining the problem, creating a hypothesis, collecting and analyzing data, and confirming or rejecting the hypothesis (Glanz, 2014). Critical thinking in this intellectual tradition requires the thinker to reflect on how they could possibly bias the process through various aspects of their presence, assumptions, or inferences.

A pragmatic view of critical thinking may use a setting of practice for their inquiry as Argyris (1976) does when presenting the double-loop learning model. The double-loop model seeks to generate valid information, and include participant's feelings (Argyris, 1976). Reflection in this intellectual tradition requires the thinker to apply criticality to their assumptions and those of the institution. Addressing the problem without that criticality may result in a solution produced through the single-loop learning model where answers emerge without asking significant questions of the problem (Argyris, 1976). Single-loop learning occurs when an instructor makes changes to their lecture in light of poor student performance. A double-loop learning scenario differs in that the instructor, instead of haphazardly adjusting their lecture, dives deeper, questioning their methods, outcomes, and student barriers to gain others' perspectives to challenge their own perceptions of the situation and causes. Double-loop learning would have the instructor share power with the student in a quest to resolve the problem, and ensure it remains solved, through the creation of useful information (Argyris, 1976).

Psychoanalysis, another intellectual tradition associated with critical thinking, tells us that experiences from childhood, lodged in one's unconscious, inhibit future action (Gould, 1978). This approach requires the learner to reflect and uncover their assumptions, and apply the critical thinking concept of empathy, to see the world from others' points of view (Brookfield, 2011). This application of empathy allows learners to step outside of their own assumptions, formed during childhood, and consider an alternate lens of the world. The adoption of this alternate lens, borne of their reflection, may encourage a more healthy behavior.

REFLECTION AND CRITICAL REFLECTION

Senge (1990) viewed reflection as the ability to slow one's thinking to become aware of how their mental models form and how those mental models may influence action. Schön (1987) used the terms reflection-in-action and reflection-on-action. Reflection-in-action involves critical questions of one's assumptions, and altering their actions while the experience is unfolding. Reflection-on-action distinguishes itself as the look back to past events, their consequences, and how one's actions contributed to the outcome (Schön, 1987). Regardless of the time or space one occupies with regards to the experience, assumption, challenge, or phenomenon, reflection is a crucial step in the process of applying the concept of critical thinking. Mezirow (2003) also states that learners must reach this level of reflective thinking to participate in higher order learning, such as in his theory of Transformative Learning.

What distinguishes critical reflection from reflection is the reassessment, not just of an experience, but also of one's orientation to perceiving, knowing, feeling, and acting (Mezirow, 1990). According to Mezirow (1990), critical reflection leads to "by far the most significant learning in adulthood" (p 13). Critical thinking requires reflection, skepticism, and the courage to take action (Siegel & Carey, 1989). These elements, and Brookfield's (1987) explanation that critical reflection is the recognition of underlying assumptions that shape our understanding and actions, further situate critical reflection as a key interfield commonality and ingredient for critical thinking. Critical reflection is the element of critical thinking that calls for one to identify assumptions and assess their legitimacy with the intent to change the current ways of thinking and acting (Brookfield, 2011). Critical reflection, therefore, assesses the validity of assumptions that form one's meaning perspectives, where one examines their sources and consequences (Mezirow, 1990). The ability to participate in these reflections leads to the appropriate application of critical thinking, presumably free of faulty assumptions, and theoretically results in better decision-making.

MOBILE LEARNING

An examination of the current state of mobile learning will make apparent how facilitators, in concert with mobile devices, create opportunity for increased learner access to the critical thinking intervention, and facilitator access to the learner. MoLeNET (2011, para. 4) defines mobile learning (mLearning) as "the exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning." One can distinguish mobile devices from other forms of technology by their portability, ability to connect, and ability to reach the learner and the learner's needs (Shippee & Keengwe, 2014).

The device, to be considered mobile, should be wearable or fit in the user's palm. If one can store the device in the pocket or pocketbook, it may bear the label of mobile device. Mobile phones, wearables, eReaders, tablets, and small laptops would fit into this category as they would fit onto the person, in a portfolio, or a bag that accompanies the learner throughout their daily routine. The device must also have connectivity to cellular or another wireless network (Shippee & Keengwe, 2014) so the learner may interact with the content, a virtual experience, or people. These features create opportunity for the very interactions necessary for the application of critical thinking throughout the conduct of our daily lives.

Components of Mobile Learning

Mobile devices differ from other technologies in a few key areas. The size and software serviceability of a mobile device makes it distinctive, each carrying with it their advantages and limitations. The "anonymity, speed of response collection, and shared visualizations" (Roschelle, 2003, p. 263) supported by incorporating mobile devices into learning also promote a purposeful process of sustained discourse. The relative anonymity provides space for shy students to participate. It allows introverts, and those not willing to expend the energy of relationship building and social graces found in traditional meetings, to forgo interpersonal rituals and focus on the task. Speed and data collection from diverse sources increase when not confined to physical space or face-to-face interactions. Mobile devices allow for multiple, fully formed ideas (statements, pictures, charts, tables, audio, and video) to be posted simultaneously for mass or selective viewing that enables groups to arrive quickly at common understandings. Mobile devices also make learning-on-the-go and just-in-time learning possible.

Learning-on-the-go, a phrase reminiscent of fast food industry catchphrases, allows the learner to engage conveniently with learning interventions in their own time, place, and pace. Mobile devices enable learners to engage in location based learning, where the focus of the activity is the location (Keskin & Metcalf, 2011) and the situatedness it provides. The idea of mobile learning "contrasts with previous generations who were taught to learn what they needed to pass a test, limited to resource materials in the library or textbook, and were limited by what they were able to memorize" (Fisher & Baird, 2007, p. 9).

Just-in-time learning refers to the learner's need for immediate, current, and relevant information (Ahmad & Orion, 2010). With just-in-time learning, one receives content at the proper time, in the proper context, to maximize the likelihood of retention and transfer of learning (Caffarella & Daffron, 2013). One may push or pull the data in just-in-time learning. A push may occur when the mobile device recognizes the location of the learner and, in concert with an application, provides relevant data in relation to the learner's position. For example, a mobile device could notify a learner of the details of a historical battlefield event or exhibit when they approach the precise GPS location associated with an engagement or piece of art (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, & Vavoula, 2009). In concert, the same location may stimulate the learner to pull information using their mobile device.

Currently, stores, historical sites, and museums create applications for mobile devices providing patrons the ability to receive pushes from their environment as well as pull information by taking photos of the object or reading the quick response (QR) code. By design, QR codes enable learners to choose which artifacts, products, and locations they wish to learn about, and skip others to save time, avoid becoming overwhelmed, and maintain interest in the activity.

Mobile Learning Design Considerations

The "spontaneous, informal, contextual, portable, ubiquitous, pervasive, and personal features of the mobile learning" (Yang, 2012, p. 148) create more frequent opportunities for authentic and situated learning (Lave & Wenger, 1991). Generally, learning is a personal and social process (Salomon & Perkins, 1998) independent of a classroom. Mobile learning fits within this ideal as a tool, an environment, and a platform for interaction and collaboration (Fisher & Baird, 2006). The shift to student centered, active learning interventions fits well with the personalization mobile technology affords. Students personalize devices by pulling information or downloading movies, music, videos, applications, etc. Learners collaborate with others through a myriad of voice, text, or video choices. Employers, leaders, and educators can also push timely content through the learner's preferred method of content delivery.

Specific considerations to intervention or outcome design increase the possibility for a successful transfer of learning (Cafferella & Daffron, 2013). Reiterating Ermi and Mäyrä's 2005 work Fisher and Baird (2006) note that

"designing learning experiences that engage the student in the content, community, and provide the architecture for meaningful exchange of knowledge" (p. 11). Thoughtful design extends the time learners spend with content and increases opportunity for knowledge exchange.

Ahmad and Orion (2010) recommend several mobile learning design considerations when implementing an intervention or an education outcome to mitigate mobile device limitations and learner motivation weaknesses. Their tips are relevant across multiple platforms from the smaller screen of a handheld device to the lightweight laptop. For example, designers should consider that a blogger may author a post via a smartphone or tablet, but few works of length are generated without a comfortable keyboard. As for learner motivation, the important information must be front-loaded. The likelihood of a learner exploring a lengthy text or video while standing in a checkout line is the same as a motor vehicle operator reading a rental car manual straight through.

Though mobile learning does not require a learner to be physically mobile, the draw of this technology is the convenience and control it offers individuals. Not everyone will participate in an entire course while patronizing a café, but many will access current events, listen to a podcast, or watch a TED Talk. These tips do not apply to all platforms or course designs, but they are important considerations to take if one expects to incorporate mobile learning into their intervention or education outcome.

The attributes and limitations of mobile technology define the perimeters of the intervention or education outcome (Fisher & Baird, 2006). Institutions who use purposeful mobile learning design considerations "cause their users to change their own behavior to accommodate a feature or…shape the tool to suit their specific requirements [and this]… may initiate further changes as the users begin to exploit the technology" (Sharples, Taylor, & Vavoula, 2006, p. 14). In other words, learners will begin critical thinking in a myriad of contexts, and possibly even develop deeper reflection supported by actively maintaining a mobile learning journal. This mobile learning journal may take the form of a video record of happenings, captured audio of thoughts, or text of small notes for reflection-on-action. Mobile devices aid in learning during reflection-on-action by keeping a log of the experience without the unintentional alteration from human factors such as memory degrade, a negative effect of time lag.

Research and Theory of Mobile Learning

Much of the research on mobile learning attempts to recreate the benefits of brick and mortar or computer based courses (Cavus & U, 2009; Coldwell, Craig, & Goold, 2011; Menkhoff, & Bengtsson, 2012). Such work includes surveying students to determine their views regarding the role of mobile devices in the classroom, coursework, and daily tasks. One current vein of research specifically asks learners about their comfort with mobile learning (Brand, Kinash, Mathew & Kordyban, 2011; Yang, 2012; Lan, & Huang, 2012). Another stream of mobile learning research focuses on student interaction and instructor facilitation in relation to specific mobile devices (Fisher & Baird, 2006). The results throughout each branch of literature demonstrate learner comfort with mobile technology, but also note a lingering requirement for shifts in the perspectives of educators and students alike.

Yang's (2012) study found that male college students were more comfortable with utilizing mobile devices for their coursework than the women enrolled in the same course. Their findings also indicate that one should consider students who normally excel when using traditional methods when instituting a technology enhanced learning intervention. Such change interferes with students' routines, and may bring about a feeling of loss as their preferred method of participation changes.

To better understand the evolving environment that mobile technology demands within higher education, Motiwalla's (2007) comparison between an eLearning and a mobile learning platform demonstrated that pedagogical methods are adaptable to mobile learning. Motiwalla's (2007) research assessed student efficacy by seeking student opinions of a proposed intervention as well as the role and value of mobile learning. The results indicated the key to successful implementation of a mobile learning intervention rests with proper consideration of good pedagogical practices. Additionally, several others also found student comfort and abilities with mobile learning were overwhelmingly positive (Brand, Kinash, Mathew, & Kordyban, 2011; Cavus, & Uzunboylu, 2009) even though the certainty with which mobile devices improved learning outcomes was not ascertained. It is not enough to ask only for learner efficacy, but to also assess if the learning outcomes received enhancement (Nguyen, Barton, & Nguyen, 2014; Garrison, Anderson, & Archer, 2001).

In Europe, academics are asking more from mobile learning; seeking new types of pedagogies to discover the possibilities learning interventions have in externally-initiated and internally-structured environments (e.g. academia), internally-structured and internally-initiated environments (e.g. museums), and externally-structured and internally-initiated environments (e.g. first aid course) (Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sanchez, & Vavoula, 2009). They also look to reach disaffected learners between the ages of 16-24 who were unsuccessful in traditional educational settings. The research provides evidence for mobile learning's capacity to support learners and educators with achieving education outcomes or workplace learning interventions (Kukulska-Hulme et al, 2009) while emphasizing the unique potential of mobile learning.

IMPLICATIONS FOR PRACTICE

Mobile learning provides space time and connectedness to engage in critical thinking. Mobile devices enable learners to record their reflections via text, picture, drawing, audio, video, or other creative means, and work through immediate reactions. Recording these reflections for immediate unpacking or for later review can produce a change in perspective, which leads to creative and critical thinking. Mobile learning also provides the space to critically reflect with others through messaging, voice, video, social media, and other native or web apps. Interfacing with the device during any free moment has become habit for the user. Learners may seize such opportunities to create a habit and time for reflection through the inherent conveniences of a mobile device.

A recording of a class, event, or experience can be viewed again after unpacking emotional responses, opening up the possibility to view the challenge in a different context. Recordings of a happening also enable the learner to overcome the negative effects of time-lag, such as diminishing recollection. Recording, unpacking and reviewing an experience may also allow the learner to overcome barriers of the mind, such as egocentrism, to think critically (Elder & Paul, 2011). The simple exercise of including a mobile device into our *process* of *purposeful self-regulatory* practice of reflection expands the time and space available for critical thinking through mobile learning.

HIGHER ORDER MLEARNING

Current mobile learning research demonstrates the potential for higher order learning, but also reveals the need for the distinction between mobile learning and higher order learning that utilizes mobile devices. Fiol and Lyles (1985) distinguish higher-level learning as being situated in ambiguous and ill-defined contexts and addressing intuitional rules and social norms resulting in long-term change. This contrasts their view of lower-level learning that focuses on activities or behaviors. The current state of mobile learning mirrors lower-level learning; both encompass the preponderance of institutional learning outcomes and interventions.

The distinction between the two levels of learning can be accomplished through the utilization of the term higher-order mLearning. The definition of higher order mLearning is the development of critical thinking, communication skills, and ethical reasoning that occurs through leveraging the inherent elements and affordances of temporality, space, and connectedness that mobile devices provide. This definition captures the elements of higher order learning while recognizing the virtue of mobile technology to bring students together around new ideas where their thinking may be challenged (Fisher & Baird, 2006). It emphasizes that interventions should allow learners to use mobile learning as a tool of convenience and traverse platforms as needed to facilitate the achievement of the education outcome (Fisher & Baird, 2006). Such interventions go beyond delivering content, to provide the platform that reduces the negative effects of time lag and makes space for critical thinking. Applications native to mobile devices allow the recording of activities for later review and create an archive of an event that does not degrade over time.

As a tool, mobile learning opens the door for new modes of learning (Fisher & Baird, 2006). Shippee and Keengwe (2014) aptly describe this possibility by stating how mobile learning "allows learners at every level to reference content faster, yet also to participate, collaborate, and generate content demonstrating a new level of self-reflective meaning making unparalleled in the history of the modern educational experience" (p. 104). New technology provides opportunity for learners to keep pace with the increasing speed of data transmission, and encroaching complexity on their lives, by providing the possibility for the new level of self-reflective meaning making that Shippee and Keengwe (2014) suggest.

SUMMARY
Critical thinking plays a large role in learners assessing the credibility of and detecting bias in the mass amounts of data pushed and pulled using their mobile device. Mobile devices provide a platform for critical reflection, and offer the opportunity to communicate their thinking effectively to other individuals or groups. Facilitating higher order mLearning requires careful design and practice, and is not the result of simply providing or allowing the use of mobile devices. Successful implementation requires a clear definition of critical thinking, method to evaluate it, and the tactical patience to allow higher order learning to occur in classes, workplaces, and areas of operation.

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