

The Pedagogy of Things: Emerging Models of Experiential Learning

C. E. Watson and J. T. Ogle

Abstract— The emergence of ubiquitous computing technologies have made the once theorized “Internet of things” a reality, and this quickly evolving technological infrastructure, in conjunction with a variety of mobile devices, including smartphones and tablets, is providing incredibly rich opportunities for learning. This article provides a description of these technological innovations and posits experiential learning as a key pedagogical strategy that is likely to benefit most from these technologies. It also provides examples of this new pedagogy of things, a pedagogy that embraces the emerging technological attributes of the real world around us.

Index Terms—mobile technologies, pedagogy of things, experiential learning, social media

I. INTRODUCTION

In 1991, working as the chief technology officer at Xerox PARC (Palo Alto Research Center), Marc Weiser shaped and observed emerging trends in computing (Weiser, 2002). He predicted a time would come when computing would become ubiquitous and technologies would become a part of and disappear into the environment around us (Weiser, 1991). They would “weave themselves into the fabric of everyday life until they [were] indistinguishable from it” (p. 94). This vision of the future is currently emerging as a reality. Many devices in homes, automobiles, public environments, retail stores, and even clothing are being equipped with computing capable of collecting and sharing information via the Internet and/or with mobile devices. It is believed that we are fast approaching a point where there will be more “things” on the internet than there are people (IBM Social Media, 2010), and this Internet of things is not only changing how we interact in the world, it will also change how we teach and learn within it. Faculty, teachers, and instructional designers, especially those that embrace experiential learning, are beginning to take advantage of these new capabilities by developing pedagogical approaches that leverage the technologies emerging in the environment around us. This is the pedagogy of things.

Experiential learning has long been embraced by those engaged in study abroad, service learning, environmental

education, the arts, experimental school-based programming, and outward bound. This emerging Internet of things holds great promise for these areas as well as any course or discipline that engages in research, data collection, or activities outside of traditional classroom walls. The Association of Experiential Education defines experiential learning as “a process through which a learner constructs knowledge, skill, and value from direct experience” (1994, p. 1). Grounded in Dewey’s conceptions of authenticity in instructional activities (Dewey, 1916; Dewey, 1938) and Vygotsky’s notions of social learning (Vygotsky, 1978), experiential learning overtly connects knowledge development to interaction and environmental experiences (Kolb, 1984). It is within this context that pervasive and permanent technological augmentations in the real world are changing the very nature of the word “authentic” (Watson, 2011).

Characteristics of this new authenticity include capabilities that are not only highly supportive of student-to-student interaction, but they are also supportive of student-to-environment interaction and vice versa. Our physical landscape now contains data collecting and sharing nodes that can provide a persistent and evolving connection between students, teachers, digital artifacts and the physical world via cellular, Bluetooth, WiFi, and other connectivity means. Ultimately, the new pedagogy of things is enabled, to a large extent, by the rapid and broad adoption of smartphones, tablets, and other similar devices that enable mobility while possessing connectivity functionality (Watson & Plymale, 2011). The potential for instructional impact is underscored by a Pew Research Center survey conducted in 2011 that found that 49% of 18-29 year olds now have a smartphone (Smith, 2011). These personal mobile devices have core features, such as touch screens, global positioning access, compasses, accelerometers, cameras, persistent Internet connectivity, and an incredible range of applications, which enable data collection, social networking, collaboration, and the analysis and synthesis of data. Large group multi-user web conferencing and collaboration platforms, similar to those currently in vogue for traditional distance learning, are emerging for the mobile device as well (Luo & Benlamri, 2009). In educational contexts, these capabilities and emerging systems can be used to leverage social learning theory, situated cognition, authentic learning, and discovery learning.

Merrill (2002) reviewed respected instructional design theories and discerned five common learning principles across these theories, among them are utilizing real-world problems,

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C. Edward Watson is with the Center for Teaching and Learning at the University of Georgia, Athens, GA 30606 (706-542-0539; fax: 706-542-6587; e-mail: edwatson@uga.edu).

J. Todd Ogle is with the Institute for Distance and Distributed Learning at Virginia Tech, Blacksburg, VA 24061 (todd.ogle@vt.edu).

encouraging the application of new knowledge, and integrating new knowledge into the learner's world. These common learning principles overlap with what have been termed essential criteria of experiential learning (Moon, 2004). These essential criteria also emphasize learning activities that encourage active and personal engagement, are relevant to the learner, and provide opportunities for self-directed learning. These complimentary theoretical perspectives, coupled with the affordances of pervasive computing, comprise the structure and context for the pedagogy of things.

II. THE PEDAGOGY OF THINGS IN PRACTICE

A number of examples of the pedagogy of things in practice have recently emerged in the literature. Wisman and Forinash (2010) suggest a model of science education that takes experiments common to the traditional laboratory and moves them into the real world. Rather than studying acceleration by rolling a ball down a slope in class, students can use the accelerometer in their phones to "be the ball" in the real world. Amusement park rides and bicycles become educational tools when coupled with sound pedagogical practice and a well-designed curriculum. Wisman and Forinash suggest that such an approach has the dramatic potential to change students' relationship with their own learning and ultimately change how they view science.

As a means to increase student engagement in a study abroad context, iPads were used to enable students to access relevant content when visiting historically significant locations. As an example, when students visited Wenceslas Square in Prague, they were able to access photographs of famous events that took place in that physical location. As a result, the relevance for the visit to this location was made palatable and more personally meaningful (Shewmaker & Shewmaker, 2011).

Beddal-Hill, Jabbar, and Al Shehri (2011) adopted smartphones and tablets for teaching and performing ethnographic and other qualitative methods of research. In one project, students recorded observations during ethnographic field trips using Apple iPhones. The smartphones were used to capture photos, video, and audio, geo-tag locations, write notes and communicate via e-mail. While the convenience and portability of the iPhones were found to be very helpful in collecting and sharing data in an unobtrusive manner, the ability of the device to enable learning and research in new ways outside of the traditional classroom context is the shift that is important to note.

Augmented Reality (AR) is a growing area of interest in experiential learning and situated cognition research because of its potential to provide social connectivity, context/location awareness, and access to additional information and artifacts in a physical location. AR is the addition of digital information, in the form of graphics, photos, and/or three-dimensional models over a view of the physical environment. AR can be marker-based or markerless. Marker-based AR relies on Near Field Communications (NFC), Radio Frequency Identification (RFID), Quick Reference (QR)

Codes (Ruzkio, Wetzstein, & Schmidt 2005; Paolucci et al., 2008), and/or image recognition and processing (such as Google Goggles). When the camera of the mobile device is pointed at the marker, an event is triggered, which typically loads audio, video, text, 3D graphics or holographs via Web service. Markerless AR relies on proximity, using GPS, cellular triangulation, and the device's compass to trigger an event or display an augmentation. Users can add their own markers or geotags to AR environments in-situ, thereby adding the mesh of linked and information-rich objects in the environment that those who visit that location in the future can access, edit, and contribute.

In describing a project using handheld computers in an augmented reality simulation game (*Environmental Detectives*), Klopfer and Squire (2007) note that handheld computers (in this context, Pocket PC's running a mobile version of Microsoft Windows) provide five key attributes that make them of interest in education: portability, social interactivity, context sensitivity, connectivity, and individuality (Klopfer, Squire & Jenkins, 2002). They leveraged these affordances to design and author the game for use by college and high-school age students, in which students are asked to help with information gathering following a toxic spill on campus. Among the pedagogical implications of their work, Klopfer and Squire found that social information exchange held a high degree of importance, as teams of students had to decide what to share with other teams due to an inability to explore the entire field of play during the simulation. Additionally, they found that physical location plays a critical role in augmented reality games; as the scenario unfolded in their own community, students felt a higher level of emotional engagement than they did on field trips.

Similarly, Dunleavy, Dede, and Mitchell (2009) developed an AR simulation that was place-independent, allowing teachers to make use of it at school rather than requiring a field trip for implementation. In *Alien Contact!*, middle and high school students work through a scenario designed to impart math, language arts, and scientific literacy skills in an inquiry-based game. Using markerless AR (interactions triggered by proximity) in combination with physical props, students moved about their school grounds, interacting with virtual characters and collecting data that would they would use to determine the intentions of alien visitors. Students were divided into teams with different roles for each team member and tasked with collecting data and solving math, language and scientific literacy puzzles. Dunleavy et al.'s findings included a high level of engagement amongst the students, with students and teachers both recognizing the novelty of performing math in a physical, evidence-based manner rather than through typical means (2009). The researchers also note the positive social interdependence among students as a result of the "jigsaw pedagogy" whereby the AR provided each team member with different and incomplete information chunks which relied on the team as a whole to synthesize. The research team also noted the power of AR to contextualize and ground learning in a physical setting, in contrast with

conventional classroom instruction, which is typically decontextualized and abstract.

In a project using GIS to engage students in inquiry-based learning, Coulter and Polman (2004) concluded that focused curricular planning led to a more successful implementation than an “activity exposure” approach. This is a significant point to note, as there must be curricular relevance for the learner to see meaning in the activity and to be purposefully motivated to engage in the learning task at hand (Kember, Ho & Hong, 2008). Further, cognitive overload and unproductive mental effort are risks to learning in real world, discovery-based learning contexts, especially those that have a high dependency on multimedia use (Clark, Yates, Early & Moulton, 2010). Both of these concerns underscore the need for instructional design practices as pedagogy of things instructional strategies are designed, developed and implemented.

III. CHALLENGES

A primary benefit of emerging technology as applied to teaching and learning is access to information. The pedagogy of things presents an opportunity for learners to access information in real-world contexts. The challenge for teachers will continue to be identifying and making the best of use of applications and services that align with the learning objectives defined for the course or program. These technologies are typically used outside the classroom, and are, thus, affected by logistical limitations. The mobile technology itself is expensive and fragile. Smartphones and tablets must be managed and maintained. Many of the research examples cited above are cost and time prohibitive. However, there are free and relatively easy to use applications and services for augmented reality for example, whether using QR codes or GPS. Given the effort that is required to prepare activities using these technologies, care must be taken to maximize their impact and make the most use of learners’ time.

IV. RECOMMENDATIONS

Preceding in-field activities with classroom, or library-based research, and preparation, and following up with summarizing evaluative activities that help learners integrate their new knowledge will prove more successful than treating the field activities as isolated exercises. Leverage the pedagogy of things by asking learners to activate prior knowledge and apply that knowledge in the field activity; for example, have learners add their own annotations to the mesh of information, asserting their own conclusions in the field prior to a summary exercise. Doing so makes learners active participants in the creation and validation of new knowledge.

The pedagogy of things can provide access to information hidden to the naked eye. This information can be embedded in environments outside the typical classroom, environments that may be helpful in integrating knowledge into the learners’

everyday world. Instructional design theory and practice are still keys to maximizing the effectiveness of this mesh of information embedded in our everyday world.

V. CONCLUSION

Regardless of the affordances mobile computing provides, as with other instructional settings, sound pedagogy and instructional design will remain primary determinants of success. The pedagogy of things allows for experiential and contextualized learning where traditional learning activities may not. These technologies provide access to information in novel ways and contexts, but the challenges to their implementation require careful thought regarding their use.

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Dr. C. Edward Watson holds a Ph.D. in Instructional Design and Technology from Virginia Tech. He is the Director of the Center for Teaching and Learning at the University of Georgia. He currently serves as an Executive Editor for the International Journal of Teaching and Learning in Higher Education and the founding Co-Executive Editor of the International

Journal of ePortfolio. He is also on the Executive Board for the Association for Authentic, Experiential and Evidence-Based Learning (AAEEBL). His book, *Self-efficacy and Diffusion Theory: Implications for Faculty Development*, was published in 2008. He is often invited to deliver presentations on the topic of innovative pedagogical practice, most recently, as a keynote at the 2013 Annual Meeting for the Association of American Colleges and Universities (AAC&U). His current research interests include digital native mythologies, dual-task processing, faculty development, ePortfolio pedagogies and practices, distance learning, and the pedagogy of things.

Dr. Todd Ogle holds a Ph.D. in Instructional Design and Technology from Virginia Tech. He is the Senior Associate Director for Applied Research and Planning in the Institute for Distance and Distributed Learning at Virginia Tech. He has co-authored presentations, reports, and articles, including a paper sponsored by the Federal Department of Education, and has worked in areas such as virtual environments, career and technical education, distance learning, and most recently, augmented reality. His current areas of interest include making use of existing data for decision making at the program level and to provide student feedback on performance, seeking innovative assessment methods for online learning, providing support to the online learner, and connecting learners with extant information in real contexts via augmented reality.