



Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media



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ABSTRACT

The purpose of this research was to explore teaching and learning when mobile computing devices, such as cellphones and smartphones, were implemented in higher education. This paper presents a portion of the findings on students' perceptions of learning with mobile computing devices and the roles social media played. This qualitative research study focused on students from three universities across the US. The students' teachers had been integrating mobile computing devices, such as cellphones and smartphones, into their courses for at least two semesters. Data were collected through student focus group interviews. Two specific themes emerged from the interview data: (a) advantages of mobile computing devices for student learning and (b) frustrations from learning with mobile computing devices. Mobile computing devices and the use of social media created opportunities for interaction, provided opportunities for collaboration, as well as allowed students to engage in content creation and communication using social media and Web 2.0 tools with the assistance of constant connectivity.

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1. Introduction

The Educause Center for Applied Research [ECAR] (2012) survey on Mobile IT in higher education states that students are driving the adoption of mobile computing devices, such as cellphones, smartphones, and tablet computers, in higher education, and 67% of surveyed students believe mobile devices are important to their academic success and use their devices for academic activities. The increased ubiquity of mobile computing devices on college campuses has the potential to create new options for higher education students and the exploration of mobility and social media as an instructional strategy.

Mobile computing devices can provide educational opportunities for students to access course content, as well as interact with instructors and student colleagues wherever they are located (Cavus & Ibrahim, 2008, 2009; Kukulska-Hulme & Shield, 2008; Nihalani & Mayrath, 2010; Richardson & Lenarcic, 2008; Shih & Mills, 2007). These facile interactions are made even more accessible by using mobile devices in conjunction with social media, free web tools that allow for communication and enhance learning (Rodriguez, 2011).

Because mobile computing devices and social media are still rather new and evolving, research has tended to focus on evaluating the

effectiveness of implementing mobile computing devices (Wu et al., 2012). Some of the most rigorous research used survey methods in order to depict students' intentions (cf., Cheon, Lee, Crooks, & Song, 2012; Liu, Li, & Carlsson, 2010). However, there is little applied research into how these tools are actually being used to support teaching and learning with few descriptions of how mobile computing devices and social media are used by university students.

The purpose of this research was to explore how higher education teaching and learning were affected by the integration of mobile computing devices. As mobile devices continue to grow as part of the higher education landscape, mobile computing devices present both opportunities and challenges to higher education institutions (Kim, Mims, & Holmes, 2006; Looi et al., 2010). The goal of our broader research was to present in-depth perspectives of instructors and students about their experiences of implementing mobile computing devices. However, this present paper will focus only on students' experiences and perceptions mobile computing devices brought to learning and the roles social media played. The primary research question for this study was, "What are students' experiences when mobile computing devices are integrated into higher education courses?"

2. Foundations of mobile learning

Technically still in its infancy in higher education, learning with mobile computing devices has been described and defined in a variety of ways. Mottiwalla (2007) stated that mobile learning "combines individualized learning with anytime and anywhere learning" (p. 2). Additional researchers have defined mobile learning as learning facilitated by

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mobile devices (Herrington & Herrington, 2007; Mobile Learning Network (MoLeNET), 2007, 2009; MoLeNET, 2007; Valk, Rashid, & Elder, 2010). Because our interest was focused on how mobile computing devices impacted learning with coursework, we felt a combination of definitions was most appropriate. So, in this study, mobile learning was defined as (a) more than just learning delivered and supported by handheld, mobile computing devices (Keegan, 2005; Mobile Learning Network (MoLeNET), 2007, 2009; Traxler, 2007) but (b) learning that is both formal and informal (Quinn, 2011; Sharples, Taylor, & Vavoula, 2007; Traxler, 2007, 2010), and (c) context aware and authentic for the learner (Sharples et al., 2007; Traxler, 2005, 2007, 2010; Winters, 2007). Each of these components is briefly discussed below.

2.1. Learning delivered and supported by mobile computing devices

Mobile computing devices have included technologies that are transportable, such as cellphones and smartphones, and these may include tablet computers, laptop computers, and netbooks (Valk et al., 2010). Keegan (2005), however, recognized that mobile learning should focus on the actual mobility of the device. That is, mobile learning should be “restricted to learning on devices which a lady can carry in her handbag or a gentleman can carry in his pocket” (Keegan, 2005, p. 33). This is the essence of mobile learning – accessing information and knowledge anywhere, anytime (Traxler, 2007) from devices that learners are used to “carrying everywhere with them” and that they “regard as friendly and personal” (p. 129).

2.2. Learning is formal and informal

Furthermore, Winters (2007), Sharples et al. (2007), Traxler (2007, 2010), Cook, Pachler, and Bradley (2008), and Pachler, Bachmeir, and Cook (2010) identified mobile learning as both formal and informal. Formal learning, by design, is where learners are engaging with materials developed by a teacher to be used during a program of instruction in an educational environment, highly structured, institutionally sponsored, and generally recognized in terms of a certificate or a credit upon completion (Colley, Hodgkinson, & Malcom, 2003; Marsick & Watkins, 1990). Informal learning is often defined as learning that results “from daily work-related, family or leisure activities” (Halliday-Wynes & Beddie, 2009, p. 3). It is often intentional but unstructured and contextualized (Marsick & Watkins, 2001). This type of learning is sometimes “unanticipated, unorganized, and often unacknowledged, even by the learner” (Jubas, 2010, p. 229). Activities such as reading, using the Internet, visiting community resources, such as libraries, museums, and zoos, and on-the-job learning are usually considered informal learning activities, though there is no conclusive definition of informal learning. During any of these activities, learners can use and access their mobile computing devices to research, investigate, or collect information to be used in their formal learning environment (Abilene Christian University (ACU) Mobile Learning Report, 2010; Mobile Learning Network (MoLeNET), 2007, 2009).

Nevertheless, Billett (2002) argued that learning is ubiquitous and much of our learning takes place outside the formal educational setting. Therefore, informal learning should not be regarded as something that occurs after formal learning has been accomplished but in combination with formal learning. Mobile computing devices can be used as the bridge between formal and informal learning opportunities.

2.3. Learning is context aware and authentic

Traxler (2010) contended that with mobile learning, content can be more context aware, authentic, and situated in the surroundings where the learning is more meaningful to the learner. Learners can personalize the way they interact with the course content. They can also customize “the transfer and access of information in order to

build on their skills and knowledge to meet their own educational goals” (Sharples et al., 2007, p. 223) based on their needs and abilities. Mobile computing devices also allow for learning to be situated and context aware in which learning takes place in meaningful surroundings – most likely outside the classroom and in the student’s surroundings or environment at a time appropriate for the learner (Mottiwalla, 2007). However, Traxler (2010) and Tella (2003) warn that learning across contexts and at different times may produce fragmented knowledge and incomplete schemata.

3. Social media

Higher education students and faculty members typically use the term *social media* interchangeably with *Web 2.0*. Web 2.0 is typically defined by the characteristics, or technical design patterns, set forth by O’Reilly (2005). Social media, a term coined in 2005 after the term *Web 2.0*, is defined more specifically as “a group of Internet based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user generated content” (Kaplan & Haenlein, 2010, p. 61). The social aspect of the term “implies that it exists in a social space” (Rodriguez, 2011, para. 3), which may be used for individual, professional, and/or entertainment purposes, and leverages social networks cultivated by individuals. The *media* portion of the term suggests that the social interactions are mediated through social networks, digital networks, and digital devices.

Admittedly, the lines among social media and Web 2.0 tools, or “web apps,” are blurred. Broadly, social media encompasses (a) social networking sites, such as Facebook, Twitter, and LinkedIn, (b) media sharing sites, such as YouTube and Flickr, (c) creation and publishing tools, such as wikis and blogs, (d) aggregation and republishing through RSS feeds, and (e) remixing of content and republishing tools (Greenhow, 2011, p. 140). Siemens’s (2005) theory of connectivism, and Sharples’ (Sharples, 2000; Sharples, Taylor, & Vavoula, 2010) notion of learning as conversation propose that learning events do not halt but may continue within other networks to which we are part. Organized, or structured, formal learning can purposively leverage these networks, such as through Facebook or Twitter. Likewise, informal learning can flow throughout a day or days, tolerating pauses and disruptions (Ng, Howard, Loke, & Torabi, 2010).

Greenhow (2011) summarizes that using social media tools in learning promotes a more student-centered course. These tools allow students to interact and collaborate with each other and instructors and “promotes personal choice, customization and student familiarity” (Hoffman, 2009, para. 23). Students are better able to create their own understanding of content when creating with these tools. Furthermore, Light (2011) identified elements that shape how Web 2.0 tools can be used meaningfully. Without structure, social media can negatively impact student learning.

4. Applications of mobile learning & social media

In this section, we describe applications of mobile computing devices and social media around three broad themes that reoccur in published studies and cases. These characteristics include (a) engaging learners with constant connectivity, (b) fostering collaborative learning and (c) enabling authentic learning on the move.

4.1. Engaging learners with constant connectivity

Mobile devices allow learners to access content and communicate with classmates and instructors, no matter where they are (Cavus, Bicen, & Akcil, 2008; Shuler, 2009). In addition, mobile technologies “enable learners to find, identify, manipulate and evaluate existing knowledge” (Brown, 2005, p. 300) and successfully integrate and communicate this new knowledge into their work. These activities

support the focus on the importance of social media in which the learners are creating user generated content (Agichtein, Castillo, Donato, Gionis, & Mishne, 2008). For example, user generated content allows for collaborative activities like the use of wikis, blogs, and even social bookmarking tools. In essence, these collaborative projects promote the idea that the joint effort of many – the idea of “collective intelligence” (Levy, 2001, p. 11; Surowiecki, 2005, p. xiv) – leads to a better outcome than any one person could achieve individually (Kaplan & Haenlein, 2010). The term collective intelligence, coined by Levy, describes a participatory, friendly environment for the growth of new ideas that grow from cyberspace. The constant connectivity afforded by the mobile devices allows students to remain engaged in content creation and receive feedback and formative guidance, which is needed in facilitating a learner-centered environment (Valk et al., 2010). Roblyer, McDaniel, Webb, Herman, and Witty's (2010) research on the use of the social networking tool Facebook, supports the potential for student-to-student and student-to-instructor interactions. However, students perceived the effectiveness of Facebook for communication more positively than the instructors.

4.2. Fostering collaborative learning

Mobile devices provide learners opportunities to collaborate, discuss content with classmates and instructors, and create new meaning and understanding. Furthermore, social media provides for collaborative and engaging opportunities for students (Hoffman, 2009; Pang, 2009). Cochrane and Bateman (2010) identified how the use of mobile computing devices in one project-based course created a sense of connectivity with students, instructors and their clients by allowing for the constant and immediate connection to the Internet to blog about work progress, share photos and communicate using instant messaging or text messaging. This social media tool allowed for students to collaborate and share with each other in learning. Implemented effectively, mobile computing devices can support this collaborative, constructivist approach to learning (Cochrane & Bateman, 2010; Liaw, Hatala, & Huang, 2010).

4.3. Enabling authentic learning on the move

Ruta et al. (2010) state that mobility with learning “enables knowledge acquisition across context and environments, rather than simply exploiting handheld devices for the fruition of learning” (p. 21). Applications on mobile computing devices – many of which are considered social media tools – allow learners to create video/audio, take photographs, geotag (i.e., geographical identification metadata added to media to identify the location to others), microblog (i.e., a type of blog that consists of a short sentence fragment, an image or embedded video), receive or send text messages, and access social networking sites for communication with classmates and their instructor (Vavoula, Sharples, Rudman, Meek, & Lonsdale, 2009). In essence, by using the applications available on mobile devices as well as social media tools, a personalized, authentic learning experience can be created for learners (Archambault, Wetzel, Foulger, & Williams, 2010; Shuler, 2009).

5. Methodology

The goal of the research was to present students' in-depth perspectives of experiences with implementing mobile computing devices. Therefore, Merriam's (1998) characterization and process of a general qualitative study were used, where transcripts were read several times to identify themes and categories. The qualitative approach allowed for the representation of reality through the eyes of the individuals interviewed in order to share their stories and hear their voices.

5.1. Context and participants

To best align with our operationalization of mobile learning, mobile computing devices in this study included the following characteristics: (a) persistent access to the Internet, (b) a variety of downloadable applications, (c) used as a communication device, specifically phone and SMS (text) messaging, and (d) small enough to carry in a pocket or handbag (see e.g., Keegan, 2005). Therefore, only handheld devices, including cellphones and smartphones, were used in this study.

This study implemented a criterion strategy with a maximum variation strategy (Miles & Huberman, 1994) to determine the purposeful sample. The criteria for inclusion were as follows: (1) The context of this research was both public and private four-year higher education institutions. (2) We sought instructors who had used and implemented mobile computing devices as operationalized above in their learning environment for at least two semesters and (3) had used mobile computing devices to facilitate teaching and learning (i.e., not the management of university related activities on a mobile computing device such as accessing university resources). Students were then invited after their instructor interview was completed to corroborate the instructor's comments. Once these three criteria were met, maximum variation sampling (Miles & Huberman, 1994) was used to diversify participants. This included selecting participants for the final sample who did not represent the same type of university (i.e., public or private) and level of course (i.e., graduate or undergraduate).

In total, three university instructors agreed to participate and between two and four each of their respective students participated in focus group interviews. Pseudonyms are used throughout the report of research for all institutions, instructors, and students; the participants are summarized in Table 1.

5.2. Data collection

The primary method of data collection for the students' perspectives was focus group interviews. After contacting the course instructors, their students were invited via email. All focus group interviews were conducted using Skype, and all of the focus group interviews were recorded using a Skype recorder. While video conferencing sometimes inhibits the observation of non-verbal behaviors (Merriam, 2002), we were able to note cues related to body language, such as engagement (e.g., leaning into the camera), agreement (e.g., head nodding), and distancing or disinterest (e.g., cross arms) with the quality of the recording (Marshall & Rossman, 2011).

Krueger's (2002) guidelines for focus group interviews were used to provide structure to the focus group interviews. A semi-structured interview protocol (see Appendix A for the complete protocol) was used, because it allowed for the variation in the order and phrasing of the questions and any additions to the protocol, such as additional questions and probes to specific individuals, when appropriate (Cresswell, 2007). While the focus group interview protocol acted as a guide, the questions were flexible to represent the emergent nature of the interview conversation.

The focus group interviews were transcribed and the additional non-verbal behaviors identified during the focus group interview were noted, such as head nodding, smiles, frowns or signs of boredom (Krueger, 2002). These behaviors were aligned with the transcription where appropriate. Additionally, other notes about student statements were written down in order to assist in making connections between the interviews and the research question.

5.3. Data analysis

Inductive analysis (Cresswell, 2007) was used to abstract the data. Based on Glaser and Strauss (1967) constant comparative method,

Table 1
Participant information.

Name of institution	Characteristics of school (size, public/private)	Location of school	Level of student & discipline	Number of student participants
Coastal College	Mid size, public	North	Graduate/Independent Study — History	2
Lakeshore University	Small, private	South	Undergraduate/Social Work	4
The University of Northbrook	Large, public	Great Lakes	Graduate/Communication	3

the analysis required an iterative process of collecting data, open coding, and then working with the codes to reveal connections. Patterns within the data were developed, then collapsed into categories, and finally overarching themes evolved. This constant comparison of the data was conducted in three rounds of inductive analysis, which included open coding, a priori coding, and research/methodological coding (Bogdan & Biklen, 2003).

5.4. Rigor & trustworthiness

In addition to the thick, rich description (Merriam, 1998) presented in the findings, three strategies were used to ensure the trustworthiness and rigor within this study. Member checks (Merriam, 1998) were managed by verifying the interview transcripts with each of the participants and requesting edits and additions. Peer debriefing (Patton, 2002) was conducted with the second author during the analysis, where categories and themes were questioned, justified, and verified. Finally, an audit trail was used to document how the data were collected; how codes, patterns, categories, and themes were derived; and how decisions were made throughout the study (Merriam, 1998).

6. Findings and interpretations

Two specific themes emerged from the student focus group interviews depicting the impacts mobile computing devices had on student learning and social media's roles. These themes include: (a) advantages of mobile devices for student learning and (b) frustrations from learning with mobile computing devices. Quotations used within each theme indicate verbatim remarks by the participants, and pseudonyms are used to denote the participants and institutions.

6.1. Advantages of mobile devices for student learning

The student participants described many advantages in which the mobile devices assisted in their learning. These advantages are organized into (a) accessing information quickly, (b) communication and content collaboration, (c) variety of ways to learn, and (d) situated learning.

6.1.1. Accessing information quickly

One advantage mobile computing devices afforded students in their learning was the ability to access information quickly. Because of the convenience of constant connectivity — specifically the connectivity to the Internet — students felt that the devices allowed them to retrieve course content quickly, stating, “You can go to any source you want to within seconds.”

The student held up his iPhone as if to remind me that the mobile device was always easily accessible and within reach. Therefore, capitalizing on the immediate access to information that the mobile devices offered.

Furthermore, students at the University of Northbrook and Coastal College spoke positively about accessing course content such as discussion boards, course readings, and video clips they needed to watch for class on their mobile device. In addition to accessing content, they used their devices to upload and post content to their course sites.

All the student participants viewed the ability to access information through the mobile device positively.

Students also noted other positives, including the immediacy of having instructors provide course documents to the students. By quickly emailing important course documents to the students instead of passing the documents out during a face-to-face class, students felt that this was a more “quick and efficient” use of time and allowed students to have the document “right in front of us,” allowing for course discussion or explanation to begin immediately.

Overall, the students found using mobile devices more convenient with statements such as “It’s just more convenient, I think. Like I hardly ever take my laptop to class.” This convenience spoke to the actual mobility of the device as opposed to using a larger device like a laptop computer. The students’ recognition of the ease of mobility and the ability to access information via the mobile device firmly supported the definition of mobile learning operationalized for this study. Mobile learning should allow for the access of information regardless of location on a device that learners are used to “carrying everywhere with them” and that they “regard as friendly and personal” (Traxler, 2007, p. 129). The mobile devices allowed students to conveniently access course content.

6.1.2. Communication

Another advantage that stemmed from the constant connectivity available to students was the ability to communicate with fellow classmates and the instructor. Lakeshore University students felt that the constant communication made available through the mobile device was key in the success of the instruction and allowed them to be “fully productive.” Additionally, one of the students from Lakeshore University shared a common sentiment:

It was the whole new experience of having an out-of-class experience while still having instruction, instruction from the professor and it still being active communication...it was constant: Text message, email.

Learning occurred informally from small group collaboration while students were gathering information around campus.

Students found themselves communicating more because of the mobile devices. They interacted with each other through applications, such as with Skype or Oovoo — both video conferencing tools — as well as engaged either through text messaging, the social networking tool Twitter, or the course website. One Coastal College student shared this explanation about communicating with the mobile device:

I probably communicate more. Texting more with people. Capturing ideas more. Putting it to use quickly. I think, you know, I do see its advantages. I use it all the time now. I was never really a big cell phone user.

The immediate access to each other impacted how the students interacted. The students seemed to leverage the structure of their course assignments (i.e., formal learning) with the anytime, anyplace convenience (i.e., informal learning) of learning with and from classmates. The participants considered communicating more often and usually in smaller chunks more effective and efficient.

Additionally, the University of Northbrook students described that posting immediate comments to Twitter was easier than logging back into a password protected course discussion board that students could not access from their mobile device:

I mean with [our course management system], it's the thing you check into just to do school work. Twitter — it's a social media tool that you are on all the time anyway. And to have the education, the class, be intermingled with the rest of our lives. It means it's ever present and when those ideas, when they develop, they are there. And you are already with your classmates. You don't have to go, "Oh my God, I have to jump on Blackboard and post this right away." The thought is there and it's more permeated into your regular life.

Twitter allowed students to share their thoughts immediately with their classmates within the course of their everyday lives. Many authors (e.g., [Hernández-Ramos, 2004](#); [Hrastinski, 2008](#)) assert and report the value of discussion boards for thoughtful reflection. However, the students at the University of Northbrook preferred the pace and convenience of tools they used personally and professionally. This immediacy also created a faster exchange of ideas as opposed to the time-consuming pace of a course discussion board.

It is important to note that students often referred to text messaging as an important communication tool, too. Though text messaging is not considered a social media tool, the students found tools that provided immediate accessibility as a positive communication tool. Moreover, all of the participants seemed to make little distinction among methods of communication other than which ones were easiest to use in order to accomplish a task.

6.1.3. Variety of ways to learn

Students interacted with course content in a variety of ways using mobile computing devices. This included recording video or voice memos to be uploaded to the course site and then discussed by the entire class. The students at Coastal College also used these tools as they created their virtual history sites.

Learners were able to communicate and collaborate about course content by using mobile computing devices to text message and email. Students also felt they had opportunities for reinforcement of the course material when using their mobile devices. For example, students were able to participate in polls using the devices as well as answer questions anonymously and then discuss the responses at length during the class session. At Lakeshore University, one student described the honesty that came from responding anonymously. He said, "In a lot of my classes we've used the QuickPolls to answer questions and I found that sometimes that it helps people answer more honestly." The anonymous discussion provided by the mobile devices allowed learners to engage in the discussion at a deeper level. The focus remained on the content and not on the concern of answering incorrectly. Furthermore, the immediate feedback received after taking a quiz on the mobile device also reinforced focus on the content.

Students also looked up information for course discussion, as well as used their devices to watch required videos to further enhance course discussion. Constant interactivity benefitted the students as they used Twitter to discuss course material. At the University of Northbrook students participated in a backchannel Twitter discussion. This backchannel conversation (see e.g., [Kwak, Lee, Park, & Moon, 2010](#); [Zhao & Rosson, 2009](#)) is a discussion that typically occurs with the assistance of a social networking tool, such as Twitter. Backchannel discussion occurs simultaneously with a live presentation and in this instance was employed in addition to the face-to-face discussion that occurred during the class meeting. The University of Northbrook students named their backchannel discussion a Tweet-A-Thon.

The use of Twitter also created connections between the students and the researchers the students were reading about in less formal

ways. A student at the University of Northbrook described the meaning for these connections:

When I started taking this class though, I think I started understanding how Twitter can function as, umm, a tool for learning. Following scholars for instance, that we've been reading in this class has been really neat to actually have a personal connection with them almost because you see what they are doing in their day-to-day. They're posting some of their favorite articles, some of their favorite theorists.

For these specific students, Twitter provided a way to informally interact with researchers, which was outside the requirements of their course. The students on their own found the continued interactions valuable to their learning. Interacting with the theorists over Twitter created a connection and a level of excitement for the student that reading and discussing the articles alone did not.

6.1.4. Situated learning

Mobile computing devices also allowed for interaction with the course content and other classmates in a highly situated and contextualized way. Situated learning proposes that learning takes place in the same context in which it is applied, typically in a real world setting ([Lave & Wenger, 1990](#)). Learning is a social process situated in a specific context and embedded within a particular environment. Therefore, social interactions and learning in situ are critical components of situated learning. Admittedly, informal learning and situated cognition are not mutually exclusive. [Choi and Hannafin \(1995\)](#) and [Marsick and Watkins \(2001\)](#) emphasize the relationships between situated learning and informal learning, where individuals are often unaware of their learning and that it occurs during the activities of their daily lives. While informal learning is mostly unstructured ([Marsick & Watkins, 2001](#)), situated learning is incumbent on the individual's interpretation and the authenticity of the context. [Choi and Hannafin \(1995\)](#) argue, "Situated learning methods attempt to induce everyday cognition by anchoring knowledge and skill in realistic contexts" (p. 57). So, learning activities — whether formal or informal — that embed authentic problems and contexts can be considered situated. Two of the institutions and participants described situated learning.

Lakeshore University students participated in situated learning while discussing the concept of community in class. While their instructor was away at a conference, he divided the students into groups, where they worked collaboratively to collect examples from around campus based on their definition of community. Students were sent prompts from the instructor via text messaging asking them to provide video examples of community on campus. By providing video support of their definition of community, students demonstrated their understanding of what was discussed in the classroom. The learning was situated in the context of the actual campus environment, where the definition of community was being examined and was individualized by the student groups.

The students at Coastal College offered yet another example of a situated learning experience. The students described their ability to collect data and interact with content as they immediately came across it in their daily lives. The students were creating a virtual history blog and shared that the experience was meaningful because they were able to post content immediately to the blog wherever they were during the day:

I just like the fact that if you saw something while you were walking around on the street...you could go to Blogger, post about it, take a picture, take a video and send it to [the instructor]...It's so much easier than "Oh, I've got to remember, when I get home to email [the instructor] about something I saw."

[[Coastal College Student 1]]

You collected information as you were going about your life, snapping it [a picture] or writing a post, tweeting somewhere, sending yourself a note to remember this or that...no matter where you are.

[[Coastal College Student 2]]

By immediately capturing information to be used for their history blogs, students were able to make important connections among instructional content and authentic contexts.

6.2. Frustrations from learning with mobile computing devices

Though the students considered mobile computing devices helpful, frustrations from learning with the mobile devices were evident. These included (a) anti-technology instructors in other classes, (b) device challenges, and (c) devices as a distraction.

6.2.1. Anti-technology instructors in other classes

Students were frustrated with instructors who were unwilling to effectively incorporate technology in their courses and felt that those instructors were not attempting to assist their students in interacting with and participating in the course content. One Lakeshore University student explained:

I have a professor who is anti-technology, so... The technological advances that we have today, well, in this case I *think* the iPhone has extremely helped, with speed, with communication and the information, the speed of that processing and when a teacher doesn't take advantage of that, you are *not* using the full potential available to you to help your students.

However, even though the students were frustrated by the unwillingness they described in some instructors, they did offer a variety of potential reasons as to why instructors may choose not to use the technology available to them, including the instructors not knowing how to use the technology appropriately or even a generational difference in their use for learning.

This perceptive dialogue indicated that students were trying to reasonably understand why some instructors chose not to implement devices that were readily available and supported on campus in their teaching.

Furthermore, the students described instructors that did not want students to use mobile computing devices during class. For example, two University of Northbrook students described their previous experiences with other faculty members:

University of Northbrook Student 1: My other instructors don't even want to see them in class. I have a film class, and I actually got chewed out a couple of weeks ago because I was looking something up about the film we were watching before it started, and my professor was like "I don't want to see your phone. Put it away."

University of Northbrook Student 2: I agree ... immensely that most professors don't want to see the, any device in their classrooms. But the university is pushing for the [course management system] application and other [university] applications for mobile devices.

Universities provided inconsistent messages about the use of mobile computing devices. On one hand, Lakeshore University provided students with devices and instructors with implementation support. Yet, all instructors were not willingly taking advantage of those opportunities. On the other hand, the University of Northbrook was working to provide university-related applications for the mobile device but did not support their use in learning. Therefore, some

instructors at the universities deemed the devices as inappropriate and asked students to store them away when entering the classroom. This inconsistent message remains a barrier.

6.2.2. Device challenges

Students identified a variety of reasons why they had some frustrations with the devices. This included applications that did not work as well as had been anticipated to collect information for class. Small mobile device keyboards made typing long responses difficult. For example, a student at the University of Northbrook said, "I found it a little frustrating with the little keypad on the iPhone, it took me a lot longer to get everything out."

Additionally, even though some students described themselves as technologically savvy, some technologies still proved challenging to the students. The University of Northbrook students also shared a scenario about a simple technology that proved challenging:

A lot of the people in the class are very tech savvy, I've noticed. You know, a lot of people have mobile devices, smart phones, laptops, everything. Obviously, we are all wired in because we have to post online. But everyone sitting around me was having a really hard time figuring out how to do the poll online.

Additionally, students at Coastal College had difficulty using the video conferencing tool Oovoo on their mobile devices. Their instructor had planned on using the tool to communicate with the students about the progress of their virtual history sites. However, even working together to determine the problem was ineffective. In the end, the tool was discarded.

For many of these issues, acceptable workarounds were found. For example, laptop computers were used for longer responses to posts on discussion threads inside a course management system. Students and instructors worked together to assist each other with any technology confusion. Applications that did not work properly on the mobile device were simply discarded and another similar application was found. Students overcame these logistical issues with support from their instructor and each other.

6.2.3. Devices as a distraction

The concept of the *devices as a distraction* appeared with conflicted thoughts. The traditional college-aged students at Lakeshore University felt that at times the device could be distracting. The allure of social networking applications that were not being used for class potentially threatened their concentration. However, they also felt that it was very easy to respond to a text message that was received and just as quickly return to the task at hand when using the devices for coursework, demonstrating that they were able to manage their time on appropriate tasks.

In contrast, the older students at the University of Northbrook discussed the concept of *devices as a distraction* and emphatically stated that the devices were not distracting. This consensus was made after the students discussed the Tweet-A-Thon they participated in during a face-to-face session. The possibility of distraction was there, especially for the student who was administering the *tweets* for the class.

I was administering the Tweet-A-Thon and so I had a lot invested in it.... And I wondered if I would be very distracted administering that many tweets in class. So that's one reason why I scheduled so many...in advance but I found that I was able to participate in the live class discussion and tweet.

[[University of Northbrook Student 1]]

Her classmates also agreed that they did not feel distracted and one in particular shared:

So I felt like I was totally connected, which is kind of, when I first heard about the Tweet-A-Thon, I thought I would be distracted

from the in class discussion. I thought maybe I wouldn't have a fulfilling experience but I actually found the opposite to be true. I really feel like I was thinking the whole time about new media theory. And I was thinking the whole time about communication. [[University of Northbrook Student 2]]

Additionally, distraction did not appear to be an issue for the student, who for work obligations, could not participate in the face-to-face class session. She was so engrossed in the Twitter discussion on her mobile device that she felt that the discussion was over too quickly and wished it had gone on longer.

7. Discussion & implications

Much of the current literature on mobile computing devices focuses on using the device to disseminate information or focuses on accessing university resources. Admittedly, these practices emphasize the transmission model of teaching and learning. In addition, some initial studies have stressed components of direct instruction, such as student practice with content (cf., Cavus & Ibrahim, 2008, 2009). The current findings, however, provide examples of using mobile computing devices to create and interact with course content, collaborate, and learn during the course of their daily lives — often with Web 2.0 and social media tools (Greenhow, 2011; Sharples, 2000).

The advantages of learning with mobile computing devices the participants discussed both corroborate existing findings and extend these. The student participants were explicit in comparisons to previous learning experiences and other courses. The Lakeshore University students found the participatory nature of their university course more beneficial than their high school experiences, because they felt the mobile devices helped them engage with the content. This corroborates the findings by Heath et al. (2005), where mobile devices and mobile applications increased students' perception of their confidence with course content.

By quickly accessing course documents and uploading and posting course content anywhere, students highlighted the advantages of using mobile devices in learning and spoke of the value of mobile learning as defined by Traxler (2007, 2010) and Sharples et al. (2007). Students described how they were able to communicate more with each other because of the mobile tools. Social media, such as QuickPolls and Twitter, allowed for immediate feedback about course content and interactions with subject matter experts. So, students' perceptions highlighted and emphasized both formal and informal learning opportunities.

Finally, students were able to situate their learning in the context of the environment. Specifically, the Lakeshore University and Coastal College students spoke of the advantages of capturing information outside of the learning environment and making connections with the material. These experiences point to the advantages of using mobile learning in higher education and reinforce the concept of knowledge acquisition across contexts and environments (Ruta et al., 2010). Furthermore, this “meaning making in everyday life” is an important component of informal learning (Pachler et al., 2010, p. 175).

The student participants in this study also experienced frustrations and challenges with using mobile computing devices in their different courses at different universities. Mobile learning researchers (e.g., Cobcroft, Towers, Smith, & Bruns, 2006; ECAR, 2010; Eisele-Dyrli, 2011; Hanley, 2010) indicate that the difference between implementation of mobile computing devices and other university-supported technologies is that mobile devices are student driven. The student participants discussed technical challenges, such as small keyboards, preferences for using mobile devices and computers, such as when responding to discussion board posts, and instructors' reluctance to use mobile devices. Some of these challenges are indicative of the early adopter phase (see e.g., Rogers, 1995) of integrating mobile computing devices into higher education teaching and learning. Others

question campuses and faculty members' readiness to integrate these devices. Quinn (2011) supports this concern by also questioning the ability of faculty to integrate mobile learning.

For example, students bring devices they have selected to campus, and students will continue to demand support and infrastructure for those devices. Therefore, mobile computing device implementation strategies need to be closely examined. Some institutions have provided mobile devices to their students (e.g., Duke University, Abilene Christian University, Stanford School of Medicine, Seton Hill University). However, students at Stanford stopped using their mobile devices in their courses a few weeks into the semester (Keller, 2011), as students did not see the benefit of using them.

Furthermore, students may drive technology integration; however, it is the instructor who must lead effective ways to implement devices in learning. It is not enough to simply provide access to the device. As the student participants in this research noted, faculty members who they deemed “anti technology” were frustrating. While the student participants appreciated the potential for distraction with mobile devices, they felt a disconnect between the faculty members' perspectives (and in some cases, generational thinking) and their own. University faculty members have opportunities to leverage mobile computing devices and the ubiquitous access to which students attend to them. Certainly, this lends credence to situated and authentic learning. Faculty members may consider designing learning activities that combine both formal and informal learning, as well as learning that can flow throughout a day or days, tolerating pauses and disruptions (Ng et al., 2010). These types of instructional activities may allow students to not only learn in situ but as Traxler (2010) suggests also in vivo.

A final implication for the findings in this study coalesced around the blurring of lines. For example, the student participants often seemed to blur the lines between the use of the social networking tools and the mobile device, making little distinctions among mobile services, such as text messaging, and social media, such as Twitter. As Liu, Han, and Li (2010) suggested, “the adoption of mobile technology...does not guarantee the adoption of mobile services” (p. 212) and vice versa. Therefore, the students' engagement with the content could have come because of the constant connectivity established by the mobile device or simply from the novelty of using a mobile device.

In addition, the student participants within their courses seemed to blur the lines between formal and informal learning. Through the use of social media and Web 2.0 applications, students within their coursework reportedly communicated more about course content. In addition, they seemed to prefer using applications and text messaging outside of class that they already used in the course of their daily lives. Connections between the curriculum and the devices need to be made for the students to successfully interact with the course content (Geoghegan, 1994). Instructors need to use pedagogy and curriculum to integrate the technology into learning. Doing so will assist students in formal and informal learning opportunities, as learning does not stop when the student leaves the classroom. In essence, it can be argued, that with the availability of mobile devices and collaborative, social media tools, student learning begins *after* leaving the classroom when students can collaborate with peers and interact with their surroundings.

Finally, while there is not a preponderance of data to support this final implication, there were data to suggest that the student participants also blurred the lines between their personal identity and their mobile computing device. The student participants recognized their need to be constantly near their device. One Lakeshore University student stated that “you always have your phone with you,” while a classmate agreed explaining, “Yeah, you don't forget it, because I mean, it kinda becomes this extra part of our bodies sort of...pretty much you don't leave without it.”

A 2010 survey conducted of 200 iPhone Stanford University students characterized the students “as digitally obsessed, even addicted”

and further explained that most slept next to their mobile devices (Keller, 2011, para. 1). Out of context, this sounds like a humorous description of what mobile devices have become to most users. However, in relation to the experiences of the research participants, the mobile device has possibly merged with the identity of the student. While some students perceived their mobile devices as possible distractions, they admitted they had invested heavily into using their devices to support their learning and their professional work. The constant connectivity made possible by the mobile devices allowed students to access course information. It also allowed students the ability to interact with the content, potentially breaking down the barrier “that as for so long separated ‘learning’ from ‘life’” (Educause Mobile Computing 5-Day Sprint, 2011).

8. Conclusion

Mobile computing devices and the use of social media allow student interaction with content. Furthermore, potential learning occurs regardless of location. Educational literature focuses on a variety of places where learning happens including collaboratively in the work place and situated in a specific environment. Learning occurs wherever a learner is and is not tied to a *space* inside a brick and mortar building or even confined to a *space* inside an online course management system. Learning happens regardless of location.

The goal of this research was to add to the significance and the possibilities mobile computing devices and social media have in higher education learning environments. Liu, Peng, Wu, and Lin (2009) acknowledged that mobile learning offers much more educational potential than simply accessing resources. These findings and implications provide a basis of support for that belief.

The student participants in this study recognized change in their learning regardless of the identified limitations, including fear of the technology not working properly, small mobile device keyboards making typing difficult, and potential device distractions. Still, it is important to note that the participants who volunteered to share their experiences did so because they felt the mobile devices did impact their learning – another story would have emerged if participants who did not see the benefits of the devices were captured.

Continuous research on mobile learning and social media can determine if a true impact is being made on an instructor's teaching and the student's learning. It is important to note that even though mobile learning may look like web-based learning in that mobile computing devices connect different technologies to exchange information, the mobile device is “a contemporary paradigm for connecting, communicating and getting things done on mass-customized and yet personal relationship level that extends to the devices themselves” (Kainz, 2011, para. 12). In the end, the potential long-term impact mobile computing devices have on the higher educational learning environment is yet to be determined.

Appendix A. Student focus group interview protocol

1. What are the changes to the learning environment when mobile computing devices are integrated?
2. Can you describe the course where you used mobile computing devices?
- 2a. Tell me how that is different from a course not using mobile computing devices?
- 2b. Tell me what your role was in interacting with the mobile technology?
- 2c. Tell me about your teacher's expectation of your interaction with the mobile computing device? What did they expect from you?
- 2d. How did that impact your understanding of the content?
3. What did you use the device for in the course?
- 3a. How did you interact with classmates/teachers using the device?
- 3b. What type of activities did you use the device for in your course?

4. What changes to do you see in the learners when you used the mobile computing devices?
- 4a. Tell me about the experience of using mobile computing devices in the learning environment.
- 4b. Tell me how that's different from a course not using mobile computing devices.
5. What change did you see in the learner's behavior? What types of change did you see in the student interaction with the content?
- 5a. Tell me about the student interaction with the devices – what course related activities did they use it for?
6. How were the devices used for communication?

References

- Abilene Christian University (ACU) Mobile Learning Report (2010). Retrieved January 6, 2012 from http://issuu.com/abilenechristian/docs/acu_2009-10_mobile_learning_report
- Agichtein, E., Castillo, C., Donato, D., Gionis, A., & Mishne, G. (2008). Finding high quality content in social media. *Proceedings of the International Conference on Web Search and Web Data Mining*, New York, New York (Retrieved January 6, 2012 from <http://www.mathcs.emory.edu/~eugene/papers/wsdm2008quality.pdf>)
- Archambault, L., Wetzel, K., Foulger, T., & Williams, M. (2010). Professional development 2.0: Transforming teacher education pedagogy with 21st century tools. *Journal of Digital Learning in Teacher Education*, 27(1), 4–11.
- Billett, S. (2002). Critiquing workplace learning discourses: Participation and continuity at work. *Studies in the Education of Adults*, 34(1), 56–67.
- Bogdan, R. C., & Biklen, S. K. (2003). *Qualitative research for education: An introduction to theories and methods*. New York: Allyn and Bacon.
- Brown, T. (2005). Towards a model for m-learning in Africa. *International Journal on E-Learning*, 4(3), 299–315.
- Cavus, N., Bicen, H., & Akcil, U. (June 23–25). The opinions of information technology students on using mobile learning. *Paper presented at the International Conferences on Educational Sciences*, Magosa, North Cyprus: Eastern Mediterranean University.
- Cavus, N., & Ibrahim, D. (2008). A mobile tool for learning English words. *Paper presented at the 5th International Conference on Electrical and Computer Systems*, Cyprus: Leftke.
- Cavus, N., & Ibrahim, D. (2009). M-learning: An experiment in using SMS to support learning new English language words. *British Journal of Educational Technology*, 40(1), 78–91.
- Cheon, J., Lee, S., Crooks, S. M., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers in Education*, 59(3), 1054–1064.
- Choi, J., & Hannafin, M. (1995). Situated cognition and learning environments: Roles, structures, and implications for design. *Educational Technology Research and Development*, 43(2), 53–69.
- Cobcroft, R. S., Towers, S., Smith, J., & Bruns, A. (2006). Mobile learning in review: Opportunities and challenges for learners, teachers and institutions. *Proceedings at Online Learning and Teaching (OLT) conference*. Brisbane, Australia: Queensland University of Technology (Retrieved January 2, 2012 from <http://eprints.qut.edu.au/5399/1/5399.pdf>)
- Cochrane, T., & Bateman, R. (2010). Smartphones give you wings: Pedagogical affordances of mobile Web 2.0. *Australasian Journal of Educational Technology*, 26(1), 1–14.
- Colley, H., Hodgkinson, P., & Malcom, J. (2003). *Informality and formality in learning: A report for the learning and skills research centre*. University of Leeds, United Kingdom: Lifelong Learning Institute.
- Cook, J., Pachler, N., & Bradley, C. (2008). Bridging the gap: Mobile phones at the interface between informal and formal learning. *Journal of the Research Center for Educational Technology*, 4(1).
- Cresswell, J. W. (2007). *Qualitative inquiry & research design*. Thousand Oaks, CA: Sage Publications.
- Educause Center for Applied Research [ECAR] (2010). Study of undergraduate students and information technology research study, 6. Boulder, CO: Educause center for applied research. Retrieved January 6, 2012 from <http://www.educause.edu/Resources/ECARStudyofUndergraduateStudents/217333>
- Educause Center for Applied Research [ECAR] (2012). *ECAR study of undergraduate students and information technology*. Louisville: CO: Educause Center for Applied Research (Retrieved April 6, 2013 from <http://net.educause.edu/ir/library/pdf/ERS1208/ERS1208.pdf>)
- Educause Mobile Computing 5-Day Sprint (April 26). Day 2 recap – Teaching and learning. Retrieved January 6, 2012 from <http://www.educause.edu/blog/gdobbin/MobileComputing5DaySprintDay2R/227812>
- Eisele-Dyrli, K. (2011). Mobile goes mainstream: A more broadly accepted concept than ever, the arrival of ubiquitous mobile learning in K12 is well under way. Retrieved from <http://www.districtadministration.com/viewarticle.aspx?articleid=2704>
- Geoghegan, W. H. (1994). Whatever happened to instructional technology. *Paper presented at the 22nd Annual Conference of the International Business Schools Computing Association*, Baltimore, MD.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. New York: Aldine.
- Greenhow, C. (2011). Youth, learning, and social media. *Journal of Educational Computing Research*, 45(2), 139–146.

- Halliday-Wynes, S., & Beddie, F. (2009). *Informal learning at a glance*. Adelaide, Australia: National Centre for Vocational Education Research.
- Hanley, M. (2010). Smart phones displace computers for more college students. Retrieved January 6, 2012 from <http://www.bsu.edu/news/article/0,1370,7273-850-64351,00.html>
- Heath, B. P., Herman, R. L., Lugo, G. G., Reeves, J. H., Vetter, R. J., & Ward, C. R. (2005). Project Numina: Enhancing student learning with handheld computers. *IEEE Computer Society*, 38(6), 46–52.
- Hernández-Ramos, P. (2004). Web logs and online discussions as tools to promote reflective practice. *The Journal of Interactive Online Learning*, 3(1) (Retrieved from ncolr.org/jiol/issues/pdf/3.1.4.pdf)
- Herrington, A., & Herrington, J. (2007). Authentic mobile learning in higher education. Paper presented at Australian Association for Research in Education (Retrieved January 6, 2012 from <https://www.aare.edu.au/07pap/her07131.pdf>)
- Hoffman, E. (2009). Social media and learning environments. *Shifting perspectives on the locus of control in education*, 15(2).
- Hrastinski, S. (2008). A study of asynchronous and synchronous e-learning methods discovered that each supports different purposes. *EDUCAUSE Quarterly*, 31(4) (Retrieved from <http://www-cdn.educase.edu/library/EQM0848>)
- Jubas, K. (2010). Everyday scholars: Framing informal learning in terms of academic disciplines and skills. *Adult Education Quarterly*, 61(3), 225–243. <http://dx.doi.org/10.1177/0741713610380444>
- Kainz, C. J. (2011). Mobile agility and the anytime, anywhere impact on IT. *Campus Technology* (Retrieved January 6, 2012 from http://campustechnology.com/whitepapers/2011/04/blackboard_mobile-agility_impact-on-it.aspx?sc_lang=en)
- Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of social media. *Business Horizons*, 53, 59–68.
- Keegan, D. (October 25–28). The incorporation of mobile learning into mainstream education and training. Paper presented at mLearn 2005 – 4th World Conference on mLearning. South Africa: Cape Town (Retrieved January 6, 2012 from <http://www.iamlearn.org/public/mlearn2005/www.iamlearn.org.za/CD/papers/keegan1.pdf>)
- Keller, J. (2011). The slow-motion mobile campus. *The chronicle of higher education* (Retrieved January 6, 2012 from <http://chronicle.com/article/The-Slow-Motion-Mobile-Campus/127380/>)
- Kim, S. H., Mims, C., & Holmes, K. P. (2006). An introduction to current trends and benefits of mobile wireless technology use in higher education. *Association for the Advancement of Computing in Education Journal*, 14(1), 77–100.
- Krueger, R. A. (2002). Designing and conducting focus group interviews. Retrieved January 6, 2012 from <http://www.comm.umn.edu/akoerner/courses/5431-S10/Krueger-FocusGroupInterviews.pdf>
- Kukulska-Hulme, A., & Shield, L. (2008). An overview of mobile assisted language. Learning: From content delivery to supported collaboration and interaction. *RECALL*, 20(3), 249–252.
- Kwak, H., Lee, C., Park, H., & Moon, S. (2010). What is Twitter, a social network or a news media. *Proceedings of the 19th International World Wide Web Conference*. NC: Raleigh (Retrieved January 6, 2012 from <http://ecaminos.com/archivos/download/2010-www-twitterlh49129.pdf>)
- Lave, J., & Wenger, E. (1990). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.
- Levy, P. (2001). *Cyberculture* (R. Bononno, Trans.). Minneapolis, MN: University of Minnesota Press.
- Liaw, S., Hatala, M., & Huang, H. (2010). Investigating acceptance toward mobile learning to assist individual knowledge management: Based on activity theory approach. *Computers in Education*, 54, 446–454.
- Light, D. (2011). Do Web 2.0 right. *Learning & Leading with Technology*, 38(5), 10–15.
- Liu, Y., Han, S., & Li, H. (2010a). Understanding the factors driving m-learning adoption: A literature review. *Campus-Wide Information Systems*, 27(4), 210–226.
- Liu, Y., Li, H., & Carlsson, C. (2010b). Factors driving the adoption of m-learning: An empirical study. *Computers in Education*, 55(3), 1211–1219.
- Liu, T., Peng, H., Wu, W., & Lin, M. (2009). The effects of mobile natural-science learning based on the 5E learning cycle: A case study. *Educational Technology & Society*, 12(4), 344–358.
- Looi, C., Seow, P., Zhang, B., So, H., Chen, W., & Wong, L. (2010). Leveraging mobile technology for sustainable seamless learning: A research agenda. *British Journal of Educational Technology*, 41(2), 154–169.
- Marshall, C., & Rossman, G. (2011). *Designing qualitative research* (5th ed.). Thousand Oaks, CA: Sage Publications.
- Marsick, V. J., & Watkins, K. (1990). *Informal and incidental learning in the workplace*. London and New York: Routledge.
- Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. *New Directions for Adult and Continuing Education*, 89, 25–34.
- Merriam, S. B. (1998). *Qualitative research and case study application in education*. San Francisco: Jossey-Bass.
- Merriam, S. B. (2002). *Qualitative research in practice*. San Francisco: John Wiley & Sons.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: A sourcebook of new methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Mobile Learning Network (MoLeNET) (2007). *The impact of mobile learning: Examining what it means for teaching and learning*. London: Learning & Skills Network.
- Mobile Learning Network (MoLeNET) (2009). What is mobile learning. Retrieved December 30, 2009, from <http://www.molenet.org.uk>
- Mottiwalla, L. F. (2007). Mobile learning: A framework and evaluation. *Computers in Education*, 49(3), 581–596.
- Ng, W., Howard, N., Loke, S., & Torabi, T. (2010). Designing effective pedagogical systems for teaching and learning with mobile and ubiquitous devices. *Multiplatform e-learning systems and technologies: Mobile devices for ubiquitous ICT-based education* (pp. 42–56). Hershey, PA: IGI Global Publishing. <http://dx.doi.org/10.4018/978-1-60566-703-4.ch003>
- Nihalani, P., & Mayrath, M. (2010). Statistics I: Findings from using an iPhone app in a higher education course. Retrieved January 6, 2012 from http://gylo.com/WhitePaper_03302010_Stats1.pdf
- O'Reilly, T. (2005). What is Web 2.0? Retrieved January 5, 2012 from <http://oreilly.com/web2/archive/what-is-web-20.html>
- Pachler, N., Bachmeir, B., & Cook, J. (2010). *Mobile learning: Structures, agencies, practices*. New York: Springer.
- Pang, L. (2009). A survey of web 2.0 technologies for classroom learning. *The International Journal for Learning*, 16(9), 743–759.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage Publications.
- Quinn, C. N. (2011). *Designing mLearning*. San Francisco, CA: Pfeiffer.
- Richardson, J., & Lenarcic, J. (2008). Text messaging as a catalyst for mobile student administration: The “trigger” experience. *International Journal of Emerging Technologies*, 6(2), 140–155.
- Roblyer, M. D., McDaniel, M., Webb, M., Herman, J., & Witty, J. V. (2010). Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. *Internet and Higher Education*, 13, 134–140.
- Rodriguez, J. E. (2011). Social media use in higher education: Key areas to consider for educators. *Journal of Online Learning and Teaching*, 7(4).
- Rogers, E. M. (1995). *Diffusion of innovation* (4th ed.). New York: Free Press.
- Ruta, M., Scioscia, F., Colucci, S., Di Sciacio, E., Di Noia, T., & Pinto, A. (2010). A knowledge-based framework for e-learning in heterogeneous pervasive environments. In T. T. Goh (Ed.), *Multiplatform e-learning systems and technologies: Mobile devices for ubiquitous ICT-based education* (pp. 20–41). Hershey, PA: IGI Global Publishing.
- Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers in Education*, 34(3–4), 177–193. [http://dx.doi.org/10.1016/S0360-1315\(99\)00044-5](http://dx.doi.org/10.1016/S0360-1315(99)00044-5)
- Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.), *The Sage handbook of Elearning research* (pp. 221–247). London: Sage.
- Sharples, M., Taylor, J., & Vavoula, G. (2010). A theory of learning for the mobile age: Learning through conversation and exploration across contexts. *Bachmair, Ben ed. Medienbildung in neuen Kulturräumen: die deutschsprachige und britische Diskussion* (pp. 87–99). Wiesbaden: VS Verlag für Sozialwissenschaften.
- Shih, Y. E., & Mills, D. (2007). Setting the new standard with mobile computing in online learning. *International Review of Research in Open and Distance Learning*, 8(2).
- Shuler, C. (2009). *Pockets of potential: Using mobile technologies to promote children's learning*. New York: The Joan Ganz Cooney Center at Sesame Workshop.
- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *Journal of Instructional Technology and Distance Learning*, 1.
- Surowiecki, J. (2005). *The wisdom of crowds*. New York: Anchor Books.
- Tella, S. (2003). M-learning – Cybertextual travelling or a herald of post-modern, education. In H. Lahti & P. Seppälä (Eds.), *Mobile learning* (pp. 7–21). Helsinki, Finland: IT Press.
- Traxler, J. (June 28–30). Defining mobile learning. Paper presented at ADIS International Conference Mobile Learning, Qawra, Malta (Retrieved January 6, 2012 from http://www.iadis.net/dl/final_uploads/200506C018.pdf)
- Traxler, J. (2007). Defining, discussing and evaluating mobile learning: The moving finger writes and having writ. *The International Review of Research in Open and Distance Learning*, 8(2).
- Traxler, J. (2010). Distance education and mobile learning: Catching up, taking stock. *Distance Education*, 31(2), 129–138.
- Valk, J., Rashid, A. T., & Elder, L. (2010). Using mobile phones to improve educational outcomes: An analysis of evidence from Asia. *International Review of Research in Open and Distance Learning*, 11(1), 117–140.
- Vavoula, G., Sharples, M., Rudman, P., Meek, J., & Lonsdale, P. (2009). Myartspace: Design and evaluation of support for learning with multimedia phones between classrooms and museums. *Computers in Education*, 53, 286–299.
- Winters, N. (2007). What is mobile learning? In M. Sharples (Ed.), *Big issues in mobile learning* (pp. 7–11). Learning Sciences Research Institute: University of Nottingham.
- Wu, W., Wu, Y. J., Chen, C., Kao, H., Lin, C., & Huang, S. (2012). Review of trends from mobile learning studies: A meta-analysis. *Computers in Education*, 59(2), 817–827.
- Zhao, D., & Rosson, M. B. (2009). How and why people Twitter: The role that microblogging plays in informal communication at work. *Proceedings of the Association for Computing Machinery (ACM) 2009 International Conference on Supporting Group Work*, New York, New York (Retrieved January 6, 2012 from <http://www.personal.psu.edu/duz108/blogs/publications/group09%20-%20twitter%20study.pdf>)