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The Relationship Between Mobile Learning, Instructional Delivery, and Student Motivation in a Large Undergraduate Science Class

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Abstract

Science learning at the early undergraduate level provides a challenging context with large classes and many complex topics to unpack with the students. The purpose of this qualitative study was to explore: how students use mobile devices for learning in a large, undergraduate classroom; what types of instructional delivery could be used with the devices in this context; and if students were motivated to learn. Classroom observations and semi-structured interviews with the professor were reported and five patterns emerged from these data: connected, personal, multimodal, engaged, and class management. From the overall findings of these data, it would appear that mobile learning can help increase student engagement and motivation in a large, undergraduate, science classroom.

Key Words

Key words: mobile learning, m-learning, mlearning, instructional delivery, instructional methods, instructional techniques, higher education, science, large class, student engagement, student motivation, motivation, education, technology

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Introduction

Greater demands are being placed on higher education institutions with global gross enrollment ratios rising from 13.8% in 1990 to 29% in 2010 (Varghese, 2013). Simultaneously, instructor accountability in regard to student achievement and learning has risen (Lund & Shanklin, 2011). Science learning at the early undergraduate level provides a challenging context with many complex topics to unpack with the students. Furthermore, a single course can often rise into the hundreds with a lack of communication between the instructor and the students (Cotner, Fall, Wick, Walker, & Baepler, 2008).

Larger classes have shown to negatively impact student retention (Arias & Walker, 2004; Ashar & Skenes, 1993), first year dropout rate (Keil & Partell, 1997), student motivation and attendance (Cooper & Robinson, 2000), and students in large classes report a sense of isolation and anonymity within the class environment (Svinicki & McKeachie, 2010).

The ever-increasing availability of instructional technologies provides many options for instructors of large classes to combat these obstacles and positively impact student motivation and learning in science (viz., Chiang, Yang, & Hwang, 2014). Mobile learning can be used to enable instructors to raise the level of connectedness between all participants in the class, students and instructors alike (Caldwell, 2007; Draper & Brown, 2004).

Purpose Statement

Following the ontological belief that there is not one universal truth of appropriate uses of mobile learning and instructional delivery methods for large science classes, the researchers adopted a constructivist paradigm for this qualitative study. The researchers constructed knowledge about mobile learning, instructional delivery and student motivation from observations of a large, undergraduate science course and interviews with the main instructor of the course. As both researchers are also instructors, they bracketed their assumptions and values by recognizing the potential impact of their preconceptions. This was done in order to remain objective while also recognizing that those assumptions and values are important in understanding the relationship between mobile learning, instructional delivery and student motivation.

The purpose of this case study is to investigate the relationship between mobile learning, instructional delivery, and student motivation in a large, undergraduate science class.

The three questions guiding this study are:

1. How do students use mobile devices in a large, undergraduate science course?

2. What instructional delivery methods are utilized in a large, undergraduate science course when mobile devices are used?
3. What impact does mobile learning and instructional delivery methods in a large, undergraduate science course have on student motivation?

Literature Review

Mobile Learning

Today's instructors have many more options for incorporating mobile learning into their classrooms. Mobile learning is defined as "Learning across multiple contexts, through social and content interactions, using personal electronic devices" (Crompton, 2013, p. 4). Advancements in digital technologies have resulted in personalized devices which are smaller, faster, and more easily transported. Instructors recognize that utilizing mobile learning within the classroom can increase student learning (Crompton, 2013), interactions between students and instructors (Caldwell, 2007; Draper & Brown, 2004) and student motivation (Ciampa, 2014). In addition, the two way interaction capabilities of mobile devices, such as mobile phones, can allow students anopportunity to challenge the traditional instructor-to-student interactions and instead reciprocate and even initiate interactions with instructors.

Connectivity is important for students of this digital age (Peters, 2007). Students are familiar with being able to chat, share images and information with friends, family, and others any moment of any day. It therefore seems contrary to think that in a class of hundreds of students they can often feel isolated from those students and the instructor. This isolation may develop from a lack of connectivity to others via mobile devices. This can be avoided when students can use these devices to connect for the purpose of learning in these situations. Governments, scholars, and organizations have advocated for science students to be connected to learn not just the science content but to also become familiar with scientific discourse (AAS, 1993; Kelly, 2007; NRC, 2012). Mobile devices can be used to provide a method to support the students in conducting scientific discourse.

Instructional Delivery

Instructors have many options when choosing instructional delivery methods. An instructor's personal experiences and beliefs about education influence his or her decisions in regard to instructional processes (Lattuca & Stark, 2009). Higher education instructors tend to fall into one of two orientations: conceptual change/student-focused approach or information transmission/teacher-focused approach (Trigwell & Prosser, 2004). The former requires active participation by students as faculty take on the role of facilitating the learning process. The instructor's role is to guide this knowledge construction or conceptual change process. The latter places the responsibility for learning on the instructor rather than the student. The instructor's role is to choose the appropriate content and then convey this information to the students.

While instructors’ orientations could be a result of their experiences and beliefs about teaching, the content and characteristics of the specific field also play a role. Courses in the hard fields (e.g., science) are more often taught using teacher-centered approaches, whereas courses in the soft fields (e.g., social sciences) are more likely to be taught using student-centered approaches (Latucca & Stark, 2009; Lueddeke, 2003; Trigwell, 2002).

Despite the focus on student-centered approaches in pedagogical literature, lecture is the most commonly chosen instructional approach in higher education (Cuseo, 2007; Mulryan-Kyne, 2010) and in large classes (Cooper & Robinson, 2000; Cuseo, 2007). Lectures typically result in students acting as passive learners (Cooper, 1995) who achieve surface level learning and often show lower levels of motivation. This is made even more apparent in larger classes where students can easily feel not connected or part of the lesson. To combat this, instructors of large lecture courses can incorporate instructional technology to increase student motivation, student-instructor interaction, student engagement and active learning.

Student Motivation

Wigfield and Eccles (2002) identified three main factors in their model of achievement motivation: social and cultural factors, situational achievement belief, and task value and expectations. Each of these factors influence the student’s goals, perceptions and motivation, which all in turn impact success

(Schunk, 2012). Furthermore, Moore (2007) reported that the level of motivation directly impacted the level of success with a class of developmental biology students. He noted that teachers who employed efforts to raise the students' levels of motivation found that those students had higher levels of follow through and success.

Faculty can have an impact on the level of motivation amongst students. From the findings of Wadsworth, Husman & Duggan (2007) it would appear that faculty who offered more autonomy had students with higher motivation. Active learning and motivation have a reciprocal relationship; thus it is important that students interact with the content and learning experience as they construct knowledge (Lattuca & Stark, 2009). Raising the level of active engagement through questioning, applying, discussing, and reflecting on the content in a classroom environment also helps students to raise their level of learning (Lattuca & Stark, 2009).

Case Studies

The case study is a research tradition that falls under the umbrella of the constructivist paradigm. Utilizing this tradition allows the researcher to focus on a specific phenomenon in the context of a unique case, or bounded system (Creswell, 2006; Stake, 2005; Yin, 2008). This bounded system has specific boundaries of time, place, and activity (Yin, 2008).

Case studies are ideal when researchers want to answer "why" or "how" questions, have limited control over the case, or want to study the phenomenon within its natural context (Schwandt, 2001). In this study, the researchers chose to conduct a single, instrumental case study (Stake, 2005) as they were examining a single phenomenon: the relationship between mobile learning, instructional delivery, and student motivation in a large, undergraduate science class.

Method

Context and Participants

This case study was conducted during the Spring 2014 semester in a 400-student, undergraduate Astronomy course at a large, East Coast American research university. The student population of this introductory course included mainly non-science majors as the course satisfied one of the general education requirements. The class was diverse in terms of gender and ethnicity. The course involved a 75-minute lecture twice a week led by an instructor with roughly thirty years of higher education teaching experience and numerous teaching awards. The instructor used Learning Catalytics, a learning management system that promotes student engagement through discussion activities, open-ended questioning, and collaborative activities while keeping track of student progress.

Research Team

In order to reduce researcher bias and have triangulation of the findings, two researchers worked together on this study. While both researchers have experience as instructors in higher education, their primary experiences involve smaller, more intimate classes. With this in mind, both researchers worked to bracket their assumptions prior to starting the study through conversations with each other.

Data Sources

Data were collected through two data sources: class observations and individual semi-structured interviews.

Class Observations. The primary researcher conducted six observations over the course of the spring 2014 semester following an observation protocol. The primary researcher took extensive observation notes of each class session, noting specifically instructional style, use of mobile learning, student questioning, and student engagement.

Semi-structured interviews. As interviews are one of the primary data collection methods for qualitative research (Creswell, 2012; Hays & Singh, 2012; Hays & Wood, 2011; Maxwell, 2013), the primary researcher conducted two semi-structured interviews with the main instructor of the course, allowing for participant voice and detail-rich data collection (Hays & Singh, 2012). The interviews were spaced approximately one month apart with the intent that the second interview would provide an opportunity for the instructor to share additional insight and reflection. Using the research questions as a foundation, the researchers developed an interview protocol with questions and probes to guide the interview experience. This protocol was designed to guide the two interviews and contained 17 questions covering the instructor's teaching and student learning philosophy (e.g., How do you feel students learn best in a large, lecture class?), incorporating mobile learning into the classroom (e.g., What role does mobile learning play in student learning, questioning, comprehension, and motivation?), instructional delivery (e.g., What teaching strategies do you implement in the classroom to maximize student learning?), and motivation (e.g., To what extent do you feel motivation plays a role in a large lecture class?).

The interviews were held in a private location on campus at a mutually convenient time. The primary researcher used the protocol to guide the conversation while allowing the instructor to freely share his experiences. The instructor was comfortable and willing to share information about his experiences, and beliefs about student learning, class assignments. The interviews lasted approximately 100 minutes and 25 minutes respectively with no time limits placed on the instructor to respond to questions.

Trustworthiness

The level of trustworthiness, or validity, of a qualitative study is determined by judging both the process and the outcome through an analysis of the research design, data analysis and interpretation, and the final qualitative report and evidence (Hays & Singh, 2012). To develop trustworthiness in this case study, the research team incorporated several strategies into the study. First, the research team participated in triangulation by collecting data from multiple sources: class observations and semi-structured interviews.

In addition, the researchers independently coded the observation notes and interview transcriptions during data analysis. Once coded, the researchers independently identified patterns from the codes. The researchers met to discuss these patterns and agreed upon the final codebook. Second, the research team used thick description in the explanation of the research process and data findings. Third, the research team wrote the final narrative by providing a thorough case description, the central principle of the case study tradition (Creswell, 2006). Finally, the research team kept a detailed audit trail of all components and stages of the research study.

Data Analysis

The research team followed the eight steps of data analysis as outlined by Hays and Singh (2012). First, the team reduced the data by identifying the topic, research questions, previous literature, access to participants and setting, trustworthiness strategies, and keywords to use as the a priori codes. The researchers bracketed their assumptions through conversations throughout the research process. Second, the primary researcher conducted six observations of a large, undergraduate Astronomy course during a single semester and two semi-structured interviews with the main instructor. Third, within a day of each observation and interview, she completed an initial case summary sheet to note the date, course session, number of students, and general impressions.

Fourth, she finalized the full observation notes and interview transcriptions within a week of each data collection. Fifth, using the a priori codes, both members of the research team analyzed and manually coded the data from the observation notes and transcriptions. During this analysis, they noted meaning units, patterns, sub patterns, and specific examples and notes through the process of pattern identification (Stake, 1995). Sixth, the team met to compare the coding and collapsed codes based on the patterns and sub patterns. Seventh, they agreed upon a revised code book and within-case display of main patterns, examples and notes. Finally, the team wrote a narrative of the findings, showing the pattern identification and naturalistic generalization (Stake, 1995) by including observation notes, participant quotes, and thick description.

Findings

Five patterns were identified from the data and used to answer the research questions guiding this study.

Pattern 1: Connected

The students were connected to the lesson, instructor, and classmates on multiple levels. The main avenue students were connected was through technology, allowing them to participate in mobile learning and raise their level of connectedness (Caldwell, 2007; Draper & Brown, 2004). Every student had a tablet, laptop, and/or phone; most students had multiple devices. The students initially logged their seat number in to Learning Catalytics when they arrived to class. This allowed them to participate in the Learning Catalytics activities and receive credit throughout the class session. This participation involved either individual work or small group work, where students were paired up with other students in close proximity. The instructor invited students to text him questions throughout the class period which he read either from his phone or his wearable technology, Google Glass.

The instructor took much effort to raise the level of connectedness between himself and the students. He consistently activated the students' background knowledge throughout his lecture so the students could feel connected to the material. He invited students to participate in live demonstrations on stage and around the lecture hall, both during and after class. He took time during every class period for announcements, and repeatedly reminded students about course information and where they could find that information outside of class. He regularly answered questions via text during the class period, and repeatedly invited students to text questions or simply raise their hands.

Finally, the students were connected with each other. During each class, the instructor incorporated discussion opportunities through the use of think-pair-share and think-pair-text, a modified version of think-pair-share where the students share their answers via text to the instructor. This allowed the students to work with their classmates on the material before presenting an answer for credit in Learning Catalytics.

Pattern 2: Personal

The instructor put forth much effort to make this large, 400-student course seem personal. He played music before every class session while students were arriving to class and getting settled. He was constantly on the move as he walked around the stage and lecture hall. He talked directly to students as though he were having a conversation with a handful of students rather than speaking to 400 students. He told jokes and shared personal stories periodically during his lecture. His personal style was very casual and inviting for students.

Consistent with Wigfield and Eccles' (2002) model of achievement motivation, the instructor addressed the affective domain to help students understand the connection between their attitude and their motivation to perform well in the course. He counseled students in regard to their attendance, persistence, engagement, and performance. He emphasized that students needed to take responsibility for their learning; at the same time, he took responsibility for creating an inviting, autonomous and engaging classroom environment.

Pattern 3: Multimodal

The instructor used a variety of methods to share information with his students. He utilized segmented lectures to structure each class session rather than traditional full lecture. He stated, "I try to break the lectures into very short segments with lots of chat between them, so it's a noisy classroom." In addition, he viewed the lecture as a performance, stating, "If you're going to lecture, you may as well make it a performance because conveying the content knowledge is no longer a necessity; the students know everything, in a sense that it's all in their iPhone." He viewed each component of his performance lecture as integral in raising student motivation and interest in the content. The slides were visually inviting, included pictures and videos, and contained minimal text. Most slides contained his cell phone number for students to text questions. He also used Learning Catalytics to send out periodic questions to the class to give them opportunities to access their background knowledge, determine their general level of understanding, and apply their newly learned knowledge. In addition, the instructor integrated videos, music, live demonstrations on stage and around the lecture hall, and props.

Pattern 4: Engaged

The instructor was very engaged with both the class topics and student body. He included a variety of questions in Learning Catalytics and was willing to pilot new types of questions during class. When he piloted a new question format, he walked around the lecture hall to see the screen from the students' point of view and to get their individual feedback. Throughout his lecture, the instructor made the topics relevant and activated students' background knowledge. He pushed students to think deeper and differently about various questions and their answers. Similar to the approach of Lattuca and Stark (2009), students in this class were invited to work with a partner to discuss a concept if they were struggling. The students could then resubmit their answers through Learning Catalytics. He then used their responses formatively to guide future instruction and activities. At the end of class, he encouraged students to write a brief summary of what they learned so they could engage with the material. Finally, the students received feedback from four main sources: the instructor during activities and texted questions, classmates during discussion activities, teaching assistants during discussion activities, and Learning Catalytics during participation activities.

Since incorporating Learning Catalytics and student questioning via texting, the professor believed student engagement and motivation increased. “There are [students] who tell me that they are very grateful for texting because they would never raise their hands. Texting enables students to ask questions without embarrassment, and I think that’s a big factor.” In addition, having students text the instructor questions kept him engaged. “Student texting keeps me honest because it prevents me from assuming that the students are listening, understanding, and engaged. It makes me work harder to keep them engaged.”

Pattern 5: Class Management

A large class can often be difficult to manage in terms of student behavior. The instructor set clear expectations of his students via the course outline, slides, announcements, and verbal explanations. He enforced those expectations during each class session, including walking directly up to a student who was being disruptive and addressing his behavior. Five teaching assistants were positioned around the lecture hall to monitor student behavior and participation. The instructor frequently walked around the auditorium as he lectured and explained concepts. In addition, students often used texting to ask the instructor to address disruptive students.

Research Questions

From the findings, it appears that students use mobile devices in order to stay connected with their classmates, instructor, and the content of the course. The instructor moved away from traditional lecture and utilized segmented lectures that incorporated multimodal activities. This helped to increase student engagement and active learning. From the instructor interviews and attendance records, the findings indicate that student engagement and motivation were higher when mobile learning was used.

Conclusion

The purpose of this case study was to investigate the relationship between mobile learning, instructional delivery, and student motivation in a large, undergraduate science class. Five patterns emerged regarding instructional delivery and the use of mobile devices: connected, personal, multimodal, engaged, and class management. From the overall findings of these data, it would appear that mobile learning can help increase students engagement and motivation in a large, undergraduate, science classroom.

Limitations

This case study focused primarily on the use of Learning Catalytics and student texting. Additional technologies were not addressed, and additional courses and instructors were not observed nor interviewed. While these were beyond the scope of this case study, it is important to note that this study is specific to this case.

Implications for Future Practice and Research

Instructors of large undergraduate science classes can incorporate mobile learning and specific instructional delivery techniques to impact the level of student engagement and motivation. With the changing technological times, it is essential that instructors stay current with technology in order to connect with their students. Additional research is needed to explore these new technologies and their relationship with instructional delivery and student motivation.

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