LEARNER PERSPECTIVES ON LEARNING USING SMARTPHONES

By

Sandra Fady Sawaya

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Educational Psychology and Educational Technology—Doctor of Philosophy

2015

ABSTRACT

LEARNER PERSPECTIVES ON LEARNING USING SMARTPHONES

By

Sandra Fady Sawaya

Over the past decade, research on the use of mobile devices for learning has seen incredible growth. Researchers and teachers alike have capitalized on the affordances of these devices and used them as tools for learning (e.g., Kearney, Schuck, Burden, & Aubusson, 2012; Kukulska-Hulme & Shield, 2008). Mobile devices, however, are personal devices and it is likely that individuals use them for learning in unique ways that best suits their needs. In addition, it follows that these individuals would also have a unique understanding of learning using mobile devices. According to Cochrane (2013) and Traxler and Vosloo (2014) the learner perspective on the use of mobile devices in learning has not been adequately examined.

The purpose of this study was to contribute to the growing field of mobile learning and shed light on the learner perspective on the use of these devices for learning; specifically, the use of smartphones for learning. To do so, this study followed a phenomenographic approach, focusing on revealing participants' use of smartphones for learning and their understanding of this phenomenon by examining their *experiences* of using their devices for learning (Marton & Booth, 1997).

This qualitative study provided an in-depth look at the phenomenon of learning using smartphones from the perspective of learners. Questionnaires were sent out to a random sample of students at a large Midwestern university. These were used to determine how individuals used their smartphones for learning. In addition, follow-up,

semi-structured interviews were conducted with a subset of participants. These examined the participants' understanding of this type of learning. This study also considered whether and how the use of smartphones changed the participants' understanding of learning.

Findings from the analysis of the questionnaire data suggested that participants used their smartphone for learning predominantly by looking up information on the web. These types of learning activities were characterized by the following dimensions: timeliness, duration, size, motive, and focus. Moreover, they each have an explicit purpose: either to consume, to practice, to keep up-to-date, to manage, to play, to participate, and to generate; and one of two implicit purposes: to achieve an emotional, cognitive, and behavioral balance or to extend one's sensory, cognitive, or behavioral self.

Analysis of the interview data suggested that participants' conceptions (or tacit understandings) of learning using smartphones are as follows: filling gap in knowledge, supporting pre-existing knowledge, adding to pre-existing knowledge, discovering new knowledge, applying knowledge, and sharing knowledge. These conceptions reflected a concrete way of understanding what learning is. In addition, the data further revealed that participants' understanding of learning has somewhat changed after having used smartphones and has taken on characteristics similar to those of mobile devices.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

Introduction

Over the past decade, research on the use of mobile devices for learning has seen incredible growth. Researchers and teachers alike have capitalized on the affordances of these devices and investigated their use as tools for learning (e.g., Kearney, Schuck, Burden, & Aubusson, 2012; Kukulska-Hulme & Shield, 2008). Mobile devices, however, are personal devices and it is likely that individuals use them for learning in unique ways that best suits their needs. In addition, it follows that these individuals would also have a unique understanding of learning using mobile devices. According to Cochrane (2013) and Traxler and Vosloo (2014) the learner perspective on the use of mobile devices in learning has not been adequately examined. To best leverage the use of mobile devices for learning, it makes sense to examine how learners are using these devices for learning in their everyday lives.

Problem Statement

Existing models for using mobile devices for learning are inadequate; they seem to be based on current teaching and learning needs or on past theoretical frameworks. After considering the empirical research and conceptual work on learning using mobile devices, two things seem apparent: (a) most research has focused on researcher-led or teacher-directed efforts to investigate the use of mobile devices for learning and (b) the conceptual work has taken a fragmented approach to studying learning using mobile devices. The learner perspective on the use of mobile devices for learning is not well represented in the scholarly literature, with only a few studies having taken that perspective (e.g., Clough, Jones, McAndrew, & Scanlon, 2007; Kukulska-Hulme & Pettit, 2008; Santos & Ali, 2012). Thus, this study examines learning using mobile devices from the perspective of learners.

Significance

This study focuses on one type of mobile device: smartphones. Smartphones are portable and very popular among college-age students, with 66% of adults between the ages of 18 and 29 owning a smartphone (Rainie, 2012). The widespread ownership of smartphones, their mobility, and their ability to be highly customizable allow learners to take control of their learning and participate in learning activities initiated by their own interests, needs, and curiosities (Kukulsha-Hulme & Shield, 2008). As such, there is a need to study how learners naturally use their smartphones for learning in their everyday lives (Gikas, 2011) and how they understand learning. Past reviews on mobile learning have investigated learning activities from the perspective of formalized and established educational and psychological theoretical frameworks (e.g., Herrington, Herrington, & Mantei, 2009; Naismith, Lonsdale, Vavoula, & Sharples, 2004). Learning, however, is a highly personalized act influenced by individuals' unique interactions with and experiences in their context. In addition, according to Schunk (2008), "there is no one definition of learning that is universally accepted by theorists, researchers, and practitioners" (p.2). Examining learning from learners' perspectives would better inform the field of mobile learning. In fact, according to Cochrane (2013) and Traxler and Vosloo (2014) – leaders in the field – the lack of focus on the learner perspective on the use of mobile devices in learning contexts constitutes a concerning gap in the mobile learning scholarly literature.

Purpose

The purpose of this study is to gain a holistic and comprehensive understanding of learning using smartphones from the perspective of the learners. To accomplish this goal, the study first examines the smartphones activities that individuals consider as learning in their

everyday lives. Then, this study explores the individuals' tacit understanding of learning using smartphones.

The following chapter reviews the literature on learning using smartphones and presents the conceptual framework and research questions of the study. Chapter 3 summarizes the methods and analyses used in this study respectively. Chapters 4 and 5 present the results from the analyses of the questionnaires and interviews. Finally, Chapter 6 situates the findings from the questionnaires and interviews within the literature on learning using mobile devices. The last chapter also presents the implications and limitations of this study and provides suggestions for future research.

CHAPTER 2

Literature Review

The current models for using mobile devices for learning are inadequate; they seem to be based on current teaching and learning needs or on past theoretical frameworks. This literature review considers the empirical research and conceptual work on learning using mobile devices. It is divided into three main sections. The first section provides an overview of the current state of empirical research on the use of mobile devices for learning. The second section presents an overview of the conceptual work done on examining the underlying theoretical frameworks of mobile learning. This section ends by presenting a unique perspective on the study of learning: the study of individuals' conceptions of learning. This perspective introduces the third section on the conceptual framework of this study: The learner perspective on learning.

As a reminder, this study focuses on learning using smartphones; the literature review, however, reports on the use of mobile devices more generally for learning. At this point, it is also important to note that the terms *learners* and *students* are used interchangeably; both refer to individuals using smartphones for learning activities. Finally, this study does not explore whether learning occurred; it only investigates whether individuals engaged in learning activities using their smartphones.

Research on Mobile Learning

Research on mobile learning does not represent varying purposes. In a meta-analysis of 164 academic studies, Wu et al. (2012) found that the purpose of most research on mobile learning has been (a) to evaluate the effectiveness of mobile learning (58%) or (b) to design mobile learning systems (32%). These results support the findings from a previous meta-

analysis conducted by Hung and Zhang (2012). The next two sections illustrate these research perspectives with examples from the scholarly literature.

Evaluating the Effectiveness of Mobile Learning

A large majority of the research on mobile learning focuses on evaluating its effectiveness in supporting learning and improving learning outcomes (Wu et al., 2012). For example, Lu (2008) investigated the use of short message services (SMS) delivered to students' phones in learning English vocabulary words. Tuttle (2011, as cited in Tuttle, 2013) explored how students' Spanish speaking skills improved after using a mobile app to translate words in real time and within a meaningful context (e.g., restaurant). Kiger, Herro, and Prunty (2012) compared the traditional flashcard approach to mathematics drill and practice to using a flashcard app on an iPod Touch. Other examples of studies that evaluated the effectiveness of mobile learning include Cochrane (2010); Kukulska-Hulme and Shield (2008); Noguera, Jiménez, and Osuna-Pérez (2013); and Santos and Ali (2012).

Designing Mobile Learning Systems

About one-third of the published studies on mobile learning involve the design of a system to promote learning (Wu et al., 2012). For example, Hung, Lin, and Hwang (2010) designed a mobile learning activity where students used their PDAs to take guided notes while observing animals in an ecological conservation. Christ, Meyrueis, and Sultana (2013) designed, developed, and implemented a mobile *Language Learning Game* where learners synchronously or asynchronously collaborated to compose short stories in a different language. Zurita and Nussbaum (2007) investigated the use of a mobile learning environment to teach second graders basic addition, subtraction, and multiplication skills. Other examples of research studies that designed mobile learning systems include Hou, Wu, Lin, Sung, Lin, and Chang (2014); Noguera

et al. (2013); Pavlik and Bridges (2013); Tesoriero, Gallud, Lozano, and Penichet (2014); and Sommerauer and Müller (2014).

After considering the purpose of the majority of the empirical research on learning using mobile devices, I can make the following two claims: (a) the research is not explicitly directed at exploring learning but rather learning outcomes and (b) most of it focuses on researcher-led or teacher-directed. A handful of studies, however, have investigated learning using mobile devices both objectively by looking at mobile device uses and applications, and subjectively from the perspective of the learner.

Objective Examination of Learning Using Mobile Devices

Some researchers conducted objective investigations of learning using mobile devices. They wanted to reveal what constitutes learning using mobile devices. For example, Patten, Arnedillo-Sánchez, and Tangney (2006) examined the use of mobile devices for learning and proposed to organize their various uses and applications into the following categories: (a) administration (e.g., grade book, calendar, etc.), (b) referential (e.g., dictionaries, electronic books, etc.), (c) interactive (e.g., animations, simulations, classroom response systems), (d) microworld (e.g., games), (e) collaborative (e.g., wikis), (f) location aware (e.g., museum guides), and (g) data collection (e.g., note-taking, video capture, etc.).

Other researchers investigated the use of mobile devices in the scholarly literature and proposed similar categories (e.g., Roschelle, 2003; Song, 2007). For example, Song analyzed several studies, conference proceedings, and book chapters and set forth the following categories of mobile device use for learning: (a) educational (i.e., communicating between students and teachers), (b) managing (i.e., organizing learning activities), (c) information seeking and handling (i.e., finding and storing information), (d) games and simulations (i.e., playing games or

watching simulations that provide a real world context for learning), (e) data collection (i.e., recording data found in real-life settings), and (f) context-awareness (i.e., receiving information based on the students' location in the real world).

The taxonomies presented above were objective attempts by researchers to organize mobile learning uses and applications into categories of learning. These categories, however, reflect the technological function of mobile devices. They are *technocentric*, focusing on the features and functions of the devices themselves and not on the learning that is taking place. Mobile devices are personal devices and their uses for learning differ between users. A few studies looked at the subjective use of mobile devices for learning.

Subjective Examination of Learning Using Mobile Devices

A subset of researchers examined the subjective use of mobile devices for learning and asked participants to indicate how they have used these devices for learning (e.g., Clough et al., 2007; Kukulska-Hulme & Pettit, 2008; Santos & Ali, 2012). Most notably, for example, Clough et al. (2007) administered an online survey and asked participants to elaborate on how they use their smartphones and personal digital assistants (PDAs) for learning. Clough et al. analyzed the participants' responses and organized them into categories to represent the type of mobile learning activities participants engaged in. These categories include: (a) referential (e.g., using an encyclopedia), (b) location aware (e.g., using the GPS), (c) reflective (e.g., reviewing notes), (d) data collection (e.g., taking photographs), (e) constructive (e.g., contributing to blogs), and (f) administrative (e.g., using the calendar feature).

The objective studies that have looked at mobile device uses and application and the subjective studies that have investigated learning from the perspective of learners have set forth categories of learning activities. Learning, however, is a complex phenomenon and should not

simply be neatly organized into discrete categories. Learning activities can be framed in a theoretical lens. The next section presents the conceptual work done to investigate the underlying theoretical frameworks of learning using mobile devices.

Conceptual Work on Mobile Learning

Most empirical research on mobile learning activities is based on the technical capabilities and affordances of the device. It is important, however, to frame mobile learning practices within the scope of existing theoretical teaching and learning frameworks.

Several frameworks and perspectives have been used to explain learning and organize learning activities by their underlying theoretical frameworks. The following subsections provide an extremely brief overview of each illustrated by examples derived from mobile learning uses and applications; these are not meant to be an exhaustive review of learning theories.

Behavioral Perspective

The behavioral perspective views learning as a change in behavior: "the process in which associations and skills are acquired" (Greeno, Collins, & Resnick, 1996, p. 16). Operant conditioning within the behavioral perspective proposes the use of reinforcement to shape behavior. Mobile learning activities that focus on acquiring and building skills all the while providing learners with feedback on their performance include drill and practice activities or quizzes.

Cognitive Perspective

The cognitive perspective views learning as information processing where individuals retrieve, store, and reorganize information (Good & Brophy, 1990). Mobile learning activities that are cognitive in nature focus on presenting information to the learners without necessarily

providing opportunities for interaction. These include using mobile devices as content delivery platforms and having students read information, watch videos or animations, listen to podcasts, and so on.

Constructivist Perspective

A constructivist perspective views learning as construction of knowledge: "a constructive process of conceptual growth, often involving reorganization of concepts in the learner's understanding" (Greeno et al., 1996, p. 16). There are mobile learning applications that focus on learners building on their prior knowledge and constructing new knowledge by interacting with learning content (i.e., cognitive constructivism) and applications that focus on learners constructing knowledge by interacting with others (i.e., social constructivism). Examples of cognitive constructive learning on mobile device include engaging with role-playing games and the use of virtual reality applications. Examples of social constructive learning on mobile device include the use of applications that connect learners with other individuals such as social media applications.

Situated Learning Perspective

The situated learning perspective views learning within an authentic context; as "becoming attuned to constraints and affordances of material and social systems which [learners] interact" (Greeno et al., 1996, p. 17). Mobile devices can promote this type of learning by mediating the interactions between individuals, objects, and other individuals in an authentic learning context. Mobile learning from the situated learning perspective includes, for example, the use of mobile devices for learning at museums or using mobile devices to record real-world data for classroom analysis.

These past theoretical frameworks provide a limited understanding of learning using mobile devices; they neglect to consider the learners' perspective. The purpose of this dissertation is to gain a comprehensive understanding of learning using smartphones. Since smartphones are personal devices and there exists a unique and intimate relationship between them and users, it follows that the learners' perspectives on and their understanding of learning using smartphones needs to be examined. This is referred to in the literature as the study of *conceptions of learning*.

Conceptions of Learning

Säljö (1979) conducted the first study of its kind aimed at revealing how individuals tacitly understand their learning. He conducted semi-structured interviews with 90 adult learners ranging in age from 16 to 73 years old and asked them the following questions:

1. How do you usually set about learning?
2. Why do you think some people are better at learning than others?
3. What do you actually mean by learning?

An analysis of the data revealed that individuals talk about their learning in qualitatively different ways. Säljö (1979) revealed that their understanding of learning, in other words, their *conceptions of learning* fall in five distinct categories:

1. The increase of knowledge
2. Memorizing
3. The acquisition of facts, procedures, and so on, which can be used in practice
4. The abstraction of meaning
5. An interpretative process aimed as understanding reality

These results have been replicated, with other researchers finding similar conceptions of learning (e.g., Giorgi, 1986; Martin & Ramsden, 1987; van Rossum & Schenck, 1984; Watkins & Regmi, 1992). Marton, Dall'Alba, and Beaty (1993) proposed a sixth category of learning:

6. A change in the person

Other researchers have found support for this sixth conception of learning (e.g., Dahlin & Regmi, 1997; Pratt, 1992; Watkins & Regmi, 1992).

Research on conceptions of learning is broad. While Säljö (1979), Marton et al. (1993), and others focused on the conceptions of learning in general, other researchers examined (a) conceptions of specific *content* areas such as engineering (Marshall, Summer, & Woolnough, 1999; Rowe, 1998) language learning (Benson & Lor, 1999), physics (Chiou, Lee, & Tsai, 2013), biology (Chiou, Liang, & Tsai, 2012), nursing education, and car mechanic education (Eklund-Myrskog, 1998), and (b) conceptions of particular topics of concepts within a content area such as cloning (Concannon, Siegel, Halverson, & Freyermuth, 2010) and vector kinematics (Aguirre & Rankin, 1989). Recently, researchers began to focus on how individuals understand technology-mediated learning, such as online learning (Tsai, 2009; Vallee, 2006), blended learning (Ellis, Goodyear, Prosser, & Ohara, 2006), e-learning (Creanor, Trinder, Gowan, & Howells, 2006) and ubiquitous learning (Tsai, Tsai, & Hwang, 2011). Despite the differences in the objects under study, research on conceptions shares an important feature. Researchers are interested in revealing individuals' conceptions of a phenomenon based on their *experience* of the phenomenon. In fact, when conducting interviews to reveal these conceptions, researchers ask participants to recall their experiences. For example, Säljö (1979) first asked: "How do you usually set about learning?" This is a distinctive feature of these kinds of investigations. The next section grounds the research on conceptions of learning within a larger epistemological

framework and provides support for the importance of investigating individuals' experience of a phenomenon.

Conceptual Framework

Typically, individuals do not explicitly think about or share out loud their conceptions of learning. These conceptions are influenced by their experiences and are often revealed by what the individuals do; in other words, their actions with respect to learning. As such, their conceptions of learning are deeply rooted in their experiences of learning. Investigating an individual's experience of a phenomenon that exists in the world, in this case learning, has deep epistemological roots.

Epistemology is the theory of knowledge. When considering and examining how individuals come to know about the world (and a phenomenon within it), different educational and psychological traditions have different foci. The behaviorist perspective focuses on examining the world. The cognitive perspective focuses on examining the mental processes of individuals as they interact with the world. The constructivist perspective focuses on examining individuals' construction of knowledge through their interactions with the world. The situative perspective focuses on the individuals' co-construction of knowledge through their interactions with the world and with other individuals. All of these perspectives embrace the *individual-world* dualism; the idea that there is the individual's *inner* and the world's *outer* that each need to be examined separately (Marton & Booth, 1997). To investigate an individual's experience of a phenomenon, researchers need to reject this dualism. They need to move away from studying the individual or studying the phenomenon or even studying the external relationship that exists between them. Instead, researchers interested in revealing individuals' experiences of a phenomenon need to consider the *internal* relationship that exists between an individual and the

phenomenon; in other words, they need to study how individuals experience the phenomenon and the understanding of the phenomenon emerges from this experience (Marton & Booth, 1997).

As such, the phenomenon under study in this dissertation is the individuals' experience of learning using smartphones. One of the major aims of this study is to reveal and categorize the individuals' tacit understanding of learning using smartphones. The purpose is to understand the experience of learning from the perspective of the learners; in other words, their conceptions of learning. The fact that each of the learners' smartphones is customized according to their own wants and needs (i.e., different installed applications) aligns well with the phenomenographic approach to research. Each of the individuals' experience of learning using smartphones is influenced by the different applications they have installed on their devices.

This distinctive approach to studying learning needs an equally distinctive and compatible research approach that will guide the data collection and data analysis. Studies on conceptions of learning that investigate individuals' understanding of their experience of learning have used a *phenomenographic* approach.

Phenomenography is used predominantly in educational research and is "the empirical study of the limited number of qualitatively different ways in which various phenomena in, and aspects of, the world around us are experiences, conceptualized, understood, perceived, and apprehended" (Marton, 1994, p. 4427). In fact, in the scope of this study, the expressions *conceptions* and *ways of tacit understanding* are both used as synonyms for the term *ways of experiencing*.

The core epistemological assumption of phenomenography is that individuals experience a phenomenon differently from one another. In fact, according to Marton and Booth (1997) "the

object of the [phenomenographic] research is the *variation* in ways of experiencing phenomena" (p. 111). To reveal the different ways in which individuals understand a phenomenon, researchers adopt a phenomenographic approach. They conduct semi-structured interviews to collect data about the individuals' experiences of the phenomenon in question. Data analysis results in categories representing the different ways in which individuals experience a phenomenon. These categories are organized in a hierarchical way to reflect the logical relationship that exists between them. This is referred to as the *outcome space*. The outcome space represents the "full range of possible ways to experiencing the phenomenon in question" (Åkerlind, 2005, p. 323). For example, this is a representation of the outcome space of the six conceptions of learning revealed by Säljö (1979) and Marton et al. (1993):

1. The increase of knowledge
2. Memorizing
3. The acquisition of facts, procedures, and so on, which can be used in practice
4. The abstraction of meaning
5. An interpretative process aimed at understanding reality
6. A change in the person

These categories are hierarchically organized to reveal the relationship between them. The first three conceptions reveal a *quantitative* understanding of learning represented by acquiring, storing, and using knowledge; while the last three conceptions reveal a *qualitative* understanding of learning represented by constructing meaning from knowledge (Marton & Booth, 1997).

With respect to this dissertation, using the phenomenographic approach reveals the differences and similarities in the experience of learning using smartphones from the perspective

of individuals using these devices. Each variation makes up one facet of the phenomenon; and mapping out these variations will lead to a holistic and comprehensive understanding of the phenomenon.

Research Questions

This study employed a questionnaire and an interview to investigate the uncharted territory of the learner perspective on learning using smartphones. The research questions target (a) the smartphone activities that individuals consider learning and (b) their tacit understanding of their experience (i.e., conceptions) of learning using smartphones.

1. Do learners consider that they use their smartphones for learning?
2. What are some ways that learners use their smartphones for learning?
    a. What dimensions of the smartphone activities do learners consider learning?
3. How do learners understand learning?
4. How do learners understand learning using smartphones?
5. Has the use of smartphones changed learners' understanding of learning? If so, how?

CHAPTER 3

Method

The purpose of this study is to gain a comprehensive understanding of learning using smartphones from the perspective of learners. This includes a surface-level description of the activities of learning using smartphones and a deep-level exploration of that phenomenon. As such, I used two methods to collect data. First, I used questionnaires to determine how individuals use their smartphones for learning. Then, I conducted follow-up, in-depth interviews to determine participants' conceptions of learning using smartphones. Since this study aimed at examining learning using smartphones from the perspective of the participants, the questionnaire and interview prompted the participants to reflect on their experiences of learning using these devices. This line of questioning aligns with the phenomenographic approach to research and allows for researchers to reveal the different ways in which participants experience a specific phenomenon (Marton & Booth, 1997). The qualitative data analyses methods used in this study aimed at deriving meaning and patterns from the participants' experiences of learning using their smartphones.

Research Design

This dissertation employed a two-stage approach to collecting data. During the second week of Spring 2015, the registrar's office at a large Midwestern university sent out a questionnaire to a random sample of freshmen, sophomore, junior, senior, and graduate students. The questionnaire gathered information about the learners' experiences with the use of smartphones and their experiences with their specific use for learning. Based on the questionnaire responses, I selected a small subset of respondents to participate in a follow-up

interview to get a better understanding of how learners understand what it means to learn using their smartphones.

The following sections provide details on the two procedures used in this dissertation: a questionnaire followed by interviews.

Questionnaire

The purpose of the questionnaire was to gather information about learners' experiences with the use of smartphones and their specific experiences with their use for learning. I developed the questionnaire and delivered it online using the survey software *Qualtrics*. The questionnaire (see Appendix A) is divided into two parts. In the first part, the participants answered a few questions related to their smartphone and provided some demographic information. In the second part, the participants responded to questions regarding their understanding of learning and their experiences with the use of their smartphones for learning.

Participants

The participant pool for this study included a random sample of 2000 freshman, sophomore, junior, and senior students, and a random sample of 2000 graduate students at a large Midwestern university. The optimal number of questionnaire respondents was hoped to be between 200 and 300.

Data Collection

During the second week of the Spring 2015 term, the registrar's office at a large Midwestern university sent out an email to a random sample of 2000 freshmen, sophomore, junior, senior students and a random sample of 2000 graduate students inviting them to participate in a research study on smartphones and learning. The email included a link to the online version of the questionnaire. As an incentive to complete the questionnaire, the

participants were offered the chance to win one of 15 Amazon.com gift cards in the amount of $40. In addition, the email also mentioned that participants could be selected to participate in a follow-up 30-minute interview, and they would be paid $20 for their participation. The survey link was left active for 1 week. See Appendix B for the recruitment email that was sent out.

Data Analysis

An analysis of the questionnaire data yielded the following findings reported in Chapter 4 of this dissertation: (a) demographic data, (b) defining learning (c) use of smartphone for learning, and (d) categories and dimensions of the use of smartphones for learning.

Descriptive analyses. I conducted descriptive analyses on the demographic information including the respondents' proficiency in the use of their smartphones, whether respondents considered that they use their smartphones for learning, and the smartphone activities they considered learning.

Content analysis. To report the data regarding examples of the use of smartphones for learning, I performed a content analysis on the examples provided by the respondents. The aim of this process was to find patterns in the examples and to (a) determine categories that the examples can fit into and (b) identify the dimensions of learning using smartphones. First, I described the action occurring in each of the examples. Then, as I read and reread the examples, patterns relating to the categories and dimensions of learning using smartphones began to emerge.

Validity. I used two methods to determine the validity of the questionnaire that was used on this study. First, I shared the questionnaire items with researchers who are experts in the field of educational psychology and educational technology. They provided feedback on the questions. In addition, I conducted a pilot study to gather preliminary data. Several individuals

who participated in the pilot provided additional feedback on the questions. I took both sets of feedback into consideration and reworded some questions and removed others.

Reliability. I did not perform reliability checks on the questionnaire responses subjected to a descriptive analysis. To make sure that there is consistency in coding of all the respondents' examples of learning using smartphones, I maintained a research journal where I kept written memos describing the codes. Moreover, another researcher not involved in the study referred to the memos to cross-check the codes with the data.

Interview

The purpose of the follow-up interviews was to gather in-depth information on how learners understand their experiences of learning and how they understand their experiences of learning using smartphones. In addition, a few of the interview questions targeted how the participants' experience of learning has changed because of the use of their smartphone. I developed the interview protocol and interview questions (see Appendix C). It was divided into three parts discussed below. The purpose of the first part was to determine the participants' understanding of their experiences of learning, in other words, their conceptions of learning. The purpose for the second part of the interview was to determine the participants' understanding of their experiences of learning using smartphones, in other words, their conceptions of learning using smartphones. The two sets of interview questions for these two parts were adapted from Säljö's (1979) conceptions of learning study to fit the scope of this particular study. The purpose for the third part of the interview was to explore whether and how the participants' experiences of learning have changed because of the use of their smartphones.

Participants

Participants who responded to the questionnaire had the option to indicate if they would like to be contacted for a follow-up interview. Of those individuals, I purposefully selected a subset of 20 participants that have varying demographics, and that indicated that they use their smartphones for learning in varying ways. This method of selecting participants is in line with the method of selecting participants for a phenomenographic analysis. This purposeful sampling increased between-participant variation and allowed for a wide range of responses. The participants selected to participate in a follow-up 30-minute interview were paid $20 for their participation.

Data Collection

The phenomenographic approach is at the core of this dissertation. In their original phenomenographic study on the conceptions of learning, Säljö (1979) interviewed 90 adult learners ranging in age from 16 to 73 years old. Most subsequent studies on conceptions of learning, however, included between 15 and 30 participants (e.g., Benson & Lor, 1999, $n = 16$; Marton, et al., 1993, $n = 29$; Prosser, Trigwell, & Taylor, 1994, $n = 24$; Tsai et al., 2011, $n = 22$).

Of the 20 participants contacted, 18 responded. They varied across grade level, gender, and varied in their use of smartphones for learning. This purposeful sampling was the same procedure used by Marshall et al. (1999) to increase between-participant variation and receive a wide range of responses. See Appendix D for the recruitment email that the participants received Appendix E for the consent form that the participants signed.

I collected data using a set and rehearsed interview protocol (Appendix C). After asking the participants to read and sign the consent form, I reminded them that the interview was being audio-recorded and I also reminded them of its purpose. The interview consisted of nine main

questions and several follow-up questions based on the participant's responses. The interviews lasted between 16 and 32 minutes. Upon completion of each interview, I thanked the participant and gave them $20 in compensation for their time and effort.

Data Analysis

After transcribing the interviews, I used the phenomenographic approach to analyze the questions that pertain to the participants' conceptions of learning and learning using smartphones. I performed a content analysis on all other questions. Chapter 5 reports the findings from the interview analyses.

Phenomenographic analysis. I subjected the following questions to a phenomenographic analysis:

- Based on your experiences in school and in your day-to-day life, when you say that you've learned something, what do you actually mean by that?
- When someone tells you that they've used their smartphone for learning, what do you think they mean by that?

The first question aimed to reveal their conceptions of learning while the second question targeted conceptions of learning using smartphones. The phenomenographic analyses I conducted on these questions were mutually exclusive.

The aim of any phenomenographic analysis is to "identify and describe conceptions of reality as faithfully as possible… [T]he more faithful [researchers] can be to conceptions of an aspect of a reality… the better [they] are able to understand learning, teaching and other kinds of human actions" (Sandberg, 1995). In this case, I aimed to describe conceptions of learning and learning using smartphones. Interviews were conducted to reveal those conceptions and the transcriptions became the data for the analysis.

A phenomenographic analysis is a bottom-up, inductive approach to come up with meaningful results. In an attempt to standardize the process, Dahlgren and Fallsberg (1991) proposed a set of steps to follow when conducting a phenomenographic analysis. These steps have been adapted and used by others (e.g., Gonzalez, 2010; Sjöström & Dahlgren, 2002). Sjöström and Dahlgren (2002) specified the following seven steps: familiarization, compilation, condensation, grouping, comparison, labeling, and contrasting. I followed these steps for the phenomenographic analysis in this study.

Familiarization. I read the transcripts several times to become familiar with their content and correcting any transcription errors. While reading, I focused on the *what* and *how* aspects of the phenomenon, that is what the phenomenon experienced is and how the participants experienced it (Bowden & Walsh, 2000).

Compilation. I read the transcripts in detail to match the answers in the transcripts to the specific questions asked and to identify their major differences and similarities. It is extremely important to note that phenomenographic data analysis focuses on the differences and similarities between transcripts and not within transcripts. Phenomenographic research aims to explore the range of meanings within a sample group, as a group, not the range of meanings for each individual within the group (Åkerlind, 2005).

Condensation. I selected quotes and parts of longer answers that are relevant to the questions asked. This included omitting irrelevant extracts.

Grouping. I selected similar answers based on the overall meaning they conveyed. At this step, I constructed a preliminary set of conceptions.

Comparison. I revised the preliminary list of conceptions by re-reading the transcripts and ensuring that the participants' reported experiences fit well into the emergent categories.

According to Richardson (1999), "categories should emerge from [constant] comparisons conducted within the data." (p. 70)

Labeling. I then named the categories to reflect their characteristics and attributes.

Contrasting. I contrasted and compared the final categories to determine the relationship between them as well as their differences and similarities. Eventually, I placed the transcripts in categories based on their overall meaning in terms of phenomenon in question (Bowden, 2005). Finally, I sorted the categories based on an increasing level of comprehensiveness. This hierarchical representation was the outcome space (Åkerlind, 2005).

As I read through and analyzed the transcripts and derived meaning from them, I was engaging in a process of discovery and construction (Hasselgren & Beach, 1997). In fact, the analysis process was not as linear and direct as the steps above suggested; it was iterative.

Content analysis. I coded the rest of the responses for themes that emerged from the data and that addressed the specific purpose of each question and the specific research questions in this study. Specifically, I used an open coding scheme to identify themes related to how the participants felt that smartphones changed their understanding of learning.

Validity. In a phenomenographic study, researchers are concerned with how well their results map on to their participants' experiences of the phenomenon and not how well the findings correspond to the reality of the phenomenon (Åkerlind, 2005). As such, to ensure the validity of the interview questions, I phrased the questions from the perspective of the individual's experience.

Reliability. To determine the validity of the findings in this qualitative study, Creswell (2003) suggests using the following strategies.

Member checking. During the interview, I verbally summarized some of the participants' responses and asked them whether or not these summaries were correct in capturing their responses. This was an attempt to capture the participants' underlying meaning of their responses. In fact, Dahlin (1999) wrote that one way to ensure the validity of a phenomenographic study is by establishing "the plausibility of the categories… i.e., to what extent they are recognizable as representing actual or possible human experiences" (p. 195). A member check accomplishes that.

Peer debriefing. An individual not involved in the study was asked to review the data analysis procedure and provide feedback on the categories of conceptions and the codes that emerged. According to Dahlin (1999), another way to determine the validity of a phenomenographic study is by establishing "the logic of the system of categories emerging from the analysis" (p. 195). Performing a peer debrief accomplishes just that.

I recorded the interviews using a digital audio recorder and I also completed the transcriptions. After the initial transcriptions, I re-read them, checked for errors, and edited them accordingly.

Summary

The main focus of this dissertation was to reveal participants' tacit *understanding* of learning using smartphones. To accomplish this, I needed to examine the participants' experience of using smartphones for learning. As such, I used two methods to collect data. Questionnaires revealed how individuals use their smartphones for learning. Follow-up, in-depth interviews revealed participants' tacit understanding of this type of learning. For the data analysis, I used descriptive analysis and content analysis to analyze the data from the questionnaires; and a phenomenographic approach and content analysis to analyze the

interviews. Since this study was grounded in learners' perspective on learning using smartphones, the data analysis procedures aimed at deriving meaning and patterns from the participants' personal experiences of using smartphones for learning. The following two chapters present the questionnaire and interview results.

CHAPTER 4

Questionnaire Results

The purpose of the questionnaire was to collect data on how participants use their smartphones for learning. The results from the questionnaire analyses are presented below.

Demographic Data

The registrar office at a large mid-western university sent out the online questionnaire to a random sample of 2000 undergraduates and 2000 graduate students, with 251 students responding for a response rate of 6.28%. Some responses were either not completed, duplicates, or the respondents indicated that they were not at least 18 years old or did not have a smartphone. Effectively, 243 responses were included in the analysis. Of the 243 individuals who responded to the questionnaire, 63.70% identified as female (*n*= 155), 35.80% as male (*n*= 87), and 0.41% as other (*n*= 1). The average age of the respondents was 24.68 years. Tables 1, 2, and 3 show the distribution of grade levels, college majors, and smartphone operating systems. Table 4 shows the distribution of smartphone use proficiency. On average, the respondents indicated an above average proficiency in their use of smartphones (*M*= 3.94).

Table 1. *Distribution of Grade Levels*

Grade Level	Number of Participants	Percentage
Freshman	23	9.47
Sophomore	29	11.93
Junior	33	13.58
Senior	34	13.99
Graduate	123	50.62
Alumnus	1	0.41

Table 2. *Distribution of College Majors*

Major	Number of Participants	Percentage
Natural Science	42	15.79
Social Science	35	13.16
Education	34	12.78
Business	31	11.65
Engineering	22	8.27
Agriculture and Natural Resources	19	7.14
Communication Arts and Sciences	19	7.14
Other	19	7.14
Arts and Letters	18	6.77
Lyman Briggs College	8	3.01
Nursing	8	3.01
James Madison College	5	1.88
Music	2	0.75
Residential College of Arts and Humanities	2	0.75
Veterinary Medicine	2	0.75

Table 3. *Distribution of Operating Systems of Respondents' Smartphones*

Operating System	Number of Participants	Percentage
iOS	169	69.55
Android	65	26.75
Windows	8	3.29
Blackberry	1	0.41
I don't know	0	0.00
Other	0	0.00

Table 4. *Distribution of Smartphone Use Proficiency*

Proficiency	Rating	Number of Participants	Percentage
Helpless	1	0	0.00
Below Average	2	1	0.41
Average	3	66	27.16
Above Average	4	123	50.62
Expert	5	53	21.81

Defining Learning

I asked participants to list keywords or phrases they would include in their definition of learning. A content analysis of their responses identified several keywords that capture how participants would define learning. These are presented in Table 5. There were 238 unique entries; some participants did not provide relevant answers and their responses were omitted from the analysis. The percentages were rounded up for simple communication of the data.

The analysis process involved reading each of the participants' entries and identifying a keyword that best represents the response. I then read through the list of keywords and collapsed them under representative labels.

Table 5. *Keywords Participants Would Include in their Definition of Learning*

Keywords	Count	Percent Frequency
Gaining knowledge	81	34%
Gaining skills	26	11%
Understanding	24	10%
Experiencing	17	7%
Applying	14	6%
Critical thinking	14	6%
Remembering	13	5%
Comprehending	6	3%
Open-mindedness	6	3%
Practice	6	3%
Making connections	5	2%
Personal development	4	2%
Problem-solving	4	2%
Active participation	4	2%
Communicating	3	1%
Change in behavior	3	1%
Adapting	2	1%
Interpreting	2	1%
Memorizing	2	1%
Making decisions	1	0%
Sharing knowledge	1	0%

These representative labels can be matched with the conceptions of learning found in the literature. Two labels, however, do not align with the conceptions of learning: communicating and sharing knowledge. These might be related to the prevalent use of mobile devices for learning and the rise of social media as a means of communicating and sharing information.

Table 6. *Mapping Keywords and Conceptions of Learning*

Conceptions	Keywords	Count	Percent Frequency
Increase of knowledge	Gaining knowledge	81	34%
Memorizing	Remembering Memorizing	15	6%
Acquisition of facts, procedures, and so on, which can be used in practice	Gaining skills Applying Practice Problem-solving Making decisions	51	22%
Abstraction of meaning	Understanding Experiencing Comprehending Active participation	51	22%
Interpretative process aimed at understanding reality	Critical thinking Making connections Interpreting	21	9%
A change in the person	Open-mindedness Personal development Change in behavior Adapting	15	7%
Miscellaneous	Communicating Sharing knowledge	4	1%

Use of Smartphones for Learning

Of the 243 respondents, 85.60% (*n*= 208) indicated that they use their smartphones for learning.

Smartphone Learning Activities

Table 7 provides a summary of the most popular smartphone learning activities that emerged from the content analysis of the participant examples of their use of smartphones for learning. At least 10 participants reported each of these categories of activities. I read each example and gave it a title that best represented the activity. I then re-read the titles, identifying patterns, and organized them into broader categories. The analysis process was highly iterative.

The participants gave 314 examples of how they use they smartphone for learning. Interestingly, all participants who reported not using their smartphones for learning nevertheless provided examples of smartphone activities they consider learning.

Dimensions of Smartphone Learning Activities

The content analysis of the 314 smartphone learning activities examples identified seven major dimensions and related attributes of the smartphone learning activities: timeliness, duration, size, motive, focus, explicit purpose, and implicit purpose. The analysis process was iterative. It involved reading, re-reading, sorting, and coding the data from different perspectives. I wanted to identify patterns in how participants were using their smartphones for learning. According to Anfara, Brown, and Mangione (2002) this iterative process brings "meaning, structure, and order to data" (p. 31). A summary of the frequency of the dimensions can be found in Table 8.

Table 7. *Most Popular Smartphone Learning Activities*

Smartphone Learning Activities	Description	Example(s)	Count	Percent Frequency
Looking up information on the web	Accessing the web on the smartphone to look up and read different types of information (e.g., definitions, biographical, historical, scientific, mathematical information, recipes, directions, etc.)	I used my phone to look up a painting we were studying in English class. I had no idea what the painting looked like so when the teacher was describing it, I didn't want to be completely lost. So I looked it up. I have a dictionary app. I had read a word in a book that I had never seen before. I looked up the word in the dictionary app on my phone and within seconds I learned the words definition, synonyms etc	155	51%
Checking the news	Checking and reading the news on the smartphone	I learned more about the ISIS conflict through my NPR app to hear a different opinion than the sensationalist television media.	19	6%
Reading articles	Accessing, viewing and/or downloading, and reading articles on the smartphone	I looked up a paper in regards to my thesis	19	6%
Practicing language skills	Using drill and practice applications on the smartphone to practice vocabulary, grammar, etc. skills	I used my smartphone to review flash cards and also used it to review DB2 certification questions.	14	5%

Table 8. *Percent Frequency of the Smartphone Learning Activities Dimensions*

Dimension	Count	Percent Frequency
Timeliness	166	53%
Duration	131	42%
Size	125	40%
Explicit purpose: Consume	197	63%
Explicit purpose: Practice	37	12%
Explicit purpose: Keep up-to-date	31	10%
Explicit purpose: Manage	15	5%
Explicit purpose: Play	15	5%
Explicit purpose: Participate	9	3%
Explicit purpose: Generate	6	2%
Implicit purpose: Achieving a balance	241	77%
Implicit purpose: Extending one's self	103	33%

Timeliness

Several examples (53%) mentioned that the activities were prompted by an external event (e.g., another person, a conversation, the surrounding context). In addition, participants also used words that suggest the passing of a certain amount of time: readily available, now, just-in-time, later, when I get back, and so on. These words indicate timeliness as a dimension of smartphone learning activities. *Timeliness* refers to the time that elapsed between the prompt and when the participants used their smartphones to engage in a learning activity. While most of the activities were immediately performed after the prompt, there is indirect evidence to suggest that some smartphone learning activities were performed some time after the prompt was introduced. As such, this property falls on a

continuum from *immediate* indicating a just-in-time use of the smartphone for learning to *delayed* indicating the use of the smartphone for learning that is far removed from the prompt. The following is an example of the immediate use of a smartphone to complete a learning activity; the participant used his/her phone to find medical information just as he/her was speaking with a patient:

> I looked up several medications and medical conditions to help me treat patients more effectively, I was able to access specialty resources and find internet resources immediately without having to wait, or go to another computer, and could instantly use that information and apply it to a particular case.

The following is an example of a delayed use of a smartphone to complete a learning activity; the participant looked up information on his/her smartphone some time after watching the film Selma: "After seeing the film Selma, I was curious about the relationship between Malcolm X and Dr. King. I watched some YouTube videos and read news and Wikipedia articles about it."

Duration

Several examples (42%) mentioned the duration of the activities using adjectives and qualifiers such as *quick*, *short*, *fast*, *extended*, a *few seconds* and so on. These implied duration as a dimension of smartphone learning activities. *Duration* refers to the time the participants took to complete the smartphone learning activity. While most of the activities were quick in nature, there is indirect evidence to suggest that some smartphone learning activities did take longer to complete than others. As such, this property falls on a continuum from *short-lasting* to *long-lasting*. The following is an example of a short-lasting smartphone learning activity: "In my orgo 2 class, I forgot

what a phenyl group was so I looked it up on my phone quickly so I could learn it." The learning activity lasted a few seconds at most. The following is an example of a long-lasting smartphone learning activity where the participant was arguable engaging in learning throughout the duration of the podcast:

> Last night I listened to the Sage Sociology podcast. The hosts were considering why the acceptance of biological racism appears to showing resurgence. I listened to this podcast because I am interested in this topic and I do not think I would be able to hear information surrounding it and consider it otherwise.

Size

When analyzing the examples of smartphone learning activities, several (40%) mentioned the size of the activities using adjectives and qualifiers such as *small*, *bite-sized*, *pieces*, *research*, *literature*, *studies*, and so on. These suggested size as a dimension of smartphone learning activities. *Size* refers to how small or large the smartphone learning activity is. While most of the activities were small in size, there is evidence to suggest that some smartphone learning activities were larger in size than others. As such, this property falls on a continuum from *small* to *large*. The following is an example of a small smartphone learning activity; the participant used his/her smartphone to perform a very specific and small-sized task: "used shazam to identify the music that I was listening to but wasn't familiar with the artist." The following is an example of a larger smartphone learning that is more involved:

> In my graduate program my cohort and I were talking about the many forms/variations of crisis and potential intervention strategies. We used our smartphones to do a quick search and learn how crisis literature has

developed/evolved over the last 50 or so years. We wanted to gain a better understanding of the roots of crisis and how we came to where we are today in relation to this topic.

Motive

The participants either directly stated or indirectly implied that the reason for completing the smartphone learning activities was either because they needed to or wanted to. Words and expressions such as *want*, *need*, *have to*, *required*, *interest*, *for fun*, *for class*, and so on suggested that motive could be a dimension of smartphone learning activities. As such *need* and *want* are the two motives for engaging in smartphone learning activities. In this example, the participant is using a smartphone because he/she needed to complete a course requirement:

> As a requirement for a course, and without the availability of my laptop, I looked up varying forms of qualitative methods that fell within the Critical Theory/Interpretivist family. This involved using the browsing application on the device to complete a search of relevant information.

In this example, the participant is using a smartphone because he/she wanted to browse a specific application: "I browse an app that updates with all sorts of interesting questions and answers and learn from them, e.g., I have learned many new things to take care of my tooth, like 'the bass method'."

Focus

I anticipated that participants would provide examples of learning using smartphones that match specific types of activities. To determine these types or *foci*, I read through the examples of learning and generated labels that best describe the focus of

learning activity occurring. The smartphone learning activities varied in their focus ranging from academic, work-related, recreational, functional, logistical, retail-related, personal, health-related, and so on.

Explicit purpose

When analyzing the examples of smartphone learning activities, it became apparent that each had a specific, intended, and explicit purpose. As I read through the smartphone learning activity examples, I compiled a list of purposes that best describe the activity. As I re-read through the examples, I condensed the purposes and developed overarching categories under which several examples fit.

Generally, the smartphone learning activities were either performed as means to an end or were the end themselves. For instance, some smartphone learning activities were completed to facilitate the completion of a specific task (i.e., means to and end) while other smartphone learning activities were the tasks themselves (i.e., ends). The following is an example where the participant indicated that he/she completed the smartphone learning activity as a means to an end: "I looked up my class syllabus on my phone so that I could go along with what my teacher was saying." The following is an example where the participant indicated that he/she completed the smartphone learning activity as an end in itself: "This past week I could not remember the location of several countries. I used the internet ability of the smartphone to look at an atlas to learn where the countries of interest are and learn about geography."

Specifically, the content analysis of the examples of the smartphone learning activities suggested that participants completed the activities for one of seven distinct

purposes: to consume, to practice, to keep up-to-date, to manage, to play, to participate, and to generate.

To consume. The purpose of 63% smartphone learning activities is for participants to consume information by either reading from e-books and websites, watching videos, or listening to podcasts. In this example, the participant is using a smartphone to read about Oscar Wilde: "I read a quote from Oscar Wilde, not knowing who Oscar Wilde was. Using my phone, a quick Google search led me to his Wikipedia page, whence I learned Oscar Wilde was a 19th-century poet." In this example, the participant is using a smartphone to read about an Edgar Allan Poe poem:

> I was reading a poem by Edgar Allan Poe, and he alluded to the fact that he had written it specifically for someone, but it would never be discovered who for. I then used the internet on my phone to look up various websites of different scholars/bloggers that attempted to divulge who it was speculated Poe was writing about, what caused them to conclude that, and why he might have been writing about him/her.

To practice. The purpose of 12% smartphone learning activities is for participants to practice their skills (e.g., language skills, music skills, etc…). In this example, the participant is using a smartphone to practice his/her language skills: "I used my smart phone to do my daily Italian lessons via the app Duolingo. Through this app, I am actively exercising my Italian skills and constantly reviewing and learning new words, phrases, and grammar." In this example, the participant is using a smartphone to practice his/her music skills:

> I am currently learning how to play guitar, and I use an app that teaches me how to play new chords, songs, etc. I used my phone because it is easier to use than my computer for quickly finding something specific, like how to play an A chord.

To keep up-to-date. The purpose of 10% smartphone learning activities is for participants to keep up-to-date with what is happening in their courses, in their social networks, with their friends and family, and in the world. In this example, the participant is using a smartphone to keep up-to-date with his/her course assignment: "My classes involve online group homeworks. I used my smartphone to check what my other group members' feedback on our homework answers were." In this example, the participant is using a smartphone to keep up-to-date with the news:

> I use my BBC app everyday to learn about what's going on in the world. In addition, the way that app is set up you can access news by country or region which is very useful for a Latin American news class I am taking this semester where I was instructed to keep up with news in Latin America.

To manage. The purpose of 5% smartphone learning activities (is for participants to manage themselves or their responsibilities. In this example, the participant is using a smartphone to manage parts of his/her academic life: "I have used smartphone to check my emails, organize my calendars, keep the important documents handy." In this example, the participant is using a smartphone to manage the registration of his/her iClicker: "Last week, I used my smartphone in Physics 184 to register my iClicker, and check other important updates from the professor."

To play. The purpose of 5% smartphone learning activities is for participants to play different types of games. In this example, the participant is using a smartphone to

play chess: “I downloaded a chess app that trained you how to play chess. / Games such as mine sweepers and flow help you learn to see higher order patterns and connections.” In this example, the participant is using a smartphone to play a trivia game: “I engage half a dozen friends in a game called 'Trivia Crack', where we challenge each other on a variety of trivia questions. I am learning little tidbits of information and refreshing my memory on things long forgotten.”

To participate. The purpose of 3% smartphone learning activities is for participants to participant in their courses either synchronously or asynchronously. In this example, the participant is using a smartphone to synchronously participate in class:

> As stated before, one of my classes (LB 145) using an app for smartphones called TopHat that works similar to iClickers. Why we use it is because this app allows us to discuss our answers with other students. This helps us get input from others and further our learning on a topic.

In this example, the participant is using a smartphone to asynchronously participate in his/her online discussion forum: “Watched an online lecture for grad classes, posted a discussion board response.”

To generate. The purpose of 2% smartphone learning activities is for participants to generate information. In this example, the participant is using a smartphone to draw a mathematical graph: “Used math app to draw graphs to get some sense of properties about a given function.” In this example, the participant is using a smartphone to take his/her notes: “I used my Evernote app to take notes.”

Implicit Purpose

An in-depth analysis of the examples of smartphone learning activities revealed that each had an additional and implicit purpose either to (a) achieve some sort of balance or (b) extend the self of the participant. These attributes were not explicitly mentioned in the examples; I had to extrapolate them.

Achieving a balance. The implicit purpose of 77% of the smartphone learning activities is for participants to achieve either an emotional, cognitive, or behavioral balance. The following is an example of a smartphone learning activity to achieve an emotional balance; the participant was curious: "After seeing the film Selma, I was curious about the relationship between Malcolm X and Dr. King. I watched some YouTube videos and read news and Wikipedia articles about it." The following is an example of a smartphone learning activity to achieve a cognitive balance; the participant did not know a specific piece of information:

> My teacher was talking in class about doula training. She made a quick reference to it and proceeded to move on with the lecture. Being too shy to raise my hand in a 200 people lecture, I instead opted to use my smartphone to look up what a doula is. I was then able to understand what my teacher was talking about.

The following is an example of a smartphone learning activity to achieve a behavioral balance; the participant did not know how to perform a specific action: "I used my smartphone to find a recipe to make salmon because I wanted to make dinner but didn't know what to make or how."

Extending one's self. The implicit purpose of 33% of the smartphone learning activities is for participants to extend their sensory, cognitive, or behavioral abilities. The

following is an example of a smartphone learning activity to extend the participant's sensory ability; specifically his/her sight: "last semester, it took some pictures of one of my friend's notes in one of lectures that really helped me to deeply understand the subject." The following is an example of a smartphone learning activity to extend the participant's cognitive ability; specifically his/her ability to perform calculations: "I used my smartphone to calculate for Stats homework, as I prefer it than a real calculator for simple math." The following is an example of a smartphone learning activity to extend the participant's behavioral ability; specifically his/her time-keeping ability: "used smartphone as stopwatch while giving a test in a classroom."

Summary

This chapter presented the findings from 243 questionnaires that asked undergraduate and graduate students about their experiences using their smartphones for learning. A content analysis suggested that participants used their smartphone for learning predominantly by looking up information on the web. Another content analysis suggested that the activities considered learning using smartphones can be characterized by the following dimensions: timeliness, duration, size, motive, and focus. Moreover, they each have an explicit purpose: either to consume, to practice, to keep up-to-date, to manage, to play, to participate, and to generate; and one of two implicit purposes: to achieve an emotional, cognitive, and behavioral balance or to extend one's sensory, cognitive, or behavioral self. The next chapter presents the findings from the follow-up, semi-structured interviews.

CHAPTER 5

Interview Results

While the purpose of the questionnaire was to engage in a surface-level exploration of learning and learning using smartphones, the interviews were intended to delve deeper into the investigation of learning. The results from the analyses of the interview transcripts are presented below.

Conceptions of Learning

I wanted to verify the conceptions of learning identified by previous research and see whether they occurred in the students I interviewed for this study. In addition, these conceptions of learning provide me with a base for comparing the participants' conceptions of learning to their conceptions of learning using smartphones. I can attribute changes between their conceptions of learning and conceptions of learning using smartphones to their devices. A phenomenographic analysis of the interview transcripts revealed the same six categories of conceptions of learning identified by Säljö (1979) and Marton et al. (1993). These categories are hierarchically organized and logically related and are as follows:

1. The increase of knowledge
2. Memorizing
3. The acquisition of facts, procedures, and so on, which can be used in practice
4. The abstraction of meaning
5. An interpretative process aimed at understanding reality
6. A change in the person

For the phenomenographic data analysis, I used the iterative procedure highlighted in the *Methodology* chapter. To summarize, the phenomenographic data analysis process is a bottom-up, inductive approach to come up with meaningful results. The process I used was adapted from Sjöström and Dahlgren (2002) and included the following seven steps: (a) *familiarization*, reading the transcripts several times to become familiar with their content; (b) *compilation*, reading the transcripts in detail to match the answers in the transcripts to the specific questions asked and to identify their major differences and similarities; (c) *condensation*, selecting quotes and parts of longer answers that are relevant to the questions asked; (d) *grouping*, selecting similar answers based on the overall meaning they conveyed; (e) *comparison*, revising the preliminary list of conceptions by re-reading the transcripts and ensuring that the participants' reported experiences fit well into the suggested categories; (f) *labeling*, naming the categories to reflect their characteristics and attributes; and (g) *contrasting*, contrasting and comparing the final categories to determine the relationship between them as well as their differences and similarities and sorting the categories based on an increasing level of comprehensiveness.

It is important to note that participants' conceptions can fall into more than one category of conceptions of learning. The following subsections provide quotes that exemplify each of the categories.

Increase of Knowledge

In this first category, participants described their conceptions of learning as simply gaining knowledge. Agnes, for example, described learning as:

> Gain[ing] new knowledge. I feel like something I don't necessarily have to use for example, I feel that studying or reading about history that's just learning something but I don't think that I'll ever have to apply like what Napoleon did to my own life.

Similarly, Andy described learning as "Increasing knowledge. Basic understanding of things."

Memorizing

In this second category, participants described their conceptions of learning as memorizing information. For example, Harry said that

> [Learning] doesn't necessarily have to be long-term, it can be short-term like learning for memory and basic facts about something or someone's phone number of things like that and then long-term like I have to use this information that I learned in class for future reference or application.

Amanda similarly described learning as "just comprehending new material to a way that I understand and am able to say it back, almost like being able to remember and produce that information again."

Acquisition of Facts and Procedures Used in Practice

In this third category, participants described their conceptions of learning as gaining facts or learning new procedures and applying them in some situation. For example, Emily described learning as

> Something I've never known before. So for the aerobics, I never knew how to do those moves so she taught us the names of them and I didn't know the names either and then how to do them on the steps.

Kate also viewed learning in a similar way:

> I think it's kind of understanding a concept and being able to apply it. That's when I really feel that I've learned something instead of being just lectured at.

Abstraction of Meaning

In this fourth category, participants described their conceptions of learning as gaining knowledge and making meaningful connections between that knowledge and different aspects of their lives or different aspects of the world around them. For example, Steve said that

> Learning is when you're presented or observe something novel and you assimilate into knowledge. And it could be a fact or an idea or it could be something you see, something someone tells you. I think it's just the learning and the process of something that you did not think of or did not know previously and then you assimilate into how it related to other things you already know.

Interpretative Process Aimed at Understanding Reality

In this fifth category, participants described their conceptions of learning as gaining knowledge and using that knowledge to understand the world around them. For example, Kristy described learning as "acquiring new skills or understanding to relate to the world around you. And certain tasks. It's a building of knowledge." Emmy echoed that understanding of learning:

> Learning to me is something that occurs everyday. To me it means that you learn something new or you acquire knowledge that is either completely new or it adds to something that you knew and therefore confirm what you knew or actually goes against what you already knew and it can be acquired is lots of different

ways and those ways can be in this setting for instance through classrooms, through conversations, through readings, through writing, through involvement outside of the class where I draw the most from. I'm an international student, so me living here in itself is a daily learning curve actually. Yeah, I'm committed to wanting to learn too, so I'm curious which means for me I want to find out more and therefore I consider that learning.

Change in the Person

In this last category, participants described their conceptions of learning as gaining knowledge that results in a personal change. For example, Anton alluded to this in an example

> Well, I guess that I've acquired new knowledge or a new skill of some kind. You said beyond the classroom and I guess that's a good point to make because there are lots of things that we do that are outside of an educational setting that I would still definitely consider learning. For example, I'm pretty interested in health nutrition and stuff and I'm not taking classes on that but I have put in a goof deal of effort into learning about how to eat healthy and properly take care of my nutrition and my own health.

In his response, Kalvin also focused on how learning can contribute to a better self: "Learning is the gathering of information useful towards future application… learning that will help me really better myself or be able to help anyone with that learning."

Table 9 shows the distribution of conceptions of learning. As mentioned earlier, participants can possess more than one conception.

Table 9. *Distribution of Conceptions of Learning*

	Increase of knowledge	Memorizing	Acquisition of fact and procedures used in practice	Abstraction of meaning	Interpretative process aimed at understanding reality	Change in the person
Emily	✔	✔	✔			
Larry			✔			
Anton	✔		✔			✔
Agnes	✔		✔			
Steve			✔	✔		
Harry	✔	✔	✔			
Karen			✔			
Kate			✔			
Andy	✔					
Kalvin	✔		✔			✔
Kristy			✔		✔	
Ron			✔			
Amanda		✔		✔		
Angela			✔			
Emmy	✔				✔	
Jack	✔		✔			
Kristen			✔			
Ellie					✔	

Conceptions of Learning using Smartphones

In addition to asking participants about their understanding of learning (see previous section), I asked them questions to get at their tacit understanding or conceptions of learning using smartphones. It is important to note that when analyzing for conceptions of learning using smartphones, I did not base my analysis on the pre-formed conceptions of learning categories or on any presupposed ideas. In fact, this approach to analysis is a characteristic of the phenomenographic analysis.

The phenomenographic analysis of the interview transcripts revealed the following six categories of conceptions of learning using smartphones. These categories are hierarchically organized and logically related.

1. Filling gap in knowledge
2. Supporting pre-existing knowledge
3. Adding to pre-existing knowledge
4. Discovering new knowledge
5. Applying knowledge
6. Sharing knowledge

The first four conceptions describe learning as gaining knowledge. This finding is explored further in the last section on *Changes in Understanding of Learning after Smartphones*. It is important to note that participants can fall into more than one category of conceptions of learning. The following subsections provide quotes that exemplify each of the categories.

Filling Gap in Knowledge

In this first category, participants described learning using smartphones as using their devices to fill some gap in their knowledge. Statements in this category referred to participants engaging in some task, coming across a gap in their knowledge, and then using their smartphones to fill that gap. This is a convenient use of smartphones for learning. In this category, the participants did not have any pre-existing knowledge of the object of their smartphone learning activity. For example, Emily said that she expressed her understanding of learning using her smartphone in the following way: "I just type it in and [Google] tells me things if it's something that I don't know." Kristy's

understanding is similar to Emily's: "Using your smartphone to seek information that you don't already have." Steve also described learning using smartphone in a similar way:

> I feel like I had a question in my mind and I wanted to go answer it so I got my phone out and either typed it in a search engine or looked through a couple of different sources to figure out if this makes sense or is this really answering my question.

Supporting Pre-Existing Knowledge

In this second category, participants described learning using smartphones as using their devices to support their pre-existing knowledge. Statements in this category referred to participants engaging in some task, coming across information that they possessed some knowledge about, and then using their smartphones to go more in depth. This is a convenient use of smartphones for learning. In this category, the participants did have some pre-existing knowledge of the object of their smartphone learning activity. For example, Agnes described learning using smartphones in the following way:

> Gaining knowledge for myself so basically anything that I want to know or need help understanding and I can use my phone for… Learning with a smartphone I feel like is more gaining a broader understanding of something you already know.

Karen had a similar understanding: "To access new information. Facts on Google… I search on the Internet if I want to know something more in depth."

Adding to Pre-Existing Knowledge

In this third category, participants described their conceptions of learning using smartphones as using their devices to add to their pre-existing knowledge. This is a purposeful use of smartphones for learning. Statements in this category referred to

participants using their smartphones to gain more information about a topic they already possessed some pre-existing knowledge on. For example, Anton described his learning using his smartphone using the following example:

> Looking up things that interest me there's the Chernobyl thing definitely, sports, news, nutritional information, that kind of stuff because then you think that that would be pertinent to me at the time or that would be interesting or that I would like to know. Interest I think is a big thing.

Discovering New Knowledge

In this fourth category, participants described their conceptions of learning using smartphones as using their smartphones and discovering new knowledge. This is an incidental use of smartphones for learning. Statements in this category referred to participants engaging in some smartphone-related task and coming across information that they did not know. For example, Larry described his understanding of learning as:

> Probably just that information is transferred from one medium to another and picked up by you and if that catches your eye you can go more in depth and look more into it or if it doesn't then you just glance over it and kind of forget it… My understanding of learning using smartphone primarily is discovery of information, just it's just so accessible on there.

Similarly, Ron defined his understanding as: "Just everyday, finding new things out about the world or about the country, or discovering new things about people, events, homework, and stuff."

Applying Knowledge

In this fifth category, participants described their conceptions of learning using smartphones as having gained knowledge using their smartphones and then applying that knowledge to some situation. For example, Kalvin described his understanding of learning using smartphones in terms of its applicability: "It's easy to look something up on Google and remember it then and quickly forget the answer. I would consider that learning because more often than not I remember and I can use it for future application." Similarly, Kristen emphasized the importance of applying information when learning using her smartphone:

> Using it to take in and maybe hold on to information. I mean I feel like using a smartphone kind of allows for better sort of integration I guess… I mean that you've heard the information and you've taken it in. Like you've felt comfortable enough with it that you can apply it to other things… I feel that if you're not going to use it, then there is no point to having it.

Sharing Knowledge

In this last category, participants described their conceptions of learning using smartphones as having gained knowledge using their smartphones and then sharing that knowledge with others. For example, Emmy described her learning using smartphones in the following way:

> For me it means that I've acquired new knowledge, I've shared things with other people too… Cause for me learning is about hearing other people's viewpoint to maybe challenge mine or to understand how people think and why they act the way they do and why I act the way I do.

Table 10 shows the distribution of conceptions of learning using smartphones. As mentioned earlier, participants can possess more than one conception.

Table 11 provides a summary of the conceptions of learning using smartphones. It shows their attributes along with an example representing each category of conception.

Table 10. *Distribution of Conceptions of Learning using Smartphones*

	Filling gap in knowledge	Supporting pre-existing knowledge	Adding to pre-existing knowledge	Discovering knowledge	Applying knowledge	Sharing knowledge
Emily	✔			✔	✔	
Larry		✔	✔	✔		
Anton		✔	✔		✔	
Agnes	✔	✔	✔			
Steve	✔					
Harry	✔				✔	
Karen	✔	✔				
Kate	✔	✔		✔		
Andy					✔	
Kalvin	✔				✔	
Kristy	✔	✔				
Ron				✔		
Amanda	✔	✔		✔		
Angela		✔			✔	
Emmy	✔			✔		✔
Jack	✔			✔	✔	
Kristen	✔				✔	
Ellie	✔					

Changes in Understanding of Learning after Smartphones

Nine participants clearly stated that smartphones have changed their understanding of learning; eight participants clearly stated that smartphones have not changed their understanding of learning; and one participant's answer was unclear. Despite different responses, all of the explanations and elaborations provided by the

participants indicated that their perception of learning has in fact changed in one or more of the ways indicated below.

Different Medium for Learning

Five participants mentioned that learning using smartphones is not necessarily any different than other kinds of learning; it just occurs on a different medium. For example, Steve said: "I think [the smartphone is] just another medium. Just another way of gathering information and interrogating it in different manners." Jack also made a similar comment:

> I'd say that in a lot of ways [learning is] the same. You can use it in a way to substitute using a laptop or reading a book because… It's just when you use your smartphone it's a different way of accessing information. It's a different way of learning. It's just a different tool really.

Characteristics of Learning

Several participants indicated that the use of smartphones changed their perceptions of the characteristics of learning and not necessarily their understanding of learning. Participants indicated that their use of smartphones for learning seemed to make learning more accessible, faster, more convenient, easier, less effortful, and more fragmented.

Learning is more accessible. Eight participants mentioned that learning using their smartphones seems to them to be more accessible than other types of learning. For example, Larry said that: "The process of learning is the same, the differences are in the accessibility." Agnes made a similar statement: "Learning is definitely more accessible."

Table 11. *Summary of Conceptions of Learning using Smartphones*

Category of Conception	Overall Purpose	Learning Using Smartphone as	Smartphone Use as	Initial State	Example
Filling gap in knowledge	To gain knowledge	Secondary task	Convenient	No pre-existing knowledge	"This morning I did not know where Erickson was so I Googled it on my phone."
Supporting gap in knowledge	To gain knowledge	Secondary task	Convenient	Pre-existing knowledge	"I think that smartphones are best when you're in a debate and someone says something and you think it's true and then you just look it up."
Adding to pre-existing knowledge	To gain knowledge	Primary task	Purposeful	Pre-existing knowledge	"Looking up things that interest me, there's the Chernobyl thing, sports."
Discovering new knowledge	To gain knowledge	Incidental learning task	It depends	It depends	"Yesterday [I learned] about an accident on the highway. It was actually from Facebook because I actually follow the local news sources on Facebook so that I can get their headlines without having to go on their websites everyday. It was in my news feed. So it just showed up that there was an accident."
Applying knowledge	To apply gained knowledge	Primary task	It depends	It depends	"I used my phone to look up a video of how to do the stick trick."

Table 11 (cont'd)

Sharing knowledge	To share gained knowledge	Primary task	It depends	It depends	"For me it means that I've acquired new knowledge, I've shared things with other people too… Cause for me learning is about hearing other people's viewpoint to maybe challenge mine or to understand how people think and why they act the way they do and why I act the way I do."

Learning is faster. Six participants mentioned that learning using their smartphones seems to them to be faster than other types of learning. For example, Harry said: "Smartphone is more like quick, quick learning, quick access, more short-term more likely to be short-term…" Agnes provided an example to elaborate on that idea:

> Most of my friends had smartphones so they could find that information immediately and even if was the stupidest thing like 'oh, where is the nearest Taco Bell' or 'what are we going to do tonight, let's look up the hours of someplace we can go' for me it was like 'oh, here's my brick, I'll sit here while you guys find information.'… I definitely do say that I am able to find information more quickly because of my smartphone.

Learning is more convenient. Five participants mentioned that learning using their smartphones seems to them to be more convenient than other types of learning (e.g., learning from books, doing their homework, etc…). For example, Larry said that:

> Smartphones came about probably halfway through my lifetime, educational lifetime so I would kind of remember back to the days before then where it was just books, homeworks, essays, things like that during school. And then when [smartphones] came along it was just a lot more convenient process of getting information I guess.

Steve also made a comment on the convenience of learning:

> I feel that just with your phone [learning is] just so convenient because [the phone] is right there. I feel that traditional media outlets struggle because they don't have the ubiquity of a smartphone that's in everyone's pocket that you can use to look it up for information, news, etc…

Learning is easier. Four participants mentioned that learning using their smartphones seems to them to be easier than other types of learning. For example, Agnes said: "So I feel that [learning] is a lot easier with a smartphone just because it's right there."

Learning is less effortful. Two participants mentioned that learning using their smartphones seems to them to be less effortful than other types of learning. For example, Larry said: "Before [smartphones] you would have to go through the effort of going through a book."

Andy also talked about how learning seems to be less effortful:

> Learning without the smartphone requires I guess more effort on your part. You would have to go to the library and check out a book… But with a smartphone, you could just look it up with the smartphone without having to drive to the library. It's a Google search away… Even on a more narrow field, when you read a book usually unless you're looking right in the index and even when you're looking in the index you can find a page that has information but you'd have to go through and weed out the information. Kind of like data mining – you'd have to figure out the meaning behind it. Whereas with your smartphone, it makes it even simpler than that. Where you can look it up and it would give you an exact definition, an exact example. It will give you that knowledge without a lot of conscious effort.

Learning is more fragmented. Two participants mentioned that learning using their smartphones seems to them to be more fragmented and short-lived than other types of learning. Emmy provided a good explanation of this: "I do feel that [learning is] snappier, like it's more sound-bitey, it's not as intense as for instance reading five chapters of a book back-to-back."

The idea that the use of smartphones changed the participants' perceptions of the characteristics of learning can be perfectly summed up by the following quote from Kalvin.

> I would compare [traditional learning and learning using a smartphone] to a microwave and a traditional oven. You can throw something in the microwave and probably won't be as tasty or in the case of your smartphone, it won't be as long lasting or as satisfying but it's quicker, gets the job done. If your objective is

> to heat something up, it does so. Whereas if you out it in the oven, it takes longer but the result is a greater satisfaction or in the case of learning via say a book or conversing with peers the result is that you probably will have a much more long lasting and much more easily applicable bed of knowledge in the future to use.

Opportunities for Learning

Six participants indicated that smartphones created more opportunities for learning. For example, Larry said that: "People have more opportunities to share and learn and everything."

In addition, participants indicated that learning can occur in everyday type situations. For example, Emmy mentioned that:

> [Learning opportunities] occur in day-to-day life but because I have access to my phone, there's more. I have access to more. For instance through a conversation, it may be that somebody says 'oh, but I saw that video of' but that would require me to make an active decision to go and see it. Whereas it I'm walking from where I live in South to here and I'm on my phone and I see something, I can pick [my phone] up and straight away run with it. So there are far more opportunities I think for that type of learning.

Control over Learning

Eight participants indicated that the use of smartphones afforded them more control over their learning. For example, several participants contrasted the kind of teacher-directed learning they are used to in a classroom to the more self-directed learning that they engage in on their smartphones where the goal of the learning activity is set by them rather than by others. For example, Emily said:

> In the classroom your teacher tells you things and a lot of times it's not really things you care to learn about but you have to be there for class but then when I learn on my smartphone it's things I'm usually curious about and I want to know and that's why I take it in.

Andy also mentioned the idea that his smartphone affords him more control over his learning:

> [My smartphone] has given me a lot more control in the way that I get information and I guess shape the education that I'm getting… So like professors assign you certain books and you have to read certain books and it will give you the certain information but on your smartphone you can get a deeper knowledge of certain things or even just look up things in particular that you might not understand that the book couldn't build on or didn't just have answers to.

Angela contrasted the rigid structure of classroom learning to the more flexible learning that happens when she uses her smartphone:

> I think that learning in class is more focused; you have a goal and a curriculum that you're supposed to have this certain set of skills by the time you're done. Whereas learning on the phone is more flexible. If you're focused on one thing and then your focus shifts, it's allowed to shift then you can kind of follow a stream of consciousness in different directions. Whereas in a class, you're relatively streamlines into one subject and into one concept.

In addition, participants indicated that while learning using their smartphones, they tend to learn about what they want to. They indicated that these devices afforded them the choice to engage in learning that interests them or pertains to them in some way.

For example, Kate said: "I think my smartphone is just personal things that I want to look up that maybe I don't have access to in an academic setting." Emmy also mentioned the element of choice when learning on her smartphone:

> [Learning with smartphone is] more personable. You have a larger element of choice. If I'm not interested in something, I can just scroll past it. If I don't want to download the app, I don't need to. Whereas in a classroom for instance, you have to read things you may not necessarily want to or what you're not interested in. So choice is a big one.

Looking up Information as Learning

The data from the interviews suggested that changes in the participants' understanding of learning have occurred because of smartphone use; participants directly and openly spoke about how their perceptions of the characteristics of learning have changed, how it seemed that smartphones afforded more opportunities for learning, and how they felt that they had more control over their learning. Upon a closer examination of the data, however, it seemed that the majority of participants inadvertently mentioned that learning using smartphones is akin to looking up information. They used terms such as *looking up, gathering, accessing, getting, finding* information when discussing learning using their smartphones. This finding supports the earlier finding that the first four categories of conceptions of learning using smartphones involve the act of acquiring knowledge. For example, Larry said: "When [the smartphone] came along it was just a lot more convenient process of getting information." Agnes also made a similar expression: "I am able to find information more quickly because of my smartphone." So

did Kate: “I think that my smartphone is just personal things that I want to look up… looking up scholarly articles or watching broadcasts.”

Disconnected Learning

Three participants noted an unfortunate implication for using smartphones to learn. These participants indicated a disconnect between learning with smartphones and its application in the real world. This is an interesting finding since the mobility of smartphones allows them to be embedded in the context of the real world. For example, Kristy said:

> I think if having a smartphone has changed anything, it’s made me understand the importance of actively trying to learn because with so many people being absorbed in their smartphone and using it for things that aren’t so much furthering knowledge. It feels like I’m living in a generation that’s reverting back and away from learning and just kind of living stagnate and glued to a phone versus associating learning with the world around them.

Ron made a similar statement to suggest how learning seems to be more disconnected:

> With my smartphone, I don’t really learn new concepts, I just really learn about what’s going on in the world or the gossip. Whereas with in class learning it just real-life learning you learn, like I said earlier, the real concepts of things.

Angela expressed a similar idea:

> I think they’re different because a lot of in general learning it involves hands-on experiences and being able to practice; whereas on a smartphone it’s kind of like

you get the information from your smartphone and then you have to go somewhere else to practice it or apply it.

Summary

This chapter presented the findings from 18 interviews that examined how participants understand the phenomena of learning and learning using smartphones and how such devices changed their understanding of learning. A phenomenographic analysis revealed the participants' conceptions of learning using smartphones: filling gap in knowledge, supporting pre-existing knowledge, adding to pre-existing knowledge, discovering new knowledge, applying knowledge, and sharing knowledge. These conceptions; however, reflect a very concrete way of understanding what learning is. In fact, a content analysis revealed that participants' understanding of learning has somewhat changed after having used smartphones. The final chapter discusses the findings from the questionnaires and interviews and situates them within the literature on learning using mobile devices. The chapter also presents the implications and limitations of this study and provides suggestions for future research.

CHAPTER 6

Discussion

The purpose of this dissertation is to understand the learner-perspective on learning using smartphones. I set out to obtain (a) a surface-level description of the activity of learning using smartphones and (b) a deep-level exploration of the phenomenon of learning using smartphones. This study yielded interesting findings that shed light on learning in today's mobile age.

Smartphones as Tools for Learning

Mobile learning did not come from or exist in a vacuum; it evolved from its predecessors: *electronic learning* and *distance learning*. Early on, researchers and scholars in the field of mobile learning have made the assumption that mobile devices can be used for learning. In fact, they weaved the notion of learning into their earliest definitions of mobile learning. For instance, Quinn (2000) described mobile learning as "e-learning through mobile computational devices", Traxler (2005) once thought of it "as any educational provision where the sole or dominant technologies are handheld or palmtop devices" (p. 262), Keegan (2005) wrote that "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" (p. 3), Kukulska-Hulme, Evans, and Traxler (2005) defined mobile learning as "learning delivered, enhanced or supported mainly or solely by wireless and mobile devices and their technologies" (para. 5). Over the years, the definition of mobile learning has evolved from being technocentric to focusing on other constructs that contribute to this phenomenon. For example, after extensive reviews of the theoretical literature (e.g., Laouris & Eteokleous, 2005; Sharples, Taylor, & Vavoula,

2007; Traxler, 2009) proposed four constructs central to a complete understanding of mobile learning: pedagogy, technological devices, context, and social interactions, Crompton, Muilenburg, and Berge set forth the following definition for mobile learning that was adopted in the *Handbook of Mobile Learning*: "learning across multiple contexts, through social and content interactions, using personal electronic devices" (Crompton, 2013, p. 4).

Despite scholarly debates on what constitutes mobile learning, the question of whether or not these tools are being actually used for learning by users and learners remained unexplored. As such, an important question at the core of this study was whether or not smartphones can actually be considered tools for learning. When asked, 85.60% of the participants indicated that they do in fact consider their smartphones as tools for learning. Whether or not learning in fact occurred on these devices was beyond the scope of this dissertation, however, this study provided evidence that mobile device users do consider them tools for learning. Hence, this study provided evidence that the concept of mobile learning is not one imposed by researchers and scholars, but also one expressed device users; in this case learners.

Smartphone Learning Activities and their Dimensions

The second research question focused on the smartphone activities that learners consider learning, specifically what those activities are and their dimensions.

Learning Using Smartphones as Looking up Information

When I asked participants to provide examples of how they use their smartphones for learning, 51% of the examples involved using the device to look up some type of information. In one of the few studies that examined how individuals use their mobile

devices for learning, Clough et al. (2007) also found that one of the main ways that participants used their device for learning was for referential activities; in other words, for accessing information.

Upon further analysis of the examples in this study it became evident that the participants were learning using their smartphones by looking up information to fulfill a particular purpose. This finding also surfaced in the interviews. The interviewed participants frequently referred to learning on their smartphones as looking up information (or used expressions to that effect). In fact, they used both expressions interchangeably at times. Specifically, the interviewed participants indicated that they were using their smartphones for learning by looking up information to help them solve a specific problem. This view of learning is aligned with the information processing metaphor of learning; specifically, its constructivist interpretation (Mayer, 1996).

Mayer (1996) described learners as information processors; they acquire knowledge when they receive information from an external source (e.g., teacher, book, lecture, etc.). The constructivist interpretation of information processing views learning as a cognitive process that "involves an active search for understanding in which incoming experience is reorganized and integrated with existing knowledge" (p. 156). This is how the majority of participants in this study indicated that they use their smartphones for learning. For example, one participant gave the following example of learning:

> I was reading a poem by Edgar Allan Poe, and he alluded to the fact that he had written it specifically for someone, but it would never be discovered who for. I then used the internet on my phone to look up various websites of different

scholars/bloggers that attempted to divulge who it was speculated Poe was writing about, what caused them to conclude that, and why he might have been writing about him/her.

This statement exemplifies how learning using smartphones majorly aligns with the constructivist interpretation of information processing. The participant was prompted by the context she was in (i.e., reading a poem) and her pre-existing knowledge (i.e., that Poe wrote that poem for someone) to use her smartphone and actively search for information that would allow her to better understand what she was experiencing (i.e., reading) at the moment. The participant used her smartphone to fulfill a specific purpose. The next subsection discusses *purpose* as a defining property of learning using smartphones.

Learning Using Smartphones as Having a Purpose

When analyzing the examples of learning using smartphones, having an explicit purpose was one of their dimensions. Generally, the smartphone learning activities were either performed as means to an end or were the end themselves. For instance, some smartphone learning activities were completed to facilitate the completion of a specific task (i.e., means to and end) while other smartphone learning activities were the tasks themselves (i.e., ends). Specifically, the content analysis of the examples suggested that participants completed the learning activities for one of seven distinct purposes: to manage, to keep up-to-date, to participate, to practice, to play, to generate, and to consume.

These findings resonate with previous findings in the literature where scholars proposed the *categories* of learning activities using mobile devices (e.g., Clough et al.,

2007; Kukulska-Hulme & Pettit, 2008; Patten et al., 2006; Roschelle, 2003; Santos & Ali, 2012; Song, 2007). These categories, however, are representative of and reflect the purpose of the learning activities. For example, Clough et al. (2007) administered an online survey and asked participants to elaborate on how they use their smartphones and PDAs for learning. They then analyzed the participants' responses and organized them into categories to represent the type of mobile learning activities their participants engaged in. These categories include: (a) referential (e.g., using an encyclopedia), (b) location aware (e.g., using the GPS), (c) reflective (e.g., reviewing notes), (d) data collection (e.g., taking photographs), (e) constructive (e.g., contributing to blogs), and (f) administrative (e.g., using the calendar feature). In another study, Song (2007) analyzed several studies, conference proceedings, and book chapters and set forth the following categories of mobile device use for learning: (a) educational (i.e., communicating between students and teachers), (b) managing (i.e., organizing learning activities), (c) information seeking and handling (i.e., finding and storing information), (d) games and simulations (i.e., playing games or watching simulations that provide a real world context for learning), (e) data collection (i.e., recording data found in real-life settings), and (f) context-awareness (i.e., receiving information based on the students' location in the real world).

In addition to possessing an explicit purpose, an in-depth analysis of the examples of smartphone learning activities revealed that each had an implicit purpose either to (a) achieve either an emotional, cognitive, or behavioral balance or (b) extend the participants' sensory, cognitive, or behavioral abilities. These findings are in support of Nickerson's (2005) definition of technology (in this case, smartphones) as "tools [that]

help people accomplish their goals" (p. 3). In this study, smartphones used for learning either augmented the participants' sensory, cognitive, or motor abilities or helped them achieve balance in one of these areas. These secondary purposes elevate the smartphone from simply being a technology in people's hands to being an "amplifier of human capabilities" (p. 3).

Conceptions of Learning using Smartphones

The third and fourth research question were concerned with identifying the participants' conceptions of learning and learning using smartphone respectively.

Conceptions of Learning

A phenomenographic analysis identified the following six conceptions of learning: increase of knowledge, memorization, acquisition of facts and procedures used in practice, abstraction of meaning, interpretative process aimed at understanding reality, and change in the person. These results match the conceptions of learning identified by other researchers (e.g., Marton et al., 1993; Säljö, 1979). In addition, the keywords questionnaire participants would use to define learning can be grouped into these six conceptions. The only two keywords that do not align with of the conceptions of learning (i.e., communicating and sharing knowledge) suggest that communicative technologies (e.g., social media, mobile devices, etc.) might be transforming how individuals understand learning.

Conceptions of Learning Using Smartphones

When examining the conceptions of learning, it is interesting to note that they progress from concrete conceptions to abstract conceptions. In addition, when I asked participants to list keywords they would include in their definition of learning, the most

popular keywords also reflected a concrete and abstract understanding of learning (gaining knowledge, gaining skills, understanding, experiencing, applying, critical thinking). The conceptions of learning using smartphones identified in this study, however, do not possess that same feature. They are all concrete in nature: filling gap in knowledge, supporting pre-existing knowledge, adding to pre-existing knowledge, discovering new knowledge, applying knowledge, and sharing knowledge. The conceptions of learning using smartphones reflect a very concrete way of understanding what learning is. When compared to the conceptions of learning as abstracting meaning, understanding reality, and changing the person, the conceptions of learning using smartphones all relate to individuals expanding their own knowledge space.

Earlier, I discussed how learning using smartphones majorly aligns with the constructivist interpretation of information processing and how participants indicated that they used the device to fulfill a specific purpose. The learning in those cases was dependent upon and prompted by the immediate context they were in and the particular challenge, task, or problem they were facing. It may be that conceptions of learning using smartphones are concrete because learning usually is occurring and embedded within a particular context.

Upon a closer examination of the transcripts and the examples of learning using smartphones provided in the questionnaire, the process of using smartphones for learning is clearer: Participants were faced with a problem in the context they were in, assessed their current state of knowledge, and used their smartphones to reach their desired state of knowledge and solve the problem. This process is highly targeted and aimed at solving a particular problem. Learning as such is not only concrete but also applicative (van

Merriënboer, 1997). The participants, however, were using their smartphones to solve determinant and well-defined problems. Examples of problems participants indicated they were trying to solve included: looking up definitions, equations, directions, recipes, the weather, etc.

Participants were not using their smartphones to solve complex and ill-defined problems. "Ill-structured problems are characterized by the availability of incomplete data or insufficient access to information; the existence of alternative and often conflicting approaches" (van Merriënboer & Stoyanov, 2008, p. 71). The current everyday life that learners live and work in has witnessed rapid technological, economical, and societal changes. Learners now have novel problems to solve and different situations to face. These challenges require a complex set of problem solving skills directed at solving ill-defined and ill-structured problems such as creative thinking, lateral thinking, ability to pick up on patterns, metacognitive skills, self regulation, to name a few. These skills are more abstract than those required to solve well-defined problems.

As such, the conceptions of learning using smartphone identified in this study can be seen as problematic. Learning is seen as concrete and applicative, aimed at solving particular and well-defined problems. To solve the kinds of problems they face in today's society, learners need to understand learning as being abstract and interpretative (van Merriënboer, 1997). The smartphone is a powerful and ubiquitous tool and is used in just-in-time situations. As such, it would be important for learners to use it to solve the complex problems they face in their day-to-day life.

Changes in Understanding of Learning after Smartphones

Participants in the study indicated that their understanding of learning has in some way changed as a result of using their smartphones. The findings suggested that learning is more accessible, faster, more convenient, easier, less effortful, and more fragmented. In addition, participants indicated that there seems to be more opportunities for learning and that they feel that have more control over their own learning. In the literature, mobile learning is described as personal, collaborative, learner-generated, learner-centered, authentic, situated, context-aware, formal, informal, continuous, bite-sized, portable, opportunistic, spontaneous, and ubiquitous (Cochrane, 2010; Traxler, 2005, 2007, 2009). As such, the findings in this study reveal that participants' understanding of learning is similar to how scholars describe mobile learning and support the idea that learning has been influenced by smartphones.

Furthermore, upon a closer examination of the results, they seemed to indicate that the phenomenon of learning is taking on the properties of the device on which learning is taking place. Smartphones possess several defining features: They are relatively small, can be carried around, possess wireless Internet capabilities and location-based services, can be used immediately, and have the ability to be personalized. The findings from the study suggested that participants' understanding of learning has changed and adopted similar properties as smartphones. Learning seems to be bite sized and simple, immediate, nomadic, contextual, and personalized.

Bite Sized and Simple

Small smartphone screens limit the content presented to the user and as such can limit their interactions. In addition, the relative short battery life forces users to use their

devices for short spurts of time. In fact, Meeker and Wu (2013) and Rogers, Connelly, Hazlewood, and Tedesco (2009) found that the use of smartphones is limited to short periods of time.

Similarly, learning using these devices seems to occur quickly and in short intervals. Learners seem to use their devices to engage in simple learning exercises such as fact checking or fact finding. As such, it follows that participants thought of learning as bite sized and fragmented, occurring over brief segments of time as learners engage in simple learning activities

Immediate

Users can access their smartphones quickly, easily, and frequently. Not surprisingly, Meeker and Wu (2013) found that people check their smartphones an average of 150 times a day. Quinn (2011) refers to this as *immediacy* or the speed with which users can access their devices and the frequency of access.

Learning using smartphones can occur with similar immediacy as learners can quickly and easily access resources on their devices. In the age of immediate and instant access to resources, it makes sense that participants consider learning as similarly immediate, occurring instantly.

Considering participants' view learning in the digital age as bite sized, simple, and immediate seems to reflect a behaviorist perspective of learning, that is learning as the association between a stimulus and a response (Mayer, 1996).

Nomadic

Smartphones are carried with the users as they move around. Being mobile is their normative state and as such they are, by definition, nomadic. According to

Patokorpi (2006), nomadic refers to "a phenomenon in which the state of being on the move is the normal state and not a break from the normal" (p. 21).

Smartphones contribute to creating a learning bubble around the learners and as such create opportunities for learning wherever the learners go. As such, learning using these devices is much more than mobile; it is nomadic (Stanton & Ophoff, 2013). It occurs across situations and contexts. It makes sense that learning in the age of mobile devices is also nomadic. Learners have been accustomed to learning everywhere they go, stumbling upon and seeking opportunities to learn, and tapping into their devices for resources when needed.

Contextual

Smartphones are sensitive to the immediate context the users are in and can connect them with a broader context. This is evidenced by their location-based services that can pinpoint the users' exact locations and their wireless Internet capabilities respectively.

Learning using smartphones allows learners to be responsive to their immediate context and connect with a larger network of resources. This possibly contributed to learners perceiving of learning as similarly contextual; influenced and dependent upon the context they were in.

The fact that smartphones are mobile means that the contexts the learners are in are similarly mobile and constantly changing depending upon the situation they are in. This situational context is where learning is taking place (Stanton & Ophoff, 2013). The view of learning as nomadic and contextual reflects a situated perspective of learning,

that is learning is a process of "becoming attuned to constraints and affordances of material and social systems which [learners] interact" (Greeno et al., 1996, p. 17).

Personalized

Smartphones are similarly personalized and tailored to the users' unique needs. Different users install different applications on their devices depending on how they plan to use them. Users then develop a sort of relationship with their device. Quinn (2011) refers to this as *intimacy* or the relationship users have with devices such as the distance between the devices and users and the use of the devices for either personal or practical purposes. In fact, the highly customizable nature of smartphones allows for differential interactions; users have unique interactions with their device. These unique interactions contribute to the *intimacy* that Quinn describes.

Learning using smartphones is also personalized as it looks different for each of the learners depending on their needs, prior knowledge, motivations, context, and so on (Koole, 2009). Learning in the mobile age seems to be similarly personalized and tailored to the learners' unique needs. Learners have more autonomy and control over the learning process and can set their own goals and objectives.

When considering how smartphones have changed learners' understanding of learning, it seems that learning is seen as quick accessing to simple information prompted by the learners' personal experiences in their situational context, that is the context they are currently in.

Implications

This study yielded interesting, preliminary, but also troubling findings about how individuals use their smartphones for learning and what their understanding of learning

using smartphones is. The following addresses some of the more alarming results and their implications.

One of the findings in this study suggested that learning using smartphones is akin (for the most part) to looking up information. Smartphones, however, provide several affordances for learning. Quinn (2013) described four such affordances: Consuming content, computing queries capturing context, and communicating with others. Other affordances include collaborating with others and creating content. Despite these possibilities for use for learning, participants mostly tapped into the *consuming content* affordance of smartphones. They primarily used these devices for seeking information and gaining concrete knowledge. The affordances described by Quinn are perceived affordances and reflect the intended use of the device for learning (Norman, 2013). In fact, the affordances of any physical object (smartphones included) are limited by the individuals' ability to perceive the different ways the object can be used (Norman, 2013). Smartphones are not simple technologies; they are nomadic, contextual, and personal. They integrate with the learners' selves and their surrounding context. As such, learners would greatly benefit from an intervention that teaches them how to leverage and capitalize on the true and possible affordances of the device and use them more effectively for learning. They would benefit from an intervention to transform their perceptions of how smartphones can be used for learning. Smartphones can then be transformed from a technology on which learning occurs, to an active agent in the learners' mediated construction of knowledge.

Another finding revealed that participants thought of learning using smartphones as being concrete. They were using their smartphones to solve determinant and well-

defined problems. In today's society, however, learners would also encounter complex and ill-defined problems. Smartphones are powerful and ubiquitous tools. Their use to solve simple problems is a waste of their true potential. As such, learners would greatly benefit from an intervention that helps them develop the applied and metacognitive skills to use their smartphones to solve complex, real-life problems. Smartphones can then be transformed from a tool to solve simple problems, to a tool that helps learners navigate the complexities of daily life and solve real-world, ill-defined problems.

Another interesting finding was that the participants' understanding of learning changed as a result of using their devices. Their understanding of learning using smartphones reflected the properties of the device. According to them learning is: bite-sized and simple, immediate, nomadic, contextual, and personalized. This finding has implications for the design of mobile technologies that have affordances for teaching and learning. The current trend is the focus on the quantified self and wearable devices. Individuals' representations of their interactions with contexts are reduced to discrete data points. As mobile technologies are becoming smaller in size, it would be important for designers to consider how these devices interact with contexts and represent those interactions to users.

Limitations

While this study deepened our understanding of learning using smartphones, specifically what it looks like and how learners understand it, there were several limitations. First, the questionnaire and the interviews relied on self-reported data about the participants' smartphone use for learning.

In addition, the study focused on learning as a general phenomenon and did not examine whether learning actually occurred. This approach was purposeful since the purpose of the study was for learners to self-identify how they use their smartphones for learning and what that phenomenon means to them. Nonetheless, I acknowledge that measuring the outcomes of learning would have added a welcomed level of complexity to this study.

Moreover, the population used in this study was the students at a large Midwestern university. The findings may not necessarily generalize to all types of smartphone users (e.g., working professionals, students in a K-12 setting, individuals with no college experience, and so on). The phenomenographic approach used in this study addressed that issue; participants were purposeful chosen for the interviews to reflect as much variability in their backgrounds as possibly. The fact remains, however, that this study did not seek participants beyond the university setting.

Finally, this study makes claims about learning using smartphones. These devices, however, are highly customizable; each smartphone has different applications installed on it depending on the user's needs and wants. As such, the claims I have made about learning are not entirely generalizable.

Suggestions for Future Research

While this study was a good first attempt at examining learning using smartphones from the learners' perspective, future research in this area would benefit from adopting a more objective, holistic, and systematic approach. One of the limitations of this study is that I collected self-reported data from the participants. Future research using objective data such as smartphone activity logs, journal entries, and so on is needed

to provide more information about how individuals actually use their smartphones for learning.

One of the findings in this study was that smartphones are considered tools for learning. This study, however, did not investigate *whether* or *how* learning using smartphones actually occurred. To obtain a more holistic understanding of learning using smartphones, an area of future research would be to determine the outcomes and processes of learning using these devices.

One of the research questions was whether or not there were any changes in the participants' understanding of learning as a result of using their smartphones. The findings suggested that some changes did occur. Such changes, however, would have happened gradually over time. As such, future research would benefit from conducting longitudinal studies to reveal the effects of smartphone use on learning. In addition, it would be interesting to look if and how individuals' understanding of knowledge has changed as a result of using smartphones.

Finally, research on conceptions recommends that a wide variety of participants be interviewed to obtain a more accurate list of conceptions. Future research would need to interview participants from different age groups, backgrounds, and with a variation in their educational experiences.

Summary

The purpose of this study was to contribute to the growing field of mobile learning; specifically, the use of smartphones for learning. The focus was on (a) describing how learners use their smartphones for everyday-type learning activities and (b) revealing their tacit understanding of the phenomenon of learning using these devices.

Over the past decade, the field of mobile learning has been in a constant state of growth; however, the perspective of the individuals using mobile devices for learning was rarely investigated. This study aimed to examine this type of learning from the perspective of the learners and help inform the design of mobile learning activities and technologies.

APPENDICES

APPENDIX A

Smartphone and Learning Questionnaire

Part 1: Smartphone use and demographic information

Thank you for participating in this dissertation pilot study on smartphones and learning. The data collect at this stage will only be used for the purposes of testing my research methods. In other words, it will not be used in the final write-up of my dissertation nor will it be published. After the data is analyzed, it will be discarded.

I would really appreciate if you could take the time to complete this questionnaire. It is divided into three main parts and should take you no more than 20 minutes to complete. Your participation is completely voluntary and you may change your mind at any time and withdraw.

At the end of the questionnaire, there's a space for you to provide your email address if you would like to be contacted for a follow-up interview. The interview is the second part of my study and will take no longer than 30 minutes to conduct. If you are interested and willing to participate, please provide your email. Providing your information does not guarantee that you will be invited, and if you are invited you will be free to accept or decline the invitation.

The first section of the questionnaire will begin on the next page and will ask you to a few demographic questions.

Question 1.1. Do you own a smartphone?
A smartphone is a cellular phone that is able to perform many of the functions of a computer, typically having a relatively large screen and an operating system capable of running general-purpose applications.

- ❍ Yes
- ❍ No

If No Is Selected, Then Skip To End of Survey

Question 1.2. What type of mobile operating system does your smartphone have?

- ❍ Android (e.g., Samsung Galaxy S4, Motorola Droid Maxx, etc...)
- ❍ Blackberry (Blackberry Bold, Blackberry Z30, etc...)
- ❍ iOS (e.g., iPhone 4s, iPhone 5, etc...)
- ❍ Windows phone (Nokia Lumia, HTC One, etc...)
- ❍ I don't know
- ❍ Other (please specify) _____

Question 1.3. How proficient are you with using your smartphone?
- ❍ Helpless
- ❍ Below Average
- ❍ Average
- ❍ Above Average
- ❍ Expert

Question 1.4. Gender
- ❍ Male
- ❍ Female
- ❍ other

Question 1.5. Age
- ❍ 18
- ❍ 19
- ❍ 20
- ❍ 21
- ❍ 22
- ❍ 23
- ❍ 24
- ❍ 25
- ❍ over 25

Question 1.6. Grade level
- ❍ Freshman
- ❍ Sophomore
- ❍ Junior
- ❍ Senior
- ❍ Graduate

Question 1.7. College/program currently enrolled in
- ❍ Agriculture and Natural Resources
- ❍ Arts and Letters
- ❍ Business
- ❍ Communication Arts and Sciences
- ❍ Education
- ❍ Engineering
- ❍ James Madison College
- ❍ Lyman Briggs College
- ❍ Music
- ❍ Natural Science
- ❍ Nursing
- ❍ Residential College of Arts and Humanities
- ❍ Social Science
- ❍ Veterinary Medicine
- ❍ Other (please specify) _____

Part 2: Learning and use of smartphones for learning

In this section, I will ask you a few questions related to learning and how you use your smartphone.

Question 2.1. Learning has been defined, approached, and studied in many different ways. At a broad level, learning can take place at school or for personal development. If someone asked you to write a paragraph answering the question "What is learning?" what kinds of ideas would you include in your answer? **Don't write the paragraph here, but just list a few key words or phrases that you would be likely to include.**

Question 2.2. Would you say that you use your smartphone for learning?

❍ Yes
❍ No

Question 2.3. Look back at the last week or so and think of ONE example when you used your smartphone for learning purposes in your day-to-day life or for the classroom. In the space below, please elaborate on that example and include, **what** you used your smartphone for and **why**.

Question 2.4. Which of the following activities have you done using your smartphone? In addition, and regardless if you have done these activities or not, which of these do you consider learning?
If there are activities that I missed, please type them in the space provided at the end of this list.

Table 12. *Question about Smartphone Activities*

	Have I performed this activity?		Do I consider this learning?	
	Yes, I've performed this activity.	No, I haven't.	Yes, I consider this learning.	No, I don't
looking up word definitions, synonyms, spelling, translation, etc...				
sending emails to and receiving emails from classmates and instructors				
sending emails to and receiving emails from friends and family				
looking up school-related information				
looking up information of personal interest or need				
looking up directions				
taking or recording class notes				
taking or recording random notes				
checking a class course management system				
performing mathematical calculations				
reading or reviewing class-related material				
reading an e-book				
reading an online article or blog post				
checking social media websites				
checking the time				

Table 12 (cont'd)

	Yes, I've performed this activity.	No, I haven't.	Yes, I consider this learning.	No, I don't
looking something up to help settle an argument or disagreement I was having				
checking the weather				
checking the news				
checking movie times				
looking up song lyrics				
checking restaurant menus				
checking store hours				
sending text messages to and receiving text messages from classmates and instructors				
sending text messages to and receiving text messages from friends and family				
downloading apps				
listening to music				
listening to podcasts				
watching videos				
playing a game				
participating in a video call or video chat				
coordinating a gathering, meeting, or get-together				
solving an unexpected problem for myself or someone else				
getting help in an emergency situation				
looking up the score of a sporting event				
getting up-to-the minute traffic or public transit information				
deciding whether or not to visit a particular business, such as a restaurant				

Table 12 (cont'd)

	Yes, I've performed this activity.	No, I haven't.	Yes, I consider this learning.	No, I don't
checking the price of a product from different websites				
checking the reviews of a product from different websites				
taking a picture				
recording a video				
looking up health or medical infomation				
checking bank account or doing any online banking				
keeping track of fitness and workout logs				
shopping online				
uploading an image or video to a social media website				
sharing a status or link on a social media website				
commenting on an image or video on a social media website				
commenting on a status or link on a social media website				
using a service such as Foursquare to "check in" to certain locations				
reading product, restaurant, hotel, etc... reviews				
posting product, restaurant, hotel, etc... reviews				
locating restaurants near your location				
Other 1				
Other 2				
Other 3				
Other 4				
Other 5				

Question 3. I really appreciate you taking the time to complete this questionnaire. The second part of my dissertation study includes a brief, 30-minute interview. If you are interested and willing to participate, please provide your email address below. Providing your information here does not guarantee that you will be invited, and if you are invited you will be free to accept or decline the invitation. Once participants are selected for interviews, I will remove all email addresses from the data set.

APPENDIX B

Questionnaire Recruitment Email

Subject:
Invitation to participate in research on smartphones and learning

Dear MSU student,
You are invited to participate in a research study on smartphones and learning. You will first fill out an online questionnaire. This will take no more than 20 minutes of your time. You may then be selected to participate in a follow-up interview. This will take approximately 30 minutes. See below for details about compensation. You must be at least 18 years old to participate in this research.

Your rights to participate, say no, or withdraw:
Participation in this research project is completely voluntary. You have the right to decline. You may change your mind at any time and withdraw. You may choose to stop participating at any time.

Costs and compensation for being in the study:
You will incur no costs in participating in this study.

Upon completing the 20-minute questionnaire, you will be asked to enter your email address if you wish to be included in a raffle to win one of 15 Amazon.com gift cards in the amount of $40. The raffle will occur approximately one month after the questionnaire is sent out. In addition, you may be selected to participate in a follow-up 30-minute interview. If you are selected and contacted, you are free to accept or decline the invitation. If you do choose, however, to participate in the interview, you will be paid $20 for approximately 30-minutes of your time.

Contact information for questions and concerns:
If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher Sandra Sawaya by email at sawayasa@msu.edu, or by phone at 517-775-4666.
If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, MSU, East Lansing, MI 48824.

Documentation of informed consent:
By following the questionnaire link below, you indicate your voluntary agreement to participate in this online survey.
https://msucoe.az1.qualtrics.com/SE/?SID=SV_86otMCVH6o0ytfL

APPENDIX C

Smartphone and Learning Interview Protocol

Part 1: Learning

Q1. In the questionnaire, I asked you to write a paragraph answering the question "What is learning?" you wrote that: *say out loud what participant wrote*

Think back to the last week or so. Please give me a few examples of instances when you learned something.

Q2. Based on your experiences in school and in your day-to-day life, when you say that you've learned something, what do you actually mean by learning?

Part 2: Smartphones and Learning

Q3. In the questionnaire, I asked you to look back at the last week or so and think of one example when you used your smartphone for learning purposes in your day-to-day life or for the classroom. You wrote that: *say out loud what participant wrote*

Could you think of another few instances?

Q4. In general, what is the learning activity you engage in most on your smartphone?

Q5. What do you mean when you say that you've used your smartphone for learning?

Part 3: Miscellaneous – Comparative Mindset

Q6. Think back to a time when you did not have a smartphone, how would you describe your view on learning then?

Q7. In what ways, if at all, would you say your view on learning is different because of your smartphone?

Q8. Is there a difference between how you use your smartphone and laptop for learning?

Q9. Please give a few examples of instances when you've used your smartphone instead of laptop for learning (and vice versa). On what basis did you decide on which device to use?

APPENDIX D

Interview Recruitment Email

Copy of interview recruitment email that the researcher will send out.

Dear [NAME],

Thank you for completing the questionnaire and indicating that you are willing to participate in a follow-up interview. The interview will take approximately 30 minutes, and you will be paid $20 for your time.

If you are still interested in participating, please click the link below to fill out a poll indicating dates and times in the coming two weeks you would be available for the 30-minute follow-up interview.

[LINK TO POLL]

Thank you,

Sandra

APPENDIX E

Interview Consent Form

Smartphones and Learning: Research Participant Information and Consent Form (interview)

1. EXPLANATION OF THE RESEARCH and WHAT YOU WILL DO:
You are being asked to participate in a research study on smartphones and learning. The interview will take approximately 30 minutes. See part 3 below for details about compensation. You must be at least 18 years old to participate in this research.

2. YOUR RIGHTS TO PARTICIPATE, SAY NO, OR WITHDRAW:
Participation in this research project is completely voluntary. You have the right to say no. You may change your mind at any time and withdraw. You may choose not to answer specific questions or to stop participating at any time. Withdrawing will have no affect on your compensation.

3. COSTS AND COMPENSATION FOR BEING IN THE STUDY:
You will incur no costs in participating in this study.

Upon completing the 30-minute interview, you will be paid $20 for approximately 30-minutes of your time.

4. CONTACT INFORMATION FOR QUESTIONS AND CONCERNS:
If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher Sandra Sawaya by email at sawayasa@msu.edu, or by phone at 517-775-4666.

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, MSU, East Lansing, MI 48824.

5. DOCUMENTATION OF INFORMED CONSENT:
Your signature below means that you voluntarily agree to participate in this research study and agree that this interview be audio recorded.

_____ _____

Signature Date

REFERENCES

REFERENCES

Aguirre, J. M., & Rankin, G. (1989). College students' conceptions about vector kinematics. *Physics Education, 24*(5), 290-284. doi: 10.1088/0031-9120/24/5/310

Åkerlind, G. S. (2005). Variation and commonality in phenomenographic research methods. *Higher Education Research & Development, 24*(4,) 321-334. doi: 10.1080/07294360500284672

Anfara, V. A., Brown, K. M., & Mangione, T. L. (2002). Qualitative analysis on stage: Making the research process more public. *Educational Researcher, 31*(7), 28-38. Retrieved from http://www.jstor.org

Benson, P., & Lor, W. (1999). Conceptions of language and language learning. *System*, *27*(4), 459–472. doi: 0.1016/S0346-251X(99)00045-7

Bowden, J. A. (2005). Reflections on the phenomenographic team research process. In J. A. Bowden & P. Green (Eds.), *Doing developmental phenomenography* (pp. 11-31). Melbourne: RMIT University Press.

Bowden, J., & Walsh, E. (Eds.) (2000). *Phenomenography*. Melbourne: RMIT University Press.

Chiou, G. L., Lee, M. H., & Tsai, C. C. (2013). High school students' approaches to learning physics with relationship to epistemic views on physics and conceptions of learning physics. *Research in Science & Technological Education*, *31*(1), 1–15. doi:10.1080/02635143.2013.794134

Chiou, G. L., Liang, J. C., & Tsai, C. C. (2012). Undergraduate Students' Conceptions of and Approaches to Learning in Biology: A study of their structural models and gender differences. *International Journal of Science Education*, *34*(2), 167–195. doi:10.1080/09500693.2011.558131

Christ, A., Meyrueis, P., & Sultana, R. (2013). Architecture of a device-independent collaborative language learning game. In Z. L. Berge & L. Y. Muilenburg (Eds.), *Handbook of mobile learning* (pp. 545-533). Florence, KY: Routledge.

Clough, G., Jones, A. C., McAndrew, P., & Scanlon, E. (2008). Informal learning with PDAs and smartphones: Informal learning with PDAs. *Journal of Computer Assisted Learning*, *24*(5), 359–371. doi:10.1111/j.1365-2729.2007.00268.x

Cochrane, T. (2010). Exploring mobile learning success factors. *Research in Learning Technology, 18*(2). doi:10.3402/rlt.v18i2.10758

Cochrane, T. (2013). A summary and critique of m-learning practice. In Z. L. Berge & L. Y. Muilenburg (Eds.), *Handbook of mobile learning* (pp. 24-34). Florence, KY: Routledge.

Concannon, J. P., Siegel, M. A., Halverson, K., & Freyermuth, S. (2010). College students' conceptions of stem cells, stem cell research, and cloning. *Journal of Science Education and Technology, 19*(2), 177-186. doi: 10.1007/s10956-009-9190-2

Creanor, L., Trinder, K., Gowan, D., & Howells, C. (2006). Who's learning and how? Researching the learner experience. *In Proceedings of the 23rd Annual ASCILITE Conference: Who's learning? Whose technology?* Sydney Australia, 3–6 December (pp. 179–188).

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Crompton, H. (2013). A historical overview of mobile learning: Toward learner-centered education. In Z. L. Berge & L. Y. Muilenburg (Eds.), *Handbook of mobile learning* (pp. 3-14). Florence, KY: Routledge.

Dahlgren, L. O., & Fallsberg, M. (1991). Phenomenography as a qualitative approach in social pharmacy research. *Journal of Social and Administrative Pharmacy, 8*(4),150-156.

Dahlin, B. (1999). Ways of coming to understand: Metacognitive awareness among first-year university students. *Scandinavian Journal of Educational Research, 43*(2), 191-207. Retrived from http://www.eric.edu.gov

Dahlin, B., & Regmi, M. (1997). Conceptions of learning among Nepalese students. *Higher Education, 33*, 471–493. doi: 10.1023/A:1002992411868

Eklund-Myrskog, G. (1998). Students' conceptions of learning in different educational contexts. *Higher Education*, *35*(3), 299–316. doi: 10.1023/A:1003145613005

Ellis, R. A., Goodyear, P., Prosser, M., & Ohara, A. (2006). How and what university students learn through online and face-to-face discussion: Conceptions, intentions and approaches. *Journal of Computer Assisted Learning, 22*(4), 244–256. doi: 10.1111/j.1365-2729.2006.00173.x

Gikas, J. (2011). *Understanding change: Implementing mobile computing devices in higher education* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (908420706)

Giorgi, A. (1986). A phenomenological analysis of descriptions of conceptions of learning obtained from a phenomenographic perspective. (Fenomenografiska notiser Nr. 4). University of Gothenburg, Institute of Education.

González, C. (2010). What do university teachers think eLearning is good for in their teaching? *Studies in Higher Education, 35*(1), 61-78. doi: 10.1080/03075070902874632

Good, T. L., & Brophy, J. E. (1990). *Educational psychology: A realistic approach* (4th ed.). New York: Longman.

Greeno, J. G., Collins, A. M., & Resnick, L. B. (1996). Cognition and learning. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 15-46). New York: Macmillan.

Gupta, B., & Koo, Y. (2010) Applications of mobile learning in higher education: An Empirical study. *International Journal of Information and Communication Technology Education, 6*(3), 75-87. doi: 10.4018/jicte.2010070107

Hasselgren, B., & Beach, D. (1997). Phenomenography - a "good-for-nothing brother" of phenomenology? Outline of analysis. *Higher Education Research & Development, 16*(2), 191-202. doi: 10.1080/0729436970160206

Herrington, A., Herrington, J., & Mantei, J. (2009). Design principles for mobile learning. In J. Herrington, A. Herrington, J. Mantei, I. Olney, & B. Ferry (Eds.), *New technologies, new pedagogies: Mobile learning in higher education* (pp. 129-1138). University of Wollongong, Wollongong. Retrieved http://www.ro.uow.edu.au/

Hou, H. T., Wu, S. Y., Lin, P. C., Sung, Y. T., Lin, J. W., & Chang, K. E. (2014). A blended mobile learning environment for museum learning. *Educational Technology & Society, 17*(2), 207–218.

Hung, J. L., & Zhang, K (2012). Examining mobile learning trends 2003–2008: A categorical meta-trend analysis using text mining techniques. *Journal of Computer Higher Education, 24*(1), 1-17. doi: 10.1007/s12528-011-9044-9

Hung, P. H., Lin, Y. F., & Hwang, G. J. (2010). Formative assessment design for PDA integrated ecology observation. *Educational Technology & Society, 13*(3), 33–42. Retrieved from http://www.eric.ed.gov

Kearney, M., Schuck, S., Burden, K. & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology, 20*. doi: 10.3402/rlt.v20i0/14406

Keegan, D. (2005, October). *The incorporation of mobile learning into mainstream education and training*. Proceedings of mLearn2005- 4th World Conference on

mLearning. Cape Town, South Africa. Retrieved from http://www.mlearn.org.za/CD/papers/keegan1.pdf

Kiger, D., Herro, D., & Prunty, D. (2012). Examining the influence of a mobile learning intervention on third grade math achievement. *Journal of Research on Technology in Education*, *45*(1), 61–82. Retrieved from http://www.eric.ed.gov

Koole, M. (2009). A model for framing mobile learning. In M. Ally (Ed.), *Transforming the delivery of education and training* (pp. 25-47). Retrieved from http://www.aupress.ca/index.php/books/120155

Kukulska-Hulme, A. & Shield, L. (2008). An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction. ReCALL, 20, 271-289. doi: 10.1017/S0958344008000335

Kukulska-Hulme, A., & Pettit, J. (2008). Semi-formal learning communities for professional development in mobile learning. *Journal of Computing in Higher Education, 20*, 35-47. doi: 10.1007/s12528-008-9006-z

Kukulska-Hulme, A., Evans, D. & Traxler, J. (2005). Landscape study in wireless and mobile learning in the post-16 sector. *JISC Technology and Standards Watch*. Retrieved from http://www.jisc.ac.uk

Lai, C. H., Yang, J. C., Chen, F. C., Ho, C. W., & Chan, T. W. (2007). Affordances of mobile technologies for experiential learning: the interplay of technology and pedagogical practices: Affordances of mobile technologies. *Journal of Computer Assisted Learning*, *23*(4), 326–337. doi:10.1111/j.1365-2729.2007.00237.x

Laouris, Y., & Eteokleous, N. (2005). We need an educationally relevant definition of mobile learning. In *Proceedings of mLearn* (Vol. 2005). Retrieved from http://www.mlearn.org.za/CD/papers/Laouris%20%26%20Eteokleous.pdf

Lu, M. (2008). Effectiveness of vocabulary learning via mobile phone: Vocabulary learning via mobile phone. *Journal of Computer Assisted Learning*, *24*(6), 515–525. doi:10.1111/j.1365-2729.2008.00289.x

Marshall, D., Summer, M., & Woolnough, B. (1999). Students' conceptions of learning in an engineering context. *Higher Education*, *38*(3), 291–309. doi: 10.1023/A:1003866607873

Martin, E. & Ramsden, P. (1987). Learning skills or skill in learning? In J. Richardson, M. Eysenck, & D. Piper (Eds.), *Student learning research on education and cognitive psychology* (pp. 155-167). Milton Keynes: Open University Press.

Marton, F. (1994). Phenomenography. In T. Husén & T. N. Postlethwaite (Eds.), *The international encyclopedia of education* (2nd Edition) (pp. 4424-4429). Oxford: Pergamon Press.

Marton, F., & Booth, S. (1997). *Learning and awareness*. Mahwah, NJ: Lawrence Erlbaum.

Marton, F., & Dahlgren, L. O. (1976). On non-verbatim learning: III. The outcome space of some basic concepts in economics. *Scandinavian Journal of Psychology*, *17*(1), 49–55. doi: 10.1111/j.1467-9450.1976.tb00210.x

Marton, F., & Säljö, R. (2005). Approaches to learning. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *The experience of learning: Implications for teaching and studying in higher education* (3rd edition), (pp. 39-58). Edinburgh: University of Edinburgh, Centre for Teaching, Learning and Assessment.

Marton, F., Dall'Alba, G., & Beaty, E. (1993). Conceptions of learning. *International Journal of Educational Research 19*(3), 277-300. doi: 10.1016/0883-0355(93)90015-C

Mayer, R. E. (1996). Learners as information processors: Legacies and limitations of educational psychology's second metaphor. *Educational Psychology, 31*(3/4), 151-161. doi: 10.1080/00461520.1996.9653263

Meeker, M. &, Wu, L. (2013). 2013 Internet trends. Kleiner, Perkins, Kaufield, Byers. Retrieved from http://www.kpcb.com/insights/2013-internet-trends

Naismith L., Lonsdale P., Vavoula G., and Sharples, M. (2004). *Literature Review in Mobile Technologies and Learning*, Report 11, Future lab Series, http://www.futurelab.org.uk/research/reviews/reviews_11_and12/11_01.htm

Nickerson, R. S. (2005). Technology and cognition amplification In R. J. Sternberg and D. D. Preiss (Eds.), *Intelligence and technology: The impact of tools on the nature and development of human abilities* (pp. 3-28). New York, NY: Routledge.

Noguera, J. M., Jiménez, J. J., & Osuna-Pérez, M. C. (2013). Development and evaluation of a 3D mobile application for learning manual therapy in the physiotherapy laboratory. *Computers & Education*, *69*, 96–108. doi:10.1016/j.compedu.2013.07.007

Norman, D. (2013). *The design of everyday things: Revised and expanded edition*. New York, NY: Basic Books.

Patokorpi, E. (2006). *Role of abductive reasoning in digital interaction. Åbo: Åbo Akademi University Press*. Doctoral Thesis.

Patten, B., Arnedillo-Sánchez, I. A., & Tangney, B. (2006). Designing collaborative, constructionist and contextual applications for handheld devices. *Computers & Education*, *46*(3), 294–308. doi:10.1016/j.compedu.2005.11.011

Pavlik, J. V., & Bridges, F. (2013). The emergence of augmented reality (AR) as a storytelling medium in journalism. *Journalism and Communication Monographs*, *15*(1), 4–59. doi: 10.1177/1522637912470819

Pratt, D. (1992). Chinese students' conceptions of learning and teaching: A westerner's attempt at understanding. *International Journal of Lifelong Education, 11*(4), 301–319. doi: 10.1080/0260137920110404

Prosser, M., Trigwell, K., & Taylor, P. (1994). A phenomenographic study of academics' conceptions of science learning and teaching. *Learning and Instruction, 4*, 217-231. doi: 10.1016/0959-4752(94)90024-8

Quinn, C. (2000, Fall). mLearning: Mobile, wireless, in your pocket learning. *LiNE Zine*. Retrieved from http://www.linezine.com/2.1/features/cqmmwiyp.htm.

Quinn, C. N. (2011). Intimacy & immediacy. *Learnlets*. Retrieved from http://www.blog.learnlets.com/?p=2253

Quinn, C. N. (2013). A future for m-Learning. In Z. L. Berge & L. Y. Muilenburg (Eds.), *Handbook of mobile learning* (pp. 82-94). Florence, KY: Routledge.

Rainie, L. (2012). *Smartphone Ownership Update: September 2012*. Retrieved from Pew Internet & American Life Project website: http://www.pewinternet.org/Reports/2012/Smartphone-Update-Sept-2012.aspx

Richardson, J. T. E. (1999). The concepts and methods of phenomenographic research. *Review of Educational Research, 69*(1), 53-82. doi: 10.3102/00346543069001053

Rogers, Y., Connelly, K., Hazlewood, W., & Tedesco, L. (2009). Enhancing learning: A study of how mobile devices can facilitate sensemaking. *Personal and Ubiquitous Computer, 14*(2), 111-124. doi: 10.1007/s00779-009-0250-7

Roschelle, J. (2003). Keynote paper: Unlocking the learning value of wireless mobile devices. *Journal of Computer Assisted Learning*, *19*(3), 260–272. doi: 10.1046/j.0266-4909.2003.00028.x

Rowe, J. W. (1998). Approaches to study by first year engineering students. *Proceedings of the Progress*, *1*, 40–47. Retrieved from http://www.hull.ac.uk

Säljö, R. (1979). *Learning in the learner's perspective 1. Some Commonsense Conceptions*. Reports from Gothenburg: Institute of Education, University of Gothenburg.

Sandberg, J. (1995). Are phenomenographic results reliable? *Journal of Nordic Educational Research, 15*, 156-164. doi: 10.1080/0729436970160207

Santos, I. M., & Ali, N. (2012). Exploring the uses of mobile phones to support informal learning. *Education and Information Technologies*, *17*(2), 187–203. doi:10.1007/s10639-011-9151-2

Sharples, M. Arnedillo-Sánchez, I., Milrad, M., & Vavoula, G. (2009). Mobile learning: small devices, big issues. In N. Balacheff, S. Ludvigsen, T. de Jong, & S. Barnes (Ed.), *Technology Enhanced Learning: Principles and Products* (pp. 233–249). Heidelberg, Germany: Springer.

Sharples, M., Taylor, J. & Vavoula, G. N. (2007). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.). *The Sage handbook of e-learning research* (pp. 221–247). London: Sage.

Sjöström, B. & Dahlgren, L. O. (2002). Applying phenomenography in nursing research. *Journal of Advanced Nursing 40*(3), 339-345. Retrieved from http://onlinelibrary.wiley.com/

Sommerauer, P., & Müller, O. (2014). Augmented reality in informal learning environments: A field experiment in a mathematics exhibition. *Computers & Education*, *79*, 59–68. doi:10.1016/j.compedu.2014.07.013

Song, Y. (2007). Educational uses of handheld devices: What are the consequences? *TechTrends*, *51*(5), 38-45. doi: 10.1007/s11528-007-0068-y

Stanton, G., & Ophoff, J. (2013). Towards a method for mobile learning design. *Issues in Informing Science and Information Technology, 10,* 501-522. Retrieved from http://iisit.org/Vol10/IISITv10p501-523Stanton0091.pdf

Svensson, L. (1997). Theoretical foundations of phenomenography. *Higher Education Research & Development, 16*(2), 159-172. doi: 10.1080/0729436970160204

Terras, M. M., & Ramsay, J. (2012). The five central psychological challenges facing effective mobile learning: A psychological perspective on mobile learning. *British Journal of Educational Technology*, *43*(5), 820–832. doi:10.1111/j.1467-8535.2012.01362.x

Tesoriero, R., Gallud, J. A., Lozano, M., & Penichet, V. M. R. (2014). Enhancing visitors' experience in art museums using mobile technologies. *Information Systems Frontiers*, *16*(2), 303–327. doi:10.1007/s10796-012-9345-1

Ting, Y. L. (2012). The pitfalls of mobile devices in learning: A different view and implications for pedagogical design. *Journal of Educational Computing Research*, *46*(2), 119–134. doi:10.2190/EC.46.2.a

Traxler, J. (2005). Defining mobile learning. *Proceedings of the IADIS International Conference, Malta*, 261-266. Retrieved from http://www.iadisportal.org/

Traxler, J. (2009) Learning in a mobile age. *International Journal of Mobile and Blended Learning, 1*(1), p. 1–12. doi: 10.4018/jmbl.2009010101

Traxler, J., (2007). Defining, discussing and evaluating mobile education: The moving finger writes and having writ... *International Review of Research in Open and Distance Learning, 8*(2), 1-12. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/346

Traxler, J., & Vosloo, S. (2014). Introduction: The prospects for mobile learning. *PROSPECTS*, *44*(1), 13–28. doi:10.1007/s11125-014-9296-z

Tsai, C. C. (2009). Conceptions of learning versus conceptions of web-based learning: The differences revealed by college students. *Computers & Education*, *53*(4), 1092–1103. doi:10.1016/j.compedu.2009.05.019

Tsai, P. S., Tsai, C. C., & Hwang, G. H. (2011). College students' conceptions of context-aware ubiquitous learning: A phenomenographic analysis. *The Internet and Higher Education*, *14*(3), 137–141. doi:10.1016/j.iheduc.2011.01.004

Tuttle, H. G. (2011). *Improving students' speaking through smartphones*. New York Association of Foreign Language Teachers Conference, Rochester, NY.

Tuttle, H. G. (2013). Improving students' modern language speaking skills through mobile learning. In Z. L. Berge & L. Y. Muilenburg (Eds.), *Handbook of mobile learning* (pp. 524-533). Florence, KY: Routledge.

Vallee, J. C. (2006). *A phenomenographical approach to understanding students' conceptions of an online learning program* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (3261870)

van Merriënboer, J. J. G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications.

Van Merriënboer, J. J. G., & Stoyanov, S. (2008). Learners in a changing learning landscape: Reflections from an instructional design perspective. In J. Visser & M. Visser-Valfrey (Eds.), *Learners in a changing learning landscape* (pp. 69-90). New York: Springer.

van Rossum, E. J., & Schenck, S. M. (1984). The relationship between learning conception, study strategy and learning outcome. *British Journal of Educational Psychology, 54*, 73–83. doi: 10.1111/j.2044-8279.1984.tb00846.x

Vavoula, G. N., Sharples, M., Scanlon, E., Lonsdale, P., & Jones, A. (2005). Report on literature on mobile learning, science and collaborative activity. Retrieved from http://www.halshs.archives-ouvertes.fr/docs/00/19/01/75/PDF/Vavoula-Kaleidoscope-2005.pdf

Watkins, D., & Regmi, M. (1992). How universal are student conceptions of learning? A Nepalese investigation. *Psychologia: An International Journal of Psychology in the Orient, 35*, 101–110. Retrieved from http://www.psycnet.apa.org/

Wu, W. H., Jim Wu, Y. C., Chen, C.Y., Kao, H. Y., Lin, C. H., & Huang, S. H. (2012). Review of trends from mobile learning studies: A meta-analysis. *Computers & Education*, *59*(2), 817–827. doi:10.1016/j.compedu.2012.03.016

Zurita, G., & Nussbaum, M., (2007). A conceptual framework based on Activity Theory for mobile CSCL. *British Journal of Educational Technology 38*(2), 211–235. doi: 10.1111/j.1467-8535.2006.00580