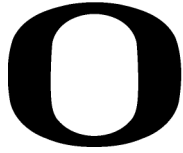


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# Mobile Instructional Design Principles for Adult Learners

CAPSTONE REPORT

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**Abstract**

This annotated bibliography explores the need to design effective and efficient mobile learning for adult learners. Mobile approaches, projects, and environments are explored to compile a set of instructional design principles for the mobile learning context. Conclusions present six key principles for use by instructional designers including the need to design: a simple and intuitive interface, interactive multi-media, short and modular lessons, engaging and entertaining activities, contextually relevant and meaningful content, and just-in-time delivery.

*Keywords:* mobile learning instructional design principles, mobile learning context, adult learners, mobile learning pedagogy





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## **Introduction to the Annotated Bibliography**

### **Problem**

While many theories of instructional design have been advanced since Confucius, most are predicated on the idea of learning taking place in a classroom between an instructor and student(s) (Sharples, Taylor, & Vavoula, 2005). Prior to the introduction of mobile devices, such as “smart” phones, the design paradigms for the delivery of adult educational materials remained essentially static (Cronje & El-Hussein, 2010). For example, distance education, defined as learning which takes place when the teacher and student are separated by time and distance, has a history dating back over 100 years (Georgiev, Georgieva, & Smrikarov, 2004). Even the expansion of distance education to electronic learning (e-learning) had very little impact on traditional instructional and learning methodologies (Ozdamli, 2011).

However, the introduction of mobile learning (m-learning) offers a chance for a fundamental change in education design (Lonsdale, Naismith, Sharples, & Vavoula, 2004). Barbosa, Reinhard, Saccol, and Schlemmer (2010) describe mobile learning as learning supported by mobile technologies and “involving mobility of human subjects who can be physically/ geographically far from each other and far from formal educational physical spaces, such as classrooms, training/ graduation/ qualification rooms or workplaces”(p.262). The Department of Defense (DoD) Advanced Distributed Learning (ADL) Mobile Learning Team defines mobile learning “as the use of handheld computing devices to provide access to learning content and information resources” (Haag, 2011, p.3). According to Evans (2008), mobile learning builds on the advantages offered by e-learning (i. e., allowing learners to learn when and where they choose) by expanding those advantages to a mobile platform users can carry with them for learning on-the-move. Park (2011), like Evans, defines mobile learning as using mobile

devices for learning on the move, but goes on to add that mobile learning is not just about the delivery method, but is also about learning across contexts. Cronje and El-Hussein (2010) extend the aspect of learning contexts in a more thought provoking definition of mobile learning for the needs of instructional designers. They include not just the mobility of the technology and learner, but also the mobility of the learning, which allows for the context of the learning to be highly individualized.

Mobile learning is quickly growing in popularity with the increasingly high saturation of mobile devices such as smart phones, tablet PCs, and other small screen, portable devices, within both the public sector and in higher education (Georgiev, Georgieva, & Smrikarov, 2004). However, according to Park (2011), the mobile learning field is still relatively immature in comparison to standard e-learning, which is intended to be delivered to a desk top or laptop.

### **Purpose**

The purpose of this annotated bibliography is to identify literature that describes the changes to instructional design principles which are taking place, or need to take place, as a result of the increased usage of mobile devices (Park, 2011). According to Ozdamli (2011), in recent years, the technology and tools available for learning have changed dramatically, but teaching and learning methodologies have not significantly changed and traditional educational methodologies have been applied to new delivery methods.

Unlike e-learning, some researchers argue that mobile learning will require a new approach for both teaching and learning (Ozdamli, 2011). The intent of this study is to examine: (a) unique aspects of the mobile learning technology context (Sharples, Taylor, & Vavoula, 2010), (b) what advantages and challenges are posed by the mobile learning context (Park, 2011), and (c) how instructional principles must change to support mobile delivery (Ozdamli,

2011). The goal is to propose a set of mobile instructional design principles that may help educators to address the unique aspects of the mobile learning context. Gibbons, Wang, and Wiesemes (2010) suggest that these aspects should: (a) be learner-focused, (b) promote autonomous learning, and (c) be meaningful and memorable.

### **Audience**

The primary audience for this annotated bibliography is educators and instructional designers, tasked with the development of adult-oriented, mobile education training programs either as independent learning delivery methods or as part of a larger, blended program with e-learning and face-to-face components. Mobile learning is rapidly becoming a critical area of knowledge to possess in the education industry order to insure continued prominence (Quinn, 2010). However, due to the relative newness of mobile as a platform for training delivery, much of the research is considered immature and lacking in strong theoretical underpinnings (Muyinda, 2007).

Instructional designers, trainers, and other adult educators in both the corporate world and higher education cannot afford to ignore the use of mobile devices in training and education if they wish to stay competitive and relevant (Ally, 2005). As the education landscape becomes increasingly competitive, the ability of institutions to offer mobile learning may give them an edge over institutions lacking that capability (Lonsdale, Naismith, Sharples, & Vavoula, 2004). As mobile content consumption continues to rise, educators need to be prepared to deliver training to mobile learners (Park, 2011).

### **Significance**

Instructional design principles, even when taken outside of the classroom to an e-learning environment, did not require significant revisions in order to remain effective (Ozdamli, 2011).

However, with mobile learning, traditional instructional methods can no longer be exclusively utilized and new thinking must be incorporated in order for learning goals to be achieved (Ally, 2005).

Mobile devices offer the potential for rich, multimedia learning experiences, however models for using and developing learning for mobile applications are somewhat lacking (Lonsdale, Naismith, Vavoula, & Sharples, 2004). As such, educators and instructional designers face a challenge of determining how to use these powerful new tools in learning applications (Cronje & El-Hussein, 2010). In order to effectively support mobile education, instructional principles must be identified that are both pedagogically sound and address the mobile learning context in terms of usability (Gu, Gu, & Lafferty, 2011).

### **Research Questions**

The goal of this study is to propose a set of instructional principles that can be applied to adult learners on mobile devices who need the ability to take training whenever and wherever and have access to “just-in-time” learning (Evans, 2008). The annotated bibliography is organized around the following content areas, framed as research questions:

**Main question.** What instructional principles should be developed when addressing the needs of an adult mobile learning audience?

#### **Sub questions.**

- What are the unique aspects of mobile learning context?
- What instructional challenges and advantages are offered by the mobile learning context?



**Delimitations**

**Time frame.** Mobile learning is commonly thought to have entered the educational arena in the early 2000s, when Nyir and his contemporaries began to argue that mobile devices were undermining the need for traditional classrooms (Cronje & El-Hussein, 2010). However, mobile learning truly began to play a significant role with the introduction of true “smartphones” other and more powerful mobile computing devices (Haag, 2011) in the early-2000s (Wikipedia, 2012). As such, preference is given to materials from peer-reviewed sources published since 2004. Older references are included as they add value to establishing foundations for the research.

**Topic and focus.** Instructional design theories and models are not industry specific – instead they are based on identifying the situations and methods available and determining how to apply them in such a way as to address the desired outcomes and instructional conditions in the learning environment (Reigeluth, 1999). As such, this study does not focus on a particular institution or field, but rather on instructional principles and methodologies that can be applied to all mobile adult learning. Materials selected focus on principals for the adult learning audience primarily, though literature exploring mobile learning in childhood or young adult education has been included if it addresses unique aspects of the mobile context which could also apply to adult learners, such as technological limitations of mobile computing devices (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009).

**Databases and sources.** References for this annotated bibliography are limited to those which can be accessed through either the University of Oregon (UO) library system or through Google Scholar’s available body of literature. Articles are accessed through either logging in to the UO library through the library web portal and utilizing its search features to identify

resources via the library search functions, or through keyword and phrase searches conducted on Google Scholar and utilizing this as a link to resources not located in the UO library.

**Audience selection.** Mobile e-learning is becoming an increasingly important topic in education (Antonis, Daradoumis, Papadakis, & Simos, 2011). The ability to support mobile learning has been identified by Lonsdale, Naismith, Sharples, and Vavoula (2004) as critical to the ability of education institutions to remain relevant in an increasingly competitive educational landscape. The audience for this annotated bibliography is then selected from those individuals who are responsible for developing and delivering mobile learning within their organizations.

**Criteria for selection of literature pertaining to potential set of mobile instructional design principles.** The references selected for use in this annotated bibliography for identification of instructional design principles for mobile learning are evaluated against the following criteria: (a) authors are subject matter experts in the subject of instructional design with an emphasis on mobile delivery, (b) the literature demonstrates that either sound research methodologies are utilized or assertions are backed by credible sources within the field, and (c) the principles proposed are backed by accepted practices and methodologies for adult learning and demonstrate a firm grasp of the complexity of the mobile learning context.

**Identification of challenges and advantages in the mobile learning context.** The mobile learning context contains many elements which did not need to be accounted for within the distance learning and e-learning contexts. When these elements have potential to facilitate the learning experience and lead to greater opportunities for ongoing, adult education they are identified as *advantages*. When these elements have potential to disrupt the learning experience and make it more difficult to develop meaningful learning experiences, these elements are

identified as *challenges*. Only elements which appear to be unique from the e-learning and distance learning contexts are identified in this annotated bibliography.

### **Reading and Organization Plan Preview**

**Reading plan preview.** The reading plan for this study is designed to examine selected references in relation to the concepts embedded in the main and supporting research questions. The reading plan describes a conceptual analysis process, as defined by Busch et al. (2005). The process consists of selecting a concept for examination and then noting its presence in a selected set of references – whether the occurrences are explicit or implicit. A conceptual analysis is conducted by identifying research questions, selecting references, coding those references by way of selective reduction, and evaluating the results (Busch et al., 2005).

References selected for inclusion in the Annotated Bibliography section of this paper are coded through eight steps outlined by Busch et al. (2005):

1. Decide on the level of analysis, in other words, whether to code for a single word or for sets of words or phrases.
2. Decide how many concepts to code for by developing a set of concepts and categories, whether pre-defined or interactive.
3. Decide whether to code for existence or frequency of concepts.
4. Decide how to distinguish between concepts and whether concepts are coded exactly as they appear or if concepts can be coded even when they appear in different forms.
5. Develop coding rules to allow for streamlining and organizing the coding process.
6. Decide whether or not to ignore irrelevant information or if this information should be used to reexamine and/or alter the coding scheme.

7. Code the references either by hand or by use of a computer program using the keywords and rules established.

8. Analyze the results in an attempt to draw whatever conclusions and generalizations are possible.

**Organization plan preview.** References coded during the deep reading process are presented thematically in the annotated bibliography and are organized around the topics and issues derived from the research questions (“Literature reviews,” 2012). The annotated bibliography is arranged around the following themes: (a) instructional design principles for adults with emphasis on evolving mobile instructional design principles (Molenda, Nelson, & Reigeluth, 2006; Ozdamli, 2012; Park, 2011); literature in this theme also supplies foundational information for the study, (b) mobile devices and technologies as instructional tools (Alsadi & AbuShawar, 2009; Evans, 2008; Motiwalla, 2007) and (c) the mobile learning context which includes instructional challenges and advantages (Gibbons, Wang, & Wiesemes, 2010), advantages (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009), and (d) unique aspects of mobile learning (Ronchetti & Trifonova, 2003).

### Definitions

The following definitions are intended to provide readers with an understanding of the terminology used throughout the annotated bibliography. The concepts defined are relevant to the adult mobile learning environment and are key concepts required for understanding the study. For the purposes of this paper, the terms mobile learning, mLearning and m-learning are understood to be synonymous. *Mobile learning* is the preferred term used in the paper for clarity and understanding.

**Activity theory** – According to Uden (2007) activity theory is a theory of learning which incorporates the notions of intentionality, mediation, history, collaboration and development. It focuses on understanding human activity and work practices through use of *activities* which consist of a subject and an object, mediated by a tool (Uden, 2007).

**Adult learner** – A term used to describe any person socially accepted as an adult who is in a learning process, whether it is formal education, informal learning, or corporate-sponsored learning (Wikipedia, 2012).

**Cognitive learning theory** – Theory of learning which states that learning involves the use of memory, motivation, thinking, and reflection (Ally, 2005).

**Digital fluency** – A process whereby users develop varying levels of expertise and ability depending on their interests, needs and individual technical limitations of the mobile devices (Gibbons, Wang, & Wiesemes, 2010).

**Electronic learning/e-Learning** – Learning delivered asynchronously via an electronic device such as a computer (Georgiev, Georgieva, & Smrikarov, 2004).

**Instructional design** – A system of procedures for developing education and training programs which deliver consistent and reliable results and should be creative, active, and iterative (Branch & Gustaffson, 2002).

**Instructional design principles** – Sets of principles drawn from many disciplines which can be applied to guide instructional designers to work more efficiently and which result in instructional materials which are more appealing and can be leveraged across a wide variety of learning environments (Molenda, Nelson, & Reigeluth, 2006).

**Mobile context** – All learning takes place in context and also creates context through continual interaction. Mobile context then is made up of all the contexts in which learning through mobile technology occurs, but also embraces the multiple communities of actors (both people and interactive technology) who interact around shared objectives, mutual knowledge, orientations to study, styles and strategies of learning (Sharples, Taylor, & Vavoula, 2010).

**Mobile devices** – Commonly this term refers to devices such as PDA and smart phones, but can be applied more generally to any device that is small, autonomous and unobtrusive enough to accompany us in every moment in our every-day life, and that can be used for some form of learning (Ronchetti & Trifonova, 2003).

**Mobile learning/mLearning** – Learning supported by mobile technology which allows for education outside of the classroom environment (Barbosa, Reinhard, Saccol, & Schlemmer, 2010), which is transferable across contexts (Park, 2011), and which allows for the context of the learning to be highly individualized for the learner (Cronje & El-Hussein, 2010). Mobile learning is a subset of electronic learning (Georgiev, Georgieva, & Smrikarov, 2004).

**Pedagogy of mobile learning** – Ally (2009), defines pedagogy as “the art or science of being a teacher” (p. 288). Pedagogy includes strategies, practices, and styles of instructions (Ally, 2009,

p.288). Combined with the definition of mobile learning in this Annotated Bibliography, the pedagogy of mobile learning can then be said to be the strategies, practices, and styles of instruction utilized by educators to facilitate learning occurring outside of the classroom, supported by mobile technology, which is transferable across contexts, personalized, and individualized.

**Social-constructivist learning approach** - An approach to learning which views learning as an active process of building knowledge and skills through practice within a supportive community (Sharples, Taylor, & Vavoula, 2005).

**Transactional distance theory** - An educational theory that defines the critical concepts of distance learning - including the idea of distance as not only geographical, but also as a pedagogical concept requiring technology as the primary form of communication between student and instructor (Park, 2011).

### **Research Parameters**

This section of the paper explains the research parameters utilized in developing and designing this study. The research parameters are organized around four main areas of content: (a) the search report which explains the strategies used to locate references for inclusion in the Annotated Bibliography; (b) the evaluation criteria applied to references to determine their relevancy, authority, and validity; (c) the documentation approached used for collecting references; and (d) the reading and organization plans which explain the process in use for analyzing and organizing the selected references presented in the Annotated Bibliography and the presentation of information in the conclusions drawn from the research.

#### **Search Report**

The search for relevant literature to support examination of within this topic focuses on three primary areas: (a) unique aspects of the mobile learning context (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009; Gu, Gu, & Laffey, 2011; Sharples, Taylor, Vavoula, 2007); (b) instructional design principles for adult learners, with emphasis on evolving mobile instructional design principles (Ozdamli, 2012; Park, 2011); and (c) mobile technology and tools (Evans, 2008; Motiwalla, 2007).

**Key words and phrases.** Key words are derived from industry centers of expertise including the American Society for Training & Development (ASTD), and industry publications including T+D Magazine.

Searches are also guided by key words and references from industry leaders including Mike Sharples, Kodak/Royal Academy of Engineering Professor of Educational Technology at the University of Birmingham, UK, and Director of the University's Centre for Educational Technology and Distance Learning (CETADL) (Sharples, 2002), and Dr. Giasemi Vavoula with



the University of Leicester who has performed extensive research into mobile learning, the evaluation of mobile and informal learning, and technology enhanced life-long learning

(University of Leicester, n.d.). The following key words/phases are utilized:

- Mobile learning
- E-learning
- Instructional design principles
- Mobile design
- mLearning
- Adult learners
- Mobile/digital fluency
- Mobile learning design
- Mobile learning pedagogy
- Mobile pedagogy
- Mobile context
- Mobile context challenges
- Mobile context advantages
- Known authors in the field of mobile education
  - Mike Sharples
  - Giasemi Vavoula
  - Mohamed Ally
  - Josie Taylor

**Search results.** Search terms are used both separately and in varying combinations in an effort to discover credible resources addressing the main and secondary research questions. The

primary databases utilized are Science Direct, IEEE Xplore, JSTOR, CiteSeer, CrossRef, Google Books and Google Scholar. These are the preferred search locations due to the availability of peer reviewed and relevant resources. In addition to searches seeking to identify materials for addressing the research questions, general searches are conducted for articles on existing instructional design principles as these principles are the basis for current instructional design practices and methodologies and the foundation of instructional design must be understood in order to identify changes which are needed.

Preference is given to peer-reviewed, refereed journals, though industry publications are also explored. Instructional design originated largely in the military and corporate sector (Branch & Gustaffson, 2002) due to their focus on creating training which was design-oriented rather than description-oriented (Reigeluth, 1999), so non-academic resources should not be ignored when exploring this topic. Articles from both academic and industry sources are only filed for further review if the full text is available.

Articles and resources located and verified to be academically credible or highly relevant to the research questions are then reviewed to identify other potential references or authors for further additional review. If possible, full text copies of resources cited by the author and deemed to be potentially relevant to the annotated bibliography are located and reviewed for possible inclusion in the annotated bibliography. Resources used by the author which are outside of the targeted timeframe for resources are generally not further explored. While academic resources are spread across a variety of publications, Computers & Education accessed through the Science Direct database is the publication providing the largest number of relevant resources from a single location.

### **Literature Evaluation Criteria**

In order for a resource to be included in the annotated bibliography rather than utilized as a supporting reference only, it must meet several criteria: (a) it must have been authored by an expert in the mobile learning field; (b) the reference must address either instructional design principles for mobile learning or the mobile learning context; (c) if the resource is based on original research, the research must follow accepted academic research methods and modalities; and (d) if the reference is not based on original research, it must make sufficient use of credible references within the field.

Expertise is established by reviewing the author's credentials, past publications, frequency with which they are cited in other publications, and whether or not the material is published by an academic, peer-refereed publication (Bell & Smith, 2009). Original research is evaluated based on if the article presents clear explanations of the experiments conducted, whether they are qualitative, quantitative, or blended, what the controls are, and how the results are evaluated against other pertinent materials in the field to draw final conclusions (Zerubavel, 1999).

### **Documentation Approach**

Zotero is utilized as the primary method of documenting and categorizing research. Zotero is a research tool available from Zotero.org which allows collected research to be saved, indexed, tagged, and organized in order to assist with research documentation ("Zotero | About," 2012). As a secondary method, a folder has been established within the Microsoft Windows 7 operating system to which relevant PDF resources can be downloaded. Once a resource is downloaded, the PDF is transferred to Zotero and the "Retrieve metadata for PDF" function within Zotero is utilized to begin a bibliographic entry within the Zotero application. The

bibliographic information is then reviewed for completeness and if any information is missing, additional exploration of the resource or the originating database is done in order to finish populating the needed information. Once the resource is set up in Zotero, a review is completed of the abstract, content, and references to allow for categorization. Five folders are being utilized for categorization in Zotero. The top-level folder represents the annotated bibliography and covers all resources which have been identified as relevant and adequate for inclusion on the research. The four sub folders are:

- Foundational
- Mobile Learning Principles
- Mobile Learning Context
- Mobile Technology and Tools

Articles, books, studies, and other resources related to the primary question surrounding mobile learning principles for adult instructional design are filed under “Mobile learning principles.” Resources which speak to the unique aspects of the mobile learning context, as well as references to challenges and advantages of the mobile context, are filed in the “Mobile Learning Context” folder. Articles which speak to the available mobile technologies and tools for delivering learning to adult mobile learners are filed in the “Mobile Technology and Tools” folder, and finally, materials which help establish the theoretical underpinnings of mobile learning and instructional design practices are filed under “Foundational.”

Once initial categorization is complete, materials are tagged with relevant keywords to facilitate future searches. The “notes” feature within Zotero is used to call out key concepts presented in the material as well as the names of other authors and researchers for future

investigation. Copies of the abstract are included in the resource description, either automatically through the metadata or manually through copy/paste by the researcher.

### **Reading and Organization Plan**

**Reading plan.** The reading plan for this annotated bibliography is designed to code and analyze selected references in the context of these content areas: (a) unique aspects of the mobile learning context (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009; Gu, Gu, & Laffey, 2011; Sharples, Taylor, Vavoula, 2007), (b) evolving mobile instructional design principles focused on adult learners (Ozdamli, 2012; Park, 2011), and (c) mobile technology and tools (Evans, 2008; Motiwalla, 2007). References are first evaluated for inclusion in the Annotated Bibliography against the literature evaluation criteria. References used in the Annotated Bibliography include articles from peer-reviewed journals, papers and proceedings from the mLearning Conference, industry publications, and selected books. Each reference must adhere to, at minimum, one of the following criteria: (a) written by an expert in the mobile learning field or (b) must make sufficient use of credible references within the field. Criteria for establishing expertise and reference credibility are outlined in the literature evaluation criteria section above.

Once a reference is established to meet the evaluation criteria, it is analyzed by use of the conceptual analysis process outlined by Busch et al. (2005). The conceptual analysis process consists of a series of choices for each of the eight steps. The steps and choices made for the conceptual analysis in this annotated bibliography are outlined below:

1. Determine the depth of analysis. For this annotated bibliography, both single terms and simple phrases are utilized for evaluation. Key terms include, *mobile learning*, *instructional design principles*, and *mobile context*. Development of terms and phrases are guided by the key words established in the search process.

2. Decide how many concepts to code for by developing a set of concepts and categories, whether pre-defined or interactive. There are three pre-defined areas for consideration in this annotated bibliography: (a) unique aspects of the mobile learning context including instructional challenges and advantages (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009; Gu, Gu, & Laffey, 2011; Sharples, Taylor, Vavoula, 2007), (b) evolving mobile instructional design principles focused on adult learners (Ozdamli, 2012; Park, 2011), and (c) mobile technology and tools (Evans, 2008; Motiwalla, 2007). Examination of each of these areas is further guided by key terms and phrases that relate to relevant concepts. As coding is conducted, if new key terms and phrases are identified, they are added to the list and previously coded resources are recoded as is appropriate.

3. Decide whether to code for existence or frequency of concepts. For the purposes of the conceptual analysis in this annotated bibliography, concepts and categories are coded for existence. Frequency is not considered a relevant parameter for the purposes of this study.

4. Decide how to distinguish between concepts and whether concepts are coded exactly as they appear or if concepts can be coded even when they appear in different forms. Concepts are coded for general match, provided the concepts presented are identical. For example, *mLearning*, *m-learning*, and *mobile learning* are considered to be a single concept and coded as such. However, if the key term is combined with other key terms and represents a unique concept, it is coded for separately.

5. Develop coding rules to allow for streamlining and organizing the coding process. Coding exists for each key concept, as well as related sub-concepts. For example, coding for *mobile learning context* includes coding for the related sub-concepts of *unique aspects of mobile context*, *mobile context challenges*, and *mobile context advantages*.

6. Decide whether or not to ignore irrelevant information or if this information should be used to reexamine and/or alter the coding scheme. For this annotated bibliography, unrelated content is excluded from the study.

7. Code the references either by hand or by use of a computer program using the keywords and rules established. References identified for deep reading are coded through a combination of manual and computer-based coding. Resources are first run through a computer search to look for keywords and phrases via as dictated by the coding rules in steps 1-6, but additional manual review are conducted to ensure that terms with similar meanings are not missed by the automated process. Results of the coding are recorded in the notes section for each resource in Zotero.

8. Analyze the results in an attempt to draw whatever conclusions and generalizations are possible. For this annotated bibliography the results and conclusions are presented as per the organization plan.

**Organization plan.** The references for this annotated bibliography are organized thematically according to themes garnered from the main research question and sub questions. The themes used in the organization are: (a) instructional design principles for adults, with emphasis on evolving mobile instructional design principles (Molenda, Nelson, & Reigeluth, 2006; Ozdamli, 2012; Park, 2011), literature in this theme also supplies foundational information for the study; (b) mobile devices and technologies as instructional tools (Alsadi & AbuShawar, 2009; Evans, 2008; Motiwalla, 2007); and (c) the mobile learning context which includes challenges (Gibbons, Wang, & Wiesemes, 2010), advantages (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009), and unique aspects (Ronchetti & Trifonova, 2003) of mobile learning.

The theme of instructional design principles for adult learners addresses resources which (a) establish the foundation of instructional design principles as they currently exist in distance education and e-learning, and references which (b) cover changes that are happening in instructional design as the result of the increasing use of mobile devices and mobile learning (Ozdamli, 2012; Park, 2011).

The second theme, mobile devices and technologies as instructional tools, presents resources which (a) explore how mobile devices can best be used to deliver education to adult learners (Haag, 2011), (b) available technologies for facilitating mobile learning (Alsadi, & AbuShawar, 2009; Evans, 2008), and studies which explore (c) real-life examples of mobile devices deployed in the learning and teaching environment (Barbosa, Reinhard, Saccol, & Schlemmer, 2010; Haag, 2011).

The final theme, the mobile learning context, addresses those resources which speak to (a) the challenges (Gibbons, Wang, & Wiesemes, 2010), and (b) advantages (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009) provided by the mobile learning environment, and (c) unique aspects (Ronchetti & Trifonova, 2003) of mobile learning. These references cover topics such as how mobile instructional design principles must account for the fact that students are utilizing the devices in environments over which the instructor has no control – such as cafes, the bank, or when waiting in line at the theater (Sharples, Taylor, & Vavoula, 2010), and how the learning context is portable, ever-changing, and highly personal for each learner (Gu, Gu, & Laffey, 2010).

References which cover only one of these topics are presented only under that theme. References which address multiple topics are listed in the topic with which they closely align, but may be mentioned in the other topics they address.



### **Annotated Bibliography**

The literature selected for this Annotated Bibliography includes materials which are considered to show the most relevancy and authority in support of the research questions described in the Introduction. The Annotated Bibliography includes 31 references, each of which address at least one of the research questions as a way to identify a set of instructional design principles for use in mobile adult learning. The entries each include: (a) a reference citation in APA format, (b) an abstract of the reference content, (c) an assessment of the references credibility, and (d) a summary of the content relevant to each specific research question category. References are organized around three themes, including (a) instructional design principles for adults, with emphasis on evolving mobile instructional design principles (Molenda, Nelson, & Reigeluth, 2006; Ozdamli, 2012; Park, 2011) -- literature in this theme also supplies foundational information for the study; (b) mobile devices and technologies as instructional tools (Alsadi & AbuShawar, 2009; Evans, 2008; Motiwalla, 2007); and (c) the mobile learning context which includes challenges (Gibbons, Wang, & Wiesemes, 2010), advantages (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009), and unique aspects (Ronchetti & Trifonova, 2003) of mobile learning.

#### **Mobile Instructional Design Principles for Adults**

The references that address the theme of instructional design principles for adult learners (a) establish the foundation of instructional design principles as they currently exist in distance education and e-learning, and (b) cover changes that are happening in instructional design as the result of the increasing use of mobile devices and mobile learning.

Ally, M. (2005). Using learning theories to design instruction for mobile learning devices.

*Learning and Skills Development Agency*, Mobile learning anytime everywhere. A book of papers from MLEARN 2004, 2. Retrieved from [http://stu.westga.edu/~bthibau1/MEDT%208484-%20Baylen/mLearn04\\_papers.pdf#page=14](http://stu.westga.edu/~bthibau1/MEDT%208484-%20Baylen/mLearn04_papers.pdf#page=14)

**Abstract.** Current instructional design models and methods were developed to design instruction for delivery on personal desktop computers that have large screens. However, there is a trend towards the use of mobile devices to deliver learning materials, and for students to learn anytime and anywhere. The use of mobile devices for learning has implications as to how learning materials are designed using learning theories and instructional design principles. This paper describes learning theories and instructional design principles for the design of learning materials for mobile devices.

**Credibility.** Mohamed Ally is the Chair and Professor of Distance Education at Athabasca University in Canada as well as a researcher for the Technology Enhanced Knowledge Research Institute (TEKHRI). His research areas include distance education, e-Learning, mobile learning, workplace learning, and using emerging technologies in education and training. He has won multiple awards for his books and articles on mobile learning and has served in multiple training development and mobile learning organizations. This article cites 18 references and builds on Dr. Ally's previous work as well as the work of other mobile education experts such as Mike Sharples. The majority of the references are scholarly books and articles, but some industry publications as well as proceedings from conferences and workshops are also included.

**Summary.** This paper presents the idea that mobile learning principles need to take advantage of cognitive learning instructional theories which state learning involves the use of memory, motivation, thinking, and reflection. It also argues that information must be organized or “chunked” appropriately in order to facilitate the learning process. According to the article, for mobile learning, 5-9 units per course are thought to be appropriate in order to compensate for short-term memory limitations. It presents the idea that mobile learning should be organized into a concept map or network rather than textual and also take advantage of multi-media formats such as audio, video, and greater use of video due to the small-screen form factor of most mobile devices. Learners should be allowed to take the units in groups and orders that make sense to them in order to retain the information. Designing instructionally sound mobile learning units will require a change in writing style by course developers (instructional designers) who currently tend to focus on text-heavy design methodologies.

Arnedillo- Sánchez, I., Kukulska-Hulme, A., Milrad, M., Sharples, M., & Vavoula, G. (2009).

Innovation in mobile learning. *International Journal of Mobile and Blended Learning*, 1(1), 13–35. doi:10.4018/jmbl.2009010102

**Abstract.** In the evolving landscape of mobile learning, European researchers have conducted significant mobile learning projects, representing a distinct perspective on mobile learning research and development. Our paper aims to explore how these projects have arisen, showing the driving forces of European innovation in mobile learning. We propose context as a central construct in mobile learning and examine theories of learning for the mobile world, based on physical, technological, conceptual, social and temporal

mobility. We also examine the impacts of mobile learning research on educational practices and the implications for policy.

**Credibility.** Inmaculada Arnedillo-Sánchez is a professor at Trinity College in Dublin with a Master's of Science in Information Technology Education. Her research areas include mobile learning and she has been published in multiple books and articles. Agnes Kukulska-Hulme is a Professor of Learning Technology and Communication and Associate Director (Learning and Teaching) in the Institute of Education Technology the Open University in the UK. She serves on multiple mobile learning boards and panels and has published scholarly articles, books, book chapters, and other materials on mobile learning. Marcelo Milrad is a Full Professor of Media Technology at the Department of Computer Science, School of Computer Science, Physics and Mathematics, at Linnaeus University (LNU) in Sweden. He has published over 145 articles in international journals, refereed conferences, books and technical reports and is currently researching the design of learning environments to support mobile and wireless applications and collaborative learning. Mike Sharples is a Professor of Educational Technology at the University of Birmingham, UK. He leads the University's Educational Technology Research Group comprised of 30 staff and postgraduate researchers and has published over 50 scholarly articles and books on the use of mobile technology in education. Dr. Giasemi Vavoula is a professor at the University of Leichester, School of Museum Studies. Dr. Vavoula's research includes mobile learning, the evaluation of mobile and informal learning, and technology-enhanced learning and she is published in many scholarly journals and books on these topics. The *International Journal of Mobile and Blended Learning* is a quarterly academic journal which aims to provide a forum for researchers to share their knowledge

and experience of mobile and blended learning environments. This article uses 70 references, which contain scholarly articles and books, conference proceedings, and reports.

**Summary.** This article presents the innovative design, development and evaluation practices that have characterized European mobile learning projects. Specific projects, which the authors believe have shaped research and development of mobile learning in Europe, are reviewed and the shifts in pedagogical and theoretical perspectives that have been observed are discussed. The authors argue that mobile learning must have a strong foundation of learning theory and cannot be technology-driven. Instead, mobile learning must consider the wider context of learning. Research into mobile learning should focus on the study of how the mobility of learners, augmented by personal and public technology, can contribute to the process of learning. The challenge is to define the role of pedagogy and theory in this process. Many existing learning theories may be relevant, depending on the social practices that develop around the use of mobile technology in instructional practices. The common denominator in all of the theories of mobile learning is context: physical, technological, conceptual, social and temporal contexts for learning. A combination of technical, pedagogical and sociological expertise will be needed to make sense of, and give direction to, emerging mobile learning principles.

Bruns, A., Cobcroft, R., Smith, J., & Towers, S. (2006). *Mobile learning in review: Opportunities and challenges for learners, teachers, and institutions*. Presented at the Online Learning and Teaching (OLT) Conference 2006, Queensland University of Technology, Brisbane. Retrieved from <http://eprints.qut.edu.au>

**Abstract.** In order to ascertain the current state of knowledge and research in mobile learning, an extensive review and synthesis of the literature in mobile learning has been undertaken to identify and harness potential factors and gaps in implementation.

This paper seeks to facilitate the inquiry into ‘What is possible in m-learning?’ and ‘Why is it necessary to pursue these possibilities?’ and advocates the development of a best-practice framework to guide future action and thinking.

**Credibility.** Axel Bruns is an Associate Professor at the Queensland University of Technology, School of Media, Entertainment, and Creative Arts in Brisbane, Australia. His research and publications center on user-led content development. Rachel Cobcroft is a PhD candidate at the Queensland University of Technology. Judith Smith is the Associate Director of Academic-Real World Learning at Queensland University of Technology. She has provided leadership to two Large Teaching and Learning Grants relating to online learning and has won multiple awards for her work in learning. Stephen Towers is the Dean of Studies at the Queensland University of Technology, Learning and Teaching Unit. Dr. Towers has led several projects around the delivery of learning programs using various information and communications technologies including mobile delivery. This article utilizes 75 resources, which represent a combination of scholarly articles and books, conference proceedings, research reports, and industry publications.

**Summary.** This article presents the idea that instructional practices are increasingly responding to external factors such as competition, market trends, and government policies as well as internal factors such as student preferences, instructor capabilities, and pedagogical approaches. As mobile becomes more prevalent and cost-effective, it becomes critical for institutions to undertake mobile learning projects to support efficient

and effective student-centered learning. However, with the need to undertake mobile learning projects comes the need to develop a theory of mobile learning which addresses differences between current learning theories and mobile learning needs, accounts for the mobility of learners, covers both formal and informal learning, theorizes learning as a constructive and social process, and analyzes learning as a personal and situated activity mediated by technology. Mobile instructional design principles must account for how to use learning activities to engage learners, acknowledge the learning context, challenge learners, and provide opportunities for practice in order to contribute to quality learning experiences. By considering learners' creative, collaborative, communicate and critical engagement, a framework for mobile learning can provide meaningful insight into a mobile learner's achievement of knowledge. However, the authors argue that until mobile technology reaches the "tipping point" where the uptake of mobile and wireless technologies reach a critical mass which will compel institutions to adopt mobile learning plans, a seamless mobile learning pedagogical approach will not be developed.

Gu, F., Gu, X., & Laffey, J. (2011). Designing a mobile system for lifelong learning on the move. *Journal of Computer Assisted Learning*, 27(3), 204–215. doi:10.1111/j.1365-2729.2010.00391.x

**Abstract.** The Life-long Learning Initiative seeks to fulfill a variety of learning needs for Shanghai citizens. Given the popularity of mobile devices in Shanghai, the ability to provide learning in informal settings through mobile devices is a key objective and challenge of the Initiative. This research builds new knowledge about design principles for lifelong learning on the move and is a milestone in the development of the future learning resource bank for Shanghai citizens.

**Credibility.** Xiaoqing Gu is a Professor of Educational Technology, School of Educational Science, East China Normal University. Dr. Gu has published several scholarly journal articles on mobile learning and has spoken at various learning conferences. James Laffey is a professor with the School of Information Science and Learning Technologies at University of Missouri. His research areas include social computing, performance support system, and interface design and usability. Dr. Laffey has written multiple scholarly journal articles about technology in education. Information could not be located about F. Gu as no first name was given and search with the initial and last name given as well as the university affiliation, East China Normal University, turned up too many results to make a firm determination of the author's credentials. However, there were other articles written on mobile learning and education with the same authorship which indicates the author has expertise within the field of mobile learning in China. The likely cause for not finding additional information is the lack of availability of the author's work in English. The *Journal of Computer Assisted Learning* is a peer-reviewed, scholarly journal, published bi-monthly out of the UK. The journal covers the whole range of uses of information and communication technology to support learning and knowledge exchange. The article uses 44 references spread across academic articles and books, conference proceedings, and conference reports.

**Summary.** The authors in this study present a framework and design principles for delivering lifelong learning content to the citizens of Shanghai. In order to identify principles for designing mobile learning, the authors explored pedagogical and usability design. In order for users to engage in informal, lifelong learning, the content must be engaging, and suited to everyday needs. Additionally, it should be micro, that is,



delivered in small enough chunks that it can be easily integrated into the busy schedule of lifelong learners and successfully compete against other distractions. Utilizing designs which are granular in fashion has been successful, according to the authors, across multiple mobile learning studies. Usability is also an important consideration for instructors to consider when designing learning for mobile delivery. While general usability standards might apply, additional considerations are to be taken into account which are (a) compatibility with features of mobile learning ‘tasks’, such as, time and effort to complete a task; (b) flexibility of use; and (c) users’ attitudes. Based on this combination of pedagogical and usability issues, the authors identified the following principles of mobile learning design: (a) content must be practical and micro, (b) activities must be micro and simple, and (c) usability must be consistent and simple. The authors went on to develop and deploy several pilot mobile learning programs designed around these principles. The authors found that learning products developed to these standards received positive evaluations for content, activity, and usability design. The results showed that effective implementation of practical and micro principles is highly valued by learners who want to make good use of their time in real-life situations. Finally, the authors concluded that usage mechanisms of learning products must be consistent with conventional usability standards, and all be provided with attractive yet appropriate media design. The authors believe these principles can begin to be implemented by other instructional designers, but that additional research should still be undertaken to insure the models are appropriate for all users and learning types.

Herrington, A., Herrington, J. & Mantei, J. (2009) *Design principles for mobile learning*. In: Herrington, J., Herrington, A., Mantei, J., Olney, I. & Ferry, B., (eds.) *New technologies,*

new pedagogies: Mobile learning in higher education. University of Wollongong, Wollongong, pp. 129-138.

**Abstract.** The *New technologies, new pedagogies* project used a design based research approach in the creation and evaluation of pedagogies and their use in a range of higher education classes. This chapter describes the findings of the project as a whole, and presents principles to inform the design of innovative learning environments employing mobile technologies in higher education learning environments.

**Credibility.** Anthony (Tony) Herrington is the Director for the Center for eLearning at Curtin University in Australia. He has published multiple articles on e-learning and mobile learning. Jan Herrington is a Professor of Education at Murdoch University in Perth. Dr. Herrington has focused on the user of educational technologies for the past 20 years and has won the Association for Education Communication and Technology (AECT) Outstanding Book of the Year Award for her writing on e-learning. Jessica Mantei is lecturer in language and literacy in the Faculty of Education, University of Wollongong. While Dr. Mantei is less focused on mobile learning than the other authors, she has published several papers on technology in education and has contributed to several books on mobile technology and its impact on education. This article makes use of 16 references including scholarly articles and books, as well as conference proceedings. However, most of the findings were based on the results of the research conducted in the study.

**Summary.** The *New technologies, new pedagogies: Using mobile technologies to develop new ways of teaching and learning* project aimed to conclude with the production of guidelines or principles for the use of mobile technologies in higher

education. The study took a design-based approach to mobile learning which focuses on creating principles which improve the learning rather than proving one theoretical approach works over another. From analyzing the findings of the study, the authors found that the following principles were important in the design and implementation of mobile learning: (a) real world relevance, (b) using mobile learning in mobile contexts, (c) providing time for mobile technology exploration, (d) building blended programs which also use non-mobile components, (e) building learning which can be used whenever, wherever, by whomever, (f) exploiting the affordances of mobile technology, (g) employing the user's own mobile device, (h) using mobile learning to mediate knowledge construction, and (i) using mobile learning to produce and consume knowledge.

However, while this study afforded many opportunities for exploring device capabilities and appropriate designs for teaching and learning in a mobile environment, the authors believe that larger scale projects must be undertaken and mobile implementation must be viewed more strategically in order to justify widespread adoption of the principles learned in this project.

Kukulska-Hulme, A., Pachler, N., & Vavoula, G. (Eds.). (2009). *Researching mobile learning: Frameworks, tools and research designs*. Bern, Switzerland: Peter Lang.

**Abstract.** This book sets out the issues and requirements for mobile learning research, and presents recent efforts to specify appropriate theoretical frameworks, research methods and tools. Through their accounts of particular mobile learning projects, leading researchers in the field present their experiences and approaches to key aspects of mobile learning research such as data capture and analysis, and offer structured guidance and suggestions on adopting and extending these approaches.

**Credibility.** Agnes Kukulska-Hulme is a Professor of Learning Technology and Communication and Associate Director (Learning and Teaching) in the Institute of Education Technology the Open University in the UK. She serves on multiple mobile learning boards and panels and has published scholarly articles, books, book chapters, and other materials on mobile learning. Norbert Pachler is a Doctor of Philosophy and Director of International Teacher Education at the Institute of Education, University of London. He is the founder of the London Mobile Learning Group. Dr. Pachler has written and edited several books on mobile learning, contributed chapters to books on mobile learning, published multiple journal articles on mobile learning in publications including *E-Learning and Digital Media*, and has undertaken research projects, presented conference papers, and has spoken at multiple venues on his mobile learning research. Dr. Giasemi Vavoula is a professor at the University of Leichester, School of Museum Studies. Dr. Vavoula's research includes mobile learning, the evaluation of mobile and informal learning, and technology-enhanced learning and she is published in many scholarly journals and books on these topics.

**Summary.** This book puts forward the rather unique perspective that learning has always been mobile – in other words learning has historically been supported across contexts and life transitions using conventional technologies such as books, pencils, and notebooks. Digital technology can perhaps instead be seen as a catalyst leading to the awareness of the mobility of learning and the criticality of beginning to reflect on how learning is developed instead of the actual basis for mobile learning. Learning facilitated by mobile technology is strongly linked with informal learning due to the highly personalized nature of the context. Mobile learning blurs the division between formal and informal learning

as it has no clear boundaries due to the much more varied circumstances where learning is taking place. Mobile learning cannot be fully described by any one discipline or methodology and in fact, for effective mobile guidelines and principles to be identified, diversity in approach is necessary. The development of guidelines for mobile learning research should focus on the new interaction of teacher and student where the student is more empowered to control their learning environment rather than focusing specifically on any given technology due to the short “shelf life” of mobile technology. The purposeful alignment of and effective integration of social and cultural practices attendant to learning with portable, multifunctional devices with high degrees of connectivity with, and into, formal education is viewed by the authors as one of the key challenges for the early 21<sup>st</sup> century. The book explores several research projects conducted in mobile learning using various methodologies. In the end the authors conclude that a fully developed set of mobile learning research guidelines are not yet possible and further exploration is necessary, however, some basic principles can be established for mobile learning research from current findings. Research into mobile learning must be (a) rigorous and result in conclusions which are transferable and trust worthy; (b) effective in terms of cost, time and effort; (c) ethical; (d) proportionate; (e) appropriate to the technology and ethos; (f) consistent with the teaching and learning methodologies used; (g) authentic; (h) aligned with the chosen medium and technology; and (i) consistent across groups of learners, time, and varied devices. Establishment of mobile learning research guidelines are a critical step on the path to developing a set of mobile learning instructional design principles which enable the development of mobile learning which is usable, effective, and has a high level of learner satisfaction.

Muyinda, P. (2007). MLearning: Pedagogical, technical and organisational hypes and realities.

*Campus-Wide Information Systems*, 24(2), 97–104. doi:10.1108/10650740710742709

**Abstract.** There are two purposes to this article. First, to explore the hypes and realities around theoretical, technical and organizational aspects of the fast evolving field of MLearning as a complementary paradigm to online and classroom learning. Second, to review challenges and the future of MLearning.

**Credibility.** Paul Muyinda is the head of the Department of Open and Distance Learning in the School of Distance and LifeLong learning, Makerere University. He has published several articles on the use of mobile learning in higher education. The *Campus-Wide Information Systems* journal is a scholarly, refereed journal published online five times a year and based out of the United Kingdom. The *Campus-Wide Information Systems* journal covers the use of campus-wide information systems, the use of computer networks on campus, and the online public-access catalogs. This article makes use of 25 references spread across scholarly articles and books, conference

**Summary.** The author presents the idea that theories and principles for mobile learning are currently lacking, but that grounds are being prepared for their development. There are several pre-requisites must be met prior to developing a working theory of mobile learning. One pre-requisite is identifying the unique aspects of mobile learning versus other methods of learning. Another is establishing how much learning takes place outside of classroom environments and how mobile learning can be leveraged to embrace that. Third, any mobile learning principles and theories must bear in mind that contemporary learning practices are learner-centered, knowledge centered, assessment centered, and community centered. Finally, mobile learning must take into account the ubiquitous use

of personal and shared technology. However, the author also presents the idea that until a set of theories and principles can be developed for mobile, educators can still take advantage of the mobile learning environment by leveraging existing learning theories such as behaviorist learning theory, constructivist learning theory, situated learning theory, collaborative learning theory, and informal and live long learning theory.

Ozdamli, F. (2011). Pedagogical framework of m-learning. *Procedia - Social and Behavioral Sciences*, 31(0), 927–931. doi:10.1016/j.sbspro.2011.12.171

**Abstract.** There is a growing amount of research concerned with applying mobile technology to learning. It must be remembered that the use of technology must be driven by pedagogical considerations rather than financial, logistical or technical reasons. The aim of this study is to describe the pedagogical framework of mobile learning according to new trends in developing technology.

**Credibility.** Fezile Ozdamli is an Assistant Professor in the Computer Education and Instructional Technology department at Near East University. Dr. Ozdamli has one international and one national academic book published by reputable publishing houses. Three of her articles are available at Social Sciences Index (SSCI) and twelve are available in Educational field indexes such as the British Education Index, ERIC, Science Direct, and Scopus. She has presented and published eight reports at international conferences. She is also the editor of the World Journal on Educational Technology.

*Procedia - Social and Behavioral Sciences* is a scholarly, refereed journal published six times per year and based in the Netherlands. *Procedia - Social and Behavioral Sciences* aims to rapidly publish high quality conference proceedings in the social and behavioral

sciences. This resource makes use of 24 references spanning scholarly journal articles and books.

**Summary.** According to the author, existing pedagogical frameworks are not sufficient when learning is delivered using mobile devices. While the constructivist approach has been found to be the most helpful in terms of describing mobile learning, it falls short in including all aspects. Per the author, there are four key aspects of a pedagogical framework for mobile learning: (a) integration of tools, (b) pedagogical approaches, (c) assessment techniques, and (d) instructor training. The specific considerations change depending on if the mobile platform is being utilized as a teaching tool (to deliver training) or a facilitation tool (to support non-mobile learning). While there are many possibilities in mobile learning, further development of principles and practices needs to be undertaken. Future studies need to be done on a larger scale in order to support successful integration of mobile into training and education.

Park, Y. (2011). A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types. *The International Review of Research in Open and Distance Learning*, 12(2), 78–102.

**Abstract.** Instructional designers and educators recognize the potential of mobile technologies as a learning tool for students and have incorporated them into the distance learning environment. However, little research has been done to categorize the numerous examples of mobile learning in the context of distance education, and few instructional design guidelines based on a solid theoretical framework for mobile learning exist. This paper can be used by instructional designers of open and distance learning to learn about



the concepts of mobile learning and how mobile technologies can be incorporated into their teaching and learning more effectively

**Credibility.** Yeonjeong Park has been working as an instructional designer, consultant, and researcher for the past ten years. She has worked as a manager in Educational Technology Lab in School of Education, Virginia Tech. Dr. Park has been actively working as a member of instructional design and technology community by publishing the papers, serving as a journal or conference paper reviewer, and presenting at the international conferences. Her recent research interests include social theories of learning and emerging technologies such as mobile devices. She earned her PhD in Instructional Design and Technology, department of Learning Sciences and Technologies, at Virginia Tech. *The International Review of Research in Open and Distance Learning* is a quarterly published, scholarly and refereed journal based out of Canada. It aims to contribute and disseminate to practitioners and scholars worldwide knowledge in the following areas: theory, research, and best practice in open and distance learning. This resource makes use of 67 references which are made up of scholarly articles and books as well as conference proceedings.

**Summary.** According to Park, instructional designers require a solid theoretical foundation for mobile learning in order to effectively integrate mobile technologies into their teaching. However, Park, differing from many other authors, adopts an existing learning theory, transactional distance theory, and adapts it to apply to mobile rather than recommending a new theory specifically designed for mobile learning. Instead, she adds a new dimension to transactional distance theory to reflect the characteristics of mobile technologies which support both the individual and social aspects of learning. The author

then reviews several existing mobile learning projects by categorizing them under the four types of mobile learning identified by applying the transactional distance framework to mobile: (a) high transactional distance and socialized mobile learning activity, (b) high transactional distance and individualized mobile learning activity, (c) low transactional distance and socialized mobile learning activity and (d) low transactional distance and individualized mobile learning activity. The author concludes that by reviewing projects within the framework of these four types, one can confirm that mobile devices uniquely support seamless movement between personalized and social learning and high transactional distance and low transactional distance.

Ronchetti, M., & Trifonova, A. (2003). Where is mobile learning going. *Proceedings of The World Conference on E-learning in Corporate, Government, Healthcare, & Higher Education (E-Learn 2003)* (pp. 7–11).

**Abstract.** M-learning is a quite new, exciting and promising field. Papers on this domain are spread through several conference and workshops proceedings, so it is rather difficult to have a complete view of the field. This paper aims at helping, by reviewing the existing work, and classifying the research directions that try to answer the questions of how m-learning will help reaching the goals of a better learning, and how it will be different from the rest of e-learning.

**Credibility.** Marco Ronchetti is a Computer Science Associate Professor and Director of the Master in Technologies for System Integration and e-government of the Università di Trento. Since 1996 Dr. Ronchetti has published approximately 110 papers in Computer Science, mostly related to e-Learning and mobile learning. Anna Trifonova is a post-doc researcher at the Future Learning research group at the University of Barcelona, Spain.

Dr. Trifonova holds a PhD in Computer Science, Electronics and Telecommunications from the University of Trento, Italy. Dr. Trifonova has published extensively on learning and technology. The World Conference on E-Learning in Corporate, Government, Healthcare & Higher Education (E-Learn) is an international conference organized by the Association for the Advancement of Computing in Education (AACCE) and co-sponsored by the International Journal on E-Learning. This paper made use of 53 resources including scholarly journal articles, white papers, and conference proceedings.

**Summary.** This paper aims at presenting a view of the field of mobile learning by reviewing the existing work, and classifying the research directions that try to answer the questions of how m-learning will help reaching the goals of a better learning, and how it will be different from the rest of e-learning. The authors attempt to catalogue the research in mobile learning into three main areas: (a) infrastructure, (b) content, and (c) communication/collaboration. Though the process of evaluation and categorization, the authors are able to offer up several guiding principles for mobile learning instructional development: (a) modules should be short, which enables learners to use small fragments of waiting or idle time for learning; (b) mobile learning should be simple, entertaining, and add value; and (c) mobile learning should deliver just-in-time information which supports teachers and students in new learning environments. The authors believe that extensive research is still needed to fully identify and catalog the challenges and advantages of mobile learning and to develop a model of mobile learning design which can be used effectively and efficiently across a wide variety of subjects and contexts. Like any new technology, mobile learning technology will require time for its full

potential to be realized and will require we shift our thinking paradigms about learning and teaching.

Sharples, M., Taylor, J., & Vavoula, G. (2005). Towards a theory of mobile learning.

*Proceedings of mLearn, 2007*(August 3). Retrieved from

<http://www.iamlearn.org/public/mlearn2005/www.mlearn.org.za/CD/papers/Sharples-%20Theory%20of%20Mobile.pdf>

**Abstract.** There is a need to re-conceptualise learning for the mobile age, to recognise the essential role of mobility and communication in the process of learning, and also to indicate the importance of context in establishing meaning, and the transformative effect of digital networks in supporting virtual communities that transcend barriers of age and culture. This paper offers a framework for theorising about mobile learning, to complement theories of infant, classroom, workplace and informal learning.

**Credibility.** Mike Sharples is a Professor of Educational Technology at the University of Birmingham, UK. He leads the University's Educational Technology Research Group comprised of 30 staff and postgraduate researchers and has published over 50 scholarly articles and books on the use of mobile technology in education. Josie Taylor is the director of the Institute of Educational Technology at the Open University. Dr. Taylor participated in the MOBIlearn project which looked at the roll of pedagogy in the mobile learning environment, and has published articles and book chapters on mobile learning in multiple scholarly works. Dr. Giasemi Vavoula is a professor at the University of Leicestershire, School of Museum Studies. Dr. Vavoula's research includes mobile learning, the evaluation of mobile and informal learning, and technology-enhanced learning and she is published in many scholarly journals and books on these topics. This paper was

presented at the mLearn conference, a conference series running since 2002 on the topic of mobile learning. mLearn was the first conference on mobile learning and is widely accepted as one of the most prestigious international conferences in the field. This article makes use of 19 references which include scholarly journal articles and books, conference proceedings, industry publications, and an unpublished thesis.

**Summary.** This paper offers an initial framework for theorizing about mobile learning and how mobile learning complements other existing learning theories. The authors present the idea that the first step in developing a framework for mobile learning is to identify the differences between mobile learning and other types of learning activities. Mobility of the learner is called out as a key, if obvious, difference. In a mobile environment learners are continually on the move and take ideas gained in one location and apply them in another. Another key aspect of mobile learning is that it takes place outside of the classroom environment and requires that learners initiate and structure their activities to enable educational processes and outcomes. Mobile learning must also be based on current successful instructional principles which enable learning. Effective learning is found to be learner centered, knowledge centered, assessment centered, and community centered. The authors found that these findings broadly match the social-constructivist approach to learning which views learning as an active process of building knowledge and skills through practice within a supportive community. Finally mobile learning must take into account the ubiquitous use of personal and shared technology. The authors go on to use a framework of control, context, and communication to evaluate the relationship between technology and semiotics within mobile learning. They believe this framework provides a step towards developing an integrated theory of mobile

learning that could both inform the analysis of learning and the design of new technologies and environments for learning. The authors suggest that the implications of this re-conception of education are profound and could be viewed as a challenge to formal schooling. However, it can also offer an opportunity to bridge the gap between formal and experiential learning, allowing for greater opportunities of lifelong learning.

Sharples, M., Taylor, J., & Vavoula, G. (2010). A theory of learning for the mobile age (pp. 87–99). VS Verlag für Sozialwissenschaften. Retrieved from [http://dx.doi.org/10.1007/978-3-531-92133-4\\_6](http://dx.doi.org/10.1007/978-3-531-92133-4_6)

**Abstract.** As personal mobile technologies for learning become more widespread, studies are starting to show evidence of the value of incorporating mobile devices in teaching and learning (McFarlane, Triggs and Yee 2008; p.7) and also substantial issues, including conflicts between informal learning with personal devices and traditional classroom education (Sharples 2007). Children are developing new skills and literacies enabled by mobile devices, such as SMS texting, moblogging (writing diaries and weblogs on mobile devices) and mobile video creation. A new generation of location-aware mobile phones will offer further possibilities, of education services and educational media matched to the learner's context and interests.

**Credibility.** Mike Sharples is a Professor of Educational Technology at the University of Birmingham, UK. He leads the University's Educational Technology Research Group comprised of 30 staff and postgraduate researchers and has published over 50 scholarly articles and books on the use of mobile technology in education. Josie Taylor is the director of the Institute of Educational Technology at the Open University. Dr. Taylor participated in the MOBIlearn project which looked at the role of pedagogy in the mobile

learning environment, and has published articles and book chapters on mobile learning in multiple scholarly works. Dr. Giasemi Vavoula is a professor at the University of Leichester, School of Museum Studies. Dr. Vavoula's research includes mobile learning, the evaluation of mobile and informal learning, and technology-enhanced learning and she is published in many scholarly journals and books on these topics. This paper has been published in several books on elearning including the one in the annotation. The paper makes use of 50 references from scholarly journals and books, industry publications, conference proceedings, reports, and an unpublished these.

**Summary.** This article expands on previous work from this group of authors. Many of the same concepts are touched on that were presented in *Towards a Theory of Mobile Learning* (Sharples, Taylor, & Vavoula, 2005). However, this article offers additional insights and expands the basis of research underlying the conclusions reached. The authors acknowledge that mobile device ownership is expanding and mobile device capabilities are expanding to include features such as cameras, media players, and other functions previously only supported on multimedia computers. With the greater use and capabilities of mobile devices, the authors propose that a conversational framework for learning with technology is important for understanding mobile learning. Within the conversational framework, the learner must (a) apprehend the structure of the discourse, (b) interpret the forms of representation, (c) action on descriptions of the world, (d) adjust actions to fit the task goals, (e) adjust descriptions to fit the topic goal, and (f) reflect on the cycle of goal, action, and feedback. The authors suggest that current learning using the conversational framework often falls short due to the lack of a partner in the conversation. However, they believe technology can fill the partnership role with the

learner if a way can be found to create and sustain a language between learner and mobile device which enables shared understanding. The authors emphasize that the involvement of a knowledgeable instructor to design the interaction is still vital and cannot be undervalued. Rather than a challenge or threat to formal learning, mobile learning should be viewed as an opportunity for a transformation of learning by enabling learners to explore their world with teachers acting as part of an ongoing conversation aimed at extending learning into all aspects of life.

Traxler, J. (2007). Defining, discussing and evaluating mobile learning: The moving finger writes and having writ . . . . *The International Review Of Research In Open And Distance Learning*, 8(2). Retrieved from

<http://www.irrodl.org/index.php/irrodl/article/view/346/882>

**Abstract.** The role of theory is, perhaps, a contested topic in a community that encompasses philosophical affiliations from empiricists to post-structuralists, each with different expectations about the scope and legitimacy of theory in their work. The mobile learning community may nevertheless need the authority and credibility of some conceptual base. Such a base would provide the starting point for evaluation methodologies grounded in the unique attributes of mobile learning. Attempts to develop the conceptualizations and evaluation of mobile learning, however, must recognize that mobile learning is essentially personal, contextual, and situated. The paper explores and articulates these issues and the connections between them specifically in the context of the wider and sustained development of mobile learning.

**Credibility.** John Traxler is Director of the Learning Lab and a Professor of Mobile Learning for the School of Computing & IT, University of Wolverhampton. He is also



the Founding Director of the International Association for Mobile Learning. He has co-written a guide to mobile learning in developing countries and is the co-editor of the definitive book on mobile learning “Mobile Learning: A Handbook for Educators and Trainers”, with Professor Agnes Kukulska-Hulme. He has also written 14 book chapters on mobile learning and has guest edited special editions of three peer-reviewed journals devoted to mobile learning. *The International Review of Research in Open and Distance Learning* is a quarterly published, scholarly and refereed journal based out of Canada. It aims to contribute and disseminate to practitioners and scholars worldwide knowledge in the following areas: theory, research, and best practice in open and distance learning. This article makes use of 33 references drawn from scholarly articles and books as well as conference papers and proceedings.

**Summary.** According to the author, mobile learning is growing in significance throughout the higher education landscape, but is still a relatively immature field both in terms of technologies and pedagogies. Currently, mobile learning is drawing on the principles and practices of technology-enhanced learning as well as other learning principles used in the classroom and community. The author acknowledges that mobile learning is becoming more prevalent in the corporate sector and is becoming a viable and imaginative component of instructional support. With different stakeholders and factors at work in the conceptualization of mobile education and due to the conflicting perceptions and expectations of these various stakeholders, the final outcome of the concept of mobile education is uncertain. Mobile learning can be conceptualized around the technology component and focus on the devices and technical details of the delivery methodologies, or it can be focused around the mobility of the learner and the portability

of learning across contexts. However, the author discounts technology as a defining characteristic of mobile learning, but does believe that technical factors must be considered when developing a set of guidelines for mobile learning. The author presents the idea that while mobile learning principles in developed countries are leaning towards the idea that mobile learning should not be “stand-alone”, in other words that it should be used as part of a broader learning program with classroom or e-learning components, in developing countries mobile learning may take a very different path due to the lack of availability for more formal learning. Mobile learning may offer opportunities in developing countries for true transformative learning by making education available to learners who might not otherwise be exposed to learning opportunities. The author concludes that while mobile learning offers enormous potential, much more research is required before mobile guidelines can be established and current questions may in fact be premature or inappropriate.

Uden, L. (2007). Activity theory for designing mobile learning. *International Journal of Mobile Learning and Organisation*, 1(1), 81. doi:10.1504/IJMLO.2007.011190

**Abstract.** It is important to have an operational understanding of the context in developing a user interface that is both useful and flexible. The author believes that the complexity of the relationships involved can be analysed using activity theory. Activity theory, as a social and cultural psychological theory, can be used to design a mobile learning environment. This paper presents the use of activity theory as a framework for describing the components of an activity system for the design of a context-aware mobile learning application.

**Credibility.** Lorna Uden is a Senior Lecturer in the Faculty of Computing, Engineering, and Technology at Staffordshire University. She is also the editor of *the International Journal of Web Engineering and Technology* and the *International Journal of Learning and Technology*. Dr. Uden has published multiple scholarly journal articles on technology in learning including papers on e-learning and mobile learning in higher education. The *International Journal of Mobile Learning and Organisation* is a scholarly, refereed journal which intends to establish an effective communication channel among decision makers and policy makers in business, government agencies, and academic and research institutions which recognize the important role mobile learning may play in organizations. This article includes 50 references which include scholarly books and journal articles as well as published conference proceedings.

**Summary.** In this article, the author states that mobile technologies offer new opportunities for educational activities because they can be used across different locations and times. From a pedagogical perspective, they offer benefits around making learning interactive and collaborative. Mobile technologies offer instructors the opportunity of fitting learning into work processes as a means of insuring learning in practice. However, collaborative learning can only occur if the technology is designed to fit within the context of use for which it is intended. Despite the growth of mobile technology, there is little understanding of the ways mobile technology can be designed to best support mobile collaborative learning. According to the author, the design of usable mobile learning applications is not a trivial task. The learning context and technological limitations of the device must be considered when designing learning for mobile delivery. The author believes that the principles of *activity theory* can be used to

show the various components of the model for a mobile learning environment. Activity theory focuses on understanding the human activity and work practices. An activity consists of a subject and an object, mediated by a tool. The principles and components of activity theory have been used as analytical tools for many different subjects. The author lays out the following four steps within the activity theory for designing a framework for mobile learning, (a) clarify the purpose of the activity, (b) analyze the context for learning and use, (c) historically analyze the activity and its constituent components and actions, and (d) search for internal contradictions as the driving forces behind disturbances, innovations and change of activity system. The author concludes that while activity theory has limitations, it is the best approach for designing a mobile learning framework. Further work is still needed for it to be used as a robust design method. For effective use of activity theory for designing context-aware mobile applications, it is important that research time be long enough to understand the objects of activity, the changes of those objects over time and their relations to objects in other settings. There should be a phased approach to the design and evaluation of technology use, such as mobile devices for collaborative learning.

### **Mobile Devices and Technologies as Instructional Tools**

The second theme presents references which (a) explore how mobile devices can best be used to deliver education to adult learners, (b) describe available technologies for facilitating mobile learning, and (c) explore real-life examples of mobile devices deployed in the learning and teaching environment.

Alsadi, J., & AbuShawar, B. (2009). m-Learning: The usage of WAP technology in e-learning. *International Journal of Interactive Mobile Technologies (iJIM)*, 3(3), pp. 10–16.

doi:10.3991/ijim.v3i3.808

**Abstract.** This paper presents the experience of Arab Open University on using WAP technology in mobile learning. The goal is to enhance e-Learning aspects of the existing learning management systems (LMS); e.g. Moodle. In addition to presenting technical aspects of the WAP, we also introduce the advantages and disadvantages of using WAP technology in the learning process. This paper discusses also the suitability and feasibility of using WAP technology devices for distance learning in real-time.

**Credibility.** Jihad Al-Sadi is an associate professor at Arab Open University, Jordan. He obtained his PhD from University of Glasgow in 2002. His research interests include e-learning, mobile learning, and management systems. Dr. Al-Sadi has published 26 scholarly articles, including articles on e-learning and mobile learning. Bayan Abu Shawar is an assistant professor at Arab Open University, Jordan. He holds a PhD in Natural Language Processing and a Master's Degree in Computer Science. Dr. Abu Shawar has published several scholarly articles about mobile learning and e-learning. The *International Journal of Interactive Mobile Technologies* is a scholarly, refereed journal published quarterly which aims to focus on the exchange of relevant trends and research results as well as the presentation of practical experiences gained while developing and testing elements of interactive mobile technologies. This article makes use of 26 references assembled from scholarly books and journal articles, conference proceedings, and industry publications.

**Summary.** According to the authors, computer-mediated communication (CMC) facilitates the development of new learning communities. The emergence of Wireless Applications Protocol (WAP), offers further potential by allowing learners and instructors to access the Internet anywhere and anytime via mobile phones equipped with web browsers. The authors present the idea that WAP can be used as tool in education to offer many advantages to both students and educators. WAP allows learners to have access to educational materials as the need arises and when the time is right for them, regardless of geographical location. Mobile devices also enable educators to deliver materials to students based on their needs and preferences. Mobile learning requires more facilitation, according to the authors, rather than less. Instructors will need to spend more time on course-delivery and follow up and also provide a rich learning resource environment for learners. The authors detail the advantages of using WAP in conjunction with Wireless Markup Language (WML) to deliver educational materials via a mobile device. WAP and WML allow materials to be delivered at a speed, size, and in a navigational interface that can be more easily utilized on a mobile device than traditional media designed for use on a larger screen desktop with a keyboard and mouse input. The specific implantation of a WAP learning management system at Arab Open University is detailed by the authors. The authors found that while WAP offers many opportunities, there are challenges such as the short battery life of the phone, slow transmission speeds, and difficulties entering text which must be considered and addressed. Mobile learning should not be used to replace traditional learning but to offer another methodology for learning. Further study and optimization for WAP delivery is needed to fully leverage it as a learning solution.

Attewell, J. (2004). A technology update and m-learning project summary. *London: Learning and Skills Development Agency*, Mobile technologies and learning, 2. Retrieved from <http://www.m-learning.org/docs/The%20m-learning%20project%20-%20technology%20update%20and%20project%20summary.pdf>

**Abstract.** In 2001, when the m-learning project commenced, few people knew about the concept of mobile learning or, indeed, could envisage the potential of mobile devices for learning. Findings from the learner research and systems trials phase of the project indicate that mobile devices can be used successfully to involve some of the hardest to reach and most disadvantaged young adults in learning. As a result, and especially as part of a blended learning strategy, mobile learning has the potential to help these young people to improve both their skills and their self-confidence and, therefore, their life chances.

**Credibility.** Jill Attewell manages the learning technologies research portfolio for the Learning and Skills Development Agency in the United Kingdom and is the co-coordinator of the EC supported pan-European research and development program called m-learning. She holds a Master's Degree in Information Technology and her doctoral research is centered on mobile learning. Ms. Attewell has co-authored several publications on technology in learning and is a regular presenter at conferences. This publication makes use of 9 resources, including news articles, industry publications, reports, and scholarly books. However, as this paper is intended to present the findings of original research from the m-learning project which was supported by the Learning and Skills Council as part of a grant to the Learning and Skills Development Agency for a program of research and development, the reference still adheres to the criteria for

credibility. The Learning and Skills Council was a non-departmental body established in 2001 which was responsible for planning and funding high quality education and training for everyone in England other than those in universities and was established by the English government. It has since been replaced with the Skills Funding Agency and Young People's Learning Agency.

**Summary.** This paper reports on the findings of the m-learning project. Specifically it focuses on the development of mobile phone technologies which have the potential to support the instructional or learning process. It also briefly outlines the work and other key findings of the m-learning research and development project. The author first summarizes the features available on smart phones of the time. She also touches on the emerging availability of 3G network capabilities as making the ability to deliver more interactive experiences to a mobile device more feasible. Viruses on the mobile phone and health concerns from mobile phone usage are also briefly discussed, but are not found to be major points of concern at the time the paper was written. Next, the author explores the decision making process for selecting the platform for developing learning materials in the study. Rather than using a generic approach to create content that could be used on multiple devices, they instead developed specific instructional materials designed to utilize the strengths of the platforms used in the study. A variety of activities were completed by the learners during the study, each utilizing different methods of mobile interaction with the learning material. Several key observations were gained as a result of the study, specifically that mobile learning (a) helps learners improve their literacy and numeracy skills and to recognize their existing abilities, (b) can be used to encourage both independent and collaborative learning experiences, (c) helps learners to



identify areas where they need assistance and support, (d) helps to combat resistance to the use of ICT and can help bridge the gap between mobile phone literacy and ICT literacy, (e) helps to remove some of the formality from the learning experience and engages reluctant learners, (f) helps learners to remain more focused for longer periods, and (g) helps raise self-esteem and self-confidence. The correct training of instructors/facilitators needs to be undertaken by organizations looking to implement mobile learning, and ongoing involvement in supporting instructors is crucial to avoid disillusionment and stalling momentum. The author concludes that mobile devices are no longer for chatting and organizing only; they are powerful tools for delivering learning objects and access to online systems and services when implemented properly.

Barbosa, J., Reinhard, N., Saccol, A., & Schlemmer, E. (2010). M-learning in practice: A training experience with IT professionals. *JISTEM - Journal of Information Systems and Technology Management*, 7(2), 261–280. doi:10.4301/S1807-17752010000200002

**Abstract.** This paper analyzes a real experience in mlearning for training IT professionals. The participants of the training activity (13 professionals) evaluated the m-learning experience via a structured questionnaire. The results generated important insights into the ergonomic, technological and pedagogical possibilities and limitations of mobile and wireless technologies for corporate training and also on methodologies and learning tools that can be applied to m-learning.

**Credibility.** Jorge Luis Victoria Barbosa is a Professor in the Interdisciplinary Program of Graduate Studies in Applied Computing at Universidade do Vale do Rio dos Sinos, Center for Science and Technology. He coordinates the Laboratory of Research and Development in Mobile Computing. His main research areas include mobile and

ubiquitous computing as well as ubiquitous education. He has published over 26 articles in scholarly journals, including articles on mobile learning. Nicolau Reinhard is a professor in the department of administration of the Faculty of Economics, Management and Accounting (FEA / USP) since 2007 in the area of Quantitative Methods and Computer Science working in research in the field of Computer Science, Information Systems and Computing Service. He is the author several scientific papers published in Brazil and abroad. Amarolinda I. Costa Zanela Saccol is a PhD in Business Administration from the Faculty of Economics and Business, University of São Paulo. He is a professor and researcher at Universidade do Vale do Rio dos Sinos and an ad hoc consultant in the area of Information Systems. His areas of research interest are information technology management, and information systems and organizations. Eliane Schlemmer is PhD in Computer for Education at Federal University of Rio Grande do Sul, Brazil. She is also a Professor of Pedagogy and E-learning at UNISINOS of S. Leopoldo, Brazil, and consultant in ICT training for professors and companies. Her research is focused on the use of virtual reality for the development of learning, a theme on which she conducted the projects of GP-edu in the last ten years. The *Journal of Information Systems and Technology Management* is a refereed academic journal published four times per year which aims to bridge the gap between the theoretical background and the application of information technology within organizations. This article makes use of 34 references drawn from scholarly books and journal articles and conference proceedings.

**Summary.** Mobile and Wireless Information Technologies (MWITs) can contribute to the teaching and learning process by enabling learning to occur in settings and

environments not dedicated to educational purposes, according to the authors. The article defines mobile learning as teaching and learning supported by MWITs and involving the mobility of human subjects far from formal educational spaces or work places. The mobility of the learning context, the authors explain, requires a change in the teaching and learning process. The paper explores the implementation of a test mobile learning environment called COMTEXT which was used to perform a workshop with a team of IT professionals. The study primarily concentrated on acceptance and usability of the learning solution as well as the limitations and possibilities of mobile learning as a corporate training tool. The mobile learning design was based on the competence management approach; the authors did not create a new approach specific to a mobile environment. COMTEXT offered learners the following tools, (a) Learning diary, (b) discussion forum, (c) E-mail, (d) YouTube Mobile, (e) Skype, (f) Conceptual maps, and (g) Learning objects. The workshop was conducted over two-weeks with 13 IT professionals. Both qualitative and quantitative data was gathered during the study. The study found that initial interest in mobile learning was high, but frustration was quickly realized by users when mobile and wireless technologies were faced. Even with users with high technology fluency, adapting to some learning interactions on a small-screen device was difficult. The authors concluded that more research is needed in mobile learning, but that any mobile learning experience must be sure to consider the limitations of the mobile environment and make sure it is easy to use and interact with in a mobile format.

Cagiltay, K, Gedik, N., Hanci-Karademirci, A., & Kursun, E. (2012). Key instructional design issues in a cellular phone-based mobile learning project. *Computers & Education*, 58(4), 1149–1159. doi:10.1016/j.compedu.2011.12.002

**Abstract.** Adding flexibility to the learning process, mobile learning offers great opportunities for education, especially for teenagers, who show great attentiveness to mobile technologies. Thus, the need to focus on design aspects of such learning is growing. This study aims to reveal critical issues in designing mobile learning based on a program for 11th graders and to unfold students' perceptions about reasons for participation, satisfaction, implementation processes, and specific content representation types.

**Credibility.** Kursat Cagiltay is an affiliated faculty member with the Information Systems department at Middle East Technical University. He has double PhDs in Instructional Systems Technology and Cognitive Science. He has published books, journal articles, research, and conference papers on the use of technology in education, distance education, the design and development of information and instructional systems, and the cognitive aspects of the human learning system. Nuray Gedik is an Assistant Professor of Computer Education and Instructional Technology at Akdeniz University, Turkey. She has published several scholarly articles on instructional design and articles on technology in learning. She has also contributed to book chapters on virtual education and presented at conferences on technology in education. Arzu Hanci-Karademirci is the Assistant Training Specialist at the Central Bank of Turkey. She holds a Master's Degree in Information Systems and has contributed to several journal articles on technology-based education. Engin Kursun is a faculty member in the Computer Education and

Instructional Technology department of Ataturk University. His main areas of interest are Open Educational Resources, OpenCourseWare movement, game-based learning, human computer interaction and multimedia design. He has published several papers on Open Education Resources. *Computers & Education* is a scholarly, refereed journal which is published eight times a year. It provides a technically-based, interdisciplinary forum for communication in the use of all forms of computing in education and will continue to publish definitive contributions to serve as a reference standard against which the current state-of-the-art can be assessed. This article makes use of 44 references spanning scholarly articles and books, conference proceedings, and industry publications and reports.

**Summary.** According to the authors of this study, despite a proliferation of studies on mobile learning, no consensus has been reached on the definition and design of mobile instruction. This study was aimed to answer to research questions, (a) what are the major issues and challenges in designing m-learning instruction, and (b) what are students' perceptions on m-learning instruction pertaining to content representations, reasons for participation, implementation processes, and satisfaction? An initial survey was conducted to learn about the test students' cell phone and mobile device usage. Based on the results of the survey and ongoing feedback during the study, the mobile instruction was designed to help students review the content and practice sample questions via their cellular phones. The actual course and final test were conducted face to face. This project revealed issues critical to the design of cellular phone-based m-learning based on the designers' experiences and lessons learned as categorized into three themes: (a) technical and technological issues, (b) curricular and pedagogical issues, and (c) management

issues. Ultimately, the study concluded that mobile learning is better used as a support for face to face or e-learning rather than the sole method for providing instruction. Mobile learning is best when it contains multi-media components rather than just text, and also when the instruction is spread out over time. Finally, extensive and effective communication and coordination must take place between all stakeholders, including managers, teachers, students, and the instructional designers. The instructional design team needs to consult with and receive help from the subject matter expert on content, duration, scheduling, and any changes to face-to-face instruction in order for mobile learning to be effective and add value.

Evans, C. (2008). The effectiveness of m-learning in the form of podcast revision lectures in higher education. *Computers & Education*, 50(2), 491–498.

doi:10.1016/j.compedu.2007.09.016

**Abstract.** In this paper we describe a study of the effectiveness of mobile learning (m-learning) in the form of podcasting, for teaching undergraduate students in Higher Education. Whilst podcasting is being utilized as a teaching tool by some educators in the secondary sector, its use in higher education, and its effectiveness as a learning tool for adults, remains to be established. The study suggests that the use of podcasts as a revision tool has clear benefits as perceived by undergraduate students in terms of the time they take to revise and how much they feel they can learn. Coupled with the advantages of flexibility in when, where and how it is used, podcasting appears to have significant potential as an innovative learning tool for adult learners in Higher Education.

**Credibility.** Dr. Chris Evans is a Fellow of Brunel's Teaching Academy. He was nominated for a National Teaching Fellowship Award and received a commendation

from the Higher Education Academy in e-Tutor of the Year. Before joining Brunel, he worked at the Open University and London University. He obtained his PhD in the Department of Computing at Imperial College. Dr. Evans has published 12 scholarly articles on technology in learning and has also contributed book chapters on the topic. *Computers & Education* is a scholarly, refereed journal which is published eight times a year. It provides a technically-based, interdisciplinary forum for communication in the use of all forms of computing in education and will continue to publish definitive contributions to serve as a reference standard against which the current state-of-the-art can be assessed. This article utilizes 17 references including scholarly journals and books, conference proceedings, and industry publications. However, the majority of the article is based on original research which follows accepted academic research parameters.

**Summary.** According to the author, one major advantage offered by mobile learning over traditional e-learning is the ability for learners to be able to take learning with them where-ever they go. This allows learners who are managing many conflicting demands on their time to incorporate learning into their day at unconventional times. Podcasting is a form of mobile learning which makes use of audio or video broadcast. In this study, the author made use of podcasts as a revision tool used by learners after their traditional lecture was completed, but before final examinations. The study was primarily focused on learner perceptions of the technology. Both qualitative and quantitative data was gathered and evaluated. The study found that students found the podcasts to be efficient, effective, and engaging. The podcasts also easily provided them with learning tools for revision and helped them engage with the material. Podcasting appears to be a valuable tool for enhancing the learning process and is a strong delivery methodology for mobile

learning content. Unlike many of the other studies reviewed in this Annotated Bibliography, few issues were found with podcasting a mobile learning instructional method.

Georgiev, T., Georgieva, E., & Smrikarov, A. (2004). M-learning - a new stage of e-learning.

*Proceedings of the 5th international conference on Computer systems and technologies Rousse Bulgaria, 17, 1–5.*

**Abstract.** Distance learning, electronic learning and mobile learning offer methods, which decrease the limitations of traditional education. This paper discusses the existing devices and technologies appropriate to realize mobile learning. Mobile learning as new stage of distance and e-learning is also examined.

**Credibility.** Tsevetozar Georgiev is a Principal Lecturer at the University of Rousse, Department of Computing. He has authored and co-authored more than 45 scientific papers and 9 books. Mobile learning is one of his primary research interests and several of his published articles address mobile learning and mobile learning readiness. Evgenia Georgieva is a member of the Department of Computing, University of Rousse. Ms. Georgieva has co-authored 6 scholarly papers on mobile learning. Angel Smrikarov is the Vice rector in science and personnel development of the University of Rousse. He is the author or co-author of 142 papers and reports, nine books, and other teaching materials. He has led numerous projects in technology-based education. The International Conference on Computer Systems and Technologies is organized by the Bulgarian Academic Society of Computer System and Information Technologies and by the Association for Computing Machinery. The objective of the conference is to intensify the information exchange of the results in theoretical research and practical developments in



this field. This paper makes use of 13 resources drawn from both academic sources and industry information. As the paper is focused primarily on presenting the available cellular and mobile phone technology in the industry rather than academic foundations of mobile learning principles, the low number of academically based references is not considered negative due to the context.

**Summary.** The authors of this paper present a review of the existing technologies and device categories available within the mobile learning landscape. Based on the high rate of mobile device adoption, the authors emphasize that educators must begin to take advantage of the mobile device platform in order to remain relevant. The article explores the advantages and challenges of devices such as (a) notebook computers, (b) tablet PCs, (c) PDAs, (d) cell phones, and (e) smart phones for delivery of mobile learning. It also looks at communications technologies in place for mobile. These include (a) GSM, (b) WAP, (c) GPRS, and (d) IEEE 802.11. The authors list the advantages of mobile learning over e-learning are (a) they can be used everywhere at any time, (b) have a lower price point than PCs, (c) are smaller and lighter than PCs, (d) take advantage of the newest technology available, and (e) offer the opportunity for location dependent education by way of GPS. The authors conclude that mobile education will only become more popular and instructors and educators need to be prepared to become more flexible and adopt modalities of instruction which support life-long learning through mobile devices.

Haag, J. (2011). From eLearning to mLearning: The effectiveness of mobile course delivery. Advanced Distributed Learning Initiative. Retrieved from [http://www.adlnet.gov/wp-content/uploads/2011/12/e\\_to\\_mLearning\\_paper.pdf](http://www.adlnet.gov/wp-content/uploads/2011/12/e_to_mLearning_paper.pdf)

**Abstract.** This paper summarizes findings from an empirical study that investigated the conversion and delivery of an existing DoD-wide eLearning course, “Trafficking In Persons (TIP) General Awareness Training”, to a mobile format. This paper presents both quantitative and qualitative results, including learner performance and overall satisfaction with the mobile course. Since mobile implementation has the potential for both formal learning experiences and performance support in the military, we will discuss the implications and provide recommendations for future research on the subject of mobile course delivery.

**Credibility.** Jason Haag's interest and background is in learning systems, web technology, and standards. He spent eight years supporting the U.S. Navy in both engineering and management roles before joining the Advanced Distributed Learning (ADL) Initiative. He is currently employed by The Tolliver Group, Inc. and provides Systems Engineering and Technical Analysis (SETA) support for the ADL, sponsored by the Office of the Deputy Assistant Secretary of Defense (Readiness). His primary focus is mobile learning, mobile device platforms & technology, and best practices for implementation. Haag’s professional affiliations include serving as chair of the DoD ADL (DADL) Working Group, member of the IEEE Learning Technology Standards Committee (LTSC), and member of the eLearning Guild. He is also a frequent speaker at industry events. Haag received his Master of Education Degree from the University of West Florida where he specialized in Education & Training Management and Instructional Technology. This paper was presented at the *Interservice/Industry Training, Simulation, and Education Conference* which promotes cooperation among the Armed Services, Industry, Academia and various Government

agencies in pursuit of improved training and education programs, identification of common training issues and development of multiservice programs. This resource uses 13 references drawing from academic articles, military publications, and reports. The primary basis for the paper is original research which follows established academic methodologies for conducting qualitative and quantitative research.

**Summary.** This article focuses on mobile education as it is being researched by the military. Per the author, while programs leveraging mobile learning have existed in the corporate sector for several years, there is a lack of academic research literature on the topic available, and very few studies about the effectiveness of mobile delivery of training in military settings. The research team developed an HTML5 course with varying CSS to accommodate the widest variety of mobile devices and browsers possible. Preliminary surveys found that very few organizations within the testing group offered mobile-friendly versions of their LMSes, despite a high willingness on the part of those surveyed to complete their annual training development on a mobile device. Due to the nature of the course used in the testing, the researchers were unable to significantly modify the instructional design and content of the course and instead were forced to present equivalently the same training as the e-learning course. However, within the changes they were able to make, they saw a reduction in seat time from 40 to 60 minutes on the e-learning course to only 25-45 minutes on the mobile learning course. By designing an easy to navigate interface and increasing the use of multi-media over textual display, a much higher rate of efficiency was achieved. At the end of the study, 85% of the participants expressed a desire to see future courses distributed through the mobile platform and over half of the participants preferred the mobile course to the e-learning

course. Users cited (a) convenience, (b) ease of use, and (c) the higher use of interactivity and multi-media components as reasons the mobile course was preferable. The mobile training could be completed anytime and anywhere which was also more convenient for personnel who had to travel. The author concludes that mobile course delivery could be a powerful instructional tool for the military and help increase satisfaction with training requirement and allow training to feel less forced upon users.

Kukulska-Hulme, A., & Traxler, J. (2005). *Mobile learning: A handbook for educators and trainers*. Abingdon, OX: Psychology Press.

**Abstract.** This book considers: the fundamentals of mobile technologies and devices the educational foundations of modern networked learning the issues that underpin mobile learning and make it accessible for all users the challenges of making mobile learning a substantial and sustainable component in colleges, universities and corporations implications and issues for the future. Mobile Learning provides useful, authoritative and comprehensive guidance for professionals in higher and further education and trainers in the business sector who want to find out about the opportunities offered by new technologies to deliver, support and enhance teaching, learning and training.

**Credibility.** Agnes Kukulska-Hulme is a Professor of Learning Technology and Communication and Associate Director (Learning and Teaching) in the Institute of Education Technology at the Open University in the UK. She serves on multiple mobile learning boards and panels and has published scholarly articles, books, book chapters, and other materials on mobile learning. John Traxler is Director of the Learning Lab and a Professor of Mobile Learning for the School of Computing & IT, University of Wolverhampton. He is also the Founding Director of the International Association for

Mobile Learning. He has co-written a guide to mobile learning in developing countries and is the co-editor of the definitive book on mobile learning *Mobile Learning: A Handbook for Educators and Trainers*, with Professor Agnes Kukulska-Hulme. He has also written 14 book chapters on mobile learning and has guest edited special editions of three peer-reviewed journals devoted to mobile learning.

**Summary.** This book is intended for lecturers, tutors, trainers, developers, managers, researches, and commercial educators tasked with explaining key benefits and concepts of mobile learning to other stakeholders. The book aims to introduce mobile learning concepts, technologies, pedagogical approaches and practices by presenting readers with case studies, mobile learning projects and strategies, and finally conclusions that can be drawn from the research in the field of mobile learning to date. Various technologies for mobile delivery of learning materials are reviewed and the types of devices available for mobile are explored. The book covers a wide range of case studies and implementations, but many of the findings can be universally applied across studies and contexts.

Technology limitations must be accounted for, but should not be the only or even the primary consideration when designing mobile training. Mobile learning designed in shorter segments with a greater user of multi-media and less text-based content performs better than longer, more text heavy learning activities. The digital fluency of the learner plays a significant role in the satisfaction with the mobile training, but smart and efficient UI design can help overcome some fluency issues. Ultimately, while many of the technologies explored in the book will become obsolete in the future, many of the issues faced will continue to be relevant and this book can help provide instructional designers

and educators with foundational information for the types of challenges they will face in designing mobile materials.

Motiwalla, L. (2007). Mobile learning: A framework and evaluation. *Computers & Education*, 49(3), 581–596. doi:10.1016/j.compedu.2005.10.011

**Abstract.** Wireless data communications in form of Short Message Service (SMS) and Wireless Access Protocols (WAP) browsers have gained global popularity, yet, not much has been done to extend the usage of these devices in electronic learning (e-learning). This project explores the extension of e-learning into wireless/handheld (W/H) computing devices with the help of a mobile learning (mlearning) framework. This framework provides the requirements to develop m-learning applications that can be used to complement classroom or distance learning. The results from this exploratory study provide a better understanding on the role of mobile technology in higher education.

**Credibility.** Lovai Motiwalla is a professor with the University of Massachusetts Lowell College of Management. Dr. Motiwalla earned his MS and PhD degrees in Management Information Systems from the University of Arizona. Professor Motiwalla's current research interests are the impact of ERP, E-Business and the evaluation of emerging technologies in e-Learning. He has published numerous articles in several national and international journals including *Computers and Education*, *Journal of Internet & Higher Education*, *Information & Management*, *Information Resource Management Journal*, *Journal of Organizational Computing & e-Commerce*, and *Journal of MIS*. *Computers & Education* which published this article is a scholarly, refereed journal which is published eight times a year. It provides a technically-based, interdisciplinary forum for communication in the use of all forms of computing in education and will continue to

publish definitive contributions to serve as a reference standard against which the current state-of-the-art can be assessed. This article makes use of 32 references including scholarly journal articles and books, conference proceedings, and industry publications.

**Summary.** This article explores the integration of mobile technology in distance or traditional classroom environments. Specifically, it looks at Smart phones usage combined with communication technologies such as WAP, SMS, and WML in higher education. According to the author, many instructors are concerned that introducing wireless devices to education is too distracting and that learners are not capable of concentrating on learning outside of a traditional classroom or e-learning environment. The paper presents the findings of a mobile learning pilot conducted across three classes over two semesters by utilizing commercial mobile application software to convert the current desktop sites for the courses to a mobile format to enhance their anytime/anywhere accessibility. Students in the study stated they found value in the flexibility of interacting with their courses in mobile format, but that more work to the UI to make it easy to navigate and interact on a small screen device would have been beneficial. Most participants indicated they would like to see further mobile learning offered and that it was a value-add to their courses. This project demonstrates that most learning pedagogies from constructive learning and conversation theories can be adapted for a mobile learning environment. The key is to understand the strengths and weakness of a particular technology, while deploying good pedagogical practices to achieve specific learning goals.

### **The Mobile Learning Context**

The third theme addresses those references which speak to (a) the challenges, and (b) advantages provided by the mobile learning environment, and (c) unique aspects of mobile learning. These references cover topics such as how mobile instructional design principles must account for the fact that students are utilizing the devices in environments over which the instructor has no control – such as cafes, the bank, or when waiting in line at the theater, and how the learning context is portable, ever-changing, and highly personal for each learner.

Ally, M. (Ed.). (2009). *Mobile learning: Transforming the delivery of education and training*. Edmonton, AB: Athabasca University Press.

**Abstract.** This collection is for anyone interested in the use of mobile technology for various distance learning applications. Readers will discover how to design learning materials for delivery on mobile technology and become familiar with the best practices of other educators, trainers, and researchers in the field, as well as the most recent initiatives in mobile learning research.

**Credibility.** Mohamed Ally is the Chair and Professor of Distance Education at Athabasca University in Canada as well as a researcher for the Technology Enhanced Knowledge Research Institute (TEKHRI). His research areas include distance education, e-Learning, mobile learning, workplace learning, and using emerging technologies in education and training. He has won multiple awards for his books and articles on mobile learning and has served in multiple training development and mobile learning organizations.

**Summary.** This book is intended for anyone with an interest in mobile learning in education and training. Faculty, researchers, teachers, instructors, trainers, business, and



government can all benefit from the information presented on the current state of mobile learning, the evaluation of the mobile learning context, and suggestions for addressing challenges while leveraging the advantages offered by mobile learning. The book consists of three parts. Part One deals with advances in mobile learning including: (a) the current status of mobile learning, (b) a model which can be used to guide the design and implementation of mobile learning, (c) theoretical information on mobile learning, (d) the definition of mobile learning, and (e) the challenges faced when designing and implementing mobile learning. Part Two presents the latest research on mobile learning. Part Three covers various examples of how mobile learning is being used in different subjects and locations throughout the world. The book presents many benefits and advantages to utilizing mobile technology in learning, and also many challenges that are faced by organizations when designing and implementing learning such as (a) institutional adoption and support of the mobile device platform, (b) teacher and instructor training, (c) technological limitations and device diversity, (d) varying digital fluency of the learners, and (e) effective integration of assessments and evaluations. The research and studies on mobile learning presented in the book make a strong case that mobile learning can be effective if designed and implemented properly.

Arnedillo-Sánchez, I., Milrad, M., Sharples, M., & Vavoula, G. (2009). Mobile learning. *Technology-Enhanced Learning*, 233–249. doi:10.1007/978

**Abstract.** Drawing on a theory of mobile learning as ‘the processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies’ (Sharples et al. 2007) we shall discuss how learning contexts are created through interaction, and how portable and ubiquitous technologies can support effective

conversations for learning. We shall draw on the findings from recent major projects to show how people artfully engage with their surroundings, peers and technology to create impromptu sites of learning and to carry their conversations from place to place, from time to time, from topic to topic.

**Credibility.** Inmaculada Arnedillo-Sánchez is a professor at Trinity College in Dublin with a Master's of Science in Information Technology Education. Her research areas include mobile learning and she has been published in multiple books and articles.

Marcelo Milrad is a Full Professor of Media Technology at the Department of Computer Science, School of Computer Science, Physics and Mathematics, at Linnaeus University (LNU) in Sweden. He has published over 145 articles in international journals, refereed conferences, books and technical reports and is currently researching the design of learning environments to support mobile and wireless applications and collaborative learning. Mike Sharples is a Professor of Educational Technology at the University of Birmingham, UK. He leads the University's Educational Technology Research Group comprised of 30 staff and postgraduate researchers and has published over 50 scholarly articles and books on the use of mobile technology in education. Dr. Giasemi Vavoula is a professor at the University of Leichester, School of Museum Studies. Dr. Vavoula's research includes mobile learning, the evaluation of mobile and informal learning, and technology-enhanced learning and she is published in many scholarly journals and books on these topics. This book chapter draws on 32 references spanning scholarly journal articles and books, conference proceedings, pre-published articles, and a PhD thesis.

**Summary.** The authors in this paper state that we have an opportunity in the mobile age to design learning differently. Learning can be designed in context with an aim towards

linking people in real and virtual worlds, creating learning communities between people on the move, providing expertise on demand, and supporting a lifetime of learning. However, in order to understand how people learn through mobile, pervasive, and lifelong interaction of technology, it is vital to understand the implications of learning with mobile technology. The mobile learning context must be considered when attempting to achieve an understanding of mobile learning. For example, a tourist in a new city might learn from: (a) a travel internet site, (b) a phone conversation, (c) a travel magazine on the plane flight, or (d) a printed brochure. It is this combined experience that constitutes mobile learning. When the *mobile* in mobile learning is explored, one will find that it includes: (a) mobility in physical space, (b) mobility of technology, (c) mobility in conceptual space, (d) mobility in social space, and (e) learning dispersed in time. Research into mobile learning is the study of how the mobility of learners augmented by personal and public technology can contribute to the process of gaining new knowledge, skills and experience. The context of use for mobile is unpredictable and can vary significantly, for example, in ergonomics, social context, and demands on the users' attention. Moreover, mobile contexts of use are often impromptu and thus difficult to observe, predict, or simulate. This varying context represents both one of the largest advantages and one of the most significant challenges of mobile learning. Until recently, most research into technology-enhanced learning has assumed that learning still happens in a classroom, mediated by a trained teacher or instructor. One major opportunity of mobile is to extend learning outside the classroom into informal environments for lifelong learning. However, this opportunity also offers a challenge, not only technically, but also philosophically, socially, and ethically. It raises issues surrounding the line

between technology and human cognition and memory, how to store or erase learning experiences, and where the lines are between formal education and informal learning. It is critical for schools and educational institutions to find ways to integrate mobile technology into their curriculum in a way that enables learning and insures that learners see school learning as relevant to their skills and interest. As organizations learn to adapt to the mobile context rather than resisting it, a more expansive and inclusive landscape of learning will develop.

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

**Abstract.** Mobile technologies are increasingly being promoted as tools to enhance learning. Our research is concerned with how mobile devices can be used to engender collaborative sensemaking activities during scientific tasks. The findings show marked differences in the amount and type of sensemaking. We discuss reasons for this in terms of task demands and workload, information type and distribution of devices.

**Credibility.** Dr. Kay Connelly is an Associate Professor in the Computer Science Department at Indiana University. Dr. Connelly's research focuses on user acceptance of ubiquitous and mobile computing technologies where there is a delicate balance between such factors as convenience, control and privacy. Dr. Connelly has published in numerous scholarly journals, though only two of her articles relate to mobile and are primarily focused on the use of technology in healthcare. Dr. William Hazlewood is a Postdoctoral Researcher at Indiana University. Dr. Hazlewood's research interests are technologies for healthcare, aging-in-place, alternative informational displays,

information visualization, ambient information, physical prototyping, and pervasive computing. He has published several articles on mobile technology in healthcare. Dr. Yvonne Rogers is a Professor of Interaction Design and director of UCLIC at University College London. Her research interests are in the areas of ubiquitous computing, interaction design and human-computer interaction. A central theme in her research is how to design interactive technologies that can enhance life by augmenting and extending every day, learning and work activities. She is one of the authors of the definitive textbook on interaction design and has been publishing articles on interaction design and technology since 1987. Dr. Lenore Tedesco is an Adjunct Faculty at the Indiana University Department of Earth Sciences and Executive Director, The Wetlands Institute. Dr. Tedesco is primarily a researcher for water source issues and has not previously published on mobile or learning design. *Personal and Ubiquitous Computing* is a peer-reviewed, scholarly journal published eight times per year in the UK. The journal focuses on issues surrounding the innovation, design, use and evaluation of new generations of handheld and mobile computers, innovative information management devices, and range of information appliances. This article cites 27 references including scholarly articles and books, conference papers and conference proceedings.

**Summary.** The authors explore the idea that the ability to use mobile devices for learning while engaged in an ongoing task in a physical environment may enhance the sense-making process by enabling students to step in and out of the tasks and reflect on these transitions. By allowing the learners to gain information and immediately apply it in context, the authors theorize the students might achieve a deeper understanding and help integrate their ideas, data and observations. A potential risk identified by the authors is

the potential for the mobile device to distract the students from their task and making it more challenging to retain information. The authors tested this theory by providing test groups of students with a PDA application for recording field information during several environmental studies. The application also allowed previously recorded data to be accessed and for messages to be exchanged between the groups. The authors conducted two different field tests with different numbers of PDAs assigned to the groups. During the test in which only one PDA was assigned per group, the authors found that the students were too busy using the PDA for data entry to make use of the information recall function to access data from previous years. However, simply adding a second PDA to the test enabled students to utilize one device for data entry while using the other to pull information on the previous observations of a specimen as a means of stimulating discussion about the specimen and constructing theories about what data anomalies might mean. Additionally, the quality of the interactions was also guided by how comfortable the team leader (instructor) was with guiding a discussion that integrated the information available on the digital device. The authors concluded that mobile devices can be useful tools for group contextual learning, but that it is important that the available information be pertinent to the learning context, the device distribution is robust enough to support use of the device for multiple tasks, and that the instructor is trained and comfortable with utilizing mobile devices as a tool for teaching and learning.

Cronje, J., & El-Hussein, M. (2010). Defining mobile learning in the higher education landscape. *Journal of Educational Technology & Society*, 13(3), 12–21.

**Abstract.** The article seeks to clarify the meaning of mobile learning by applying its key concepts to learning experiences in post-school education. The article argues that in order

to comprehensively understand and define mobile learning, we should from the outset separate its key components and arrange them under three different concepts. The first concept relates to the mobility of the technology. The second concept hinges on increased learner mobility. The third concept examines the mobility and dynamism of the learning processes and the flow of information.

**Credibility.** Dr. Johannes Cronje is the dean of the Faculty of Informatics and Design at the Cape Peninsula University of Technology in South Africa. Dr. Cronje has published numerous scholarly articles on technology in learning, mobile instruction, and instructional design theory. Mohamed Osman M. El-Hussein was a graduate student in the Faculty of Informatics and Design at the Cape Peninsula University of Technology in South Africa at the time he co-authored this paper. His thesis was titled, *Toward a theory of Mobile Learning: the Design of Learning Space for the higher Education Landscape*. The *Journal of Educational Technology & Society* is a peer-reviewed, scholarly journal published quarterly. It seeks academic articles on the issues affecting the developers of educational systems and educators who implement and manage such systems. The articles should discuss the perspectives of both communities and their relation to each other. This article contains 24 references which include scholarly journals and books, conference proceedings, and industry publications.

**Summary.** According to the authors, the increasing prevalence and sophistication of mobile devices is adding another layer to the computer-based model of teaching and learning. Educators, designers, and developers need to begin to consider the implications of these devices in the modern learning and teaching environment as a means of providing learners with content instruction and information outside of the traditional

learning space. Mobile learning development must account for the increasing mobility of learners, learning, and learner technology. Significantly, mobile devices are revolutionary because they transcend the boundaries of the structural stasis of classrooms and lecture halls and their associated modes of communication – they do not have to be confined to one particular place in order to be effective. With the increasing prevalence of mobile learning, educators and instructional designers need to account for the increasingly personal context of education. Instructional theory in the mobile age must be learner-centric rather than technology- or teacher-centric. Students learning via mobile delivery are not only remote from their instructor, they can fully control the information they chose to interact with on their device. If mobile learning is not applicable and designed to match the needs of the learner, the learner can chose to not interact with it. Instructional designers, however, often continue to not adapt their designs to consider the entire context in which a learner will use a particular mobile learning program and instead borrow ideas from their e-learning experiences which do not always translate well to mobile delivery. However, the proper design of the technologies leads to greater effectiveness of mobile learning. Designers and practitioners of education should clarify the design paradigm shifts that this mode of delivering higher education has introduced into the world of practice in order to ensure mobile learning is effective and efficient and the continuing needs of their students are being met.

Gibbons, C., Wang, R., & Wiesemes, R. (2010). Developing digital fluency through ubiquitous mobile devices: Findings from a small-scale study. *Computers & Education*, 58(1), 570–578. doi:10.1016/j.compedu.2011.04.013



**Abstract.** As part of the Visual Learning Lab's initiative of promoting visual learning supported through technologies in Higher Education, this VLL funded study explored part-time mature doctoral students' use and perceptions of a mobile device in support of their research activities. This paper raises a vital question about what constitutes a meaningful mobile learning experience which takes into account the different biographical and life stage factors. It challenges the ongoing debate on generational issues on uses of mobile or other digital technologies and leads to discussion of the concept of digital fluency with all learners.

**Credibility.** Dr. Cathy Gibbons is the Head of Researcher Development at the University of Exeter. Dr. Gibbons has experience of formal and informal education in the UK, Eire, USA, Middle and Far East, from compulsory to post-doctoral levels. Her teaching and research interests are in qualitative research methodology and the development of researcher self-efficacy. Dr. RuoLan Wang is a Research Fellow at the University of Nottingham. Dr. Wang's primarily interest is in generating an evidence-base for teaching and learning and, particularly, assessing the impact of technological interventions with an educational component. Dr. Rolf Wiesemes is a senior research fellow and Visual Learning Lab coordinator at the School of Education for The University of Nottingham. He has a strong interest in visual learning and especially in the use of video conferencing with schools and for teacher training. *Computers & Education* is a scholarly, refereed journal which is published eight times a year. It provides a technically-based, interdisciplinary forum for communication in the use of all forms of computing in education and will continue to publish definitive contributions to serve as a reference standard against which the current state-of-the-art can be assessed. This article has 44

references including scholarly journals and books, conference proceedings, and case studies.

**Summary.** One consideration of the mobile learning context not often considered in other studies under review in this Annotated Bibliography is the digital fluency of users receiving mobile training. The authors of this article argue that mobile learning can be relevant to learners without generational barriers, but that mature learners' needs need to be explored with the same rigor as has been invested in studying how to engage young learner's in the mobile environment. Mature learners are often less likely to be fluent in new technologies and there is a concern that while mobile learning may be available to everyone, a 'fluency gap' could leave mature learners unable to take advantage of mobile learning. This study attempts to begin addressing the gap in research on how more mature learners perceive and experience mobile learning. The study provided PDAs to a group of mature doctoral students for performing research activities. The device usage was somewhat unstructured with the intent to discover how the learners did on their own with integrating mobile as part of their learning process. The authors found that most students used the devices for storage and file transfer as their primary function, but that some performed research or modified presentations when they were unable to reach a desktop or laptop machine. Many students also utilized the devices for recording audio notes, especially at times where writing would have been difficult. All of the students reported challenges in familiarizing themselves with the technology as well as impatience with the necessity to sit down and learn the device. The students encountered many difficulties with the technology working as advertised and with the built in cameras not being of good enough quality. Overall, many of the difficulties reported with the technology were

the same as those reported by other, more digitally fluent, learners. However, the authors did find that mature learners were less comfortable with the mobile device platform and would require a greater up-front time investment in learning the technology. The mobile learning experience is highly personalized and contextual and the context for mature learners can be more complex than that for younger, more digitally fluent learners, but with commitment by all stakeholders, mobile training that is valuable to all learners regardless of digital fluency can be developed and mature learners can find benefits and advantages in mobile learning.

Guy, R. (Eds.). (2010). *Mobile learning: Pilot projects and initiatives*. Santa Rosa, California: Informing Science.

**Abstract.** This book examines the meaning as well as the benefits and barriers of mobile learning, details various global projects and initiatives that showcase the development and delivery of mobile learning, and traces the history of mobile learning to the present and provides a glimpse into the future of mobile education and the technologies used to facilitate the learning process.

**Credibility.** Dr. Retta Guy is an associate professor of Business Information Systems, College of Business, Tennessee State University. Dr. Guy has written or edited three books on mobile learning, contributed book chapters to six other publications, and has written multiple scholarly articles on mobile learning and technology in education.

**Summary.** This book presents the idea that the important distinctions between mobile learning and other forms of learning which must be considered are that mobile learning (a) enables knowledge building by learners in different contexts, (b) enables learner to construct understandings, (c) technology often changes the pattern of learning and

activity work, and (d) context is about more than just time and space. Mobile learning is also distinct from e-learning in that to deliver e-learning the learner must be brought to the device while in mobile learning the instructional material is brought to the learner. Mobile learning offers some distinctive challenges and advantages not seen in other forms of learning. Advantages include (a) performance support through offering users information, guidance, and support in context; (b) communication capabilities which allow learners to access experts input anywhere and anytime, and establishes communities of practice; and (c) appeals to learners who can now access information whenever and wherever without feeling awkward and embarrassed. Challenges include (a) technology constraints as a result of smaller screens, keyboards, and varying device capabilities; (b) a fragmented learning experience; (c) a lack of well-developed meta-cognitive skills (i.e. the lack of ability for learners to self-assess their learning process), (d) small screen size; (e) costs of development and deployment; and (f) security. The author concludes that the key to deploying a successful mobile learning program is to understand and plan for the challenges faced in the mobile learning context and to select good pedagogical practices designed to achieve learning goals.

Lonsdale, P., Naismith, L., Sharples, M., & Vavoula, G. (2004). *Literature Review in Mobile Technologies and Learning* ( No. 11). FUTURELAB SERIES (p. 48). University of Birmingham. Retrieved from

<http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.136.2203>

**Abstract.** This review provides a rich vision of the current and potential future developments in the area of mobile learning. It moves away from the dominant view of mobile learning as an isolated activity to explore mobile learning as a rich, collaborative

and conversational experience, whether in classrooms, homes or the streets of a city. It asks how we might draw on existing theories of learning to help us evaluate the most relevant applications of mobile technologies in education. It describes outstanding projects currently under development in the UK and around the world and it explores what the future might hold for learning with mobile technologies.

**Credibility.** Pete Lonsdale is a Learning Technologist at Keele University in the UK. Dr. Lonsdale has a PhD in Education Technology from the Learning Sciences Research Institute in Nottingham. His research interests include technology enhanced learning, mobile learning, and human computer interaction. Laura Naismith is a PhD Student at McGill University. Her current research interests include the role of feedback in supporting medical expertise development, technology-based assessment, communities of practice and mobile learning. Mike Sharples is a Professor of Educational Technology at the University of Birmingham, UK. He leads the University's Educational Technology Research Group comprised of 30 staff and postgraduate researchers and has published over 50 scholarly articles and books on the use of mobile technology in education. Dr. Giasemi Vavoula is a professor at the University of Leicester, School of Museum Studies. Dr. Vavoula's research includes mobile learning, the evaluation of mobile and informal learning, and technology-enhanced learning and she is published in many scholarly journals and books on these topics. This literature review was part of the FUTURELAB SERIES, a series of seminars which debated key issues, approaches and policies around home-school-community links, informal learning and the use of digital technologies. The literature review makes use of 76 references which include scholarly

articles and books, news articles, conference proceedings, reports, and industry publications.

**Summary.** This literature review explores many themes and concepts related to mobile learning, however, this summary primarily concentrates on the exploration of the mobile context and its accompanying benefits and challenges presented by the authors.

According to the authors, one of the great advantages to mobile learning is that it is extremely context-sensitive and can gather and respond to real or simulated data unique to the current, location, environment and time. However, this contextual awareness also carries with it privacy concerns. While contextual learning can be very valuable and authentic, enabling learners to gain information which is immediately applicable, it also raises moral concerns in relation to students' consent to be tracked at all times for the purposes of providing contextual learning. The mobility of the device also presents challenges as well as advantages. While mobility presents opportunities for learning outside of the classroom, it also means students have the capability to link to activities which do not correspond with the curriculum or goals of the instructor and can distract from learning. Life-long learning and informal learning can encourage learners to continue their education and learning past the formal educational experience, but ways must be offered for these learners to record, organize and reflect on their learning experiences for them to be fully realized opportunities. Ownership is another double-edged sword. Institutional ownership of devices can enable a standardized experience, but requires a significant investment in the technology and support. Individual ownership of the device relieves the financial burden, but can complicate the support paradigm and make developing mobile learning more challenge as a wider variety of platforms must be

accounted for in the interaction design. Mobile technologies provide for each student to have a personal interaction with the technology in an authentic and appropriate context of use. This does not mean, however, that the use of mobile devices is a panacea. Significant technological and administrative challenges are encountered along with the more difficult question of how to use mobile technology to truly facilitate a learner-centered approach to learning.

Quinn, C. (2011). *Designing mLearning: Tapping into the mobile revolution for organizational performance*. John Wiley & Sons.

**Abstract.** Mobile is a powerful new tool for supporting organizational performance, including a wide-variety of learning opportunities including innovation, collaboration, research, and design. Mobile generates new products, services, and helps solve problems. Whether providing needed tools, augmenting learning, or connecting individuals, mobile devices are empowering individuals and organizations.

This book presents step-by-step guidance for designing, delivering, and deploying mobile solutions, covering both the background model and pragmatic considerations for successfully navigating mobile projects.

**Credibility.** Dr. Clark Quinn holds a PhD in Cognitive Psychology from the University of California, San Diego. Dr. Quinn has led the design of award-winning online content, educational computer games, and websites, as well as adaptive, mobile, and performance support systems. Dr. Quinn works for clients in organizational learning strategy as a founding member of the Internet Time Alliance and in learning experience design via Quinnovation. He has also published several books on mobile learning.

**Summary.** This summary primarily reviews Chapter 5 of Quinn's book. This chapter is titled *Getting Contextual*. Per Quinn, one of the unique advantages offered by mobile learning is the ability for learners to receive knowledge in context. According to Quinn, removing formal learning from the classroom environment is beneficial for several reasons; (a) learners are more active outside of the classroom which can contribute to health, (b) getting out of the classroom is motivating, and (c) connecting learning to context helps ground the learning in the real world. Learning using the support of mobile devices can also allow learners to use a single device which can be moved between classrooms and in contexts outside of education. However, taking learning outside of the classroom also presents challenges. In instructor facilitated training, the needs for supporting students are no longer centralized, but distributed and requires different support measures be put in place. For informal learning which does not require an instructor, mobile devices can offer up the ability for learners to gather information on their own time and at their own pace. Many museums have begun offering tours with mobile devices acting as virtual guides. Businesses and conferences are also beginning to offer mobile as a contextual tool for conducting surveys and gathering feedback in the moment from participants. Information gathered from these interactions can allow trainings and presentations to be adapted in the moment based on the needs and responses of the learners. In the global environment, Quinn suggests that having educational materials available for users to download to cell phones in developing countries could help educate individuals on AIDs prevention, basic math and reading skills, and language and other learning. Contextual learning offers huge opportunities and while it is impossible to say where it will ultimately go, it is important to watch its development.



### **Conclusion**

This scholarly annotated bibliography presents 31 references selected from books, peer-reviewed journal articles, academic literature reviews, and industry conference papers. The research goal is to propose a set of mobile instructional design principles that may help educators to address the unique aspects of the mobile learning context. The Conclusion includes brief consideration of the relationships between selected existing learning theories and the mobile learning environment as a way to frame mobile learning instructional design principles within more familiar educational principles and practices. The primary objective of this annotated bibliography is to identify literature that describes the changes to instructional design principles which are taking place, or need to take place, as a result of the increased usage of mobile devices. This paper also explores the mobile learning context and the challenges and advantages offered by the mobile learning, as stated in the Research Questions section of the paper. Specific questions include: (a) what instructional principles should be developed when addressing the needs of an adult mobile learning audience, (b) what are the unique aspects of mobile learning context, and (c) what instructional challenges and advantages are offered by the mobile learning context? Understanding the mobile learning context is crucial to adequately and accurately identifying guiding instructional design principals which can be utilized to develop mobile learning which is effective, efficient, and achieves learning objectives.

Conclusions reached in this annotated bibliography are drawn from the coding and data analysis process in the Reading and Organization Plan section of the paper. These conclusions seek to support the needs of the audience of educators and instructional designers who are developing mobile education and training programs by providing them with a guiding set of principles for mobile instructional design. Mobile devices offer the potential for rich, multimedia

learning experiences, however models for using and developing learning for mobile applications are somewhat lacking (Lonsdale, Naismith, Vavoula, & Sharples, 2004). As such, educators and instructional designers face a challenge of determining how to use these powerful new tools in learning applications (Cronje & El-Hussein, 2010). In order to effectively support mobile education, instructional principles must be identified that are both pedagogically sound and address the mobile learning context in terms of usability (Gu, Gu, & Lafferty, 2011).

### **The Mobile Learning Context**

All learning takes place in context which establishes context as a crucial foundation for understanding and defining educational principles. While the mobile learning context includes many elements which are similar to the e-learning context and other educational contexts, this annotated bibliography focuses on identifying aspects of the mobile learning context which are unique and not present in other learning contexts – and thus not accounted for in other sets of instructional design principles. It also seeks to identify the advantages and challenges presented by the unique attributes of the mobile learning context.

Specifically, the references selected for presentation in this paper find that the mobile learning context contains three unique aspects when compared to other learning contexts: (a) mobility of the learner, (b) mobility of the learning, and (c) mobility of the context. As noted by Arnedillo-Sánchez, Milrad, Sharples, & Vavoula (2009), when the *mobile* in mobile learning is explored, it includes: (a) mobility in physical space, (b) mobility of technology, (c) mobility in conceptual space, (d) mobility in social space, and (e) learning dispersed in time.

**Mobility of the learner.** Learners are on the move! As mobile devices become ever more ubiquitous (Gibbons, Wang, & Wiesemes, 2010), and as information becomes ever more available for mobile consumption, learners increasingly look for opportunities to receive

education and training outside of traditional educational environments (Bruns, Cobcroft, Smith, & Towers, 2006). For example, time spent on the bus, waiting in line at the bank, and waiting for a flight can now be viewed as opportunities for learning (Gu, Gu, & Laffey, 2010).

While traditional classroom learning, and even e-learning, require learners to set aside time to focus on learning in specific locations, mobile learning de-tethers learners from a physical location and allows them to receive training anytime and anywhere that makes sense for them (Haag, 2011; Motiwalla, 2007). Learners may pass between multiple contexts while receiving mobile learning. For example, a tourist travelling to a new city could begin his learning about his destination at home by reading an article on the city on his mobile device. He could go on to research restaurants and attractions on his mobile device while traveling on the plane. Finally, upon reaching his hotel room, he could obtain directions on his device to reach various points of interest (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009).

The mobile learning context is controlled by the learner and not the instructor (Kukulsk-Hulme, Pachler, & Vavoula, 2009), making mobile learning more learner-centered and less technology or instructor centered (Lonsdale, Naismith, Sharples, & Vavoula, 2004; Muyinda, 2007). Learners are able to control not only when and where they learn, but to a large degree, they are able to select what they learn (Cronje & El-Hussein, 2010).

**Mobility of the learning.** Traditionally, learning takes place in a designated and defined formal educational context and must be retained and applied at a later time (Sharples, Taylor, & Vavoula, 2010). However, mobile learning can be delivered in varied contexts, which means that it is frequently available for immediate application. For example, in a study conducted by Connelly, Hazlewood, Rogers, and Tedesco (2009), research data was provided through mobile devices to users in the field test environment. The study found that users were able to review the

information and immediately apply it in context to increase sense-making (Connelly, Hazlewood, Rogers, & Tadesco, 2009). Mobile learning also allows users to carry their knowledge from one context to the next and continually have access to knowledge and expert advice and direction regardless of their geographic location or time of day (Guy, 2010) which represents a major advantage of mobile learning over e-learning (Evans, 2008). The ability of the learner to immediately connect learning with context can assist in retention (Quinn, 2011). Even in a classroom environment, the introduction of mobile devices can allow learners to carry information with them seamlessly between classrooms and locations (Quinn, 2011).

**Mobility of the context.** In traditional learning and e-learning, context is typically static (Cronje & El-Hussein, 2010), and learning takes place in a context which can be predicted, and to a degree controlled, by the instructor (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009). However, mobile learning can happen anytime and anywhere (Ally, 2005) and transcends the boundaries of the structural stasis of classrooms and lecture halls (Cronje & El-Hussein, 2010), making the mobile context unpredictable, with significant variation in terms of ergonomics, social context, and demands on the users' attention (Arnedillo-Sánchez, Milrad, Sharples, & Vavoula, 2009). Unlike traditional learning or e-learning, learners do not have to travel to a context specified by the learning – instead, the learning is brought to the learner in a context which is chosen by the learner (Guy, 2010). While mobility presents opportunities for learning outside of the classroom, it also means students have the capability to link to activities which do not correspond with the curriculum or goals of the instructor and can distract from learning (Lonsdale, Naismith, Sharples, & Vavoula, 2004). Ways must also be offered for learners in mobile context to record, organize, and reflect on their mobile learning experiences in order for

them to be fully realized educational opportunities (Lonsdale, Naismith, Sharples, & Vavoula, 2004).

### **Instructional Challenges and Advantages Unique to the Mobile Learning Context**

The many unique aspects of the mobile learning context also present advantages and challenges that must be considered when developing an effective set of instructional design principles for guiding mobile content development.

**Mobile context advantages.** Understanding the differences between the mobile learning context and other learning contexts can offer significant advantages to instructors and learners. Seven advantages unique to mobile learning are summarized in Table 1; more detailed analysis of each one follows the Table.

Table 1

#### *Mobile Learning Context Advantages*

<b>Mobile Learning Context Advantage</b>	<b>Brief Description</b>
#1: Learning is context-sensitive	Learning activities can be delivered which are specific to location and situation (Lonsdale, Naismith, Sharples, & Vavoula, 2004).
#2: Learning can be personalized	Instructors can direct learners to content designed to meet their specific needs (Alsadi & AbuShawar, 2009).
#3: Delivery of learning is more flexible	Mobile learning does not require that a learner attend a class at a specific place and time (Cronje & El-Hussein, 2010).
#4: Learning is learner-centric	Mobile learning is learner-centric and focuses on the needs learner instead of the instructor (Gibbons, Wang, & Wiesemes, 2010).
#5: Learning is immediately useable	By delivering learning in context, mobile learning can offer immediate benefits to the learner (Connelly, Hazlewood, Rogers, & Tedesco, 2009).

#6: Facilitates life-long learning	By removing learning from the classroom only environment and making it contextually-aware and immediately usable, learning becomes valuable to a broader audience (Gu, Gu, & Laffey, 2011).
#7: Learning can occur in non-traditional environments	In some developing countries where learners are unable to access a traditional learning environment, mobile devices offer an opportunity for education not previously available (Traxler, 2007).

**Advantage #1: Learning is context-sensitive.** The mobile learning context is very contextually-aware (Uden, 2007). Learning activities can be delivered to learners which are specific to their location and situation (Londsdale, Naismith, Sharples, & Vavoula, 2004). For example, museums have begun to leverage context-aware content delivery for conducting virtual, self-paced tours of their exhibits (Quinn, 2011). Businesses are increasingly using mobile devices as a way of gathering immediate feedback from participants in training classes and conferences (Quinn 2011). The ability of a mobile device to be aware of the context of the learner can allow for significant improvement in the ability of educators to delivery just-in-time information to learners (Guy, 2010).

**Advantage #2: Learning can be personalized.** Mobile learning can be personalized for the learner to a greater degree than other learning (Gibbons, Wang, & Wiesemes, 2010). Instructors are presented with the opportunity to review learners' activities and mobile devices enable educators to deliver materials to students based on their needs and preferences (Alsadi & AbuShawar, 2009). Learners also retain greater control of their educational experience by being able to select a time and place for learning which most closely meets their scheduling needs, in

which they feel comfortable, and where they can progress at their own pace without feeling awkward or embarrassed (Guy, 2010).

**Advantage #3: Delivery of learning is more flexible.** Mobile learning is more flexible than other methods for delivering learning in that it does not require that a learner attend a class at a specific place and time (Cronje & El-Hussein, 2010). Mobile learning does not require that a learner be located somewhere that has access to a desk top machine as does e-learning (Motiwalla, 2007). Instead, learners can have access to educational materials as the need arises and when the time is right for them, regardless of geographical location (Alsadi & AbuShawar, 2009).

**Advantage #4: Learning is learner-centric.** Mobile learning is learner-centric and focuses on the needs learner instead of the instructor (Gibbons, Wang, & Wiesemes, 2010). Unlike with other forms of learning, the learner often has the opportunity to choose to participate or not participate in mobile learning (Cronje & El-Hussein, 2010). As such, instructional designers must develop training which is compelling and valuable to the learner and meets the learner's needs (Gu, Gu, & Laffey, 2011) in order to ensure participation.

**Advantage #5: Learning is immediately useable.** By delivering learning in context, mobile learning can offer immediate benefits to the learner (Connelly, Hazlewood, Rogers, & Tedesco, 2009). The learner can obtain training at the time and place they need the information and immediately apply what they have learned (Lonsdale, Naismith, Sharples, & Vavoula, 2004). Mobile learning offers learners access to expert advice and direction whenever and where ever it is needed (Arnedillo-Sanchez, Milrad, Sharples, & Vavoula, 2009; Guy, 2010).

**Advantage #6: Facilitates life-long learning.** Mobile learning blurs the line between formal and informal learning (Kukulka-Hulme, Pachler, & Vavoula, 2009). By removing

learning from the classroom only environment and making it contextually-aware and immediately usable, learning becomes valuable to a broader audience (Gu, Gu, & Laffey, 2011). As mobile learning becomes more personalized and not strictly limited to academic applications, increasing opportunities are offered for learning which can be used by older members of the community who may no longer view themselves as candidates for formal education (Gibbons, Wang, & Wiesemes, 2010).

**Advantage #7: Mobile learning can be utilized in non-traditional environments.** This can be especially advantageous when attempting to offer education and training to users who are unable to access a traditional classroom (Traxler, 2007). In many third-world countries where class-room opportunities are limited and wired internet is scarce, mobile devices are becoming more prevalent (Traxler, 2007). In these areas, mobile learning presents a significant opportunity to improve the quality of life of the learners by providing valuable training on considerations such as basic math, reading, and HIV/AIDS prevention (Quinn, 2011).

**Mobile context challenges.** Many of the advantages offered by the mobile learning context also pose challenges to developing effective learning. Six challenges unique to mobile learning are summarized in Table 2; more detailed analysis of each one follows the Table.

Table 2

*Mobile Learning Context Challenges*

<b>Mobile Learning Context Challenge</b>	<b>Brief Description</b>
#1: Fragmented learning experience	Because learning is distributed across time and space (Sharples, Taylor, & Vavoula, 2005), fragmentation of the learning experience can occur (Guy, 2010).
#2: Lack of instructor control	It is difficult for the instructor to direct and structure the learning experience as the needs for supporting students are no longer



	centralized and require different support measures be put in place (Quinn, 2011).
#3: Technology limitations	Technology constraints as a result of smaller screens, keyboards, and varying device capabilities (Guy, 2010), as well as varying institutional support capabilities (Lonsdale, Naismith, Sharples, & Vavoula, 2004) must be considered.
#4: Varying levels of digital fluency	In some audiences, additional time is needed to assist learners in developing familiarity with the device in order to facilitate mobile learning (Gibbons, Wang, & Wiesemes, 2010).
#5: Lack of training	Instructors must be educated on the unique aspects of the mobile learning context (Ozdamli, 2011) and must also become familiar with the technology capabilities and limitations offered in the mobile learning environment (Attewell, 2004).
#6: External distractions	Users are often attempting to fit learning in around other conflicting demands (Evans, 2008), and external distractions can be disruptive to the learning experience and prevent effective learning (Gu, Gu, & Laffey, 2011).

**Challenge #1: Fragmented learning experience.** The mobile learning context often leads to a fragmented learning experience. Because learning is distributed across time and space (Sharples, Taylor, & Vavoula, 2005), continuity between lessons can be lost. Additionally, the experience is fragmented as individual learners navigate through distinctly different paths in the varied types of materials (Guy, 2010). This can lead to instructional design challenges in determining the best approach for developing content for a broad audience of learners with different needs and goals due to the lack of direct contact between the instructor and learner (Park, 2011).

**Challenge #2: Lack of instructor control.** The mobile learning context removes some level of control of the learning experience from the instructor and places it in the hands of the learner (Gibbons, Wang, & Wiesemes, 2010). While this can be an advantage to the learner in terms of personalization and comfort with the learning experience (Guy, 2010), it can also make it more difficult for the instructor to direct and structure the learning experience, as the options for supporting students are no longer centralized and different support measures may be required (Quinn, 2011). Learners also have a greater capability to link to activities which do not correspond with the curriculum or goals of the instructor (Lonsdale, Naismith, Sharples, & Vavoula, 2004).

The role of the instructor is still vital in a mobile learning environment to ensure the learning experience is meeting the needs of the learners (Sharples, Taylor, & Vavoula, 2010). Mobile learning requires more facilitation rather than less, according to Alsadi and AbuShawar (2009) and instructors will need to spend more time on course-delivery and follow up as well as providing a rich learning resource environment for learners.

**Challenge #3: Technology limitations.** The third, and one of the largest challenges, is the mobile technology itself. The devices available for mobile learning delivery are incredibly diverse and continually evolving (Kukulska-Hulme & Traxler, 2005). The life span of any specific device in the mobile space is relatively limited which means learning modules must be continually updated to ensure full compatibility with current technologies (Kukulska-Hulme, Pachler, & Vavoula, 2009). The diversity of the devices also mean that the learning experience can vary significantly from platform to platform based on factors such as (a) screen size, (b) processing capabilities, (c) presence or absence of a keyboard, (d) touch screen interfaces, (e) mobile browser type, and (f) mobile operating system (Guy, 2010). Even for users with a high

fluency in technology, adapting to learning interactions on a small-screen device can prove challenging (Barbosa, Reinhard, Sacco, & Schlemmer, 2010). Instructional designers and developers are required to make decisions early in the process of building mobile learning on which platforms and devices the materials will be designed to support (Attewell, 2004). As such, learners on devices for which the learning experience has not been optimized may have a less than ideal experience or unable to participate in the training due to the fragmentation of the mobile platforms (Haag, 2011). The variable connection rates depending on the data plan and capabilities of the device can also pose challenges (Alsadi & AbuShawar, 2009). Streaming large volumes of information to a mobile can be slow or cause connections to drop (Ronchetti & Trifonova, 2003). Poor connection speed and challenges in accessing materials due to connection challenges can be off-putting to learners and result in a resistance to undertaking mobile learning (Bruns, Cobcroft, Smith, & Towers, 2006). Organizations must also be prepared to support mobile devices before deploying mobile learning (Lonsdale, Naismith, Sharples, & Vavoula, 2004). Information technology (IT) teams must be trained to support mobile devices, the organization must make a decision about which devices will and will not be supported, and it must be determined if users will supply their own devices or if the organization will supply devices for them (Lonsdale, Naismith, Sharples, & Vavoula, 2004). Security measures must be established for how the devices will interact with the existing networks and technologies, and users must be made aware of these processes and procedures (Guy, 2010). Without careful thought regarding all the technology considerations that accompany mobile learning, any attempt at deploying mobile learning programs will fail.

**Challenge #4: Varying levels of digital fluency.** The digital fluency of the learner plays a significant role in the satisfaction with the mobile training (Kukulska-Hulme & Traxler, 2005).

While younger learners who are part of the so-called *device generation* are likely familiar with mobile devices and can seamlessly transition into mobile learning, older learners may be less comfortable with mobile devices (Gibbons, Wang, & Wiesemes, 2010). When deploying formal, informal, and life-long learning to audiences with varying generations, especially those audiences with a higher concentration of older users, additional time is needed to assist learners in developing familiarity with the device in order to facilitate mobile learning (Gibbons, Wang, & Wiesemes, 2010). Lack of fluency with the mobile device platform was cited in several studies as the greatest barrier to entry into mobile learning by older learners (Gibbons, Wang, & Wiesemes, 2010; Haag, 2011).

**Challenge #5: Lack of training.** The lack of training for instructors, instructional designers, and other educators on how to effectively integrate mobile poses a challenge to the deployment of mobile learning programs. Instructional designers must significantly change their approach to training design in order to support mobile delivery (Ally, 2005). Instructors must become educated on the unique aspects of the mobile learning context when designing curriculum for mobile delivery (Ozdamli, 2011) and must also become familiar with the technology capabilities and limitations offered in the mobile learning environment (Attewell, 2004). Without adequate training for instructors, instructional designers, and educators, it will be difficult if not impossible to develop effective and efficient mobile learning programs. Instructors and instructional designers are critical components in the mobile learning environment and time should be invested in the necessary education for the design of mobile learning (Sharples, Taylor, & Vavoula, 2010).

**Challenge #6: External distractions.** External distractions represent a challenge to learners in the mobile learning context. In a classroom or e-learning environment learners are

able to focus on learning (Motiwalla, 2007). However, in mobile learning, users are often attempting to fit learning in around other conflicting demands on their time and attention (Evans, 2008). These external distractions can be disruptive to the learning experience and prevent effective learning (Gu, Gu, & Laffey, 2011). Any model of mobile instructional design must account for the presence for outside distractions and provide strategies for mitigating their impact on learning (Gu, Gu, & Laffey, 2011).

### **Considering Existing Learning Theories in Relation to Mobile Learning**

The mobile learning context sets the stage for beginning to establish a set of guiding principles for instructional designers developing learning for the mobile environment. However, in addition to the unique aspects, challenges, and advantages of the mobile context, effective and efficient instructional design principles must also consider and be grounded in proven pedagogy and learning theories. While approaches to teaching and learning should be adjusted for mobile delivery, mobile learning principles must be based on a sound foundation of learning theory and cannot simply be technology-driven (Arnedillo- Sánchez, Kukulska-Hulme, Milrad, Sharples, & Vavoula, 2009).

Several existing learning theories represent sound starting points for developing a set of guiding principles for mobile instructional design. Arnedillo- Sánchez, Kukulska-Hulme, Milrad, Sharples, and Vavoula (2009), believe that many existing theories of learning may be relevant in mobile, depending on the social practices that develop around the use of mobile technology in instructional practices.

Activity theory is presented by Uden (2007) as a theoretical framework that can be used to design a mobile learning environment and mobile learning activities. Per Uden, the four steps within activity theory can be effectively leveraged for designing a framework for mobile

learning, (a) clarify the purpose of the activity, (b) analyze the context for learning and use, (c) historically analyze the activity and its constituent components and actions, and (d) search for internal contradictions as the driving forces behind disturbances, innovations and change of activity system. Activity theory also utilizes activities which consist of a subject and an object, mediated by a tool as a method for understanding human activity and work practices (Uden, 2007). These activities can be adapted as interactions between a learner and a learning activity, with the mobile device acting as a tool.

Park (2011) proposes that transactional distance theory can be adapted as a basis for developing a set of guiding principles for mobile instructional design. Park categorizes mobile learning under the four types of mobile learning which she identified by applying the transactional distance framework to mobile: (a) high transactional distance and socialized mobile learning activity, (b) high transactional distance and individualized mobile learning activity, (c) low transactional distance and socialized mobile learning activity, and (d) low transactional distance and individualized mobile learning activity. Park goes on to express that transactional distance theory confirms that mobile devices can uniquely support movement of learners between personalized and social learning.

Ally (2005), presents the idea that mobile learning principles need to take advantage of cognitive learning instructional theories. Cognitive learning theory states that learning involves the use of memory, motivation, thinking, and reflection (Ally, 2005).

Sharples, Taylor, and Vavoula (2005), find that mobile learning broadly matches the social-constructivist approach to learning which views learning as an active process of building knowledge and skills through practice within a supportive community.

A consensus is not held by any of the experts on which theory of learning best supports the mobile learning context, and in fact Kukulska-Hulme, Pachler, and Vavoula (2009) suggest that mobile learning cannot be described fully by any single methodology. Muyinda (2007) does not believe that any existing learning theories currently encapsulate all the considerations in the mobile learning context, but that until a theory of mobile learning is fully developed, many existing learning theories can be utilized to at least begin allowing instructors to take advantage of the mobile learning environment. He puts forth the idea that behaviorist learning theory, constructivist learning theory, situated learning theory, collaborative learning theory, and informal and life-long learning theory can all at least partially meet the needs of instructors designing mobile learning materials (Muyinda, 2007). Herrington, Herrington and Mantei (2009) recommend that instructors take a design-based approach to mobile learning, with an eye towards improving the learning experience, rather than focusing on creating principles which prove one theoretical approach over another. However, it is clear that existing learning theories *should* be evaluated for their relevance to mobile learning. Additionally, instructional designers will be able to leverage their existing knowledge of learning theories and pedagogy to assist in developing sound mobile learning.

### **Mobile Instructional Design Principles for Adult Learners**

The mobile learning environment offers instructional designers an opportunity to re-envision education and to redefine the relationship between instructor and learner. After reviewing the mobile learning context as well as the theoretical foundations of learning, it is possible to begin offering a set of mobile instructional design principles for guiding the creation of effective and efficient mobile learning. These principles should act as a guide to instructors, instructional designers, and other educators who are tasked with designing effective and efficient

mobile learning. The following six instructional design principles are recommended as a framework for mobile instructional design: (a) develop a simple and intuitive interface; (b) integrate interactivity and multi-media; (c) build short, modular lessons and activities; (d) design activities that are engaging and entertaining; (e) design content that is contextual, relevant, and valuable to the learner; and (f) consider just-in-time delivery. More detailed descriptions of each principle are provided below.

**Principle #1: Develop a simple and intuitive interface design.** Mobile learning design should be simple and easy to understand. The usability should be simple and consistent to enable learners to quickly and easily learn how to use the interface (Gu, Gu, & Laffey, 2011; Ronchettie & Trifonova, 2003). Smart and efficient UI design can help overcome some fluency issue experienced by users (Kukulaska-Hulme & Traxler, 2005).

**Principle #2: Integrate interactive and multi-media.** Mobile devices offer the potential for rich, multimedia learning experiences (Lonsdale, Naismith, Vavoula, & Sharples, 2004). Mobile learning design should take advantage of multi-media formats such as audio, video, and greater use of video due to the small-screen form factor of most mobile devices (Ally, 2005). Mobile learning is best when it contains multi-media components rather than just text (Cagiltay, Gedik, Hanci-Karademirci, & Kursun, 2012). In cases where the use of multi-media was used in place of textual display, a much higher rate of efficiency was achieved (Haag, 2011). Mobile learning designed in shorter segments with a greater user of multi-media and less text-based content performs better than longer, more text heavy learning activities (Kukulaska-Hulme & Traxler, 2005).

**Principle #3: Build short, modular lessons and activities.** Mobile learning must be organized or “chunked” appropriately in order to facilitate the learning process and 5-9 units per



course are thought to be appropriate in order to compensate for short-term memory limitations (Ally, 2005). Mobile learning should be micro, that is, delivered in small enough chunks that it can be easily integrated into the busy schedule of lifelong learners and successfully compete against other distractions (Gu, Gu, & Laffey, 2011). Short, modular lessons also enable learners to use small fragments of waiting or idle time for learning (Ronchetti & Trifonova, 2003)

**Principle #4: Design activities which are engaging and entertaining.** Mobile learning should be engaging and entertaining (Ronchetti & Trifonova, 2003). Instructional designers must use learning activities to engage learners (Bruns, Cobcroft, Smith, & Towers, 2006) and the content must be engaging, and suited to everyday needs (Gu, Gu, & Laffey, 2011).

Entertainingly designed mobile learning activities help to remove some of the formality from the learning experience and engage reluctant learners (Attwell, 2004). If mobile learning is not applicable, engaging, and designed to match the needs of the learner, the learner may choose not to interact (Cronje & El-Hussein, 2010).

**Principle #5: Design content that is contextual, relevant, and valuable to the learner.**

Mobile learning content should add value to the learner (Ronchetti & Trifonova, 2003).

Location-aware mobile phones offer the possibility of education services and educational media matched to the learner's context and interests (Sharples, Taylor, & Vavoula, 2010). One of the great advantages to mobile learning is that it is extremely context-sensitive and can gather and respond to real or simulated data unique to the current location, environment, and time (Londsdale, Naismith, Sharples, & Vavoula, 2004).

**Principle #6: Just-in-time delivery.** Mobile learning should deliver just-in-time information which supports teachers and students in new learning environments (Ronchetti &

Trifonova, 2003). Just-in-time delivery can improve efficiency by providing support and information for the learner's immediate priorities (Traxler, 2007).

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