

# **Strategizing for Mobile Learning: A Holistic Approach for Designing Mobile Learning**

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## **Abstract**

Mobile learning provides unique learning experiences for learners in both formal and informal environments, supporting various pedagogies with the unique characteristics that are afforded by mobile technology. Mobile learning, as a growing topic of interest, brings challenges of design for teachers and course designers alike. Current research on mobile learning has covered various aspects such as personalization, context sensitivity, ubiquity and pedagogy. While existing theories and findings are valuable to the understanding of mobile learning, they are fragmented and separate, and need to be understood within the broader mobile learning paradigm.

This paper unifies existing theories into a method for mobile learning design that can be generalized across mobile learning applications. This method develops from a strategy: by seeking objectives, identifying different approaches to learning and understanding the context in which the course will exist. The method helps to guide the content, delivery and structure of the course towards a successful implementation that is evaluated against the initial objectives set out. This paper brings to light the need for more guiding literature that assists teachers in applying the theory around mobile devices and the method proposed is a step in this direction.

**Keywords:** Mobile learning, Course design, E-learning, Mobile strategy.

## **Introduction**

Mobile learning has been an emerging topic since the introduction of cellular phones and wireless technology; recently this interest has picked up pace due to further technological advances that are making mobile technology simpler and more interesting to use as a means of learning (Burdick & Willis, 2011; Weilenmann & Juhlin, 2011). Mobile learning is the combination of mobile technology and its affordances that create a unique learning environment and opportunities that can span across time and place.

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Learning is a form of communication, of transferring knowledge and information, so it makes sense that the most 'ubiquitous form of communication' (Franklin, 2011) is used as a tool for learning. What is questioned, however, is not so much whether mobile technology should be used but how it should be used. The uniqueness of mobile learning lies in it being a ubiquitous, social, context sensi-

tive, and collaborative tool (Ozdamli & Cavus, 2011; Patokorpi, 2006). Various models for understanding mobile learning systems have been created and adapted to measure performance, user acceptance, understand the user's context, and understand and develop mobile systems and technology (Parsons & Ryu, 2006; Sha, Looi, Chen, Seow, & Wong, 2012; Williams, 2009).

Mobile learning design is the design of a mobile learning course taking into account what needs to be delivered, how it will be done and the structure of such a delivery. This design needs to look at the 'real needs of instructors and learners' (Alvarez, Alarcon, & Nussbaum, 2011) and at the social aspects that mobile technology was originally intended for to get the most out of mobile learning. In addition it should consider the 'as-lived-experience' of mobile learners (Kjeldskov & Stage, 2012), because in essence learning is deeply social (Burdick & Willis, 2011). However, the determining factor for mobile technologies in learning will be dependent on its adoption by both educators and the learners (Alvarez et al., 2011).

Williams (2009) considers the major element of a successful mobile learning platform to be the instructional design; by simply posting lecture content as-is on the Web, the teacher is not necessarily creating a viable tool for learners. While many universities have provided applications, these have been non-instructional, and thus there is little experience of how to deliver learning through mobile technology (Cheon, Lee, Crooks, & Song, 2012).

Another issue is that "few researchers have discussed ways of integrating mobile devices with web-based learning systems to cover most learning processes by generating a ubiquitous learning environment" (Chen et al., 2008, p.78). Designers and teachers need to have a basic understanding of the various characteristics of mobile learning and how they can best be used. The use of traditional user experience knowledge is insufficient for this as it doesn't take into account those unique characteristics of mobile learning such as mobility and how smaller screens limit the type of content delivered (Chittaro, 2011; Costabile et al., 2008; Naismith, Lonsdale, Vavoula, & Sharples, 2004).

Where mobile learning is a supporting tool to the classroom, understanding the contexts and teaching concepts are required to effectively implement the system (Alvarez et al., 2011). The theme that arises in the literature is one of understanding: the designer needs to be able to understand and conceptualize all aspects of the mobile learning system to be as effective as possible in delivering the objectives.

This paper consolidates research around mobile learning to create a method for mobile learning design that does not prescribe the content and structure but rather facilitates the process of planning and creating a course while ensuring that the various aspects such as technology, context, usability, and pedagogy are considered along with the objectives of the course. The objective of this research is to create and evaluate a method for mobile learning design from existing mobile and learning theory that can be used by business persons and teachers alike. The research explores the following questions:

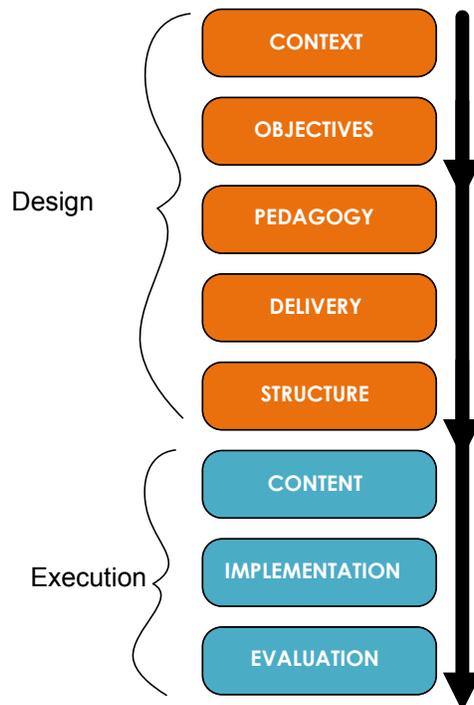
- How can the technical aspect of mobile learning research and educational research be combined to get a holistic and effective approach to designing mobile learning?
- What would a method for mobile learning design look like, and what are the steps to follow this method?
- How can an understanding of a mobile user's as-lived mobile experience be used to maximise the potential of mobile learning?

A design science research methodology was selected as a research approach that allows for the research artefact – a method – to be developed and evaluated in multiple iterations, such that the method can be improved upon constructively. Design science is a creative and generative ap-

proach which is appropriate for the type of contribution that this research is attempting to create. It is important to realize that knowledge is at the core of the research, and in this research the aim is to create prescriptive knowledge from evaluating the identified problem and creating an artefact (method) to address these problems (Baskerville, Kaul, & Storey, 2011; Hevner, March, Park, and Ram, 2004). The next section presents the resulting method with reference to existing literature as its basis.

## Method for Mobile Learning

Based on previous research, this section proposes a method for designing mobile learning. Figure 1 outlines the eight phases that will be described in designing and implementing mobile learning. The first five phases (highlighted in orange) illustrate the general design process of considering the context, objectives, pedagogy, the delivery and the structure of the course. The last three phases (highlighted in blue), are the content, implementation and evaluation of the course that are outside of the design of the course and are included as completing the process ensuring that the design meets its objectives. The phases proceed in order as indicated by the arrows. The following sections will describe each phase in detail.



**Figure 1: Phases in designing mobile learning**

### **Context**

Creating the context around the course is the first step in the method. The context has multiple parts and assists in guiding the designers and teachers as to what is appropriate and expected from the course. For example, if the context is in an impoverished area that does not have high connectivity then it would be unrealistic to use images when text and voice would be easier to access for the learners, whereas a university with good connectivity and access to multiple devices would expect a higher quality of presentation.

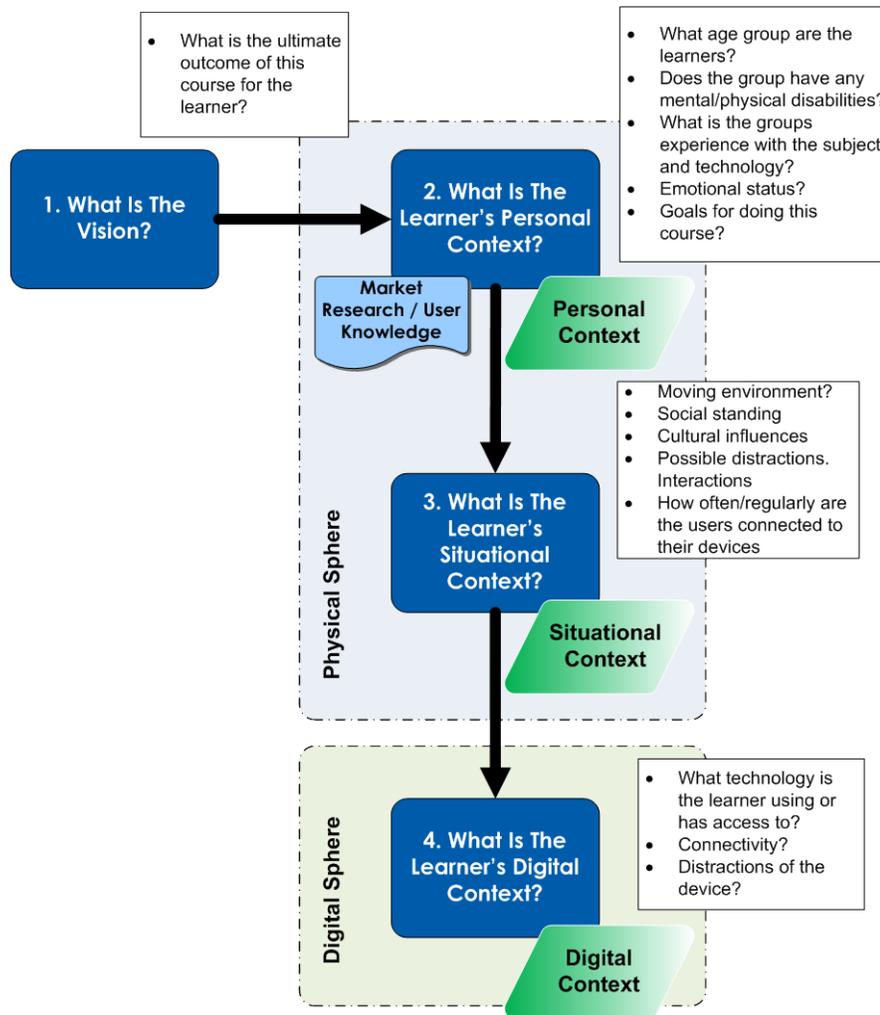


Figure 2: Initial considerations in creating context

Context is an area that needs to be considered and, depending on the category of learning chosen, the context may be more crucial to the success of the course; it ties strongly to the objectives of the course and ‘how’ it will be delivered. Figure 2 presents the Initial considerations in creating context and gives an example of what kinds of questions to ask for each of the contextual areas.

### Creating a vision

As an initial step to context, an overall vision should be put into place that will guide the design going forward. This vision should have a purpose. Purpose is important to any design: is the purpose simply to transfer information to a learner or is there a more intrinsic value to the purpose, perhaps to deepen the learner’s understanding or thinking? The vision will provide the complexity of the design and content required.

It is important to note that at any point during the process described here aspects can be changed. So the vision can be changed later as the method develops, and a new aspect comes to light.

## Physical and digital sphere

Al-Hmouz et al. (2010) and Koole (2009) described three major categories of context: (1) learner's personal status that takes into account personal motivation and prior knowledge of the learner; (2) situational context that looks at where the learner is using the course, how often and when and what kind of social environments; (3) learning environment context that is the link between what the device can offer (digital sphere), the content and engagement with the learner.

The physical sphere (learner's personal and situational context) and the digital sphere are considered individually below and influence each other.

### Learner's personal context

The learner's context considers aspect of the learner such as preferences, demographic information, and learner history as well as cognitive ability, memory, prior knowledge, emotions and possible motivations (Al-Hmouz, Shen, Yan, & Al-Hmouz, 2010; Koole, 2009). The designer/teacher should ask such questions as:

- What age group is the learners?
- Does the group have any mental/physical disabilities?
- What is the groups experience with the subject and technology?
- What is the learner's emotional status?
- What are the learner's reasons for doing this course?

These questions will establish the numerous influences surrounding the learner that can affect his/her behaviour, emotional state and concentration and ultimately his/her ability to use the mobile learning service appropriately. While there is no control over these influences, keeping these in mind when considering the implications of the design will assist in aligning the course to the learner and finding ways to engage the learner that will suit his/her personal context.

### Situational context

The nomadic and ubiquitous nature of mobile technology means that a user's context is constantly changing due to the freedom of movement.

The social/situational context is the actual context in which the learner currently exists as they access or receive learning from a mobile device. It can be defined by the social interactions, cultural surroundings and rules around communication. This context will involve any distractions or interruptions to the learning environment context. Chittaro (2011) points out that using mobile technology can often be a secondary task within our social context - mobile phones have introduced an unpredictability, when one person calls another they are not sure what situation that person is in and cannot know whether they are interrupting that person. It is also a common expectation that someone can answer a call at any time as they will always have access to their phone. The mobile device is then an extension of that person's situation, so while a user is interacting with the mobile technology they are also involved with "the world as negotiated and enacted in the moment" (Fischer, 2011).

This is an important consideration as it questions how often and how regularly users would engage with their phones for mobile learning. Fischer (2011) also noted that "when users were away from home, they carried their mobile phone with them significantly more often than when at home." This means that the situational context of a user will often be in a non-constant state; being on the move often means "that people can devote only a very limited attention to the device while they are on the move" (Chittaro, 2011). This brings up an interesting conflict that needs to

be taken into account when designing: even though learners are able to learn on the move there is also a higher chance of distraction and interruptions. Questions to consider in this regard include:

- Whether the learner is in a moving environment? This will affect the length and type of delivery of the course.
- Are there cultural influences on these learners that may impact his/her learning? Some cultures may have a high resistance to the use of technology.
- What are the possible distractions and interactions that the learner might have with the technology being used for the delivery of the course? Think of text messaging, phone calls and other social media that may take preference over learning.
- How often/regularly are the users connected to their devices? If a learner can only get access to the device between certain hours or at a specific place then this will impact the regularity and type of material used on the device.

### Digital sphere and learning environment

The digital sphere is defined as the device and technology, looking at the functional ability of the device, its physical and technical attributes from the hardware and software. Mobile learning includes the learner's personal context within a situational context, and these can be considered physical spheres. By introducing the digital sphere into the learning context we have a mobile learning environment.

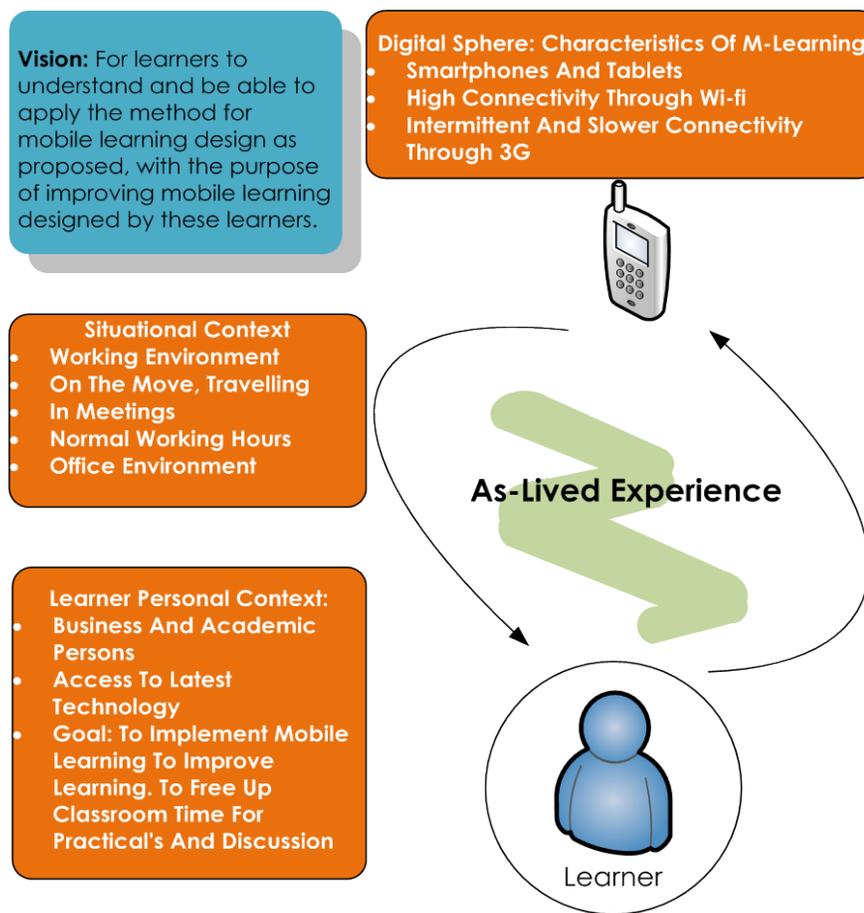


Figure 3: Example of creating context

The mobile learning context is thus created in the way that it is delivered and the learning styles that it caters for. The mobile learning context is where the situational and learner's personal context meet with the digital sphere. The learning environment is what will be created by implementing this course and combining these contexts.

In essence, what is being sought is the 'target audience' and then looking at how the different contexts of this audience influences the design of the course. Figure 3 provides an example of how the answers may be captured. With these contexts described, the as-lived experience must be addressed to show the relationship between these contexts in creating the learning environment.

### As-lived experience

As the various contexts are unpacked it becomes simpler to understand where the learning is going to take place. The as-lived experience takes this one step further, in understanding how the learner relates to mobile technology and hence will relate to the mobile learning designed.

The context leads to awareness of the as-lived experience where questions around readiness-to-hand, anticipation of breakdown and the blindness created by design can be offered to assist in usability and consideration of the user in design (Winograd & Flores, 1986).

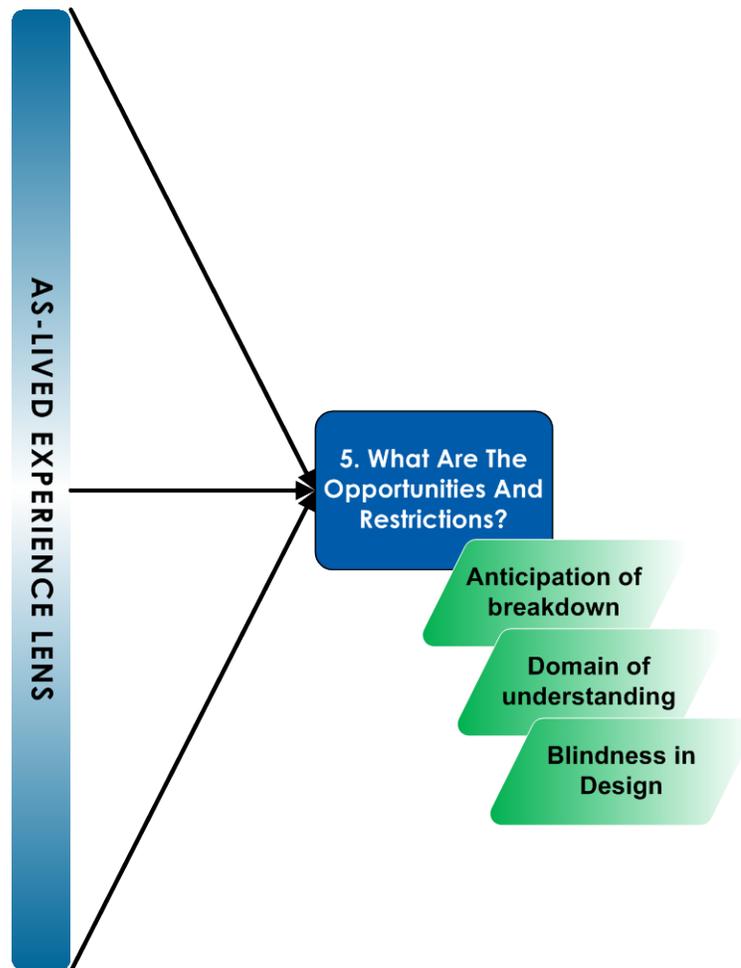


Figure 4: As-lived context considerations

The as-lived experience provides a look into ‘the opportunities and restrictions created by this mobile learning course’ – as seen in Figure 4. Some of these aspects come from and have been mentioned in the context already created, in understanding the learner, his/her environment and access to technology. The as-lived experience takes this a step further and defines the users relationship to technology and hence the course being created.

Step 5 in the process is about considering the different aspects of the as-lived experience, which may trigger certain requirements around how the course is to be put together and delivered to the learner. In discussing the as-lived experience the designer is looking for ways to create a “Readiness to Hand” (Winograd & Flores, 1986).

The designer is looking to create the course in such a way that it is part of the environment that the learner exists in and is easy to use. The less foreign the implementation the more accessible and effective it may meet its objectives.

Identifying the domain of understanding in which the learner is working will provide information for design of the course that will allow the learner to interact with the course and technology intuitively. Using language and terminology that the learner relates to and understands is one way to ensure an uninterrupted experience to the learner. The learner’s context, gathered in the previous steps, provides information about the learner’s “goals, needs, desires and values” to assist in creating this domain of understanding of how and why the learner connects with technology (Nussbaum, 2001).

The designer should identify the possible ‘blindness in design’ that could come about from using mobile technology as a tool for learning, this means the designer must consider what is being removed that the user would have benefited from in traditional learning and what is being added. This consideration may lead to opportunities for enhancing the course (Winograd & Flores, 1986). An example of blindness in design may be that the course limits discussion that learners would have had in a classroom environment; however this may force the learner to seek more information in their own way. Now that this aspect has been identified, it is possible to decide on whether to intervene or allow it in the course.

### Modules and the depth of mobile learning to be used

The next step is to split the course into manageable modules. This can be done in many ways and is up to the discretion of the designer. Following the next step is to identify areas where mobile learning is to be used as shown in Figure 5. An overall decision as to whether the mobile learning will be used for the entire course or as a support or reference tool will help in splitting the classroom requirements from the technological ones if necessary.

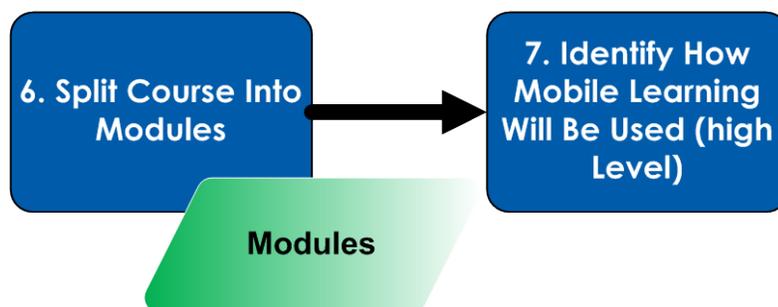


Figure 5: Final steps in creating context for mobile learning design

The classroom requirements would refer to venue bookings, material distribution and what the teacher would require in the physical environment to conduct the class; whereas the technological requirements are specific to the requirements around material, availability and approach using the device. For the purposes of this paper, the technological requirements will be the main focus. For the purposes of illustration, Figure 6 is an example of how this paper might be separated into several modules to be taught using a mobile phone.

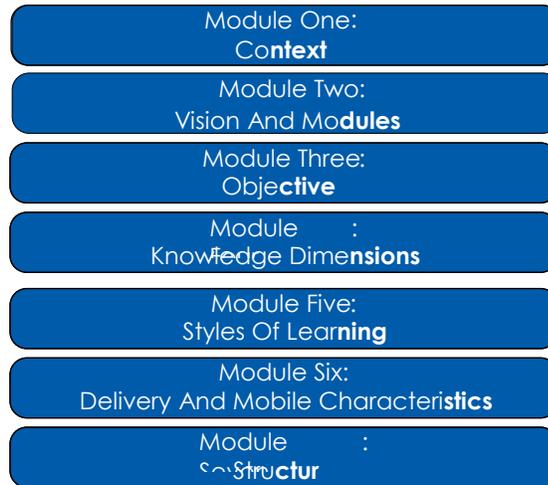


Figure 6: Example of separating a course into modules

Figure 7 combines all the steps in creating context together as described above. A holistic context has been considered up to this point, and the designer should have a good idea as to who is receiving the learning, why they are receiving the learning, their domain of understanding and what needs to be taught to the learner.

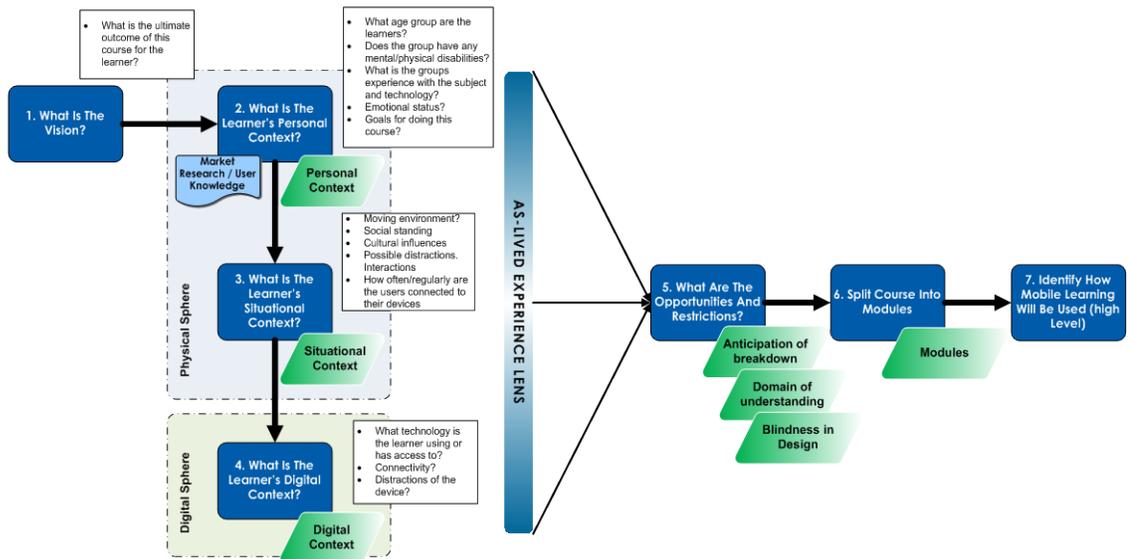
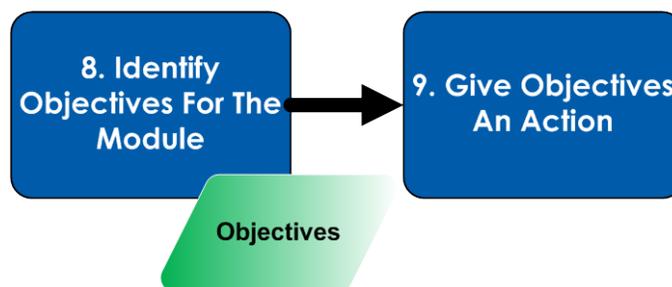


Figure 7: Complete process of creating context for mobile learning design

## Objectives

Identifying objectives, as illustrated in Figure 8, is the next part of the design of the mobile learning course, it is the question ‘why’ are we doing this course and ‘what’ do we want out of it. The objectives should be made with the pedagogical and contextual considerations in mind using Bloom’s Taxonomy (1956) and keeping in mind Franklin’s (2011) high-level objectives of learning, to give access to knowledge, encourage critical thinking and responsibility for learning to the learner. The objectives should not describe the technology - they should be the objectives of the learner, and the technology will need to match in the following steps to see how it can enhance and assist these objectives.

For each module or section of the course the high-level objectives need to be identified. Objectives must be learner oriented, this is to say that it is not about what the technology must do but rather what the learner must obtain from the course. The actual course must then be designed to cater to these objectives. Starting each objective with the words ‘the learner’ helps to orient the objective to what the learner must be able to do at the end of that module of the course (Bloom, 1956).



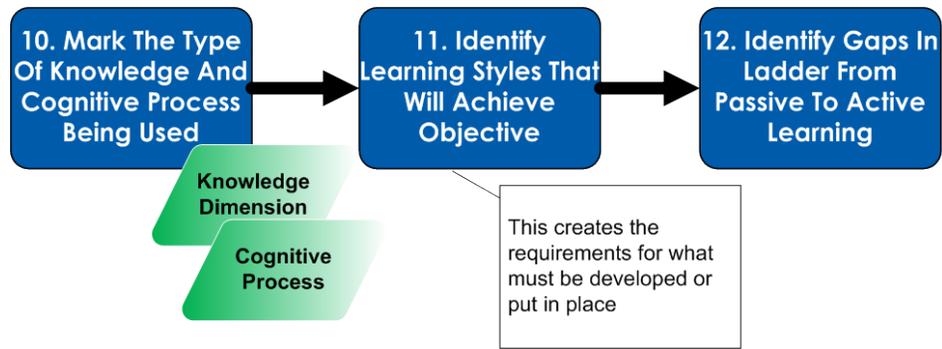
**Figure 8: Steps in creating objectives for mobile learning**

It may take some time to unpack the objectives. The modules that have been identified will assist in that they help to focus the attention of the objective, and the area it is specific to. Using Bloom’s taxonomy (1956) will assist with triggering the wording of the objectives. It is important to define these and ensure that they are measurable so as to be able to evaluate the success of the course later on. Objectives will be the crux of the design as it influences all other aspects of design. If a new objective comes to light then all other aspects of design need to be reconsidered.

Each objective must also be given an action, to explain how the objective will be achieved. Mobile characteristics become more important at this point as the designer begins to identify the kinds of activities that will assist in achieving the objective such as creating a discussion forum, an online test or assignment that will be assisted through the technology. The objective here is giving rise to a need that will be met with a mobile function.

## Pedagogy

The next few steps as seen in *Figure 9* may occur simultaneously with the creation of objectives as they are developed. For each objective identify what the type of knowledge is (e.g. factual) and what cognitive process (e.g. remember) is being used to achieve the objective developed (Merhbi, 2011; Munzenmaier & Rubin, 2013).



**Figure 9: Pedagogical phase in the process of designing mobile learning**

The objectives should lead the learner from passive to active learning and into metacognitive thinking where possible. This allows for the educator to further understand the objectives that are being put into place and how it fits into pedagogical theory to ensure that the learning taking place is grounded by these tested theories. When it is visible where the passive and active learning is taking place, the mobile learning platform and its requirements for each of these objectives becomes clearer. For instance, where a more passive approach is being used then providing information to the user is what is required, whereas in a more active learning approach more dynamic mobile learning techniques can be used.

Pedagogy speaks to the learning styles, as shown in Figure 9. It is interlinked with the objectives of the course and ‘how’ it will be delivered. The designer must decide how to cater for the various learning styles through audio, visual and interactive means. Using the main objectives of learning, as outlined by Franklin (2011) to guide the objectives of the course, the designer should be asking how the course is (1) enabling learners to reach their potential by allowing learners to access knowledge beyond the classroom; (2) encouraging critical thinking and problem solving skills; and (3) encouraging learners to take responsibility for their learning. It is also useful to identify in the objectives of the course what category of learning it will be and what that means for how it needs to be designed. Taking Bloom’s taxonomy into account the designer may want to use the overarching objective of moving a learner to a higher level of thinking (Forehand, 2010).

Step 13 involves re-organising the objectives so that gaps can be identified in helping the learner to climb the ladder from passive to active learning. When re-organising the objectives in a grid with the knowledge dimensions as headers and the cognitive processes as the vertical headers, it will be easy to see where there are gaps. Perhaps the course does not take the learner to the cognitive level, or the course is moving too quickly in that it is jumping from remembering to creating without giving the learner time to assimilate and apply the knowledge. In this case new objectives may need to be created or objectives need to be adjusted to give a more fluid learning experience. Looking at what type of knowledge and cognitive processes are being used gaps in the objectives can be identified. Where there is a gap the educator should consider objectives that will improve the course by filling those gaps in the learner’s education (Krathwohl, 2002; Munzenmaier & Rubin, 2013).

At the end of the objectives and pedagogical considerations, the designer may have something like the example in Figure 10. From this example it can be seen how the course is going to achieve its objectives, whether it is taking into account the multiple cognitive processes of learning according to pedagogy being applied here, and what mobile actions and types of learnings are going to influence the course. It then becomes necessary to consider how the course is to be delivered from what has been identified.

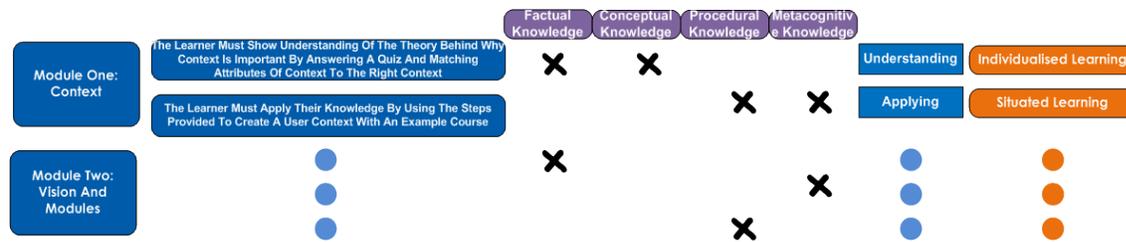


Figure 10: Example of creating an objective for a mobile learning course

### Delivery

The delivery of each module needs to be defined. Delivery asks the question of ‘how’ we are going to get the information to the learners. The context, objectives, and pedagogy that have been considered should trigger how delivery takes place. The steps described in Figure 11 begin with deciding how to deliver the material of the course. Considering the context and objectives created, what aspects will be made available through audio or images. There may be multiple ways of delivering the material.

Step 15 in the process is about considering each of the mobile learning characteristics: ubiquity, nomadicy, social interactivity, personalization, and context sensitivity against each module (Al-Hmouz et al., 2010). The question to be answered is how mobile technology could enhance the delivery of each module with the context and objectives created thus far. It is important that the characteristic is necessary or enhances the learning experience and not just applied for the purposes of applying mobile technology.

With a clearer idea of what the objectives are and what and how it needs to be delivered within a context, Step 16 is to write out the requirements according to what has been decided on thus far. The requirements must provide a clear guideline as to the delivery. An example of a requirement may be that for a particular module the concepts must be displayed visually and when selecting a part of the visual it must provide the written description of it. This still allows the designer of the course to be creative in achieving this but provides a guideline as to what must be the input and result (output).

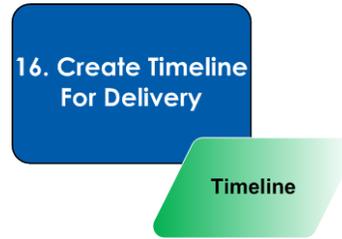


Figure 11: Steps to considering the delivery of mobile learning

### Structure

Structure is ‘when’ the course will deliver the content to meet our objectives within the appropriate context and pedagogical considerations. This should be the final stage of the planning (Figure 12). It includes the timing of the course, bringing in all the previous aspects and monitoring the flow, ensuring it is put together in a way that will guide learners without being restrictive and allowing for the flexibility that the mobile learning environment affords. This can be done visually using a Gantt chart or simply by writing out the requirements and deadlines of the delivery. Some

courses may not have any timelines while others may prescribe reminders and penalties to be put in place.



**Figure 12: Delivery - the final stage**

### ***Content, Implementation and Evaluation***

Content is the ‘what’ is being taught. It’s any research, collecting of necessary information, and resources. It’s not only creating the materials to be delivered but also ensuring that the objectives are met and all necessary information is available and can be made ready for the mobile learning platform, dependent on the contexts and requirements provided. The information made available here will feed directly into the implementation of the course. The content is not part of the overall process of design but rather a part of gathering the necessary information for the actual development of the course.

While implementation and evaluation of the mobile learning course are separate from the design of the mobile learning course, it is important to note that in implementation the aspects of the method are being followed and should be detailed enough to do so. The evaluation phase will also be influenced by the various aspects in the method, as the method allows for generalized areas to evaluate the mobile learning course. The evaluation should also speak directly to the objectives that should have measurable outcomes. Figure 13 combines the steps in the five phases from end-to-end of mobile learning design as discussed in this chapter.

### ***Summary***

The value in the proposed method is that it brings together various research topics in a structured way, allowing designers to consider the various aspects of a mobile learning course. By going through these steps the designer is able to get a more holistic view and is less likely to only focus on one aspect, such as personalisation, while ignoring other influencing theories. The method is general, in the hope that it can easily be adapted for future research. Figure 14 provides a summary of the phases and the steps within each phase that have been discussed in this chapter.

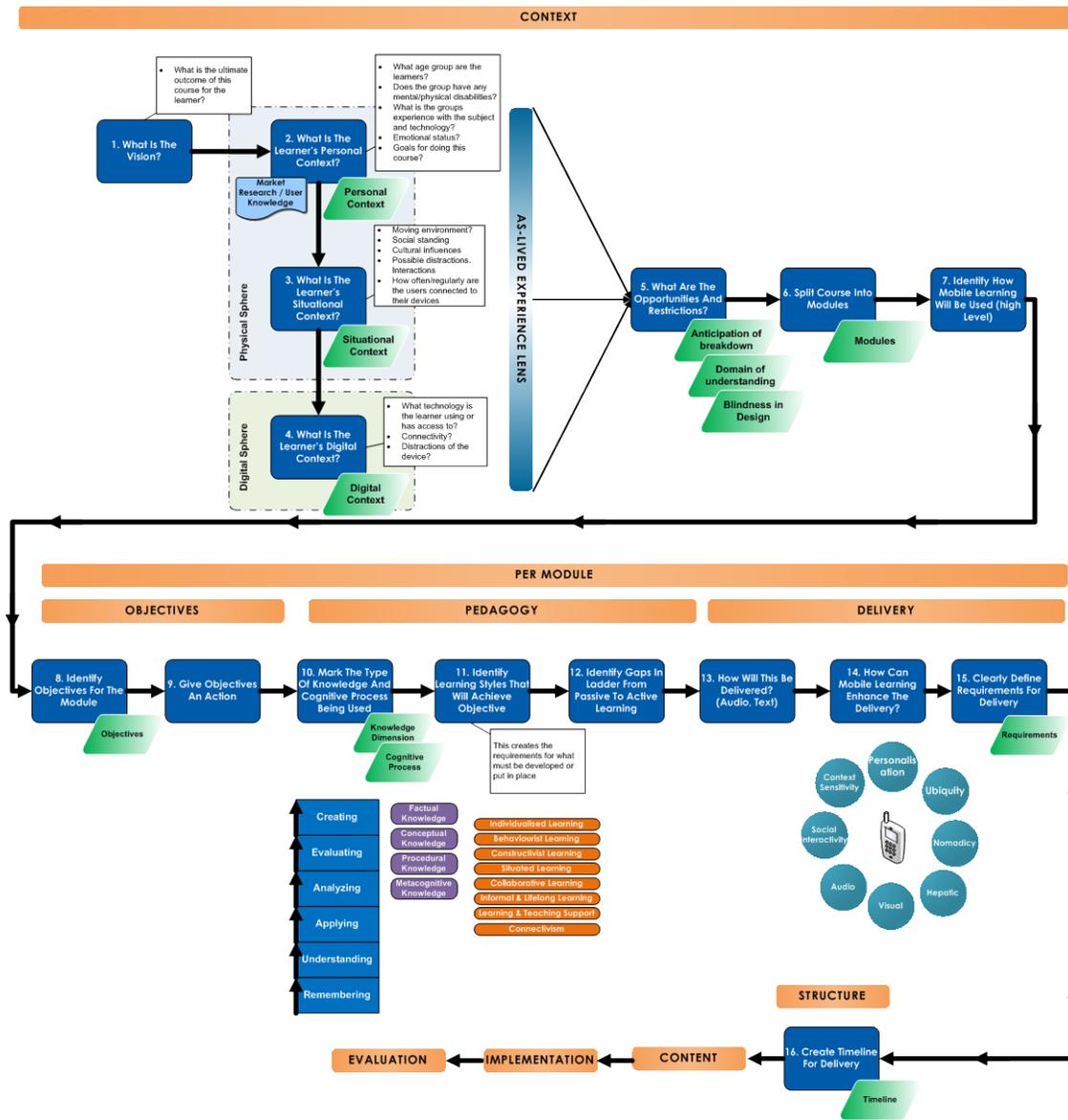


Figure 13: Process of Mobile Learning Design

<b>CONTEXT (Where)</b>	<ul style="list-style-type: none"> <li>• Overall vision/purpose of course</li> <li>• Social, Learner, Technology (Kooie, 2009; Al-Hmouz et al., 2010)</li> <li>• As-Lived Experience (Winograd &amp; Flores, 1986)</li> <li>• Separate subject into modules/parts</li> <li>• Identify the anticipated use of mobile devices in this course</li> </ul>
<b>OBJECTIVES (Why)</b>	<ul style="list-style-type: none"> <li>• For each module/part provide a learning objective/outcome</li> <li>• Learning Outcomes and knowledge areas (Bloom, 1956; Franklin, 2011)</li> <li>• Create an action that achieves this</li> </ul>
<b>PEDAGOGY (What To Use)</b>	<ul style="list-style-type: none"> <li>• Knowledge Dimension</li> <li>• Cognitive Process</li> <li>• Three Main Objectives of Learning (Franklin, 2011)</li> <li>• Categories of Learning (Cheon et al., 2012; Naismith et al., 2004)</li> <li>• Identify Gaps in objectives ladder</li> </ul>
<b>DELIVERY (How)</b>	<ul style="list-style-type: none"> <li>• Delivery through audio, text, visual, hepatic</li> <li>• Characteristics of Mlearning (Ubiquitous, nomadic, collaborative...) (Al-Hmouz, Shen, Yan, &amp; Al-Hmouz, 2010; Cavus &amp; Uzunboyly, 2009; Ozdamli &amp; Cavus, 2011; Rogers, Connelly, Hazlewood, &amp; Tedesco, 2009)</li> <li>• Design Principles (Ryokai, 2012; Killilea, 2012)</li> <li>• Describe requirements for delivery</li> </ul>
<b>STRUCTURE (When)</b>	<ul style="list-style-type: none"> <li>• Flow of the course over time, frequency of delivery in format prescribed</li> <li>• Curriculum, communication</li> </ul>
<b>CONTENT</b>	<ul style="list-style-type: none"> <li>• Course Material – audio, video, images</li> <li>• Active vs. Passive (Hemabala &amp; Suresh, 2012)</li> </ul>
<b>IMPLEMENTATION</b>	<ul style="list-style-type: none"> <li>• Following the Plan/Structure designed in the previous steps</li> </ul>
<b>EVALUATION</b>	<ul style="list-style-type: none"> <li>• Evaluate and reflect on the course using each step as a guiding measure to match to the objectives of the course.</li> </ul>

**Figure 14: Summary of steps in each phase of designing mobile learning**

## Conclusion

By combining the various aspects of mobile learning and the research in these areas, this paper has proposed a method for mobile learning that does not prescribe the content and structure but rather facilitates the process of planning and creating a course while ensuring that the various aspects such as technology, context, usability, and pedagogy are considered along with the objectives of the course. It is hoped that this research can create a central point of reference to more detailed and focused research around mobile learning, allowing for improved mobile learning courses.

The artefact developed in this research addressed the problem that mobile learning, being a relatively new area has had very few attempts at combining and providing a way for a practitioner to use the available information and research in a relevant and holistic manner to design mobile learning. One of the driving forces of this research area is the increase in mobile devices, and access to these devices to all populations of the world. This research has provided a reference point for different areas of research relating to mobile learning from context sensitivity, technological abilities and pedagogical expectations.

The answer to the research questions posed in the introduction can be summarized as follows:

- The different aspects of the mobile learning design were catered for by simplifying the method into phases and further into steps that could be followed sequentially and still influenced each other in creating a holistic view of mobile learning.
- The method is the result of the question being asked and provides a visual representation of how the method works with clear steps to navigate the phases of design considerations.
- The as-lived experience became relevant as part of the context phase, where it reached further into the requirements and objectives of the course. Its consideration of anticipation of breakdown, domains of understanding and blindness in design create an awareness for the designer in continuing with the steps of mobile learning design.

The high-level areas or modules in the method allow for other frameworks and theories to be brought into the method without having to fundamentally change the method, ensuring that each area is covered if only using a different theory within that area. Initial experimentation with the method displayed promise: the sequence of the steps came up as being important to the participant and in gathering the right information to influence the next steps of the method and avoid having to back track too much.

The method proposed has made effort contribution in combining research from mobile learning and pedagogical research into format that is more readily applicable and usable; it is by no means an extensive study but it does provide a starting point. The method includes a focus on mobile learning characteristics that provides a guideline for educators to decide how they will use and deliver their teachings through a mobile device. In this way this paper has addressed its objective to create a method that facilitates the process of planning and creating a course while ensuring various aspects such as technology, context, usability and pedagogy are considered along with the objectives of the course.

Further investigation into this method, its applicability, generalisability and improvement is necessary. To get the most value from this method it needs to be continually reviewed so that it is taking into account the latest theories and technological abilities. It is recommended that this method and its process be more rigorously tested in more experiment cycles in future and further theories integrated into the process succinctly so that it remains accessible and useable.

## References

- Al-Hmouz, A., Shen, J., Yan, J., & Al-Hmouz, R. (2010). Enhanced learner model for adaptive mobile learning. *Proceedings of the 12th International Conference on Information Integration and Web-based Applications & Services - iiWAS '10*, 783 – 786. doi:10.1145/1967486.1967614
- Alvarez, C., Alarcon, R., & Nussbaum, M. (2011). Implementing collaborative learning activities in the classroom supported by one-to-one mobile computing: A design-based process. *Journal of Systems and Software*, 84(11), 1961–1976. doi:10.1016/j.jss.2011.07.011
- Baskerville, R., Kaul, M., & Storey, V. (2011). Unpacking the duality of design science. *Thirty Second International Conference on Information Systems*, Shanghai 2011, 1–15.
- Bloom, R. S. (1956). *Taxonomy of educational objectives, Handbook I: The cognitive domain*. New York, New York, USA: David McKay Company.
- Burdick, A., & Willis, H. (2011). Digital learning, digital scholarship and design thinking. *Design Studies*, 32(6), 546–556. doi:10.1016/j.destud.2011.07.005
- Chen, G. D., Chang, C. K., & Wang, C. Y. (2008). Ubiquitous learning website: Scaffold learners by mobile devices with information-aware techniques. *Computers & Education*, 50(1), 77–90. doi:10.1016/j.compedu.2006.03.004

- Cheon, J., Lee, S., Crooks, S. M., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & Education*, 59(3), 1054-1064. doi:10.1016/j.compedu.2012.04.015
- Chittaro, L. (2011). Designing visual user interfaces for mobile applications. *Proceedings of the 3rd ACM SIGCHI symposium on Engineering interactive computing systems - EICS '11*, 331. doi:10.1145/1996461.1996550
- Costabile, M. F., Angeli, A. De, Lanzilotti, R., Ardito, C., Buono, P., & Pederson, T. (2008). Explore ! Possibilities and challenges of mobile learning. In *CHI 2008 Proceedings* (pp. 145–154). Florence, Italy.
- Fischer, J. (2011). *Understanding receptivity to interruptions in mobile human-computer interaction*. University of Nottingham.
- Forehand, M. (2010). Bloom's taxonomy. Emerging perspectives on learning, teaching and technology. Retrieved March 03, 2013, from [http://epltt.coe.uga.edu/index.php?title=Bloom%27s\\_Taxonomy](http://epltt.coe.uga.edu/index.php?title=Bloom%27s_Taxonomy)
- Franklin, T. (2011). Mobile learning : At the tipping point. *The Turkish Online Journal of Educational Technology*, 10(4), 261–275.
- Hevner, A. R., March, S., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75–105.
- Kjeldskov, J., & Stage, J. (2012). Combining ethnography and object-orientation for mobile interaction design: Contextual richness and abstract models. *International Journal of Human-Computer Studies*, 70(3), 197–217. doi:10.1016/j.ijhcs.2011.10.004
- Koole, M. (2009). *A model for framing mobile learning*. Athabasca University, Canada.
- Krathwohl, D. R. (2002). A revision of Bloom's taxonomy : An overview. *Theory into Practice*, 41(4), 212–218.
- Merhbi, A. (2011). *Bloom's revised digital taxonomy wheel & the knowledge dimension*. educteachology. Retrieved February 22, 2013, from <http://educteachology.org/swfapp/blooms/wheel/engage.swf>
- Munzenmaier, C., & Rubin, N. (2013). *Perspectives. Bloom's taxonomy : What's old is new again*. The Elearning Guild Research. Retrieved from [http://educationalelearningresources.yolasite.com/resources/guildresearch\\_blooms2013\(1\).pdf](http://educationalelearningresources.yolasite.com/resources/guildresearch_blooms2013(1).pdf)
- Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2004). *Report 11: Literature Review in Mobile Technologies and Learning*. FutureLab Series.
- Nussbaum, M. (2001). *Upheavals of thought: The intelligence of emotions*. Cambridge: Cambridge University Press.
- Ozdamli, F., & Cavus, N. (2011). Basic elements and characteristics of mobile learning. *Procedia - Social and Behavioral Sciences*, 28, 937–942. doi:10.1016/j.sbspro.2011.11.173
- Parsons, D., & Ryu, H. (2006). A framework for assessing the quality of mobile learning. *Proceedings of the 11th International Conference for Process Improvement, Research and Education (INSPIRE)*, Southampton Solent University, UK, 13.
- Patokorpi, E. (2006). *Role of abductive reasoning in digital interaction*. Åbo: Åbo Akademi University Press. Doctoral Thesis.
- Sha, L., Looi, C.-K., Chen, W., Seow, P., & Wong, L.-H. (2012). Recognizing and measuring self-regulated learning in a mobile learning environment. *Computers in Human Behavior*, 28(2), 718–728. doi:10.1016/j.chb.2011.11.019
- Weilenmann, A., & Juhlin, O. (2011). Time to revisit mobility in mobile HCI? *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services - MobileHCI '11*, 717. doi:10.1145/2037373.2037495

Williams, P. W. (2009). *Assessing mobile learning effectiveness and acceptance*. The George Washington University.

Winograd, T., & Flores, F. (1986). *Understanding computers and cognition: A new foundation for design*. Menlo Park, California: Addison-Wesley Publishing Company.

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