Towards a Sustainable Business Model for Mobile Learning Services

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Abstract

In today’s mobile world, people demand access to learning materials and courses anytime and anywhere. There is a high market potential for mobile-learning services, but the mere existence of such services does not mean market readiness. Added values of mobile-learning services are necessary to attract new users. Mobile technologies both expand and constrain the practicability of value-based mobile learning. Existing evaluation systems primarily focus a didactical or a technical point of view. This study utilizes the design science paradigm to address the design of an mobile-learning application that meets the needs of users and augments their willingness-to-pay so that suppliers can bring it to market sustainability. The results of an extended technology acceptance model (TAM) based evaluation shows that user acceptance and willingness-to-pay for mobile-learning is driven by the special exploitation of didactic added value of mobile-learning content and a technologically adopted implementation of mobile-learning applications.

Keywords: Mobile learning, design science, technology acceptance model, mobile application, business model, intensity of use, willingness to pay, sustainability.
1 Introduction

In today’s world advanced mobile technologies are being used in different sectors of society. The size of the global smartphone market has exceeded that of the laptop market since 2009 and is still growing. Ally (Ally, 2007) discusses the phenomenon that “people are on the move and demanding access to learning materials and information anytime and anywhere”. M(obile)-learning is made possible by the existence and application of mobile computing technologies. Over the last decade the market for mobile computing technologies has changed dramatically. On the one hand, the mobile market is characterized by an extremely high number of brands, products and services that try to attract customers in a very competitive market. On the other hand, customers have become more and more demanding with regard to innovation and are quick to change mobiles if something new is introduced to the market and/or promoted by media (Garito, 2009). As a result, the number of different smartphone platforms continues to grow and each phone’s individual characteristics continue to evolve. M-learning application development is challenged by the fact that “a lot of distinct mobile devices entail a lot of distinct operating platforms, all of them supporting distinct types of devices, their manufacturers offer distinct software development kits (SDks), and finally, most of these distinct operating systems are incompatible to each other” (Garcia-Barrios et al, 2009). But the term “mobility” is not only characterized by technology. Mobile communication extends the range of social contexts (e. g. family, friends and colleagues) to ‘anywhere’. M-learning is significantly different from e-learning or traditional learning as it is capable of generating its own value – due to its “mobility” and coupled with the appropriate pedagogy (Mostakhdem-Hosseini, 2009). To gain sustainable market success, m-learning providers have to successfully and sustainably introduce m-learning services to the market. It is necessary to develop appropriate and sustainable business models for m-learning that provide added value for both providers and users (Breitner & Hoppe, 2005). It is discovered that there are a lot of m-learning projects that began as enthusiastically as projects at industrial or academic institutions but never gained sustainable success on the market due to technical, didactical and/or economical restrictions (Frohberg et al, 2009). In order to provide sustainable m-learning services a design-science research approach is suggested to be taken in the development of m-learning applications, business models, and course materials. In this approach feedback received from users will be used to create a mobile application and several courses that represent the artifact. The artifact created will be evaluated against a modified version of the Technology Acceptance Model (TAM) introduced by Davis (Davis et al, 1989). The following research question will be answered:

- Which critical factors can strengthen the sustainable design of business models for m-learning services?

2 Literature Review

2.1 M-Learning

M-learning combines mobile computing with e-learning. There are a number of different definitions of m-learning in literature. The most common definition is that “m-learning is described as e-learning through mobile [...] devices” (Trifonova, 2006). This explicitly excludes laptops but allows learning anywhere, anytime and in anyway (taking place outside formal learning situations). In literature, it is discussed if laptops or similar devices (e. g. netbooks or subnotebooks) should be included into m-learning definition. Of course, such devices become smaller and smaller. But we decide not to include them because even if they can be transported easily from one place to another, they are commonly not used in phases of mobility like it’s typical for m-learning (e. g. walking, cycling etc.) (Georgiadis, 2006). Therefore, m-learning shares some similarities with e-learning but complies with the basic definition of a m-business application: “use of the mobile information technologies, including the wireless Internet, for organizational communication and coordination, and the management of the firm” (Scornavacca et al, 2006). E-learning itself covers learning, which is supported and/or made
possible by the “delivery of education […] through various electronic media” (Harman & Koohang, 2005). Traxler (Traxler, 2007) explored two main directions for defining and conceptualizing m-learning: First, he examines the technology-centric perspective, which defines it purely in terms of its technologies and its hardware. Secondly, he provided a learning-oriented perspective that examines the underlying learning experiences and asks how mobile learning differs from other forms of education, especially other forms of e-learning. Adapted from Cobcroft et al. (Cobcroft et al, 2006) and enhanced with a qualitative analysis of later publications, we identified three characteristic added values that an m-learning services can provide. These three characteristics are weighted differently in definitions of the 17 authors reviewed:


### 2.2 Business Models

The potentials of m-learning services have to be successfully and sustainably introduced to the market. Therefore, it is necessary to develop appropriate and sustainable business models. The literature about electronic and mobile business is not consistent in the usage of the term business model. In general a business model can be understood as “an architecture for the product, service and information flows, including a description of the various business actors and their roles; and a description of the potential benefits of the various business actors; and a description of the sources of revenues” (Timmers, 1998).

A sustainable business model for m-learning integrates and consolidates strategic prepositions concerning a market sub model, an activity sub model and an asset sub model. An analysis of these issues provides the identification of critical success factors for the commercialization of m-learning services (Breitner & Hoppe, 2005). In this work we focus on the activity sub model that integrates the application design as well as the design of learning courses (e. g. an m-learning provider that provides the application and complementary learning courses together). According to the value chain approach, successful m-learning business models allow all players in the value chain to generate revenue streams. This requirement involves the revenue sub model as part of the asset model that usually describes the generation of revenue streams. Revenue sub models for electronic markets can make use of four types of revenue streams (Breitner & Hoppe, 2005; De Reuver et al, 2008):

- **Fees per use** (e. g. the purchase to use an m-learning course).
- **Usage-independent fees** which are independent from a concrete use (e. g. a monthly membership fee).
- **Revenues by brokerage** come from fees or commissions for bringing interested parties together and facilitating the transaction.
- **Mobile Advertising** messages that are posted by suppliers of m-learning services (e.g. content-related advertising messages that are embedded into a learning course).

Usage-independent fees, fees per use and brokerage gain revenues from a singular purchase decision that is done before an m-learning application is used (adoption phase). To motivate users to a singular purchase decision, the application needs to propose a clear and identifiable value to the user that leads to a willingness-to-pay (Petrova, 2007). Mobile advertising needs a good frequency and intensity of use after an m-learning application is purchased (acceptance phase). This need is justified by
advertisers’ demand of attractive ad spaces that require large numbers of possible ad impressions (Vatanparast & Butt, 2009). To motivate users to a good frequency and intensity of use the activity sub model needs to be linked to the market sub model that itself is strongly characterized by critical user acceptance factors as well as added values. A mobile service must provide special added values that cannot be gained without mobility (Pousttchi et al, 2003). M-learning applications can provide as special added values: anywhere learning, anytime learning and anyway learning. But to gain these values, it is figured out that the applications need to fit to didactic-related requirements as multimedia integration, appropriate number of exercises and interactive exercises that give immediate response to improve the learner’s receptiveness (Petrova, 2007; Sharp et al, 2007; Liu et al, 2009). Additionally the cost sub model is linked to the asset model. The cost model of m-learning software projects, deducted from software projects in general, are highly impacted by application development and maintenance costs (Jorgensen & Shepperd, 2007).

2.3 M-Learning Application Development

Mobile devices range from very small or embedded devices for everyday life, through a variety of common cellular phones to smartphones and handheld devices (Charsky & Raisinghani, 2009; Wu & Unhelkar, 2009). The power of mobile CPUs and the average memory capacity are much lower than that of stationary CPUs. The playback of multimedia content is commonly limited due to small displays and the user interface suffers from small keypads and multiple-shared keys or touch pads. These limitations are conceptual because of the mobile devices’ miniaturization and their commonly battery-powered use. It is anticipated that conceptual limitations of mobile technology will persist for the short or medium term. It is argued that every software engineering process on mobile devices must also take these special mobile characteristics into consideration (Marhameh & Unhelkar, 2009; Rupnik, 2009). In difference to e-learning on stationary PCs m-learning is directly bound and diversified by the mobile hardware platform provided by the manufacturer. An m-learning application cannot be built on a generic and expandable hardware platform as it is possible for an e-learning application running on the PC platform (Traxler, 2007). The heterogeneity of mobile software and hardware platforms complicates the software development process. As a result, mobile applications are cost-intensive to develop and maintain (Mostéfaoui, 2006).

<table>
<thead>
<tr>
<th>Native application languages</th>
<th>Web application languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java ME</td>
<td>C/C++</td>
</tr>
<tr>
<td>C#/.NET</td>
<td>(Visual-)Basic (NET)</td>
</tr>
<tr>
<td>Objective-C</td>
<td>Flash-Lite</td>
</tr>
<tr>
<td>Silverlight</td>
<td>Web application (HTML)</td>
</tr>
<tr>
<td>Webappl./Widget (HTML &amp; AJAX)</td>
<td>Other languages</td>
</tr>
<tr>
<td>Symbian OS</td>
<td>X</td>
</tr>
<tr>
<td>Windows Mobile</td>
<td>X**</td>
</tr>
<tr>
<td>Blackberry OS</td>
<td>X</td>
</tr>
<tr>
<td>iOS (Apple iPhone)</td>
<td>-</td>
</tr>
<tr>
<td>Android</td>
<td>X</td>
</tr>
<tr>
<td>Palm webOS</td>
<td>-</td>
</tr>
<tr>
<td>Linux (ALP/MeeGo)</td>
<td>X**</td>
</tr>
<tr>
<td>Frequency</td>
<td>5</td>
</tr>
</tbody>
</table>

** Support is announced by manufacturer but currently not official available.
*** Support can be installed by user.
** Flash-Lite is officially supported; full Flash support is announced by Adobe.
# Support is available but currently prohibited by manufacturer’s policy.

Table 1. Synopsis of supported programming languages by mobile operating systems.
Mobile applications can be provided either as client-side applications that run \textit{natively} on the mobile device or as web applications that run on a remote server and are displayed on a mobile web browser (Wagner et al, 2008). Depending on the mobile operating system, not all client-side applications are portable to other platforms. To transfer web applications to another platform, only the presentation layer (e.g. CSS and/or HTML-code) has to be modified. More challenging is to transfer natively running client-side applications. Smaller modifications are necessary in application- and presentation layer program codes between JavaME compatible operations systems. The port from JavaME to Android is possible, since the two support Java, but is more complex, as Android’s application framework (SDK) is completely different. This situation is similar to port applications written in C/C++ from one mobile operating system to another. Each mobile operating system uses its own SDK. Ports between any other application frameworks will result in a completely new development, as programming languages and/or frameworks are incompatible. See Table 1 for a synopsis of supported programming languages by mobile operating systems. This synopsis has been aggregated from a qualitative literature review of 50 technological specifications provided by producers of mobile operating systems and programming languages. As mobile technologies change and evolve rapidly, it is remarkable that this literature review has been done from January to September 2010.

3 Design as an Artifact

The use of the design-science research framework is justified on the grounds of this research project. First, it provides a framework that can be used for IS applied research. Second, design science provides a framework for the evaluation of models and/or artifacts. Finally, the framework can be used to extend the scope of this research. The design science approach is intended to contribute to the knowledge base of the scientific community in general in an explanatory way as well as to help managers design sustainable m-learning applications as a design task. We identify a field of \textit{problem relevance} to design m-learning applications that can be introduced sustainably to the market. The ensemble of three major influences on m-learning requires an integrated, interdisciplinary understanding of this research subject. According to (Hevner et al, 2004), both the construction and evaluation of the artifact uses \textit{rigorous research} methods.

![Figure 1. Design Science Research process](image-url)

See Figure 1 for an overview of the research methodology used in this paper. The intended artifact is an m-learning application running on a smartphone that provides a sample interactive learning course to students. The implementation of this course accesses an existing ubiquitous m-learning system (UMLS) which provides flexible content storage and content distribution capabilities to various
mobile hard- and software platforms. Maske et al. (Maske et al, 2005) discuss the problem of designing m-learning applications for heterogeneous mobile hard- and software platforms, as well as the strengths and weaknesses of online content delivery methods in comparison to offline methods. Therefore, prior to building the artifact, there was performed an expert study to determine which delivery method is acceptable and which type of revenue sub model is suitable for business models. A survey of 31 German experts from science and industry about the m-learning domain has been conducted using a questionnaire (Gordon & Gill, 1997). The questionnaire encompasses of closed questions on a five-point Likert scale. The experts were asked for their opinion regarding two challenges facing sustainable m-learning development (see results in Table 2):

- Suitability of three methods of dealing with heterogeneous and incompatible mobile hard- and software platforms on m-learning application development.
- Suitability of four revenue sub model types according to (De Reuver et al, 2008) for m-learning applications.

<table>
<thead>
<tr>
<th>M-Learning application development</th>
<th>Median</th>
<th>Frequency suitable or very suitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offer a web application compatible to all platforms</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>Develop native applications for each platform</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>Users have to use a standardized mobile devices</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M-Learning revenue sub models</th>
<th>Median</th>
<th>Frequency suitable or very suitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fees per use</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Mobile advertising</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Revenues by brokerage</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Usage-independent fees</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

*Likert scale: 5=very suitable, 4=suitable, 3=neutral, 2=little, 1=low.*

Table 2. Suitable application development and revenue sub models for m-learning services.

UMLS uses several open source technologies (Linux, Apache, and MySQL). Learning courses are stored in a central MySQL-database and can be distributed both to web applications and native applications. For distribution to web applications the content is rendered through a PHP-module to a format that fits the smaller screen sizes of mobile devices using HTML and CSS. For distribution to native applications the content is rendered to special XML files that can be imported into the application. Because the UMLS supports interactive and immediate examination of answers it is possible to calculate individual scores for each task. It is also possible to enrich each task with multimedia elements (e.g. pictures, sounds, videos and animations). In the second step, an exemplary m-learning course is created. To adjust the didactic-related requirements that are necessary to gain m-learning added values, a field study has been conducted with a randomly selected sample of 150 students in several economic courses. The students were asked to give their preferences in the following categories: maximum number of exercises in the course, the preferred question types on mobile devices (e.g. single-choice or multiple-choice, algebraic or text) and the integration of multimedia elements into the learning course. From the selected sample 131 questionnaires were usable for the analysis. Most of the students (51.9%) preferred the integration of multimedia elements into the course. Additionally, 61.1% favored to have not more than 20 exercises in one course. The most desired exercise types were single- or multiple-choice exercises (76.3%) or algebraic exercises (74.1%). Just 20.6% of the students liked better to have text-style exercises. The m-learning course is designed in a quiz-style and composed of eight single- and multiple choice exercises. In conjunction with each exercise, several multimedia elements including videos, pictures and sound files (e.g. recordings of spoken explanatory notes) were presented. The title of the m-learning is course is “Mobile Learning”. The goal of the m-learning course is to introduce the users to the characteristics of web-based m-learning on smartphones using wireless networks for content distribution. The topics of the exercises include: Benefits of m-learning, differences between e- and m-learning, characteristics of mobile devices, mobile wireless networks, data communications, wireless communication protocols, mobile multimedia, and mobile application development. Each exercise is designed using single- and/or multiple-choice questions and includes multimedia attachments (e.g.
audio comments, pictures, videos, and animations). See example screen shots of the created m-learning course in Figure 2. The left screen shot shows the way, multimedia elements are embedded and presented to the user. The screen shot in the middle shows the selection dialog which allows starting the created m-learning course (labeled: “Mobile Learning”). The screen shot on the right presents an exemplary single-choice question. The application automatically adjusts to various screen resolution sizes and display orientations, guaranteeing correct rendering on different mobile hardware platforms.

Figure 2. M-Learning Course Screen Shots

4 Design Evaluation

4.1 Modified TAM as Kernel Theory

TAM is an IS theory that models how users accept and use a technology that was originally introduced and developed by Davis (Davis et al, 1989) and further developed from a variety of authors. Two critical factors determine user acceptance:

- **Perceived usefulness (PU)** is defined as the prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context.
- **Perceived ease-of-use (PEOU)** refers to the degree to which the prospective user expects the target system to be free of effort.

In an empirical study, Davis et al. (Davis et al, 1989) determined that the frequency and intensity of use of computer technology can be reasonably well predicted from a person’s intentions. PU is a major determinant of people’s intention to use computer technology (INTUSE) and PEOU is a significant secondary determinant of their intention to use. Beyond PU and PEOU, the user’s attitude towards using technology influences INTUSE, which is then influenced by PU and PEOU. The explanatory power of TAM is just as good as without regarding the originally included construct of ‘attitude towards using’ (Venkatesh et al, 2003). We therefore propose the following hypotheses for the designed m-learning artifact:

- **H1**: PEOU will have a positive effect on PU.
- **H2**: PEOU will have a positive effect on INTUSE.
- **H3**: PU will have a positive effect on INTUSE.

Even if m-learning applications are a subset of mobile applications, which are then a subset of computer technology, they can provide special and unique characteristic due to their didactical dependency. Traxler (Traxler, 2007) argues that m-learning cannot be defined just in terms of its technology and its hardware. Instead he suggests a view originating from the didactical needs and benefits of teachers and learners, making learning personal, spontaneous, opportunistic, informal, pervasive, situated, private, context-aware, bite-sized and portable. Therefore, from a didactic point of view, m-learning can provide an ensemble of three additional values that cannot be provided by e-learning and/or conventional classroom settings: first, it is possible to learn location-independent outside predetermined classrooms (‘anywhere learning’). Second, m-learning can provide the user the freedom to learn without time-restrictions as it would be due to teaching times of conventional
classroom settings (‘anytime learning’). And finally, the personal and mobile character of mobile devices allows learning in more informal ways (e.g. learning through peer-group discussions) than in a strict teacher to learner relation (‘anyway learning’). The findings from Doll et al. (Doll et al, 1998) suggest that the construction of PU is to be extended by environment-related external variables. We posit for the special case of m-learning applications:

- **H4**: The freedom of location-independent m-learning (‘anywhere m-learning’) will have a positive effect on PU.
- **H5**: The possibility to learn without time-restrictions (‘anytime m-learning’) will have a positive effect on PU.
- **H6**: Informal m-learning settings (‘anyway m-learning’) will have a positive effect on PU.

The potential offered by m-learning services needs appropriate business models to be successfully and sustainably introduced onto the market. The sustainability of every business model is strongly determined by appropriate revenue sub models. In prior expert study most experts suggest to generate revenues from fees per use that are paid directly from the user. For this purpose, the application does not only need to propose a clear and identifiable added value to the user, it is important that the perceived usefulness increases the willingness to pay in user’s adoption phase. Additionally the perceived ease-of-use is intended to influence the user’s willingness to pay in the purchase decision for additional m-learning courses. We posit:

- **H7**: PU will have a positive influence on the willingness to pay for m-learning services.
- **H8**: PEOU will have a positive influence on the willingness to pay for m-learning services.

### 4.2 Measurement Design

Considering the recommendations of Hevner et al. (Hevner et al, 2004), a quantitative research was carried out to evaluate the usability and adoption of the artifact. The research model was tested on a randomly selected group of 300 students of economics. The selected sample did not overlap with the previous samples of research. The participants used the m-learning course on their private smartphone devices. Between the announcement of the study and its closing there has been a time frame of two weeks. In this frame the participants could use an m-learning course anytime, anywhere and anyway they wanted (e.g. in university but as well at home or during recreation). The goal of the m-learning course was to introduce the users to the characteristics of web-based m-learning on smartphones using wireless networks for content distribution. They could try to solve the course as often as desired. After the time frame closed, the participants were asked to fill out a questionnaire. The survey setting was in a lecture auditorium. Of the 300 issued questionnaires 257 were retumed. 230 of the questionnaires were usable and the remaining 27 questionnaires were unusable due to inconsistencies or incompleteness. In an effort to avoid biases in the responses, participants could fill out the questionnaire anonymously. The collected data were analyzed using SPSS software. In the questionnaire, the participants should assess hypothesis-related parameters in a Likert scale from 1 (very low) to 5 (very high). The reliability of each construction is tested using the Cronbach’s α test. According to (Streiner, 2003) and (Gliem & Gliem, 2003) the α-value should be at minimum 0.5 to 0.6 for early stages of research and at minimum of 0.8 for basic research.

### 4.3 Perceived Usefulness

Deducted from underlying TAM it is posited that PEOU will have a positive effect on PU (H1). Additionally it is posited for m-learning services:

- The additional freedom of learning anywhere (PU_ANYWHERE) will have a positive effect on the PU of m-learning (H4).
- The possibility of anytime learning (PU_ANYTIME) will have a positive effect on the PU of m-learning (H5).
- Informal anyway learning settings (PU_ANYWAY) will have a positive effect on the PU of m-learning (H6).
A multiple regression model is created to measure the effects of PEOU, PU_ANYWHERE, PU_ANYTIME and PU_ANYWAY on PU of m-learning services (model 1). This model shows an $\alpha$-value of .891 and a high correlation (R) of .880. The result of the R square value suggests that PEOU, PU_ANYWHERE, PU_ANYTIME and PU_ANYWAY explain 77.5% of the variance in PU. There is just barely acceptable p-value for PU_ANYWAY of .023. The p-value of PU_ANYTIME is at a not acceptable level of .551 as well as the constant with .399. Considering these values PU_ANYTIME and the constant is not taken into account in this model. The predictive power is as follows: $PU = .525 \times PU\_ANYWHERE + .117 \times PU\_ANYWAY + .335 \times PEOU$. Hypothesis H5 is not accepted while H1, H4 and H5 are accepted: PU_ANYWHERE, PU_ANYWAY and PEOU have a positive effect on PU. See Table 3 and Table 4 for aggregated correlations and significance assessment of model 1.

4.4 Intention to use

A multiple regression model is created to measure the effect of PEOU (H2) and PU (H3) on INTUSE (model 1). The obtained $\alpha$-value of this model is 0.844. The result of a regression analysis suggests that there is a good correlation (R) in model 1 of .714. The result of R square value suggests that PU and PEOU explain 51.0% of the variance in participants INTUSE. Paying particular consideration to the p-value of .016 there is a significance level of 0.05 for PEOU. The predictive power of model 1 is: $INTUSE = 1.157 + .151 \times PEOU + .585 \times PU$. This implies that an increase in positive PU results in an increased INTUSE of the application while the gradient of PEOU is still positive, but much smaller. The hypotheses H2 and H3 are accepted: PU and PEOU will have a significant positive effect on INTUSE by reference to the p-value of .016. (see Table 3, Table 4 and Table 5).

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PU</td>
<td>.880</td>
<td>.775</td>
<td>.770</td>
<td>.60160</td>
</tr>
<tr>
<td>2 INTUSE</td>
<td>.714</td>
<td>.510</td>
<td>.505</td>
<td>.85353</td>
</tr>
<tr>
<td>3 WTP MLEARN</td>
<td>.544</td>
<td>.296</td>
<td>.288</td>
<td>.96917</td>
</tr>
</tbody>
</table>

Table 3. Aggregated models.

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Regression</td>
<td>243.181</td>
<td>4</td>
<td>60.795</td>
<td>167.981</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>70.574</td>
<td>195</td>
<td>.392</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>313.755</td>
<td>199</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Regression</td>
<td>162.892</td>
<td>2</td>
<td>81.446</td>
<td>111.797</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>156.631</td>
<td>215</td>
<td>.729</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>319.523</td>
<td>217</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Regression</td>
<td>74.074</td>
<td>2</td>
<td>37.037</td>
<td>39.431</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>176.586</td>
<td>188</td>
<td>.939</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>250.660</td>
<td>190</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. ANOVA models.

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>T</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Constant)</td>
<td>.135</td>
<td>.160</td>
<td>.333</td>
<td>8.475</td>
</tr>
<tr>
<td>PEOU</td>
<td>.335</td>
<td>.039</td>
<td>.541</td>
<td>8.804</td>
</tr>
<tr>
<td>PU_ANYWHERE</td>
<td>.525</td>
<td>.060</td>
<td>.028</td>
<td>.597</td>
</tr>
<tr>
<td>PU_ANYTIME</td>
<td>.031</td>
<td>.053</td>
<td>.127</td>
<td>2.293</td>
</tr>
<tr>
<td>PU_ANYWAY</td>
<td>.117</td>
<td>.051</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (Constant)</td>
<td>1.157</td>
<td>.180</td>
<td></td>
<td>6.442</td>
</tr>
<tr>
<td>PEOU</td>
<td>.151</td>
<td>.062</td>
<td>.156</td>
<td>2.434</td>
</tr>
<tr>
<td>PU</td>
<td>.585</td>
<td>.063</td>
<td>.600</td>
<td>9.349</td>
</tr>
<tr>
<td>PU_ANYWHERE</td>
<td>.374</td>
<td>.219</td>
<td></td>
<td>1.707</td>
</tr>
<tr>
<td>PU_ANYTIME</td>
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<td>.074</td>
<td>.572</td>
<td>7.029</td>
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<tr>
<td>PU_ANYWAY</td>
<td>.041</td>
<td>.074</td>
<td>-.045</td>
<td>- .550</td>
</tr>
</tbody>
</table>

Table 5. Significance assessments.
4.5 Willingness to pay

In H7 it is posited that PU and in H8 it is posited that PEOU will have a positive influence on the willingness to pay (WTP_MLEARN). Measuring willingness to pay in a survey might be influenced by heavy biases (Don et al, 1987). We decided to use a special technique of surveying method. According to the critic of Cameron et al. (Cameron & James, 1987), we did not ask e. g. “how much would you pay for the m-learning application?”. Instead we preferred asking the following way: “imagine your smartphone would cost $50 more to be suitable to use this m-learning course. Would you still buy it?” The same question was repeated four times by raising the amount of cost. The answers of the participants were coded into a five-point Likert-type scale and analyzed against the PU of the m-learning application. Additionally we identified 13 strange cases by the function of SPSS software and removed them. A multiple regression model is created to test the effect of PU and PEOU on WTP_MLEARN (model 3). The α-value of this model is .761. The result of a regression analysis suggests that there is a good correlation (R) in model 3 of .544. The result of R square suggests that PU and PEOU explain 29.6% of the variance in the user’s willingness to pay for m-learning. The p-value of constant and PU are acceptable, the p-value of PEOU is .583 and not acceptable. The significance assessment of model 3 suggests a predictive power as follows: WTP_MLEARN = .374 + .523 * PU. We accept hypothesis H7 but hypothesis H8 is not accepted. PU will have a positive effect on WTP_MLEARN (see Table 3, Table 4 and Table 5).

5 Conclusions and Outlook

The findings of the literature analysis suggest that market trends in mobile devices, both for hardware- and software platforms are dynamic and evolving. Up to this point no mobile application platform has clear market dominance due to the lack of standards for mobile application development. New mobile platform announcements from several companies will probably confuse the mobile market even further. It is outlined that it is not possible to develop a natively running m-learning application that is portable to each of the seven main mobile software platforms. The findings during the artifact design in this research project are: An m-learning application can be designed in two distinct types of development. Either as a native application which is developed in a programming language that is compiled to an individual combination of mobile hardware and software platform, or as a web application which shifts most functionality to a remote server and solves the problem of incompatible application development environments of different mobile platforms. The findings in the expert study indicate an undetermined suitability of both development types because creating a web application is suitable to reduce the costs of development and the costs maintenance. But most experts agreed with (Rupnik, 2009) that web applications have several disadvantages. The main disadvantage is: The application cannot run in environments where no wireless network is available or the usage is forbidden, e. g. hospitals, airplanes, trains or subways. It is expected that the market situation of mobile hardware and software platforms remains incompatible and dynamic in the next years. If web applications are not suitable, the results of the studies indicate that the provider of m-learning services has to consider the costs of individual application development processes for each mobile platform expected in the target user group as well as the maintenance costs of these application instances. The costs of application development and maintenance are balanced against the revenues. The most suitable revenue types for m-learning business models are specified by an expert study. To improve sustainability of the highest rated revenue model fee per use it is necessary to evaluate the user’s perceived usefulness of m-learning which influences the user’s willingness to pay. The quantitative research study of the evaluation phase confirmed a positive relationship between the perceived usefulness of m-learning services and the user willingness to pay. Even if the perceived usefulness explains “just” 29.6% of the variance in the willingness to pay, it is recommended to increase the user’s perceived usefulness generally because it is positively correlated to the user’s intention to use the m-learning service. A good frequency and intensity of use is necessary for the second best rated
revenue type of mobile advertising as advertisers’ demand for attractive ad space that provide large numbers of possible ad impressions (Vatanparast & Butt, 2009). See aggregated results in Figure 3.

Figure 3. Quantitative analysis against the modified Technology Acceptance Model

The perceived ease of use is correlated with the perceived usefulness. Our study suggests that the correlation between PEOU and PU has a value of .335. As an extension of the TAM the influences from the usefulness of the didactic values anywhere learning, anytime learning and anyway learning on PU are analyzed as external variables. The result from this study suggests a high correlation of .880 between an aggregation of all three variables and PU. We can identify predictive functions for the usefulness of anywhere learning and anyway learning. Due to a lack of significance a predictive function for the usefulness of anytime learning cannot be accepted. In order to build sustainable business models for m-learning the positive influences of the m-learning specific values anytime learning and anyway learning on the perceived usefulness should be considered. To gain these m-learning specific added values some basic didactic requirements should be followed as preliminary stage during the learning course design: Most of the users prefer very short learning courses (microlearning), it is appropriate to restrict the number of exercises from 10 to 20. The exercise types single-/multiple-choice or algebraic exercises should be preferred. Just a minor number of participants prefer text exercises which require a lot of typing with small keyboards of mobile devices. Most participants prefer the inclusion of multimedia elements into the m-learning course. If these recommendations are followed, m-learning services should provide functions that allow learning anywhere. Additionally the provided values of m-learning services should not remain in traditional formal learning settings (e.g. with traditional tutor to learner relationships). The results of this research indicates that it is better to accent informal characteristics (‘anyway’) during learning course design (e.g. to give the users the feeling to learn as much they want in an individual sequence combined with peer-to-peer communications). Another critical factor to increase the perceived usefulness is the user’s perceived ease of use. Common recommendations to increase that value are designing appropriate user interfaces and building easy to install applications. It was not possible to identify a causal relationship between the didactic value of anytime learning and the perceived usefulness of m-learning. Because of this finding we could not identify a necessity to design m-learning services with time-independent added values (e.g. providing a tutor who assists learner 24/7). This result of the quantitative research is not conforming to the results of the qualitative analysis in 17 m-learning definitions of several authors. The results of this qualitative analysis indicate that the added value of anytime learning plays a dominant role in conjunction with m-learning services. Therefore we suggest that the object of further research could be to find out if it is possible to observe significant correlations between anytime learning and the perceived usefulness in different samples of participants. A possible reason for the lack of significance might be that the members of the sample user group are students. It is possible that students do not benefit from anytime added values because in their personal environment there is simply no lack of time. In addition to the group of students, there are different groups which have more time-critical daily routines, e.g. executives, health professionals or politicians. Another object of further research could be the evaluation of critical
economic factors, e.g. the willingness to pay, on m-learning in different samples of participants, e.g. in groups of persons with higher financial resources than that one of students. It would be interesting to find out if these samples of participants show different characteristics of their willingness to pay.

References


