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## Significant Developmental Factors That Can Affect The Sustainability Of Mobile Learning

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### Abstract

This study aims to investigate factors influencing m-learning sustainability and specify the current design and development status of m-learning. The literature was reviewed about current sustainability factors and a model for developmental m-learning sustainability was established. In light of the model, an investigation was made in order to assess the current status of m-learning initiatives. A survey research is conducted with 36 heads of academic units and m-learning staff from content and design and development units. The paper concludes that some developmental m-learning sustainability factors are critically important. The most of the m-learning initiatives disregard these factors. The study may provide guidelines to assist m-learning initiatives in sustaining an effective mobile learning in terms of design and development.

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### 1. Introduction

In the last ten years, mobile devices usage is increasing throughout the world and many educational institutions using advantages of the mobile devices. Traxler defined m-learning as “any educational provision where the sole or dominant technologies are handheld or palmtop devices” (as cited in Berge & Muilenburg, 2013). Even if m-learning is spreading rapidly in many regions of the world, m-learning is still in its infancy (Muyinda, 2007). Research results indicate that few of efforts have produced any lasting outcomes (Wingkyist, 2009). For instance,

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high dropout rate is frequently reported in online courses (Sulcic & Sulcic, 2007). It is evident that the initiatives are faced with inherently complex settings and that the outcomes might not live up to their promises; will not be adopted and, hence, will not become sustainable (Wingkyist, 2009). On the other hand, literature review show that sustainability of mobile learning depends on not only adoption of mobile learning but also educational needs, success factors, limitations and challenges, and changes and risk of mobile learning projects.

### *1.1. Defining sustainability in the context of m-learning*

In light of the literature, we specified four abilities which define the sustainability of m-learning for our study: ability to address current educational needs and intent of m-learning; ability to have potential to be adopted by users; ability to maintain a certain condition indefinitely or make progress; ability to adapt to possible changes.

### *1.2. Research aims*

This study aims both specifying the current situation of m-learning in design and development, and identifying factors affect m-learning sustainability which helps to facilitate and promote future empirical research. The study may provide guidelines to assist m-learning initiatives in sustaining an effective mobile learning in terms of design and development. The following guiding questions were used in this research study:

- What are the significant and relevant developmental factors that can affect the sustainability of m- learning?
- What does the statistical evidence suggest about how the significant and relevant developmental factors affect the sustainability of m-learning?
- What is the current situation of the developmental sustainability of m-learning at universities in Turkey?

## **2. A Review of the Literature**

With technology started to use in education intensively, research on educational technology sustainability factors also started to make because of rapid technology development. Romano (as cited in Timpone, 2012) specified 10 educational technology sustainability factors in his study: Leadership, Funding, Professional Development, Technical Support, Assessments, Technology Integration, Digital Content, Equitable Access to Technology, Connectivity and Communication/Shared Practices. Merisotis and Phipps, (2000) also identified some benchmarks for success in Internet-Based distance education. These are Institutional Support, Course Development, Teaching/Learning Process, Course Structure, Student Support, Faculty Support, and Evaluation and Assessment. With spreading of e-learning, educational leaders started to research on e-learning sustainability factors. Attwell ,(2004) focused on five aspects of e-learning sustainability which are learning platforms and learning software, institutional responses to the use of e-learning, e-learning materials development, pedagogic approaches, and teacher and trainers skills. Sun and et al., (2008) studied on thirteen factors under the six dimensions which are learner dimension, instructor dimension, design dimension, environmental dimension, technology dimension and course dimension. There is not more research about sustainability of mobile learning but we specified some abilities which define the sustainability of m-learning in our study and we can research in the light of this definition. Researchers have studied about educational needs, adoption, success factors, limitations and challenges, and changes and risk of mobile learning projects.

### *2.1. Requirements*

Firstly, there are some requirements for sustainable mobile learning in order to able to address current educational needs and intent of m-learning. Casany and et al., (2012) specified some requirements for m-learning projects sustainability. These requirements are changes in the traditional practices of educational institutions, motivation to change technology, time for customizing and adapting materials and content to different types of devices or platforms, budget for hardware and Internet connections, consolidation, and content and services for different sociocultural realities. On the other hand, Al-Bahadili and et al., (2011) studied on learner's requirements

for successful m-learning and specified as identification of learner's needs, structuring of the pedagogical material, enhancement of the m-learning environment, motivation for learner participation, tutorials, collaborative mechanisms, supporting tools and combination of learning processes.

## *2.2. Adoption*

Secondly, sustainable m-learning should have ability to potential to be adopted by users. Zurita and Nussbaum (2004) emphasized some factors that essential for the adoption of the project such as interactivity, coordination, negotiation and communication, organization of material, mobility and, motivation and collaboration. Liu, (2008) studied on an adoption model for mobile learning. His research model includes such issues: Social influence, facilitating conditions, self-management of learning, performance expectancy, effort expectancy, mobility, self-efficacy, attainment value, and perceived enjoyment.

## *2.3. Success factors, limitations and challenges*

Thirdly, a successful project can maintain a certain condition or make progress therefore success factors are essential for m-learning sustainability. Papanikolaou and Mavromoustakos (2006) handled the issues as critical success factors for the development of mobile learning applications such as understanding of characteristics, peculiarities and constraints of the various mobile devices and technologies to be used in m-learning, learners' needs and requirements and examination of the quality components which are usability, functionality, reliability, efficiency, maintainability and portability. According to Bates and Poole, (2003) the appropriateness of the technology for students, ease of use and reliability, costs, teaching and learning approaches, interactivity, organizational issues, novelty and speed are important factors. In addition to success factors, limitations and challenges are also essential for maintaining a certain condition or progress. Al-Bahadili and et al., (2011) specified some constraints for mobile device such as software constraints, hardware constraints and network constraints. Ting (2005) studied on future challenges of m-learning and specified three challenges: the concept of adaptive learning, where the instructional strategies and learning content should be designed to adapt to learner's profile and personal needs, the limited text display and the location and response time. Berge and Kearsley (2003) studied about the sustainability of distance training and received a wide variety of responses. Such responses are deal with design and development: time and costs associated with the development of e-learning; keeping up with rapid changes in technology; identifying what training needs can best be met by e-learning; creating and maintaining interest in e-learning; too much time spent on developing the technology and not enough on the instruction.

## *2.4. Changes and risks*

Lastly, there are some challenges and limitation for mobile learning, and they also will be in future so sustainable m-learning should adapt to possible changes. Grohmann and et al., (2005) studied on changes and risks of mobile learning and specified as follow developmental factors: integration into the course of work, loss of privacy and lack of profitability. Georgiev et al., (2006) also examine the developmental challenges of transition from e-learning to m-Learning. According to them, while mobile device properties, the information transfer speeds, connection technologies, memory, development platform choice and test ability are challenges, educators challenge with requirement of fluency in the authoring tools for mobile learning systems and the system restrictions. Igwe (2002) identified some challenges which are using e-learning as an add-on to traditional forms of teaching and learning in tertiary education and unsatisfactory knowledge on the real costs and benefits of e-learning investments. In this study, partnerships and networks are seen as possible solutions for these challenges. As a summary of the literature, 22 factors were involved under the seven aspects; those factors are novelty, interactivity, usability, and flexibility and maintainability under the learning environment aspect. The factors of effectiveness and novelty are in the material and application aspect, and stimulating and efficiency in the content aspect. The factors of compatibility with mobile communication device are screen resolution, memory adequacy, processor speed and connection technologies. Identification of new trends, investment and implementation of new ideas were identified in

innovation aspect. Testing and evaluation aspects are quality standards, requirement specification, expansion and upgrade, maintenance, piloting and cost effectiveness. Finally, the cooperation among staff, instructors and users/students aspect has not any factor. We integrated these factors into one framework subject to. (shown in Fig. 1).

## 2.5. Hypotheses

With the previous research, a framework was developed to assist this study and 22 factors are discussed under the seven titles. Hypotheses are presented in this section:

- **Hypothesis 1:** There is a meaningful relationship between novelty of the learning environment and perceived developmental m-learning sustainability.
- **Hypothesis 2:** There is a meaningful relationship between interactivity of the learning environment and perceived developmental m-learning sustainability.
- **Hypothesis 3:** There is a meaningful relationship between usability of the learning environment and perceived developmental m-learning sustainability.
- **Hypothesis 4:** There is a meaningful relationship between flexibility and maintainability of the learning environment and perceived developmental m-learning sustainability.
- **Hypothesis 5:** There is a meaningful relationship between effectiveness of the materials and applications and perceived developmental m-learning sustainability.
- **Hypothesis 6:** There is a meaningful relationship between novelty of the materials and applications and perceived developmental m-learning sustainability.
- **Hypothesis 7:** There is a meaningful relationship between stimulating of the contents and perceived developmental m-learning sustainability.

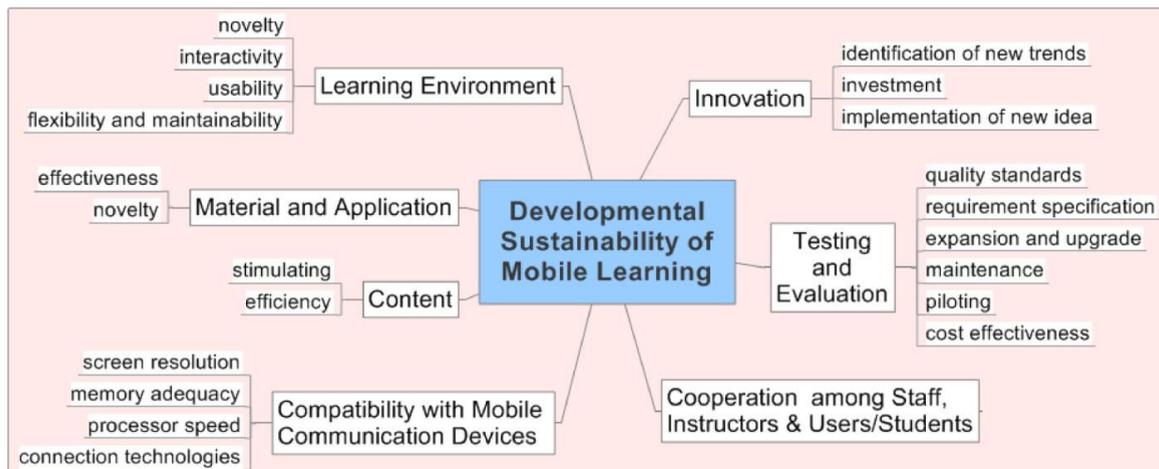


Fig. 1. Developmental sustainability model

- **Hypothesis 8:** There is a meaningful relationship between efficiency of the contents and perceived developmental m-learning sustainability.
- **Hypothesis 9:** There is a meaningful relationship between screen resolution compatibility with mobile communication devices and perceived developmental m-learning sustainability.
- **Hypothesis 10:** There is a meaningful relationship between memory adequacy compatibility with mobile communication devices and perceived developmental m-learning sustainability.

- **Hypothesis 11:** There is a meaningful relationship between processor speed compatibility with mobile communication devices and perceived developmental m-learning sustainability.
- **Hypothesis 12:** There is a meaningful relationship between connection technologies compatibility with mobile communication devices and perceived developmental m-learning sustainability.
- **Hypothesis 13:** There is a meaningful relationship between identification of new trends and perceived developmental m-learning sustainability.
- **Hypothesis 14:** There is a meaningful relationship between investment and perceived developmental m-learning sustainability.
- **Hypothesis 15:** There is a meaningful relationship implementation of new idea and perceived developmental m-learning sustainability.
- **Hypothesis 16:** There is a meaningful relationship testing and evaluating with quality standards and perceived developmental m-learning sustainability.
- **Hypothesis 17:** There is a meaningful relationship requirement specification and perceived developmental m-learning sustainability.
- **Hypothesis 18:** There is a meaningful relationship expansion and upgrade and perceived developmental m-learning sustainability.
- **Hypothesis 19:** There is a meaningful relationship maintenance and perceived developmental m-learning sustainability.
- **Hypothesis 20:** There is a meaningful relationship piloting and perceived developmental m-learning sustainability.
- **Hypothesis 21:** There is a meaningful relationship cost effectiveness and perceived developmental m-learning sustainability.
- **Hypothesis 22:** There is a meaningful relationship between cooperation among staff, instructors & users / students and perceived developmental m-learning sustainability.

### 3. Methodology

With the literature review about current sustainability factors, educational needs, adoption, success factors, limitations and challenges, and changes and risk of mobile learning projects, the following developmental sustainability aspects were identified and discussed: learning environment, material and application, content, compatibility with mobile devices, standardization, innovation and improvement, testing and evaluation and cooperation among staff, instructors and users/students. The results were evaluated and analyzed, and a conceptual model for developmental m-learning sustainability was developed. In light of the model, an investigation based on a survey research was made in order to assess the current developmental m-learning sustainability of universities in Turkey and SPSS (v.17.0) is used for analyzing of this study.

#### 3.1. Participants

The survey research conducted with heads of academic units, lecturers who use a range of innovative m-learning strategies, and m-learning staff from content, design and development units. This includes 36 staffs from twelve universities. Although it cannot be claimed that the respondents of this study represent all universities has m learning initiative in Turkey, this section of the study provides some indication about the development process of mobile learning. For instance, the study revealed that majority of respondents (44.4%) have been deal with m-learning for more than 5 years and nearly 52.8% of the participants were between 30 and 40 years old.

#### 3.2. Instrumentation

The survey which has been developed to assess the developmental m-learning sustainability of universities in Turkey includes two sections. The first section consisted of 4 items to gather data about demographic characteristics, such as age, institution, position and working year. The second section included 10 items to assess respondents' self-

report perceptions of their universities' developmental status. The items were developed using five-point Likert-scales (ranging from "strongly disagree" to "strongly agree").

#### 4. Results and Discussions

The reporting of results and discussion is handled under three sections. The first section is for discussing the reliability of the survey instrument. The second section reports results for the third research question, "How do staffs and instructors of m-learning initiatives perceive their developmental sustainability of m-learning?". The third section includes a regression analysis for the hypotheses.

##### 4.1. Reliability Analysis

Cronbach's Alpha analysis was used for finding the reliability values of each variable. According to Cronbach's Alpha analysis, as can be observed from the [Table 1](#), the reliability of instrument was found overall to be quite high (0.892). The reliability of the factor novelty of learning environment has highest value (0,895) and the factor usability of learning environment and requirement specification has lowest value (0,884).

Table 1. Reliability statistics

Cronbach's Alpha	N of Items
,892	23

##### 4.2. Descriptive Analysis

With the survey, a value from 1 to 5 is given to each factor and these values represent the developmental status of the m-learning initiatives. While '5' represents highest status, '1' represents lowest status. The [Table 2](#) includes the mean values belongs to each top category of the developmental sustainability factors which are reached from literature review. The mean of each factor was as follows: Learning Environment: novelty = 4,07; interactivity = 3,90; usability = 4,07; flexibility and maintainability = 3,97; Material and Application: effectiveness = 3,90; novelty = 3,79; stimulating = 3,69; efficiency = 3,76; Compatibility with Mobile Communication Devices: screen resolution

Table 2. Descriptive statistics

Factors	N	Mean
Learning Environment	36	3,89
Material and Application	36	3,82
Content	36	3,69
Compatibility with Mobile Communication Devices	36	3,53
Innovation	36	3,34
Testing and Evaluation	36	3,59
Cooperation among Staff, Instructors and Users/Students	36	3,53
Perceived Developmental m-Learning Sustainability	36	3,67

= 3,52; memory adequacy = 3,55; processor speed = 3,66; connection technologies = 3,55; Innovation: identification of new trends = 3,72; investment = 3,31; implementation of new idea = 3,48; Testing and Evaluation: quality standards = 3,38; requirement specification = 3,93; expansion and upgrade = 3,69; maintenance = 4,00; piloting = 3,93; cost effectiveness = 3,24; Cooperation among Staff, Instructors & Users/Students = 3,62. The value perceived developmental m-learning sustainability is 3,76. According to descriptive analysis, each factor has value more than 3 which is average of the values. Cost effectiveness, evaluation with quality standards and investment are critical issues.

### 4.3. Hypothesis analyzing

For testing the hypothesis, a multiple regression analysis was used. The 22 influential variables used as independent variables, while perceived developmental m-learning sustainability was used as a dependent variable. Significance value is less than .05 (Table 4.), and R and R square values close to 1 (Table 3). So we can examine the hypotheses and coefficients in Table 5.

Table 3. Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,994	,988	,946	,202

Table 4. Anova

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21,065	22	,957	23,396	,000
	Residual	,246	6	,041		
	Total	21,310	28			

The results of regression analysis are presented in Table 5. P-values of five independent variables are more than .05 and they are not considered to have meaningful relationships with perceived developmental m-learning sustainability. Those factors are memory adequacy, investment, expansion and upgrade, and cost effectiveness. Therefore, Hypotheses 10, 14, 18 and 21 are not supported by this test.

## 5. Conclusions and Recommendations

This research specifies relevant factors affect developmental m-learning sustainability. With this study, 18 factors in seven titles are identified to contribute to research. Cost effectiveness, evaluation with quality standards and investment are issues which m-learning initiatives need to improvements. The multiple regression analysis was used for analyzing this study. The results is that memory adequacy, investment, expansion and upgrade, and cost effectiveness are the factors not affect the perceived developmental m-learning sustainability. This study helps institutions to improve their m-learning initiatives in terms of developmental. However, more factors and questions can easily be added. For further research, in addition to developmental dimension, other dimensions also can be handled such as technological, psychological, organizational etc. On the other hand, the researchers claim that for more reliable and verifiable data, it is required to conduct the survey instrument to more initiatives.

Table 5. Hypotheses and coefficients

Hypothesis	Factors	Coefficients			
		Beta	t	Sig.	Significant
<b>Learning Environment</b>					
1	LEN [novelty]	-,390	-4,722	,003	Yes
2	LEI [interactivity]	,555	6,726	,001	Yes
3	LEU [usability]	1,190	6,417	,001	Yes
4	LEFM [flexibility and maintainability]	-,431	-3,019	,023	Yes
<b>Material and Application</b>					
5	MAE [effectiveness]	,836	7,049	,000	Yes
6	MAÖ [novelty]	-1,041	-6,858	,000	Yes
<b>Content</b>					
7	CS [stimulating]	-1,415	-5,868	,001	Yes
8	CE [efficiency]	1,164	6,204	,001	Yes

<b>Compatibility with Mobile Communication Devices</b>					
9	SR [screen resolution]	,804	3,294	,017	Yes
10	MA [memory adequacy]	-,237	-1,122	,305	No
11	PS [processor speed]	-1,564	-3,714	,010	Yes
12	CT [connection technologies]	1,304	3,110	,021	Yes
<b>Innovation</b>					
13	INT [identification of new trends]	-,586	-4,241	,005	Yes
14	I [investment]	,097	,551	,601	No
15	INI [implementation of new idea]	,493	3,641	,011	Yes
<b>Testing and Evaluating</b>					
16	QS [quality standards]	-,489	-2,797	,031	Yes
17	RS [requirement specification]	-,409	-3,090	,021	Yes
18	EU [expansion and upgrade]	,032	,256	,806	No
19	M [maintenance]	,560	5,083	,002	Yes
20	P [piloting]	,378	2,809	,031	Yes
21	CE [cost effectiveness]	,150	1,227	,266	No
22	<b>CSIU [Cooperation among Staff, Instructors &amp; Users / Students]</b>	-,585	-4,243	,005	Yes

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