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Systematic Review of Literature for Smartphones Technology Acceptance Using Unified Theory of Acceptance and Use of Technology Model (UTAUT)

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Abstract

Systematic Review and Meta-analysis are techniques which attempt to associate the findings from similar studies and deliver quantitative summaries of the research literature [1]. The Systematic review of research literature identifies the common research methods, research design, sample size, parameters used, survey instruments, etc. used by the group of researchers. This study intends to fulfill this purpose in order to identify common research mythologies, dependent variables, sample sizes, moderators and mediators used in the field of analysing technology adoption based studies that utilizes the UTAUT2 model. This research collected over 59 published articles and conducted descriptive analytics. The results have revealed performance expectancy/perceived usefulness, trust and habit as the best predictors of consumer behavioural intentions towards the adoption of mobile application. Behavioural intention was the best predictor of use behaviour among the 57 articles selected. 274 was the mean sample size of research with 25 mean questionnaire items. SPSS and AMOS were the most common softwares used in all 57 studies, and 32 of those studies used UTAUT1 model while 14 researches incorporated the UTAUT2 model. There were also two promising predictors such as perceived risk on behavioural intention and habit on use behaviour.

Keywords

Systematic Review of Literature, UTAUT, Technology Acceptance, Smartphone, Education Technology, Technology Acceptance

1. Introduction

Wolf [2] posits that good Systematic Reviews and Meta-analyses cover a large sample of relevant studies, which aids in the robustness of the conclusion and findings. Schmidt and Hunter [3], describe a four-step temporal sequence in conducting meta-analysis which begins by collecting research studies, followed by extracting information, followed next by meta-analysis methods to extract information, and then finally ends in presenting the results.

2. Research Background

UTAUT2 model has been widely used since its inception, and it has already gained more than 6000 citations in Google Scholar which includes widespread use from Information Science, Technology Adoption, Human Behaviour, and e-Learning. This gives empirical advantage and relevance for researchers to use UTAUT2 as the theoretical underpinning towards understanding technology adoption. This theory not only gives flexibility in a variety of settings, it also enables the addition of external variables. UTAUT2 studies are not limited only to the consumer user type alone. Researchers have deployed UTAUT2 to examine various users types such as users' adoption of m-health [4], nurses' willingness for home tele-health [5]. A robust understanding of such a widely used theory can only be possible after conducting large collections of literature reviews.

Since the advent of smartphones, numerous studies were conducted on technology adoption in the field of information and communication technology (ICT) worldwide. Conducting a systematic review of literature is expected to provide exciting context for individual technology acceptance and use research and what lies ahead in future. This research is an attempt to fill the gap in exploring the UTAUT2 central role in individual technology adoption research, a systematic review of the existing UTAUT2 studies that will provide insights, and the limitations of the model. It is also expected to lay the directions for future research. With this aim this research will attempt to:

1) identify common research mythologies;
2) most common dependent variable;
3) sample size;
4) moderator and mediators.

3. Research Methodology

The fundamental principal of this research methodology is descriptive analysis of literature specifically designed to more quickly and accurately identify trends, common dependent variables, sample sizes, the most common moderators and mediators identified as well as to eliminate biases. A systematic review is a research summary that addresses a focused question in a structured, reproducible manner, which may be often accompanied by a meta-analysis. Both systematic reviews and meta-analyses explore to identify all topics relevant to a specific

question and to summarize and evaluate its validity.

This research conducted the systematic review and meta-analysis of literature by first criteria was to strictly selecting the relevant published literature for the last 10 years. This was due to the fact that Smartphone technology was invented around 2007. The other reason was that the derivation of the UTAUT model was in the year 2003 while the UTAUT2 model was conceived in 2012. The second criteria was considered for selecting the relevant literature adhering to Information and Communications Technology (ICT), mobile technologies, e-Learning and mobile learning technology acceptance in educational settings. Finally, the third criteria was to select the published research from varied geographical regions, as mentioned in **Table 1**.

The selection of the articles was conducted using Adobe Acrobat Processional software text find and Highlight script. This macro script identifies specified words and phrases across multiple documents tags, highlights and counts their respective occurrences in each article. This technique automated the selection of research articles defined by the criteria identified in Appendix B and resulted in recognizing 59 research articles. The next filtered the research articles to 49 after removing those studies which were not quantitative or were repetitive, those that did not discuss results and analysis; it also removed studies with large sample sizes (>500). The selection of literature for the meta-analysis of study was carried out after a comprehensive manual search from databases such as Science Direct, JSTOR, SAGE Online, Elsevier, ProQuest, Wiley Inter-Science, ACM Digital Library, Elsevier, and MIS Quarterly. The keywords identified in the criteria include "UTAUT", "UTAUT2", "Technology Acceptance", "mobile learning", "Smartphone", "Technology acceptance in Engineering Education", "Technology acceptance in Teacher Education", "Technology Adoption" and "Behaviour Intention to Use Technology".

A few publications were eliminated even though they met the above-mentioned criteria; this was because they did not conclude the results or findings of the research. Like any other statistical techniques, meta-analysis can also mislead if the selection and elimination criteria are not well defined or properly conducted. The required care and steps suggested by [3] [6]. This study incorporated all the necessary steps highlighted by to make sure that there is no unintended bias, errors or any skipped process in selecting the literature pool [6].

4. Meta-Analysis Results

The collected literature review data was classified into six main categories as highlighted in **Table 2**. The first category was "Descriptive information" which included the Code, Author, Year of publication, Technology investigated and the Geographical region of the study. The second group was "Statistical Power" which categorized sample size, number of constructs and number of survey items used. The third group "Software" identified software tools used and the Pilot study carried in the research. The fourth set "Model" identified the use

Table 1. Research article selection criteria.

Must Include	Preferred
	1) involve mobile technology in higher education
	2) investigate ICT devices
1) involve quantitative analysis	3) Smartphone technology acceptance
2) UTUAT or UTAUT2 model	4) Smartphone as a learning tool
	5) published journal article
	6) published between 2006 to 2015

Table 2. Meta-analysis classification criteria.

No	Items	Description
1	**Descriptive Information**	Author Year Technology Region Mobile Tech.
2	**Statistical Power**	Sample Constructs Items
3	**Software**	Software Pilot
4	**Model**	UTAUT UTAUT2
5	**Moderators**	Gender Moderator Age Moderator Other Moderator
6	**Analysis Techniques**	Descriptive (Mean, STD, Cronbach's alpha,) EFA (Exploratory Factor Analysis) Scale Evaluation (Model-Fit) CFA (Confirmatory Factor Analysis) t-Test ANOVA (Analysis of variance) Regression

of UTAUT and UTAUT2 models by the research. The fifth group "Moderator" collected the moderators investigated by each study respectively. Finally, the sixth group identified types of descriptive statistics, inferential statistics, (exploratory factor analysis, model-fit, confirmatory factor analysis and scale evaluation) and other common statistical tests used by respective studies, as shown in Appendix A. These results were achieved after running a script in Adobe Acrobat Professional Batch Processing which allows to define a series of PDF document processing using actions. This action can be applied multiple more files, or

to an entire content of the folder.

The list was sorted in the descending order by the year of publication. Each corresponding information was recorded with an "X" in the conforming entry, and only the information for the sample size, number of constructs and survey items was recorded against their actual values. Basic descriptive data analysis was carried out against each group to assess the average values to establish the assertion.

Statistical Power: The second set of meta-analyses assessed sample size, UTAUT constructs studied and average number of questions used in each study. The results identified that an average of 274 responses were collected per study, as well as an average of seven constructs per study. The meta-analysis identified that the average number of questionnaire items used per study was 25 as mentioned in Table 3.

The software applications used while analysing technology acceptance using UTAUT and UTAUT2 models were mostly IBM SPSS, IBM AMOS, PLS Graphs and LISREL. 29% of researchers used IBM SPSS for exploratory factor analysis, 16% of them used IBM AMOS for confirmatory factor analysis, the rest 27% of researchers used PLS Graph for confirmatory analysis. 6% of the researchers were found to have used a combination of IBM SPSS and AMOS for the same purpose. 2% were also found to be using the LISREL application for conducting factor analysis and for confirming the hypothesis of the research. With the above data it was evident that IBM SPSS and AMOS were found to be the most common software's among the selected set of literature, as shown in Table 4.

Study Model: The systematic analysis of the literature review focused mainly on the studies that incorporated the UTAUT and UTAUT2 models which investigated technology acceptance. From the collection of research studies, a total of 65% investigated information technologies acceptance by using the UTAUT; while 29% research studies focused on the UTAUT2 model, as shown in Table 8.

Table 3. Sample size, UTAUT constructs and the no of questionnaires items frequency.

2-Statistical Power	Mean Score
Sample size	274
UTAUT Constructs Studied	7
Questionnaire Items	25

Table 4. Type of software applications used by the researchers.

3-Software Application	Total	%
SPSS (IBM)	14	29%
AMOS (IBM)	8	16%
PLS	13	27%
SPSS/AMOS (IBM)	3	6%
LISREL	1	2%

An analysis of moderators used in technology acceptance revealed that a total of 67% of the studies investigated gender as a moderator and at the same time 63% of them investigated age as the moderating effect. A total of 47% of the studies had also incorporated other genders such as the experience of using technology, the educational level, etc. The analysis of the literature review also highlighted that a total of 18% of the studies had ran Pilot studies before conducting the main study as shown in Table 5.

Year of Publication: An analysis of the research publication year reveals that 2013 witnessed 27% of the studies from the pool of research publications selected for this literature review, with most of the studies focused on mobile technology acceptance, as illustrated in Table 6. The year 2012 witnessed the next highest published with a total of 16% of them investigating technology acceptance. Among those eight studies, three covered mobile technology acceptance. The years 2012 and 2010 had 16% and 12% published research with three of those studies covering mobile technology acceptance respectively. While in 2009, 2014, 2008, 2007 and 2006, all pooled 3 to 2 studies respectively.

Table 5. UTAUT models and moderators used by the researchers.

	4-Models	Total	%
1	UTAUT Model	32	65%
2	UTAUT2 Model	14	29%
	5-Moderators		
	Gender Moderator	33	67%
	Age Moderator	31	63%
	Other Moderator	23	47%
	Pilot Study	9	18%

Table 6. Year of publication with the respective technologies.

Year	Technology	Count	Total	%
2015	Pervasive Information Systems	1	2	4%
	Phablets	1		
2014	Mobile Hospitality	1	4	8%
	Smartphone	1		
	Social Media	1		
	Social Networking	1		
2013	LMS	2	13	27%
	Mobile banking	1		
	Mobile Learning	**5**		
	Mobile Payment	1		
	NFC	1		
	Online Banking	1		

Continued

	Online Music Service	1		
	Technology	1		
2012	Computer	1	8	16%
	Mobile banking	2		
	Mobile Learning	1		
	Smart Card	1		
	Technology	1		
	Telecom	1		
	WBT	1		
2011	eBay	1	3	6%
	Smartphone	2		
2010	Driver Support System	1	6	12%
	ICT	2		
	Mobile Computing	1		
	Mobile Search	1		
	Model Validation	1		
2009	Mobile Learning	4	5	10%
	Smartphone	1		
2008	3G Mobile	2	3	6%
	Mobile Learning	1		
2007	ICT	1	2	4%
	Infomediaries	1		
2006	Games	1	3	6%
	Mobile Technology	2		
	TOTAL	49		100%
	Total Mobile Learning	13		27%
	Total Smartphone	4		8%

A total of 27% studies out of 49 research journals covered mobile learning and about 8% research studies covered Smartphone technology acceptance. Among these four, only one study investigated Smartphones for ubiquitous learning (u-learning). The concept of U-Learning is an extension of basic mobile learning where learning content is accessed in various contexts and situations [7].

Region: It was found that the investigation of technology acceptance was being conducted among all regions of the globe. The region of Asia had seen 47% studies conducted with China registering most of the studies followed by Malaysia with 6 studies each. The second region investigating technology acceptance most (by using the two models) was Europe with 24% of the research studies. North America saw 8% of the studies followed by the Middle East with 6%, Oceania with 4% of the studies and finally South America with 1 study 2%, as illustrated in **Table 7**.

Table 7. Frequency of UTAUT models used against the regions and countries.

Region/Country	UTAUT	UTAUT2	Total
ASIA			**47%**
China	4	2	6
Malaysia	4	2	6
Taiwan (China)	4	1	5
Bangkok	2		2
Thailand	2		2
Indonesia		1	1
South Korea	1		1
Total	17	6	23
OCEANIA			4%
Australia	1	1	2
AFRICA			
Nigeria	1		1
MIDDLE EAST			6%
Jordan	1	1	2
Saudi Arabia	1		1
Total	2	1	3
EUROPE			24%
UK	2	1	3
Germany		2	2
Finland	2		2
Sweden	1		1
Netherland		1	1
Portugal		1	1
Spain		1	1
EU	1		1
Total	6	6	12
NORTH AMERICA			8%
USA	4		4
SOUTH AMERICA			2%
Brazil	1		1
TOTAL	**32**	**14**	
	65%	**29%**	

Meta-Analysis of Mobile Learning Technology Acceptance Studies: The next stage of meta-analysis focused on extracting studies which exclusively concentrated on assessing the acceptance of mobile technologies or mobile learning out of the final 49 research studies. A total of 23 research studies were identified after this criterion, as shown in Table 8. A total of nine studies focused exclusively on mobile learning.

This stage results were acquired with Adobe Acrobat Text batch process which can run searches to find specific text field in PDFs from the journal articles folder. A simple search term can run complex variables in one or more PDFs. Acrobat searches the PDF body text, layers, form fields, and digital signatures. Acrobat exports metadata, structures searches indexed structure tags and creates output as Comma Separated Values (CSV) file. It can be observed that most of the publications were reported after 2008 and about 12 studies accounting to 50% of the research were published in the years 2012 to 2014. The analysis also revealed that a total of nine studies focused on Mobile Learning, while ten research studies focused on varied Mobile technologies ranging from 3G, Mobile banking, Mobile computing etc. Finally, a total of four studies exclusively focused on Smartphone technology integration using UTAUT2 models.

Table 8. Research studies using mobile technologies and Smartphone.

No	Author	Year	Technology	Count	Region
1	Abu Al Aish & Love [8]	2013	Mobile Learning		UK
2	Yang S. [9]	2013	Mobile Learning		China
3	Yang *et al.* [10]	2013	Mobile Learning		China
4	Jambulingam [11]	2013	Mobile Learning		Malaysia
5	Faaeq *et al.* [12]	2015	Mobile Learning	9	Iraq
6	Nassuora [13]	2012	Mobile Learning		Saudi Arabia
7	Wang *et al.* [14]	2009	Mobile Learning		China
8	Jairak *et al.* [15]	2009	Mobile Learning		Bangkok
9	Liu *et al.* [16]	2008	Mobile Learning		Finland
10	Wu *et al.* [17]	2007	Mobile (3G)		Taiwan (China)
11	Raman & Don [18]	2013	Mobile (LMS)		Malaysia
12	Yu [19]	2012	Mobile (Banking)		Taiwan (China)
13	Moran *et al.* [20]	2010	Mobile (Computing)		USA
14	Zhang & Venkatesh [21]	2018	Mobile (Search)		China
15	Carlsson *et al.* [22]	2006	Mobile (Technology)	10	EU
16	Sundaravej [23]	2010	Mobile (Validation)		USA
17	Williams *et al.* [24]	2012	Mobile (Technology)		Australia
18	Abdulwahab & Zulkhairi [25]	2012	Mobile (Telecom)		Nigeria
19	Alraweshdeh *et al.* [26]	2012	Mobile (WBT)		Jordan
20	Pheeraphuttharangkoon *et al.* [27]	2014	Smartphone		UK
21	Shin *et al.* [28]	2011	Smartphone	4	South Korea
22	Pitchayadejanant [29]	2011	Smartphone		Thailand
23	Chen *et al.* [30]	2009	Smartphone		Taiwan (China)

Table 9 illustrates that the average sample size was 246, with an average of 7 constructs and about 24 items reported as part of the questionnaire for the 23 studies. A total of 50% of the studies among the 23 listed used IBM SPSS and AMOS, while a total of 90% used the UTAUT model to study technology acceptance. More than 65% of the studies assessed the effect of gender as a moderator while more than 60% of the 23 enlisted studies had conducted descriptive and inferential statistics using exploratory and confirmatory factor analysis techniques.

The research conducted by Pheeraphuttharangkoon, *et al.* [27] used the Unified Theory of Acceptance and Use of Technology (UTAUT) to assess the adult adoption of Smartphones by using the 50+ age demographic group. Data was collected with an online survey and a total of 204 completed replies. The path analysis found that observability, compatibility, social influence, facilitating conditions, effort expectancy and enjoyment were significant predictors of the use of Smartphones by adults over 50.

Table 9. Research studies using statistical power, software's application.

	Statistical Power	No. of Studies	Average
1	**Sample**		246
2	**Constructs**		7
3	**Items**		24
	Software		
1	SPSS	6	26%
2	AMOS	5	22%
3	PLS	6	26%
	Model		
1	Pilot	2	9%
2	UTAUT	19	83%
3	UTAUT2	3	13%
	Moderator		
1	Gender	17	74%
2	Age	15	65%
3	Other	13	57%
	Data Analysis Technique		
1	Descriptive	18	78%
2	EFA	14	61%
3	Scale Evaluation	17	74%
4	CFA	15	65%
5	t-Test	1	4%
6	ANOVA	0	0%
7	Regression	6	26%

The second research conducted by Shin, *et al.* [28] was aimed at understanding the primary factors influencing the user's intention to continually use Smartphones as a ubiquitous learning tool. The aim was to enhance this tool's usability and functionality by assessing the learner's experience after collecting the data form ten South Korean Universities. The study incorporated the UTAUT model and confirmed its significance in predicting user attitudes and behavioural intentions towards using the Smartphone as a learning tool.

A similar study conducted by Pitchayadejanant [29] in using Smartphones, studied the significance of Perceived Value between the two groups of Smartphone users, by comparing iPhone and Blackberry users. The Structural Equation Model (SEM) technique was used and the results indicated that Perceived Value and Facilitating Conditions were the two strongest predictors of Behavior Intention to use Smartphones. Furthermore, Performance Expectancy, Effort Expectancy and Social Influence did not directly impact on Behavior Intention but they made a significant impact on the Perceived Value construct. This study concluded that Perceived Value is the mediating variable for Performance Expectancy, Effort Expectancy and Social Influence for the Behavior Intention to use Smartphones.

The fourth study assessed the empirical acceptance of Smartphones after comparing the four models [30]; Model-1: Technology Acceptance Model (TAM); Model-2: TAM with Self-Efficacy; Model-3: Innovation and Diffusion Technology (IDT) and Model-4: TAM with IDT and Self-Efficacy. The study varied all the factors and combined them to collect the survey data. Results show that the relationships amongst constructs were similar with Self-efficacy being the strongest predictor of behavioral intention followed effort expectancy and facilitating condition. The results also show that organizational and environmental factors were driving the attitude towards Smartphone adoption.

5. Conclusions

There seems to be an increasing trend in studying user acceptance of technology in various settings, technologies, region, parameters and population sample. As the both UTAUT and the UTAUT2 model are relatively new, the amount of publications available is considerable with reliable results. The literature review of this research had found UTAUT and UTAUT2 models had been the predominant model for conducting research in the fields of acceptance and user perceptions of different technologies. The amount of research on the acceptance of Smartphone as mobile learning device and technologies is very limited. The findings of this study are a valuable addition to the research continuation of technology acceptance in the academia and particularly in tertiary education. The literature review conducted in this chapter investigated the underlying theories used as a foundation of the research methodology, the evolution of technology acceptance theories, and its dimensions, quantitative techniques, instrument design covering a large pool of research papers as part of the meta-analysis as

explained earlier in this chapter. Factors influencing Smartphone as a mobile learning acceptance are identified through literature review, along with identifying the UTUAT2 moderators.

This research selects UTAUT2 model as the theoretical framework and aims in addressing the importance of further improvising the constructs and moderators to assess the acceptance of Smartphones in contextual environments.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix A: Meta-Analysis Articles Results

1-DESCRIPTIVE INFORMATION						2-STAT. POWER			3-SOFTWAR		4-MODEL		5-MODERATORS			6-DATA ANALYSIS TECH.						
No	Author	Year	Technology	Region	Mobile Tech.	Sample	Constructs	Items	Software	Pilot	UTAUT	UTAUT2	Gender	Age	Other	Descriptive	EFA	Scale Evaluation	CFA	t-Test	ANOVA	Regression
1	Segura et al.,	2015	Pervasive Infformation Systems	Germany		346	6		S-A			X	X	X		X		X	X			
2	Huang et al.,	2015	Phablets	Taiwan (China)	X	266	9					X	X	X	X							
3	Estorninho,	2014	Mobile Hospitality	Portugal	X	348	9	32	P	X		X	X	X	X	X	X	X	X			
4	S Pheerap et. All.,	2014	Smartphone	UK	X	160	8	27	P		X		X	X		X	X	X	X			
5	Oechslein et al.,	2014	Social Networking	Germany	X	266	8	22	P			X					X	X		X		X
6	Harsono et al.,	2014	Social Media	Indonesia		419	9		P	X		X				X						X
7	Leong et. All.,	2013	NFC	Malaysia	X	265	7	23	S	X	X		X	X	X	X		X	X			
8	Abu-Al-Aish et. Al.,	2013	Mobile Learning	UK	X	174	6	23	S		X		X	X	X	X	X	X	X			
9	Yang S.,	2013	M-Learning	China	X	182	8	25	P	X		X	X	X	X	X		X	X			
10	Martins,	2013	Online Music Service	Spain		329	11	37	P	X		X	X	X		X		X				X
11	Yang,	2013	Mobile Learning	China	X	182	7	22	P	X		X				X	X	X	X			
12	Raman et. All.,	2013	LMS	Malaysia		320	8	27	P			X				X		X	X			
14	Admiraal et. All.	2013	Technology	Netherland		111	4	21				X	X	X	X	X						X
15	Jambulingam,	2013	Mobile Learning	Malysia	X	351	6	20	A		X		X	X				X	X			
16	Alalwan et al.,	2013	Mobile Banking	Jordan	X	344	6	32	A			X				X	X	X	X			
17	Slade et. All.,	2013	Mobile Payment	UK	X		7	43				X	X	X		X		X				
18	Almatari et. All.	2013	Mobile Learning	Malaysia	X	0	7	0	S		X		X	X	X							
19	Fehrenbacher D.,	2013	Online Banking	Australia		0	8		S	X		X				X						
20	M.-Y. Wu et al.,	2012	Smart Card	Taiwan (China)	X	201	6	18	L		X		X	X	X	X		X	X	X	X	
21	Chain Yu,	2012	Mobile banking	Brazil	X	441	8	30	S		X		X	X		X	X	X	2			
22	Abdulwahab et al.,	2012	Telecom	Nigeria		191	9	30	A		X		X	X	X		X	X				X
23	Yu,	2012	Mobile banking	Taiwan (China)	X	441	8	32	S		X		X	X		X	X	X				X
24	Williams et al.,	2012	Technology	Australia		300	6	24	S		X					X	X	X	X			
25	Nassuora,	2012	Mobile Learning	Saudi Arabia	X	80	6	18	S		X					X	X					X
26	Alrawesh et. All.,	2012	WBT	Jordan		290	8	24	A		X							X	X			
27	Wong et. All.,	2012	Computer	Malysia		245	4	14	A		X					X		X	X			
28	Seppo et. all.,	2011	eBay	China		180	8	43	S		X		X	X		X	X	X				
29	Dong-Hee et. All.,	2011	Smartphone	South Korea	X	215	9				X		X	X		X	X	X	X			
30	Pitchsys..,	2011	Smartphone	Thailand	X	204	5	24			X		X	X	X	X		X	X			
31	Zhang et al.,	2010	Mobile Search	China	X		5	16	P		X		X		X	X	X	X	X			
32	Moran et al.,	2010	Mobile Computing	USA	X	263	9	35	P		X		X		X	X		X		X		X
33	Adell E.,	2010	Driver Support System	Sweden		20	4	19		X	X		X	X	X	X						X
34	Sundaravej,	2010	Model Validation	USA		262	8	32	A		X		X	X	X	X	X					
35	Raman et. All.,	2010	ICT	USA		320	8	27	P		X					X	X	X			X	X
36	Wilson et. All.,	2010	ICT	USA		213	8	27	P	X			X	X		X		X	X		X	X
37	Chen et al.,	2009	Smartphone	Taiwan (China)	X	274	12						X	X	X	X	X	X	X			
38	Wang et. All.,	2009	Mobile Learning	China	X	330	4	21	A		X					X	X	X	X			
39	Jairak et al.,	2009	Mobile Learning	Bankok	X	390	6	23	S		X		X	X	X	X						X
42	Y.-L. Wu et al.,	2008	3G Mobile	Taiwan (China)	X	394	6	29	S-A		X		X	X	X	X	X	X	X			
44	Liu,	2008	Mobile Learning	Finland	X		9	0			X		X	X	X							
45	Bandyopadhyay et al.,	2007	ICT	USA		502	3	14	A		X		X	X	X	X		X	X			
46	Weiwei SHI,	2007	Infomediaries	China	X	650	6	27	S		X					X	X	X		X		
48	Carlsson et al.,	2006	Mobile Technology	EU	X	157	6	48			X		X	X	X	X	X		X			X
49	Chesney T.,	2006	Games	UK		170	5	15	S													X
									AVERAGE	20%	64%	30%	68%	64%	45%	82%	48%	73%	52%	9%	7%	32%

Appendix B: Meta-Analysis, Scale Evaluation

S No.	Research	Usability		Reliability			Validity				
									Construct Validity		
		Content Design	Visual Design	Test-Retest Reliability	Alternate Forms Reliability	Internal Consistency C-Alpha	Content Validity	Criterion Validity	Convergent	Discriminant	Nomological
1	Pahnila et al., 2011					x	x		x	x	
2	Xu, 2014					x	x		x	x	
3	Yang, 2013					x	x		x	x	
4	Raman et al., 2013					x			x	x	
5	Raman & Don, 2013			x		x	x		x	x	
6	Alrawashdeh et al., 2012					x					
7	Pheeraphuttharangkoon et al., 2014					x				x	
8	Shin et al., 2011					x					x
9	Luan et al., 2008										
10	Yu, 2012					x					
11	Wang et al., 2009					x	x		x	x	
12	Jairak et al., 2009					x	x				
13	Venkatesh et al., 2012								x	x	
14	Park et al., 2012						x				
15	Admiraal et al., 2013								x		
16	Raman & Don, 2013					x			x	x	
17	Admiraal et al., 2013					x	x		x	x	
18	Chesney, 2006					x					
19	Fehrenbacher, 2013						x		x		
20	Leong et al., 2013			x		x	x		x	x	
21	Leong et al., 2013										
22	Abu-Al-Aish et al., 2013					x			x	x	
23	Oshlyansky et al., 2007										
24	Adell, 2010						x				
25	Oshlyansky et al., 2007										
26	Jairak et al., 2009					x					
27	Sundaravej, 2010					x			x	x	
28	Bandyopadhyay et al., 2007						x		x	x	
29	Jambulingam, 2013					x			x	x	
30	Moran et al., 2010					x			x	x	
31	Yu, 2012					x			x	x	
32	Martins, 2013					x	x		x	x	
33	Wang et al., 2009					x			x	x	
34	Nassuora, 2012					x					
35	Carlsson et al., 2006					x					
36	Williams et al., 2012										
37	Y.-L. Wu et al., 2008					x					
38	Weiwei SHI, 2007					x			x		
39	Liu, 2008					x					
40	Lederer et al., 2000					x	x				
41	Chen et al., 2009					x			x	x	
42	M.-Y. Wu et al., 2012	x				x					
43	Abdulwahab et al., 2012					x	x		x	x	
	TOTAL	**1**	**0**	**2**	**0**	**33**	**16**	**0**	**24**	**22**	**1**