Review of Mobile Learning Trends 2010-2015: A Meta-Analysis

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ABSTRACT

This study examined the longitudinal trends of mobile learning (M-Learning) research using text mining techniques in a more comprehensive manner. One hundred and forty four (144) refereed journal articles were retrieved and analyzed from the Social Science Citation Index database selected from top six major educational technology-based learning journals based on Google Scholar metrics in the period from January, 2010 to December, 2015. Content analysis was implemented for further analysis based on (a) category of research purpose, (b) learning domain, (c) sample group, (d) device used, (e) research design, (f) educational contexts (i.e., formal learning and informal learning), (g) learning outcome (i.e., positive, negative and neutral), (h) periodic journal, (i) country, and (j) publisher. This review study of M-Learning presents findings, which can become a layover platform and guidance for researcher, educators, policy maker or even journal publisher for future research or reference in the realm of M-Learning regarding the latest trends.

Keywords

Mobile learning, M-Learning, Research trends

Introduction

With the advent of mobile technologies, new paradigm of teaching and learning with technology aid had been emerged, that is mobile learning (M-Learning). Mobile technologies purvey opportunities to hold new and interesting methods of teaching and learning, both beyond and inside the classroom. Apropos to the teaching-learning process, the integration of mobile devices into educational context has considerable benefits and profoundly potential which consistence with Valero et al. (2012) who claimed that the technological features of M-Learning are portability, immediacy, connectivity, ubiquity and adaptability. It enables collaboration among pupils, knowledge creation, information searching and improved interaction and communication between teacher and student. Moreover, it facilitates access to learning anytime and anywhere by enabling connectivity and the employ of multiple apps for educational purposes (Fundación Telefónica, 2013). In short, M-Learning has been recognized as one of the most influential technologies for education (Johnson, Adams, & Cummins, 2012).

Therefore, this paper intends to provide insights into the research trends and issues in the studies of M-Learning through content analysis of selected journals from January, 2010 to December, 2015, covering six major journals: (1) Computer & Education (C&E), (2) British Journal of Educational Technology (BJET), (3) Educational Technology & Society (JETS), (4) Journal of Computer Assisted Learning (JCAL), (5) The Internet and Higher Education (IHE) and (6) The International Review of Research in Open and Distance Learning (IRODL).

This study reported herein, investigated longitudinal trends of M-Learning research with text mining techniques. In sum, this study systematically reviews and synthesizes the relevant literature through a meta-analysis (Creswell, 2002, pp. 351-353) to provide a more comprehensive analysis of previous studies.

Specifically, the present study poses the four research questions:
- What are the sources of the article regarding periodic journal, publisher and country that were related to M-Learning that were published in these selected journals from 2010 – 2015?
- What are the main research purposes, sampling and outcome/conclusion that was related to M-Learning that were published in these selected journals from 2010 – 2015?
- What are the learning domains, device used, and educational context related to M-Learning that were published in these selected journals from 2010 – 2015?
- What types of research design have been applied in article research of M-Learning that were published in these selected journals from 2010 – 2015?

Literature review

Definition of M-Learning

M-Learning, which means learning through mobile devices (such as smart mobile phones and tablet PCs), is changing the educational environment by offering learners the opportunity to engage in asynchronous, ubiquitous instruction (Hyman et al., 2014). M-learning is a teaching method that has the intersection between mobile computing and e-learning (Quinn, 2000; Keengwe, 2014) that integrates several software and firmware technology in multimedia applications (Lavín-Mera et al., 2008) which facilitate learning through a variety of wireless mobile devices (Kukulska-Hulme, 2005; Stevens & Kitchenham, 2011) using wireless networks (WiFi) or broadband services (Caudill, 2007) without limit in terms of location or time. (Kukulska-Hulme, 2005; Hussin et al., 2012; Quinn, 2000). Furthermore, Keegan (2002) contemplates the possibility of M-Learning as a harbinger of the future of learning.

M-Learning research

The use of mobile devices for educational purposes, recognized as M-Learning has gained substantial attention from researchers in the technology-enhanced learning discipline. Recent research findings on using mobile devices in different learning environments have exemplified their ability to effectively enhance students' learning knowledge. Understanding and experience in divergent subject areas such as science (Looi et al., 2011; Hwang Wu, & Ke, 2011; Ahmed & Parsons, 2013), mathematics (Huang et al., 2012; Mahamad et al., 2010; Lan et al., 2010), language and art (Yu et al., 2013; Martin & Ertzberger, 2013), social science (Shih et al., 2010), engineering (Yang et al., 2013) and others. This promising role in education can tremendously be noticeable within the informal and formal learning context, such as guiding an interactive tour with museum visits (Sung et al., 2010; Hou et al., 2014) facilitating knowledge acquisition in field trips (Menkhoff & Bengtsson, 2012), game-based learning (Young et al., 2012), in-class collaboration learning (Echeverría et al., 2011). Nevertheless, there is always a contrasting scenario in every context, including M-Learning as Chu (2014) argued that the performance of students, known to be "effective," might be disappointing or may even negatively affect the students" learning achievements if without proper treatment employed.

Previous review paper on M-Learning

In recent years, there were three literature reviews with high citation as in December, 2015 in Google scholar studied on research trends in M-Learning. Literature review paper with the title, "Examining M-Learning trends 2003–2008: a categorical meta-trend analysis using text mining techniques" which written by Hung and Zhang (2012) and cited 45 times according to Google Scholar, used text mining techniques to investigate research trends in 144 academic articles based on five journal include Lecture Notes in Computer Science (LNCS), JETS, JCAL, C&E, and International Journal of Engineering Education on mobile learning (IJEEML) from 2003 to 2008 taken from the SCI/SSCI database. In general, they investigated publication date, publication category, taxonomy, article clusters, and country, university and journal of origin. Results showed that articles on M-Learning increased from 8 in 2003 to 36 in 2008; the most popular domains in M-Learning studies are effectiveness, evaluation, and personalized systems and studies on strategies and frameworks are more likely to be published. Apart from that, they found that Taiwan is the most contributing country and university regarding journal publications on M-Learning.

Another review paper entitled "Research trends in mobile and ubiquitous learning: a review of publications in selected journals from 2001 to 2010" which written by Hwang and Tsai (2011) and cited 121 times according to google scholar, reviews the advancement of mobile and ubiquitous learning research from 2001 to 2010 by selecting 154 articles on mobile and ubiquitous learning based on the articles published in six major SSCI journals included BJET, C&E, JETS, Educational Technology Research & Development (ETRD), JCAL and Innovations in Education and Teaching International (IETI). It is found that the number of articles has significantly increased during the past 10 years; moreover, researchers from other countries have contributed to the related field in recent years. Scope of the review included a number of articles published, research sample groups selected, research learning domains, and country of origin. They found out that research in mobile and ubiquitous learning increase drastically in number between 2006 and 2010; higher education students were the most frequent research sample, followed by elementary school students and high school students; most studies did not explicitly focus on any particular learning domain but rather investigated the motivation, perceptions and attitudes of students toward mobile and ubiquitous learning, along with course-orientation for engineering

(including computers), language and art, and science; and most articles were contributed from US-based authors, followed by authors in the UK and Taiwan for the first five years and it was vice versa for the another second five years.

Following these two literature reviews-based studies, another review paper entitled "Review of trends from M-Learning studies: A meta-analysis" which written by Wu et al. (2012) and cited 162 times according to Google scholar comes about to step into the breach since there were issues that still needed to be examined from other directions such as the distribution of research purposes. This study takes a meta-analysis approach to systematically review the literature of 144 studies based on the articles published in six major SSCI journals included JCAL, Computer in Human Behavior (CHB), BJET, JETS, and IRODL from 2003 to 2010. Major findings include that most studies of M-Learning focus on effectiveness, followed by M-Learning system design, and surveys and experiments were used as the primary research methods. Apart from that, mobile phones and PDAs are currently the most widely used devices for M-Learning, but these may be displaced by emerging technologies. Moreover, most M-Learning studies feature positive outcomes and M-Learning is more prevalent at higher education institutions, followed by elementary schools. In addition, the most highly-cited articles are found to focus on M-Learning system design, followed by system effectiveness.

Apart from the above mentioned on high cited review paper, there were another review paper that ought to be included in this section which is review paper entitled "Applications, impacts and trends of mobile technology-enhanced learning: a review of 2008–2012 publications in selected SSCI journals" which written by Hwang and Wu (2014) and cited 26 times according to Google scholar, reviews the 214 publications from 2008 to 2012 in seven well-known SSCI journals of technology-enhanced learning included C&E, JETS, Educational Technology Research and Development (ETRD), IETI, BJET, JCAL and Interactive Learning Environments (ILE) as to examine on the applications and impacts of mobile technology-enhanced learning. It is found that M-Learning is promising in improving students" learning achievements, motivations and interests with proper use of mobile technologies and education design together with proper support and strategy; top four applications were language learning, environmental and ecological education, engineering and computer education and historical and cultural education; most of the applications were conducted both indoor and outdoor activities indoors, followed by indoor and then outdoor; smartphones and followed by Personal Digital Assistants (PDAs) are the most frequently used M-Learning devices, and only then tablet PCs, but smartphones and tablet PCs had replaced on the use of PDAs in educational settings which started from 2011 and 2012; mobile technologies have been increasingly applied to formal and informal.

After all, recent literature review paper seems to be filling in the breach of previous review papers, which were incomplete and act as complementary. This study adopts a meta-analysis method in examining trends in M-Learning studies in term of the various criteria across years in the period under review comprehensively all in one as to refine and update with the most present M-Learning trend. These findings may provide insights for researchers and educators, even policy makers into research trends in M-Learning.

Method

Data sources and search strategies

This study examines the M-Learning papers published in the SSCI database from 2010 to 2015. Top six major educational technology-based learning journals were selected to analyze the research trends, including the (1) C&E, (2) BJET, (3) JETS, (4) JCAL, (5) IHE and (6) IRODL. These journals are widely accessed with high impact factors based on top publication reports released by the Google Scholar metrics. The thorough and plenary searching were through manual electronic searches of the following databases: Science Direct for journal (1) and (5), ProQuest for journal (3) and (6) and Wiley Online Library for journal (2) and (4).

Two researchers who have had years of experience carrying out studies in this area were asked to filter the M-Learning studies from the 1338 papers published by these six journals (378 from BJET, 61 from JCAL, 492 from C&E, 70 from IHE, 243 from JETS, and 94 from IRODL) from 2010 to 2015. Only papers that were identified as being of the type "articles" in the SSCI were considered; that is, publications such as "book reviews," "letters," "colloquium," "conference paper," "workshop paper," "presentation paper," "book chapter," "proceeding," "thesis," "dissertation" and "editorial materials" were all excluded from this study. We intend to include all of the papers published in these journals about Mobile Learning and M-Learning without utilizing other filtering criteria. It is expected that such a review can provide a more thorough view of M-Learning research. To be more precise in selecting the M-Learning articles from the candidate pool, the articles selected by

the two researchers were compared to see if there were inconsistent selections, and if so, these selections were shown to the researchers for further discussion. A total of 144 studies concerning M-Learning were selected after two iterations of filtering the papers and discussing on the inconsistency of decisions.

Data coding and analysis

Ten features related to the quality of study research methodology were coded, including (a) category of research purpose, (b) learning domain, (c) sample group, (d) device used, (e) research design, (f) educational contexts (i.e., formal learning and informal learning), (g) learning outcome (i.e., positive, negative and neutral), (h) periodic journal, (i) country, and (j) publisher.

This study uses the methodology of content analysis to analyze trends and issue about M-Learning. Stemler (2001) confirmed that content analysis indeed is a powerful method for examining trends and patterns in documents. It is also a useful technique to discover and describe the focus of individual, group, institutional or social attention (Weber, 1990). By conducting a content analysis from the 144 selected journals in the timeframe of 2010 to 2015, this study will look out for issues and trend that underlies the studies of M-Learning currently. Besides that, this study cross-examines papers related to M-Learning; published in six selected journals from 2010 to 2015. Three databases were chosen for the cross-examine purpose. The different databases were chosen due to the availability of certain journals and accessibility of the abstract and full text of the selected articles. The databases were; *ProQuest Education Journals, Science Direct* and *Wiley Online Library*. Google scholar as a search engine was also used for the purpose above.

The first procedure in conducting this research is setting three items to search for the related articles in all databases above. They are; (1) Selected Journal Name for Journal Name, Publication Title or Journal Title column, (2) mobile learning for Topic or Title column and (3) 2010-2015 in Time span, Year or Coverage column. This step is important to ensure standardization in order to search the related articles in spite of the different interface between all databases.

There were 162 articles have been identified from the first procedure. The next procedure consists of further comprehensive review, which needs the researchers to examine 162 articles carefully to determine the articles which is related to M-Learning. Finally, a total of 144 articles were selected for the analysis.

Trend analysis

Trend analysis of an article can show the periodic discussion taking place in a knowledge discipline (Erford et al., 2010). In the analysis of trend and frequency, justification for selection of articles is found in the BJET, JETS, C&E, ETS, IHE and IRODL only.

Content analysis

Based on content analysis or the process of summarizing and reporting of written data (Hsieh & Shannon, 2005). The research topics in the articles selected for analysis were categorized involves counting and comparisons according to key words in the given abstracts and content, issues discussed as well as research scope followed by the interpretation of the underlying context. Throughout the data analysis carried out, each category identified was further clarified using thematic analysis.

Result

Research question 1

Trend of periodic journal contributing to M-Learning field across the years

As depicted in Figure1 and Table 1, out of top six major educational technology-based learning journals that were selected to analyze the research trends, which including the C&E, BJET, JETS, JCAL, IHE and IRODL, it is obvious that JETS (26.39%) were the most contributing journal towards M-Learning field till peak in 2014 then drop abruptly in 2015, which causes BJET (27.78%) leads in front for the six year period due to its sudden

increment in 2015. This rank is followed by C&E (23.61%), IRODL (13.89%), JCAL (6.26%) and IHE (2.08%). BJET and C&E saw a dramatically growth between the six year period. The rest fluctuated unevenly over the years. Overall, there is a tremendous increment in total from year to year except in 2011.

Table 1. Distribution of M-Learning studies by periodical journal across years from 2010 to 2015

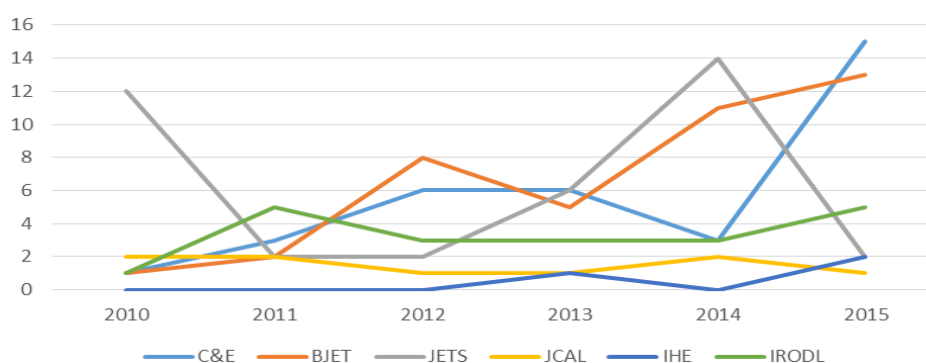| Periodical Journal	Year						Sum
	2010	2011	2012	2013	2014	2015	
C&E	1	3	6	6	3	15	34
BJET	1	2	8	5	11	13	40
JETS	12	2	2	6	14	2	38
JCAL	2	2	1	1	2	1	9
IHE	0	0	0	1	0	2	3
IRODL	1	5	3	3	3	5	20
Sum	17	14	20	22	33	38	144

Figure 1. Distribution of M-Learning studies by periodical journal across years from 2010 to 2015

Trend of publishers that contributing to M-Learning field across the years

Two periodic journals embodied in each publisher database. Science Direct consist of journal C&E and IHE, while ProQuest comprises of journal JETS and IRODL and whereas Wiley Online Library contain journal BJET and JCAL. Since database sources are linked to the periodic journal, it is acceptable that ProQuest headed up all the rest and so violently increase in between 2012 to 2014 due to the proliferation of total number of journal JETS and IRODL followed by Wiley Online Library and Science Direct as illustrated in Figure 2. Apart from that, Wiley Online Library rises gradually along these years while Science Direct shown considerable fall in 2014 and then increase tremendously in 2015 due to the proliferation of journal C&E in 2015.
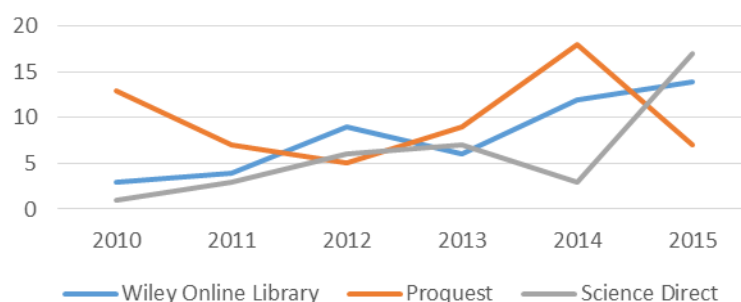

Figure 2. Distribution of M-Learning studies by publisher database across years from 2010 to 2015

Trend of countries that contributing to M-Learning field across the years

As indicated in Figure 3, it is perceivable that more country has contributed their research on M-Learning as there are new emerging country like China, Malaysia, Sri Lanka, Pakistan, Iran and several more. This may due to the existence of awareness on the significance of M-Learning as a new and trendy teaching and learning paradigm in this advent of the technology era. Conspicuously, Taiwan is the most dominance country contributing to M-Learning research with the total up across the years at 25.30%, followed by USA (15.06%),

United Kingdom (7.23%), Singapore (6.63%), Turkey (6.02%), Canada (5.42%), and others country with percentage less than five percent.
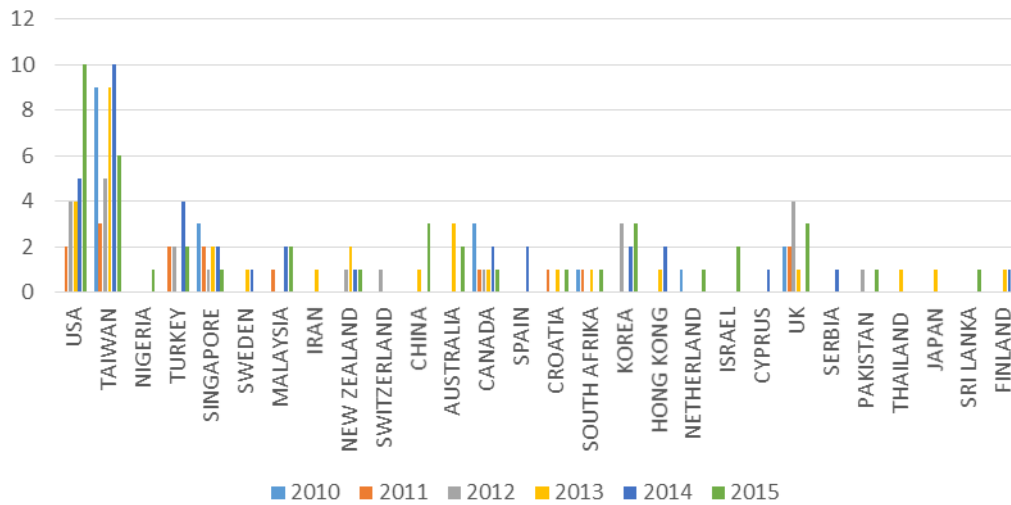

Figure 3. Distribution of M-Learning studies by country across years from 2010 to 2015

Research question 2

Trend of issue category regarding M-Learning across the years

Articles were categorized into one of four categories according to its research purpose: (1) evaluating the effects of M-Learning, (2) designing a mobile system for learning, (3) elicit perceptions of M-Learning, (4) review on M-Learning or (5) evaluate or explore the factor towards M-Learning. As delineated in Figure 4, evaluating the effects of M-Learning was the most common research purpose (52.53%) which mainly covered large portion of the stacked area line chart across years, followed by review on M-Learning (17.09%), evaluate or explore the factor towards M-Learning (15.82%), elicit perceptions of M-Learning (7.59%) and designing a mobile system for learning (6.96%). Category of evaluating the effects of M-Learning start to increase progressively in 2012 till 2015. For the category of evaluating or explore the factor towards M-Learning, it showed gradually rising along these years. Nevertheless, the rest categories had shown fluctuation along these years.
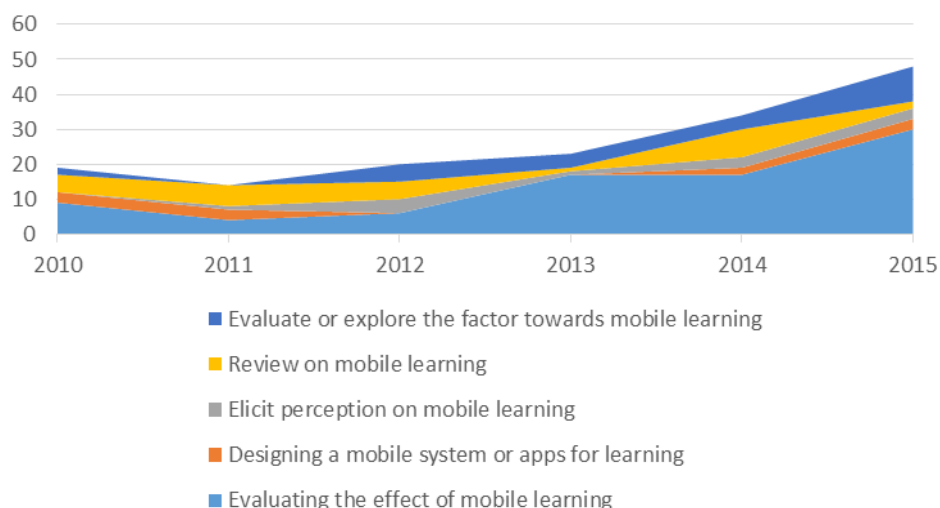

Figure 4. Distribution of M-Learning studies by issue category across years from 2010 to 2015

Trend of sampling taken regarding M-Learning across the years

By exclusion from review paper, Figure 5 shows that M-Learning research mainly focuses on higher education institution (36.17%), followed by not specific (35.11%), elementary or primary school (21.28%), High or Secondary School (6.38%) and the rest were working adult. There was a sharp shoot up in 2014 for the number

of articles using higher education as sample institution while the rest was showing up and down unstably. Besides, Fig. 6 indicates that higher education student leads the trend (50.75%), followed by elementary or primary school student (19.40%), elementary or primary school teacher (13.43%), high or secondary school student (7.46%) and lastly tailed by higher education instructor (1.49%). A number of articles that were utilizing higher education students as the sample are topping all others sample, but it's shown unstably fluctuate as others sample except in year 2015.
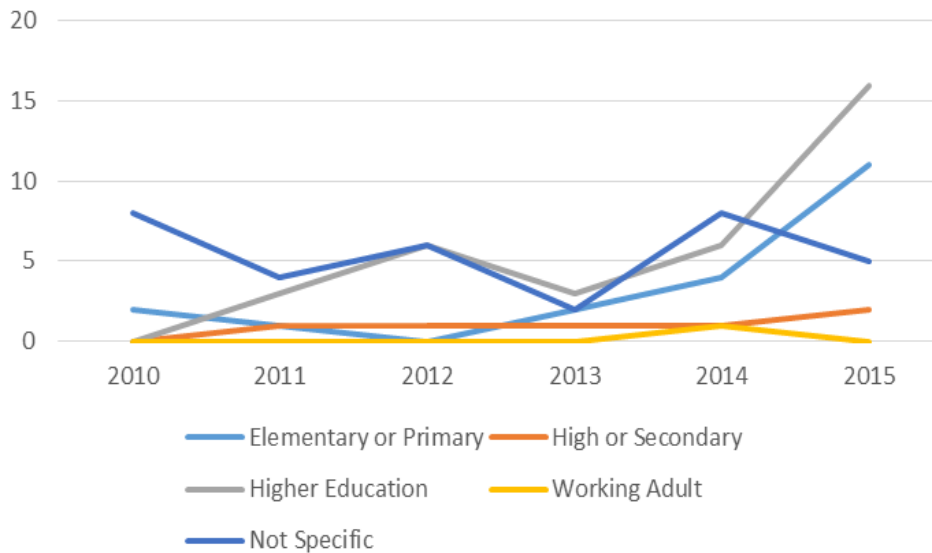

Figure 5. Distribution of M-Learning studies by sample institution across years from 2010 to 2015
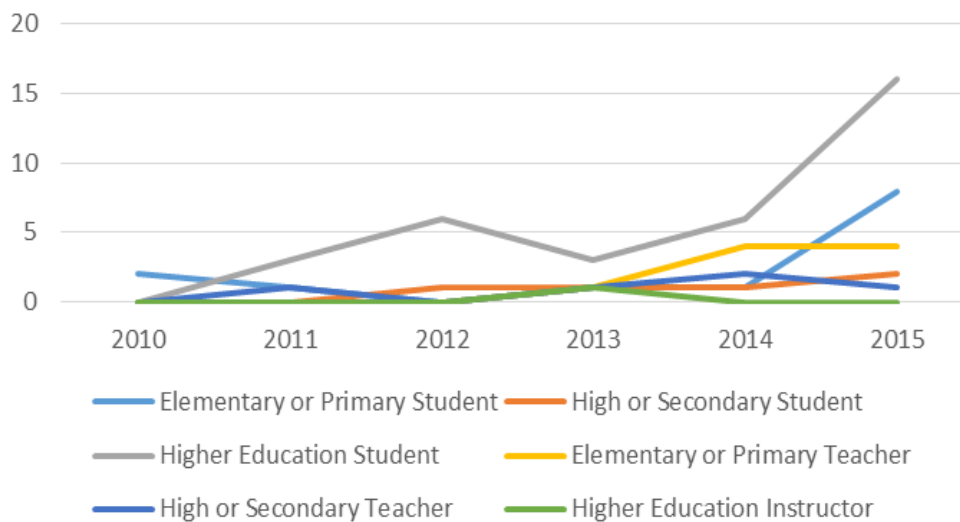

Figure 6. Distribution of M-Learning studies by sample individual across years from 2010 to 2015

Trend of outcome/conclusion resulting in M-Learning across the years

Despite of irrelevant outcome (37.66%) synthesized by others from the evaluating effect purpose, Figure 7 indicates that 52.60% of studies reported positive research outcomes, while only 6.49% and 3.25% respectively reported neutral and negative outcomes generated from the journal with evaluating effect purpose. All the outcomes showed a steady increase along the period.
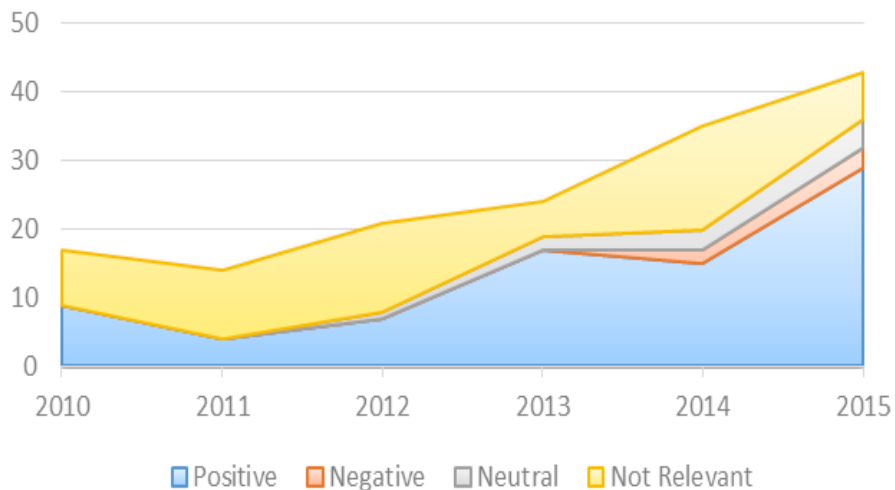
Figure 7. Distribution of M-Learning studies by outcome across years from 2010 to 2015

Research question 3

Trend of learning domain regarding M-Learning across the years

Regardless of journal without specific on learning domain with reach 53.06%, a majority of published M-Learning studies focused on two subject areas: Science (12.24%) and Language and Art (12.93%). Additional studies were conducted in fields like Social Science (8.16%), others (6.80%), Engineering (4.08%), and Mathematics (2.72%). Despite of that, Science, and Language and Art peaked in 2015 although all categories shown up down pattern.
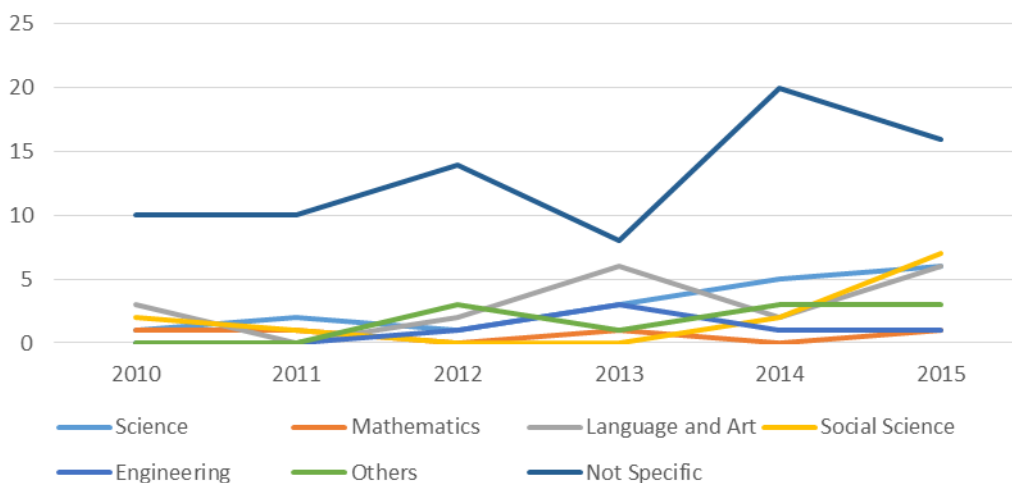

Figure 8. Distribution of M-Learning studies of learning domain across the years from 2010 to 2015

Trend of device used regarding M-Learning across the years

Mobile phone in this study referred to the basic cell phone without the function that exist in a smartphone, which included 3G/4G, or Wi-Fi connection. Term of smartphone used in this study is a general term without specifying in android or iOS as a platform. In spite of journal without specific stated device used (57.02%), Fig. 9 indicates that, among the 144 studies, smart phone was most commonly used for M-Learning (14.09%), followed by PDAs (8.05%), mobile phone (7.38%), tablet (5.37%), iPad (4.70%), iPhone (2.68%), and iPod (1.34%) in total. All the line moves unstable along the period as the preferred device used in M-Learning research, however, it can be observed that PDA has shown a sharp drop starting in the year 2013.
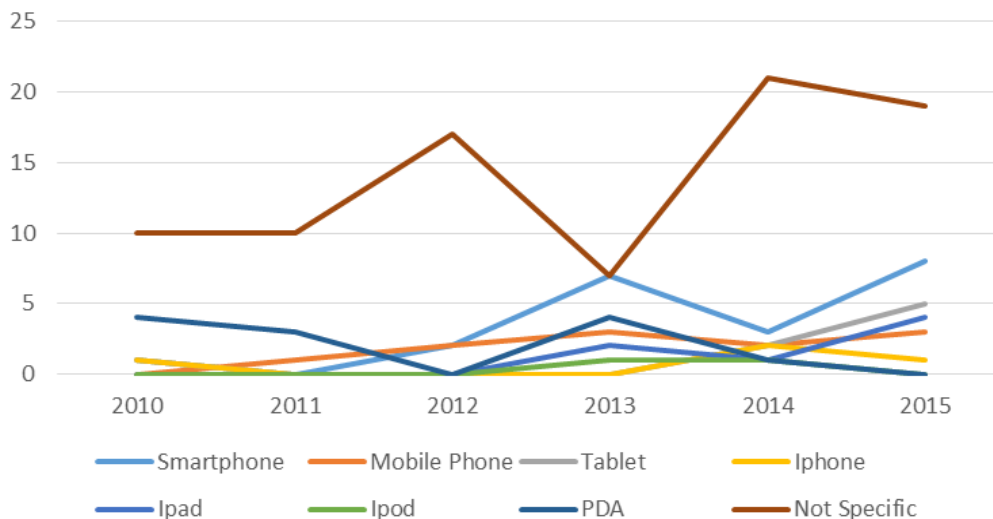
Figure 9. Distribution of M-Learning studies by device used across the years from 2010 to 2015

Trend of educational context regarding M-Learning across the years

As can be seen in Figure 10, informal learning (11.11%) was predominant in the M-Learning studies compared to formal (8.33%) and a combination of both (6.25%). Formal line and informal line showed gradual increase along these years while a combination of formal and informal line shown up and down.
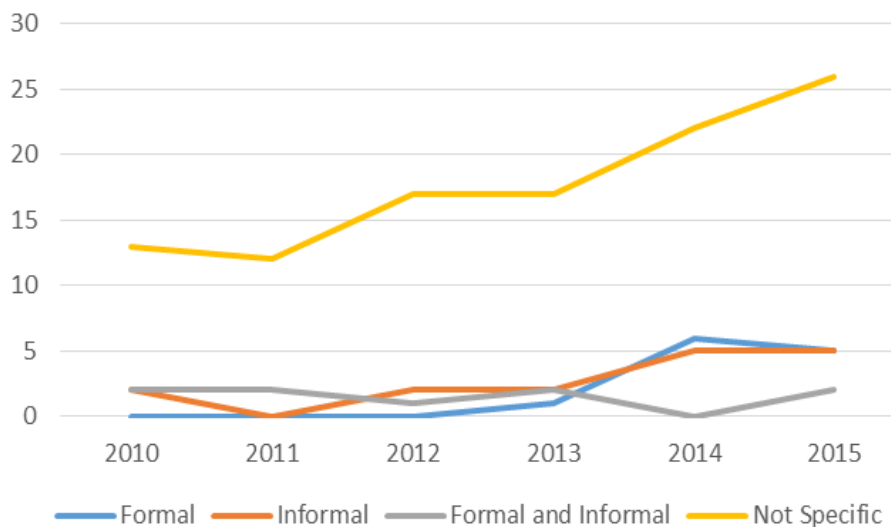

Figure 10. Distribution of M-Learning studies by educational context across years from 2010 to 2015

Research question 4

Trend of research design regarding M-Learning across the years

Quantitative approach (47.92%) is the most employed research designs for M-Learning research studies, followed by a mixed method (18.75%) and Qualitative (14.58%) as depicted in Figure 11. Out of 144 articles analyzed, there were 18.75% articles with no specific approach due to the existence of the review paper. There was a dramatically shot up shown by the quantitative design line in 2012, whereas others shown unstable rise and fall across the years.
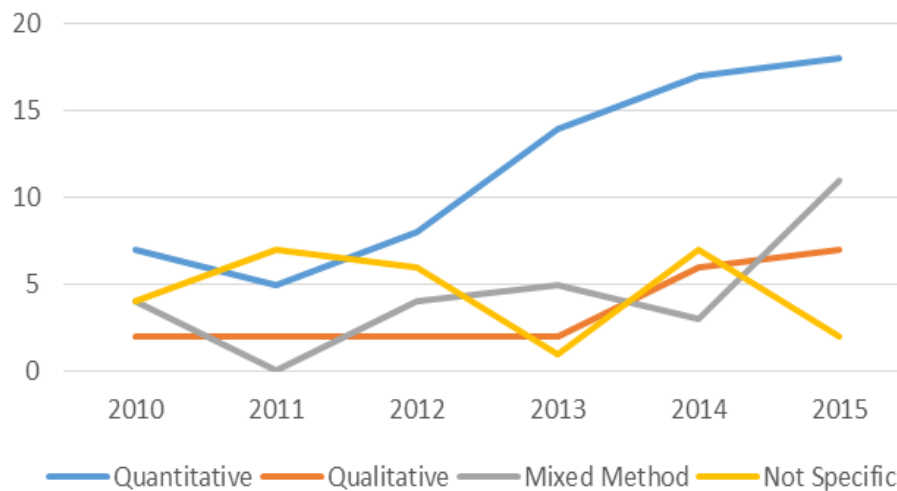
Figure 11. Distribution of M-Learning studies by research design across the years from 2010 to 2015

Discussion

Based on several studies selected and merely four literature review papers as reference, this review paper can be produced in a more detailed and refined even up-to-dated all in one version. This is because in the previous three review papers on M-Learning recently authored by Hwang and Tsai (2011), Hung and Zhang (2012), Wu et al. (2012), and Hwang and Wu (2014) are just a compliment to each other with the older version of the newborn.

Wu et al. (2012) reproved on the previous two is still incomplete in their criteria and the topic being further explored from different directions. This study imparts comprehensive results and new findings. For example, this research found that most M-Learning research paper could be obtained in certain journals like JETS, BJET and C&E whereas in a database like ProQuest based on the frequency count and even country that most M-Learning research is derived from Taiwan followed by the USA which in line with Hung and Zhang (2012). There were more findings that will further describe at below.

Taiwan is the most dominance country contributing to M-Learning research

As claimed by Hung and Zhang (2012) in the research period, and Hwang and Tsai (2011) in the second half period, Taiwan has become the top country regarding M-Learning research which corresponds with finding in this paper.

BJET and JETS are the most Periodic Journal while ProQuest is the most Publisher Contributing to M-Learning Field

From the result, it is affirmed that BJET and JETS are the most Periodic Journal while ProQuest is the most Publisher Contributing to M-Learning Field.

Most studies of M-Learning focus on effectiveness, followed by M-Learning review

Out of the 144 studies, 52.53% took evaluating the effectiveness of M-Learning as the main research purpose as depicted in Figure 4. This focus on effectiveness evaluation is in line with Wu et al. (2012), and Hung and Zhang (2012). The second-most frequently cited research purpose was M-Learning review, which is also a new finding which is contrary to Wu et al. (2012), and Hung and Zhang (2012). More importantly, we found that the number of studies devoted to all M-Learning research increased over time, which supported by Hwang and Tsai (2011) and Hung and Zhang (2012). This may be due to the advent of mobile technology and the enormous advantages that bring along with and mean that the trends are still keep increasing till to date.

Most M-Learning studies took samples from a higher education institution, followed by the elementary or primary school

As seen in Figure 5, the result which consistent with Wu et al. (2012) revealed that higher education institution is the main sampling pool regarding to M-Learning research may be due to the convenience factor. This is because researchers mostly were originated in university or college. Primary school is the next most sampling taken from. Reason behind this need to be justified in the future research. As a result, there is tremendous room for research to be carried out for others sample such as secondary or high school and working adult.

Most M-Learning studies took higher education students as sample, followed by elementary or primary school student

As shown in Figure 6, the result which consistent with Hwang and Tsai (2011) revealed that higher education student is the main sampling pool regarding to M-Learning research may be due to the convenience factor, the same reason as a sampling institution above. Again, this is because researchers mostly were originated in university or college. The primary school student is the next most sampling taken from. Reason behind this need to be justified in the future research. As a result, there are tremendous room for research to be carried out for others sample such as working adult, primary or elementary school teacher, secondary or high school teacher and student.

Most M-Learning studies feature positive outcomes

Figure 7 shows that most of the 144 M-Learning studies present positive outcomes. This finding corresponds to the finding from (Wu et al., 2012). Neutral outcome ranked next and negative outcome ranked the least.

M-Learning most frequently support learning in the Language and Art, followed by Science

Figure 8 illustrates that studies on M-Learning in educational contexts, most frequently focus on use in supporting subject Language and Art, followed by the Science, Social Science, others, Engineering and Mathematics. In terms of M-Learning activity in various sub-disciplines, our findings partially support those of Wu et al. (2012), and Hwang and Wu (2014) but fully support to Hwang and Tsai (2011). For instance, Wu et al. (2012), and Hwang and Wu (2014) showed M-Learning was often used in language courses. Profoundly, the present study found that M-Learning is also widely used in courses related to Science, Social Science, engineering and others but considerably less in other courses such as Mathematics. Nevertheless, there is scarcity of M-Learning research in the related fields should be emphasized in the future research conducted as to fill in the gap.

Smartphone currently is the most widely used devices for M-Learning

The type of devices that were used in the context of M-Learning is influenced by the mobile consumer preference. Figure 9 indicates that smartphones are most widely used as teaching and learning tool in educational contexts corresponds with the Mobile Consumer Report (Nielson, 2013) which stated that smartphone owners may be the majority of mobile users in countries like the US and UK PDAs ranked second as it has been used as learning tools a decade ago and thus supporting the result from Wu et al. (2012), and Hwang and Wu (2014) but it is shown a sharp drop starting in year 2013 due to displacement of smartphones and tablet PCs as emerging technologies over the use of PDAs in educational settings consistent with Wu et al. (2012), and Hwang and Wu (2014).

McQuiggan et al. (2015) affirmed that it is widely predicted that mobile devices are the wave of the foreseeable future in educational technology. Thus, through the advancement of technology, the invention of new mobile devices will never come to an end and it will be applied to the educational context if its efficacy towards the field. This is supported when Martin et al. (2011) used predictions from 2004 to 2010 (i.e., from seven Horizon Reports), which cover the period 2004–2014, to analyze the technologies that have impacted education in the past or are likely to have an impact in the future. Horizon report 2007 predicted that the use of mobile phones in M-Learning, particularly in higher education, would increase dramatically after 2009, which corresponds with our findings.

Informal learning is the most preferred approach carried out along with M-Learning

As depicted in Figure 10, informal learning dominates the M-Learning context which in line with Traxler (2007) claimed that M-Learning definition can emphasize those unique attributes that position it within informal learning, rather than formal.

Most M-Learning studies adopted quantitative method as the primary research design

Figure 11 shows that, among the 144 studies, quantitative approaches were favored over mixed method approach and qualitative approaches. This finding corresponds with finding from Wu et al. (2012).

Conclusions

Three previous literature review-based studies on the use of M-Learning in academic contexts provided valuable insights, but they were just a compliment amongst them to cover up their incompleteness. This study was conducted a systematic meta-analysis to provide more comprehensive analysis of past studies, refined on previous review studies, and discusses the implications of new findings.

The current study presents nine new findings: (1) Taiwan is the most dominance country contributing to M-Learning research. (2) BJET and JETS are the most periodic journal while ProQuest is the most publisher, contributing to the M-Learning field. (3) Most studies of M-Learning focus on effectiveness, followed by M-Learning review. (4) Most M-Learning studies took sample from higher education institution, followed by elementary or primary school. (5) Most M-Learning studies took higher education students as sample, followed by elementary or primary school student. (6) Most M-Learning studies feature positive outcomes. (7) M-Learning most frequently supports learning in the Language and Art, followed by Science. (8) Smartphone currently is the most widely used devices for M-Learning. (9) Informal learning is the most preferred approach carried out along with M-Learning. (10) Most M-Learning studies adopted quantitative method as the primary research design. As a conclusion, this study of issues in M-Learning presents findings, which can become a layover platform and guidance for researchers, educators, policy makers or even journal publishers for future research or reference in the realm of M-Learning.

Implications for research and practice

The findings of this study contribute to an in-depth understanding of M-Learning, by providing a broad and a longitudinal overview of reputable publications according to Google Scholar metrics. It provides a quick, comprehensive overview for scholars interested in publications on M-Learning. For instance, researchers know which journal to be targeted on when M-Learning take its place. It has also identified the topics and areas that have been studied more intensively regarding M-Learning. Furthermore, the findings suggest topics and areas needing additional research to fill in the gap. Thus, researchers should pay more attention to the gap that is a scarcity of research and development of M-Learning in order to synthesize knowledge in the field.

As an emerging research method, text mining enables researchers to obtain summative information in virtually any given field. This study illustrates the power and potential of text mining techniques to discover research patterns, themes, and trends. These techniques enable scholars to pay more attention to data interpretation and pattern analysis, comparing to traditional information processing or data (content) analysis.

For government policy makers, the findings will provide supporting information to enhance understanding of research strengths and weaknesses, which in turn can influence decision-making and policy change towards the advancement in educational discipline.

For researchers, this finding will give a bigger picture on how importance of M-Learning as it gains more and more attention from all over the world due to the proliferation of country that have embarked on this new and trendy paradigm of teaching and learning method in education fields. Researchers and educators will ascertain on where to find about and target on M-Learning research with remarkable quantity and quality articles.

For journal publishers, this finding will notify on the statistics about M-Learning research published in their journal or even their database so that call for paper on M-Learning will be ushered in as to lure more papers

regarding M-Learning into particular journal publisher if it is necessary and create a healthy competition in the publication battlefield.

Limitation of the study

The results and conclusion are limited and not intended to be exclusive. SSCI journals adopt stringent journal reviewing criteria. Articles might take 2 years from submission to publication. In addition, the SSCI database does not collect conference proceedings in education. Therefore, the findings in this study may not reflect the most recent research trends.

This study used only two search terms to analyze M-Learning publications from the beginning of 2010 to year end of 2015 collected in the SSCI databases at that time. Future studies with greater resources, using more search terms, are needed to expand these findings.

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