M-Learning Curriculum Design For Secondary School: A Needs Analysis

Ahmad Sobri Shuib, Saedah Siraj, and Muhammad Ridhuan Tony Lim Abdullah

Abstract—**The learning society has currently transformed from 'wired society' to become 'mobile society' which is facilitated by wireless network. To suit to this new paradigm, m-learning was given birth and rapidly building its prospect to be included in the future curriculum. Research and studies on m-learning spruced up in numerous aspects but there is still scarcity in studies on curriculum design of m-learning. This study is a part of an ongoing bigger study probing into the m-learning curriculum for secondary schools. The paper reports on the first phase of the study which aims to probe into the needs of curriculum design for m-learning at the secondary school level and the researchers adopted the needs analysis method. Data accrued from responses on survey questionnaires based on Lickert-point scale were analyzed statistically. The findings from this preliminary study serve as a basis for m-learning curriculum development for secondary schools.**

Index Terms— **m-learning, e-learning, future curriculum, curriculum design, mobile society, mobile devices**

I. Introduction

The rapid development in technology has altered our lives and on how we learn. The learning process has expanded beyond the physical classroom walls [1], becoming increasingly globalize and life-long in nature [2]. Technology intervention has always been the interest of academic researchers specifically on how technology could be incorporated into teaching and learning; however studies and researches could barely catch up with the rapid technology advancement. Academics were still grappling with electronic learning (e-learning) when the world is almost instantly hit by the mobile technology which gave rise to a new emerging learning concept - mobile learning or m-learning. The rapid flooding of mobile devices with their internet access capability would easily shift e-learning to m-learning without any major changes in the learning content [3]. There is substantiate evidence pointing to the emerging of m-learning reported [4]. Among them are: 1) more than 50% workers spend half of their working time outside their office; 2) mobile phone users worldwide reached 1.5 billion people equivalent to a quarter of the world's population by mid year 2005; 3) M-commerce usage reach USD 600 million in US alone in 2005; 4) wireless internet subscribers reached 2 billion people worldwide in 2006; 5) PDAs and mobile phones have become top demanding products; and 6) most major companies in US adopted wireless network by 2008.

Albert Einstein (born 1879) warned us when he said that: "We live in a world of problems which can no longer be solved by the level of thinking that created them" [5]. This saying indicates that human creativity and imaginative powers evolve faster than our learning process to find solution for problems, that is, we need to know more, since our generation power is faster than our knowledge generating and learning abilities. Fortunately, some researchers took the initiative to quickly respond to the emerging mobile society which led to the build up of literature in mobile technology in education ranging from studies which focuses on impact of mobile devices, mobile applications, learning environment, learning theories and models, learning modules to course designs, and etc. For example, the literature reveals that mobile technology has significant impact in supporting teaching and learning [6], improving students' learning achievement and motivation in subjects like Science and Mathematics [7] while Wierzbicki [8] stressed a pertinent point that wireless technology in education offers solution to the widening digital gap which inflicts most developing countries as mobile phones and PDA are significantly cheaper than desktop computers. Wireless mobile devices coupled with wind or solar powered cell towers which create significant infrastructure advantage compared to wired technology, heighten m-learning prospect in future curriculum for all [9].

The development in mobile technology has also resulted in the launching of m-learning projects both in small and large scales. Among worth noted would be 'Leonardo da Vinci Project' and 'IST FP5 in Europe [10], and UniWap Project [11]. Besides this, course and module designs were initiated to be compatible with mobile applications and devices [12][13].

Although m-learning is still at its infancy stage, there is a massive bulk of research studies in m-learning. However

Author A. Dr Ahmad Sobri Shuib is with Institut Pendidikan Guru Malaysia

Author B: Prof Dr Saedah Siraj is with the Faculty of Education, University of Malaya as Dean of the Faculty (email: saedah@um.edu.my)

Author C: Muhammad Ridhuan Tony Lim Abdullah was with University of Malaya. He is now with the Management & Humanities Department, PETRONAS Universiti of Technology, Tronoh, 31750 Perak, MALAYSIA (phone: 6053687769; fax: 6053656280; e-mail: ridhuan_tony@ petronas.com.my).

literature reveals that most of the studies concentrated largely on mobile devices either on digital functions of mobile devices [14][15][16] which were mostly conducted by telecommunication giants like Ericsson, Apple, Intel & Sun for trade and commercial competition; the effectiveness of mobile devices on preparation of learning activities [17][18][19] and professional learning [20]; or focused research study on a type of mobile device based project such as mobile computer based project [21][22][23].

However there is a large vacuum in the literature on research studies with regards to m-learning curriculum design although curriculum design is one of the major issues which hinders implementation of any new technology based initiatives in education. Among the earlier studies conducted in Malaysia is an assessment on a m-learning program set up for the fifth graders in a primary school in Kuala Lumpur [24]. Besides identifying the strengths and weaknesses of the m-learning program, the study reported that the implementation of the program achieve its predetermined desired results.

Contributing to leverage the scarcity of studies in m-learning curriculum design specifically on curriculum objectives, subject and learning content, implementation approaches, and forms of assessment; this study partakes the responsibility of developing one. This paper is the first of three parts of a bigger study in m-learning curriculum design. The paper explores the needs of m-learning in secondary school which will act as scaffolding for the m-learning curriculum design. The present and future education stakeholders, policy makers, teachers, researchers and private sectors could benefit from this study especially in gaining some insights into the needs of m-learning curriculum in schools and other learning institutions as a guide to set up relevant infrastructures, selection of mobile devices and learning content, management of learning system, or skills and form of training needed for instructors. Based on the aim of the whole study that is to develop a curriculum design for m-learning at the secondary level, the researchers will discuss the methodology adopted, and through the result generated, the researchers attempt to explore the needs of m-learning in secondary school based on teachers' views.

M-learning Concept

Quinn [25] and O'Malley et. al [26] defined m-learning as learning via mobile devices such as Palms, PDA and mobile phones while Nyiri [3] stated that m-learning is learning which occurred when individuals communicate wirelessly. To conclude, m-learning is any learning or training via mobile devices such as personal laptops, PDA and mobile phones anywhere and anytime [27][28]. Conceptually, Brown [29] stated that m-learning is subset of e-learning which is subset of distance learning. E-learning is the macro concept which involves online learning environment and m-learning (refer to Fig. 1).

II. Theoretical Framework

The study as a whole adopted two models as a framework for curriculum design and development. The first model is TABA Curriculum Development Model [30] which is used to develop the m-learning curriculum and the second model, Instructional System Design Model [31] is chosen to be used as a base for specific design of m-learning curriculum for secondary school level. TABA Model outlines seven steps in curriculum design: 1) Needs diagnosis 2) Identifying objectives 3) Selection of content 4) Arrangement of content 5) Determine learning experiences 6) Arrangement of learning experiences 7) Determine what and how to assess the curriculum.

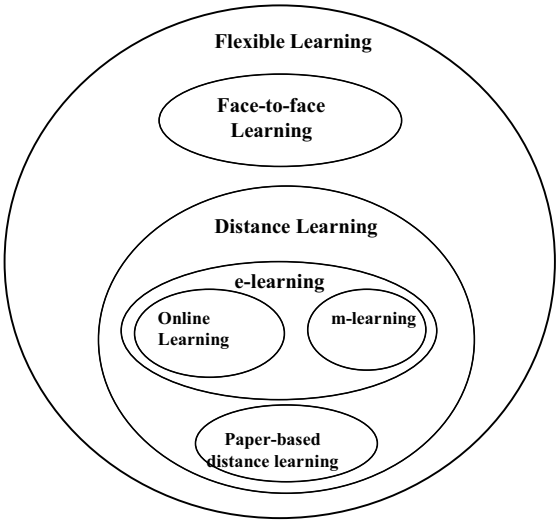

Fig.1. M-learning model
Source: T. H. Brown (2005). Towards a model for m-learning in Africa. International Journal on E-Learning, 4(3), 299-315.

Since its development in 1962, TABA model has been the major model adopted by curriculum designers, policy makers, educationists, and researchers worldwide. Fraenkel [32] asserted that the model is an ideal model to lean on as it innovatively emphasized the acquisition, understanding, and the use of ideas and concepts rather than facts alone; it carefully defines the terminal behaviours expected of students; it includes a number of carefully designed teaching strategies which encourage the development an acquisition of certain specified intellectual skills; it encourages the examination of students' attitudes and values; it includes sequentially designed learning activities in order to encourage cumulative learning; and it provides for continual teacher and evaluation students' progress.

Instructional System Design Model [31] on the other hand was developed based on ADDIE [33] and ASSURE [34] while developing their instructional design. This model consists of six steps: 1) Needs analysis of students and mobile environment 2) Integration of instructions based on mobile technology 3) Design of m-learning strategies 4) Design and development of m-learning content 5) Implementation of learning activity 6) Assess effect of m-learning. This model serves as the theoretical framework for the specific strategies

adopted in the design of the intended m-learning curriculum in this study.

III. Methodology

The researchers aim to develop a curriculum design for m-learning at the secondary school level which would be mainly based on experts' collective opinions. The whole study consists of three (3) phases: phase one - needs analysis study for m-learning curriculum based on selected experts among secondary school teachers; phase two - design of m-learning curriculum for secondary schools based on Delphi technique; phase three - evaluation of m-learning curriculum designed from phase two.

However as this is the first part of the study, the researchers describe the method used in phase one of the study. Phase one as stated earlier involves needs analysis of m-learning curriculum for secondary school level based on teachers' opinion which was conducted via survey technique. Needs analysis is not new and has been an important methodology used in education planning. Witkin [35] defined needs analysis as a method to identify the gap between the current situation and targeted situation. While McKillip [36] stated that needs is a judgment value that a specific group has a problem which needed to be solved.

Forty-eight teachers (n=48) who have expertise in Information Technology (IT) were involved as samples in this phase. They were teachers of the IT subjects (Form 4 & 5) in schools; coordinators of school computer lab (EPU labs); and coordinators of smart school computer labs in Kedah. They were chosen as they would be able to respond to survey questionnaire relating to technology-based education owing to their qualification background and expertise in IT. The questionnaire contains 29 structured items combined with open ended questions developed by the researchers based on literature study. The questionnaire was then validated by three (3) curriculum experts to determine its construct validity. A pilot study was conducted among 10 secondary school teachers in Ipoh, Perak, Malaysia to improve the questionnaire. Findings from the analysis of survey will serve as a base for m-learning curriculum design for secondary schools.

IV. Findings and Discussion

The elements drawn from this study are needs of m-learning curriculum objectives, m-learning curriculum tools and services, m-learning curriculum implementation, m-learning curriculum contents, teaching and learning strategies, forms of assessment, and teachers' and students' skills. The results are as shown in Table 1.

Based on Table 1, m-learning curriculum objectives should include 'students would be able to explore new learning activities through innovative approaches in m-learning (95.8%)', to encourage more self-learning opportunities anywhere and anytime (95.8%), to overcome shortage and overcrowded classes (85.4%), to conduct dynamic and quick assessment on students' learning progress (70.8%), to save time, energy and cost (70.8%), to sustain interest of students towards learning (66.7%), and to solidify

TABLE I

CURRICULUM NEEDS FOR M-LEARNING IN SECONDARY SCHOOLS

CURRICULUM NEEDS	Mode	%
Curriculum Objectives		
Students would be able to explore new learning activities through innovative approaches	46	95.8
To encourage more self learning opportunities anywhere and anytime	46	95.8
To overcome shortage and overcrowded classes	41	85.4
To conduct dinamic and quick assessment on students' learning progress	34	70.8
To save time, energy and cost	34	70.8
To sustain interest of students towards learning	32	66.7
To solidify collaborative process among students	29	60.4
To be able to overcome shortage of teachers	22	45.8
To overcome transfers of teachers	22	45.8
To overcome illiteracy, inability to count and low learning participation among children, adolescents and adults.	19	39.6
To overcome truancy/dropouts	16	33.3
Electronic Tools And Services		
Laptops	48	100
Desktops	45	93.8
Personal Digital Assistant (PDA);	11	22.9
Mobile phones	12	25.0
Tablet PCs	11	22.9
3G Mobile phones;	24	50.0
Web camera	3	6.3
Digital camera	3	6.3
Pendrive	3	6.3
Technology softwares		
Websites	47	97.9
e-mail	43	89.6
SMS	25	52.1
MMS	11	22.9
WAP	8	16.7
GPRS	3	6.3
Bluetooth	3	6.3
Level of Implementation		
School Level		
Form 1	36	75.0
Form 4	22	45.8
Form 5	22	45.8
Form 6	22	45.8
Form 3	18	37.5
Form 2	15	31.3
Method of Implementation		
Integrated with KBSM	43	89.6
Separate from KBSM	6	12.5
Curriculum content		
Subjects		
Information Technology	46	95.8
Mathematics	43	89.6
Science	42	87.5
Biology	41	85.4
Chemistry	40	83.3
Physics	40	83.3
Geography	32	66.7
English Language	29	60.4
History	29	60.4
Islam Studies.	27	56.3
Bahasa Melayu(*Malay Language*)	27	56.3
Literature	20	41.7

collaborative process among students (60.4%). These preferable objectives are aligned to the literature which describes the objectives as advantages of m-learning [37][38]. However, objectives like being able to overcome shortage of teachers (45.8%); to overcome transfers of teachers (45.8%); and to rectify illiteracy, inability to count and low learning participation among children, adolescents and adults (39.6%), receive low acceptance to be included in m-learning curriculum objectives especially the objective to overcome truancy/dropouts receives a minority vote of 33.3%. Most of the subjects were of the opinion that m-learning should not be regarded as a panacea especially in solving long standing educational issues like shortage of teachers, illiteracy, and truancy/dropouts. Nevertheless, the seven preferred objectives produced here are aligned to design principles of objectives in a curriculum development as proposed by Taba [30].

In terms of needs for electronic tools and services, high percentage of confidence to be included in m-learning curriculum are given to laptops (100%) and unexpectedly desktops (93.8%) as desktops are not mobile devices. When asked by the researchers, the subjects (teachers) felt that desktops are still needed for m-learning content management (LMS) and content repository which are currently in used for e-learning for schools which have the facility. They indicated that since m-learning is still new to the country, for the meantime, m-learning could take the advantage to share the readily e-learning platform which currently overwhelms the desktops. This in time conveniently allows a smooth shift from e-learning to m-learning.

In terms of softwares, websites (97.9%) and e-mail (89.6%) are favoured more to be included in m-learning curriculum compared to SMS (52.1%), MMS (22.9%) and WAP(16.7%), while GPRS and Bluetooth only received three votes of acceptance each. The subjects felt that since websites and e-mail are major mode of e-learning, it is more relevant to include these softwares especially in the initial implementation of m-learning in order to facilitate familiarity in learning among students who are used to e-learning. SMS is given a moderately high preference to be included in the m-learning curriculum as it has become a major form of communication especially among teenagers due to its low costs, students' preference to communicate through SMS especially for those who are intimidated by voice calls, and its communication effectiveness.

On the implementation needs, majority of the teachers believe m-learning should start as early as in Form 1(75.0%) where the m-learning curriculum is more preferred to be integrated with the present national KBSM curriculum (89.6%). The implementation of m-learning beginning as early as in Form 1 would be most appropriate to students to start their secondary level. Early exposure to new learning environment would facilitate continuous learning as they progress through their class levels. In probing into subjects preferably to be included in m-learning curriculum, Table 1 reveals that science and technical subjects are preferred to be taught through m-learning such as Information technology which accrued the highest percentage of acceptance of 95.8%, followed by Mathematics (89.6%), Science (87.5%), Biology

TABLE 2

CURRICULUM NEEDS FOR M-LEARNING IN SECONDARY SCHOOLS (continuation)

CURRICULUM NEEDS	Mode	%
Teaching And Learning Strategies		
Teaching Techniques		
Inquiry-discovery technique	37	77.1
On-line training	37	77.1
Project technique	35	72.9
Small group discussion	35	72.9
Problem-solving technique	35	72.9
Questioning technique	30	62.5
Drilling technique	30	62.5
Case study technique	29	60.4
Lecturing	16	33.3
Activities		
Quizzes	47	97.9
Internet Information search	46	95.8
Video conferencing	45	93.8
Group discussion	45	93.8
Giving responses	41	85.4
Collecting field data	41	85.4
Sending SMS	39	81.3
Sending MMS	39	81.3
Receiving instruction from teachers	39	81.3
Reading teachers' notes	33	68.8
Chat	33	68.8
Forum	4	8.3
Assessment		
Form Of Test		
Group work	46	95.8
E-folio	43	89.6
Produce a product	42	87.5
Online test	39	81.3
Quizzes through SMS	37	77.1
Forum	27	56.3
In class Pencil/paper test	27	56.3
Paper work	25	52.1
Form Of Examination		
Online Objective questions		
Observation	45	93.8
Practical test	42	87.5
Online essay test	36	75.0
Pencil/paper test	32	66.7
	16	33.3
Teacher And Students' Skills		
Teachers' Skill		
Internet access and information search	47	97.9
Use of e-mail for communication	47	97.9
Electronic spreadsheets for information process	46	95.8
Use of presentation application	45	93.8
Word processing to design printed materials	44	91.7
Planning for computer organizational needs	42	87.5
Maintenance of computer system and network	42	87.5
Management of data and tools security	41	85.4
Use of Learning Management System(LMS)	33	68.8
Coordinate and analyze data and information	31	64.6
Students' Skills		
Internet access and information search;	48	100
Use of e-mail for communication;	48	100
Use of technology devices such as digital camera, scanner and pen drives	46	95.8
Electronic spreadsheets for information process	44	91.7
Word processing to design printed materials	44	91.7
Use of presentation application	43	89.6

(85.4%), Chemistry (83.3%) and Physics (83.3%). This shows that most subjects (teachers) believe that m-learning is more suited for teaching of technical subjects. They indicated that technical subjects are more factual and objective in nature which is more ideal to be managed via m-learning. However although, non-technical subjects obtained lower percentage of preferences, these subjects still accrued considerable high percentage except for literature which obtained a low 41.7% of preference. This shows that non-technical subjects like English Language and History could still be included in m-learning curriculum.

Next, on m-learning curriculum needs for teaching and learning strategies, Table 2 shows that the percentage majority is below 80% for all teaching techniques with inquiry-discovery technique and on-line teaching voted most favoured techniques for m-learning which indicated 77.1% acceptance each. Other selected techniques are project technique (72.9%), small-group discussion (72.9%), problem-solving technique (72.9%), questioning technique (62.5%), drilling technique (62.5%), and case-study technique (60.4%). However lecturing technique indicated significantly low acceptance of 16 out of 48 votes. This is predictable as m-learning promotes student-centred learning rather than teacher- centred as m-learning allows more liberty for learners to take charge on their learning [24]. On suitable learning activities for m-learning, quizzes tops other learning activities acquiring 97.9% acceptance. Quizzes especially short ones are compatible to m-learning to accommodate the general small screen size of most portable devices and they are more practical for learners on the move as short quizzes do not take much time to respond and more importantly allow the learners to respond at any time or in-between their tight schedules.

Other favoured activities are internet information search (95.8%), video conferencing (93.8%), group discussion (93.8%), giving responses (85.4%), collecting field data (85.4%), sending SMS (81.3%), sending MMS (81.3%), and receiving instruction from teachers (81.3%). However forum activity is not favoured to be included in m-learning learning activity needs as it yielded only 8.3% acceptance.

These responses showed that the subjects (teachers) were of the opinion that m-learning is more garnered for personalized learning which involves more of students' own initiative in fulfilling their learning activities such as internet information search, video conferencing, group discussion, giving responses, collecting field data, sending SMS, or receiving instruction from teachers. However this could be understood as the subjects felt that these activities would be more relevant in the initial implementation of m-learning and would in time students' personalised learning would become more collaborative in manner through online forum like blogs or moblogs as the students progress,.

Another curriculum needs which is vital to be included would be assessment. Proper assessment tools are important to evaluate the curriculum as they identify whether the output of instructions and learning meet the set curriculum objectives or not which finally determine the success of the curriculum. Table 2 shows that group work (95.8%), e-folio (89.6%) and produce a product (87.5%) are the more important form of test to be included in m-learning compared to in-class pencil/paper test (56.3%) and paperwork (52.1%) which are more widely use as form of test in conventional in-class curriculum. Pencil/paper test (33.3%) is also not favoured to be included as form of examination compared to online objective questions (90.0%) and observation (80.0%). This can be understood as the nature of m-learning involves instant learning through small chunks of inputs at a time detached from the boundaries of space and time. Online objective questions would be a more practical form of examination for m-learning compared to pencil/paper test as it allows quick and easy response from learners.

Finally on m-learning curriculum needs for teacher and students 'skills, both internet access and information search, and use of e-mail for communication skills seemed to be more vital to be included in m-learning compared to other skills, judging from the high 96.7% acceptance for teachers' skills and 100% for students skills. Other skills which yield significantly high acceptance are electronic spreadsheets for information process (95.8%), use of presentation application (93.8%), word processing to design printed materials (91.7%), planning for computer organizational needs (87.5%), and maintenance of computer system and network (87.5%) which deemed needed to be included for teachers' skills. Other students' skills which are selected to be relevant are use of technology devices such as digital camera, scanner and pen drives (95.8%), electronic spreadsheets for information process (91.7%), word processing to design printed materials (91.7%), and use of presentation application (89.6%).

However, all these findings should not be taken objectively as m-learning curriculum needs for all levels of education or institutions. The data accrued here are based on the subjects' best expert opinion in the context of being teachers in Malaysian secondary schools. The data may differ if the needs analysis would to be carried out among IT lecturers in a university for instance.

V. Conclusion

Based on the theoretical framework outlined earlier, the findings from the study serve to fulfil the preliminary stage in developing the intended m-learning curriculum. As highlighted in both curriculum development models, TABA model and Instructional System Design Model, needs analysis is required as a basis for curriculum development. In this preliminary study, the needs analysis revealed m-learning curriculum needs on the elements: 1) M-learning curriculum objectives for secondary level; 2) M-learning electronic tools and services; 3) M-learning level of implementation; 4) M-learning curriculum content; 5) M-learning teaching and learning strategies; 6) M-learning assessment; and 7) Teacher's and students' M-learning skills. The findings will be used to form questionnaires for survey purpose in phase two of the bigger study to gather experts' opinions via Delphi technique. To elaborate, items for each elements which achieved 50% or more acceptance among the subjects (teachers) from this needs analysis would be included as items for survey questionnaires in phase two of the whole study. Items which received acceptances lower than 50% would not be included in the phase two questionnaire unless being added by the panel of experts later. M-learning curriculum for

secondary level would then be developed based on results (accrued from selected experts) from phase two. The developed curriculum would then enter phase three of the study for evaluation.

Education stakeholders, policy makers, teachers, researchers and private sectors could benefit from this study especially in gaining some insights into the needs of m-learning curriculum in schools and other learning institutions as a guide to set up relevant infrastructures, selection of mobile devices and learning content, management of learning system, or skills and form of training needed for instructors. For example, based on the findings, if the ministry decides to implement m-learning, they would be more informed not to conduct major changes in the present KBSM curriculum. M-learning curriculum could be integrated with the current curriculum with minor changes in the use of mobile learning tools and devices for instance. Teaching strategies would still assume the inquiry-discovery technique, project technique, small group discussion, problem-solving technique, questioning technique, or case study technique as applied in the current curriculum but the strategies would be more technological oriented via wireless mobile devices and infrastructure.

Through the findings, the ministry as well as teachers and students would also be more informed of the expected new lists of skills needed to face this new learning environment and could prepare beforehand prior to the implementation. The ministry for instance could then make necessary plan to train the teachers to obtain necessary ICT skills such as internet access and information search, use of e-mail, electronic spreadsheets for information process, use of presentation application, word processing to design printed materials, planning for computer organizational needs, maintenance of computer system and network, management of data and tools security, use of learning management system(LMS), and coordinate and analyze data and information as suggested in the findings to facilitate students learning. The ministry and schools could also make necessary early initiatives in implementing ICT courses and prepare relevant infrastructures. The use of mobile technology in education could also have its implication in curriculum evaluation. Major educational stakeholders would be more informed in the types of evaluation in m-learning. Among the implication are assessment would be conducted through wireless computer system, flexible examination schedule, flexible examination venues, questions could reach every student instantly, and evaluation could be conducted online by schools [24]. These would definitely decrease teachers' workload, and save time and costs with minimal errors in management and administration.

This study could also be replicated to investigate needs of m-learning curriculum for primary or tertiary level as well as m-learning curriculum for business organizations. M-learning should not be understood as merely learning through portable devices, but learning across context [39]. M-learning enables students to construct knowledge at different context, to develop their understanding, and to change their learning activities and learning style anytime and anywhere [40].

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