

Designing an Intelligent Mobile Learning Tool for Grammar Learning (i-MoL)

<http://dx.doi.org/10.3991/ijim.v9i1.4238>

Munir Shuib, Amelia Abdullah, Siti Norbaya Azizan, Thenmolli Gunasegaran
Universiti Sains Malaysia, Penang, Malaysia

Abstract—English is the most important second language in most non-English speaking countries, including Malaysia. A good English proficiency comes from good grasp of grammar. To conquer the problems of low English proficiency among Malaysians, it is important to identify the key motivators that could facilitate the process of grammar learning. In this digital age, technology can play a very important role and mobile technology could be one of it. Thus, this study aims at designing a mobile learning tool, namely the Intelligent Mobile Learning Tool for Grammar Learning (i-MoL) to act as the “on-the-go” grammar learning support via mobile phones. i-MoL helps reinforce grammar learning through mobile phone with game-like applications, inquiry-based activities and flashcard-like information. The intelligent part of i-MoL lies in its ability to map the mobile-based grammar learning content to individual’s preferred learning styles based on Felder-Silverman Learning Style Model (FSLSM). The instructional system design through the ADDIE model was used in this study as a systematic approach in designing a novel and comprehensive mobile learning tool for grammar learning. In terms of implications, this study provides insights on how mobile technologies can be utilized to meet the mobility demand among language learners today.

Index Terms—Mobile learning, English language, grammar, learning styles, FSLSM, instructional system design, ISD, ADDIE, higher learning institutions, graduates, Malaysia

I. INTRODUCTION

In today’s competitive and globalised world, there is a tremendous emphasis on the use of English in various working sectors. However, to date, there is still much room for improvement on English Language competency among Malaysian graduates, especially those from rural areas who are still struggling to grasp the rudiments of the language. While the government puts much effort to raise the level of English Language proficiency, the standard of English among Malaysian undergraduates is still declining. Amid this issue, effective efforts are urgently needed in the educational system to ensure that the future cohorts of Malaysians are able to master the English language in order to remain competitive in the job market. Since grammar is one of the areas that most students are still struggling with [1], it could be an area worth tackling in order to improve their English competency. The acquisition of English grammar by university students is important as accuracy in speech and writing is highly required in performing academic activities. Therefore, it is important for students not only to be able to communicate in English fluently but also be able to use and understand English grammar forms and functions accurately.

The fact is, today’s students are vastly different from the way they were a few decades ago. According to Eaton [2], today’s students are tech-savvy. They can access a world of resources and information just at their finger tips. They are hungry for motivation, inspiration, and guidance. They harness their creativity to express themselves and demonstrate what they know using technology. They are the creators, not simply consumers, of technology. In line with such tech-savvy attributes, the field of English language education has witnessed rapid changes in teaching methodology, material development, and assessment. Traditional beliefs and practices of language teaching are giving way to newer, more innovative ways of teaching. Old, authoritative, “teacher-centred” approaches to teaching are giving way to more collaborative and interactive approaches. Audio language labs, which were once considered a significant innovation, have begun to fall out of favour [3]. The reason for this most likely had its roots partly in the methodological move away from structural approaches to language learning, to a flurry of novel techniques for second learning acquisition [4]. Therefore, for grammar learning to be effective, the learning materials designed for students should be interesting and interactive. They also have to be in line with the learning needs of young generations in today’s technological environment who would prefer more digital motivation, flexibility and mobility.

In a survey conducted by the Malaysian Communication and Multimedia Commission [5], it was reported that mobile phones penetration in Malaysia in the last four years kept growing tremendously in most states and the main mobile phone users were found to be those ranging from 20 to 49 years in age. Thus, it may not be impossible that mobile phones are used in learning as an alternative approach to complement the traditional and formal approaches to English grammar learning for the Malaysian graduates. There are many ways in which mobile learning may be utilized in HEIs. One of the ways concerns the teaching and learning of English grammar among undergraduates. Mobile-based approach to teaching and learning of English grammar is unique in that it allows the language learners to benefit the learning process in ubiquitous and more personalized manner. This approach can also enrich, enliven, or add variety to the conventional method of grammar learning. Teaching and learning of English grammar via mobile phone is seen as a viable alternative to enhance learners’ proficiency in the language as it is digitally designed, flexible and mobile - i.e. anytime and anywhere.

For learning to be effective, is important for lesson delivery to match with students’ style of learning. As Bertolami [6] has suggested, “one of the focal points of stu-

dent frustration with the curriculum is the disparity between learning (content) and the delivery of instruction (form)". In line with this need, this study presents how a personalized intelligent mobile learning system for grammar learning, namely i-MoL, can be designed to support effective grammar learning via mobile phones which is tailored to students' preferred learning styles. The ADDIE instructional system design model was used in this study as a framework to guide the designing process of i-MoL. In this vein, this research attempts to marry the elements of learning styles with the concept of instructional system design in developing the intelligent mobile learning tool for grammar learning.

II. LITERATURE REVIEWS

A. *M-Learning in General*

M-learning is introduced globally as a flexible learning approach. It is a learning process that is delivered through wireless mobile handheld devices which let learning takes place at anytime and anywhere. Mobile learning takes learning to individuals, communities and countries that were previously too remote, socially or geographically, for other types of educational initiative [7]. In this way, it is more advantageous and convenient as compared to e-learning which always require computer and internet access. 'Mobile learning' is not simply the combination of 'mobile' and 'learning'. According to Traxler [7], it has always implicitly meant 'mobile e-learning' and its history and development have to be understood, thus many wider issues should be addressed in terms of explaining, understanding and conceptualizing it.

There has never been a specific definition of 'mobile learning. However, there are many evolving definitions that attempt at identifying and defining mobile learning. Quinn [8] defined m-learning as "e-learning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone". Another view of mobile learning considers m-learning as an "exploitation of ubiquitous handheld hardware, wireless networking and mobile telephony to enhance and extend the reach of teaching and learning" [9]. A 2004 study conducted by Naismith et al. [10] suggested that mobile technologies can relate to six types of learning, or 'categories of activity', namely behaviourist, constructivist, situated, collaborative, informal/lifelong, and support/coordination. Jones et al. [11], by contrast, considers the motivational or affective aspects of mobile learning as defining characteristics, namely control (over goals), ownership, fun, communication, learning-in-context and continuity between contexts. The work of Winters [12] concluded that current perspectives on mobile learning generally fall into the following four broad categories:

- Techno-centric: mobile learning is primarily seen as learning that is supported by mobile devices
- An extension of e-learning: mobile learning is a subset of e-learning
- Augmenting formal education: mobile learning complements the formal education
- Learner-centred: mobile learning is about mobility and context

Mobile learning is often viewed not only as a silver bullet in education, but also as a tool for learners to access

knowledge while they are on the move at anytime and anywhere. More and more educational institutions around the globe are now moving toward mobile learning as a way to benefit from the ubiquitous quality it may offer for educational purposes. An emerging body of literature that explores the potential of mobile learning for educational contexts has identified several significant benefits of mobile learning and these include cost effectiveness, convenience, motivation to learn, accessibility, flexibility, as well as immediacy of information and interaction [13][14][15][16].

A common type of m-learning which uses Short Messaging Service (SMS) is known as SMS-based learning. According to Gupta [17], SMS is a delivery mechanism of short messages; a store and forward way of transmitting messages over the mobile networks. The messages sent will be stored in a central short message center which then forwards it to the destination mobile. One may send up to 160 characters using a basic mobile phone. SMS-based learning is a new learning phenomenon and exists because of the drastic increase in the number of mobile devices used nowadays [18]. It is often defined as learning that takes place with the help of portable electronic tools [8]. SMS-based learning also offers a virtual learning environment. However, unlike e-learning which has been relatively established in many higher learning institutions, SMS-based learning is still at its infancy and has not been widely used yet.

B. *M-Learning in Malaysia*

M-learning in Malaysia is still in its infancy [19]. Despite this, many studies have already been carried out to determine its feasibility as a learning tool [20][20]. Generally, studies found that m-learning is accepted by students and feasible to be used by students and teachers. M-learning is also perceived well among scholars in terms of its potential in Malaysian educational institutions [24][25][26][27]. However, the majority of the studies conducted in Malaysia have focused on science and technical courses. Thus far, very few studies have been done involving students and teachers of non-science /non-technical courses including English language. Although the introduction of mobile phones for learning in Malaysia is considered a new idea, there was a forecast that smart phones would be used in secondary schools in Malaysia from the year 2016 to 2020 [22]. Siraj [23] estimated that Malaysia has a huge potential to implement mobile learning in its curriculum.

The mobile learning research team from Universiti Sains Malaysia (USM) has attempted to identify and fill the aforementioned gap by carrying out a few studies on mobile learning. The studies aimed to explore the potential of SMS-based learning in supporting the existing pedagogical practices in various fields, including information technology (IT), linguistics, education, education technology, management, distance education and informal education. As an outcome of this project, an SMS-based mobile learning system has been developed to serve as a flexible and affordable learning alternative for bottom billion students to learn at anytime and anywhere.

The team also conducted a study to determine if the SMS technology could be used as a supplementary tool to help students in developing their English language grammar competency. The research sought to explore students' and teachers' perception about the use of SMS in learning

grammar which could offer some indication on the feasibility of the teaching of grammar using SMS. The research reported positive input from the participating students and teachers who are willing to try it out with their students. Teaching grammar via SMS is thus found to be a feasible pedagogical tool which will offer benefits to students. This research work has shed some light on the feasibility of SMS-based mobile learning in facilitating the teaching and learning of English grammar for undergraduate students, while tapping into the desire for more advanced and interactive features of mobile learning tools [28].

III. DESIGNING I-MOL

This paper seeks to introduce an intelligent mobile learning tool for grammar learning called i-MoL. The model is proposed as an alternative ‘on-the-hand’ approach to teaching and learning of English Grammar. The term ‘i-MoL’ is coined to express the mobile concept of grammar learning. The ‘intelligent’ part of the proposed model lies in its ability to create a personalized grammar learning environment for the learners. Specifically, personalization in this context is referring to the provision of learning contents that are tailored to suit each learner’s learning style. In this regard, the proposed model is equipped with a mechanism to firstly model learners’ learning styles and then adapt the grammar learning content to each type of learning styles. Through the i-MoL model, a mobile learning system is to be developed as a tool to facilitate a seamless ubiquitous learning environment for grammar learning. The system will include several mobile-based applications for grammar learning including notes, alerts, query, quizzes, polling, and forum.

i-MoL consists of two major parts: grammar content management and system management. Thus, it requires a joint initiative of linguistic and technological experts and educators to research the possibilities of using advanced mobile platforms for transferring English skills and competencies to the learners. This project aims to develop, test, and evaluate the usability of such educational approach for grammar learning. The i-MoL project can be seen as an extension of the previous work by the mobile learning team from USM on an SMS-based mobile learning project. The i-MoL model is proposed as an effective multimedia-based mobile learning tool for learning of English grammar.

The current i-MoL project intends to explore the next continuum; to design and develop a more diversified approach to pedagogical use of mobile devices for English grammar. This is in line with the advancement of mobile technologies, proliferation of mobile phone ownership in Malaysia [29] and increasing significant mobile learning projects among Malaysian scholars [25]. i-MoL is thus seen as an innovation in mobile learning that supports grammar learning through cross-platform user interface, i.e. from low-end to high-end mobile platform, including Android, iPhone, and basic mobile phones with SMS and MMS capabilities. By exploiting these various mobile platforms, i-MoL aims to provide a personalized and flexible learning environment to facilitate learners in learning grammar. In conjunction with this aim, i-MoL aims to enhance the existing teaching-learning modes by utilizing an adaptive mechanism for personalized contents that are made available to learners via mobile devices.

A. i-MoL System Architecture

i-MoL consists of two subsystems - the i-MoL server and the i-MoL tool. Figure 1 illustrates the system architecture of the i-MoL model. The i-MoL server is a learning server whereby lecturers and system administrators can connect to it via Internet connection through their personal computers. It consists of six modules, namely User Management, Content Management, Assessment Management, Feedback, Forum, and Push Modules. Each module is described as follow:-

- *User Management*: This is the heart of the i-MoL intelligent system that creates the personalization of learning content. The User Management module is composed by databases of learners’ personal details, learning style, a map of the knowledge obtained from the domain module and a profile analyzer that helps to analyze learners’ learning styles and map them to the appropriate content group
- *Content Management*: The Content Management module stores the learning materials in the mobile learning content database which are multimedia materials like texts, images, videos, and audios. The materials are fetched online from the web-based portal using a set of web services; packaged, structured, and then delivered to the learners according to their learning style group
- *Assessment Management*: The Assessment Management module includes interactive applications for lecturers to conduct quiz and polling in order to give assessment to learners to evaluate their learning results
- *Feedback*: This unit provides the mechanism for learners to give feedbacks or send course-related queries to their lecturers. Data is managed through the inbox database
- *Forum*: Through this unit, lecturers can organize group discussions for learners to participate and share their learning experiences
- *Push*: This unit allows lecturers to deliver and disseminate any alert, notifications, or learning tips to learners

The other subsystem of the i-MoL system architecture is the i-MoL tool. It is a set of software applications that provide learners access to the mobile-based grammar learning activities. The learners who are equipped with handheld devices will interact with the system by sending and responding to special instructions for each application. The system will deliver the required learning contents to the learners. The applications of i-MoL tool are as follow:-

- *Learning content*: access to various types of grammar learning contents (text-based and multimedia-based) and content managing tools like archive, download, bookmark, and notepage
- *Game-based application*: a selection of interactive game-like (e.g. quiz, poll, inquiry-based, ranking game) mobile modules.
- *Discussion room*: forum application to facilitate group-based learning
- *Alert and reminder*: a reinforcement tool to help students obtain instant information on grammar learning content

- *Learning style identifier*: SMS-based and mobile application that can automatically identify students' learning style through a series of questions
- *Query*: a student-centered mobile application that helps students to get instant feedback from their lecturer regarding the subjects

B. Tailoring i-MoL To Learning Styles

i-MoL is designed with a unique mechanism to adapt the grammar learning contents to learners' learning styles. The model promotes an adaptive approach for grammar learning whereby learning contents are tailored to adapt to an individual's learning style within a mobile learning environment. The i-MoL learning environment aims at providing the learners with a grammar learning experience that is not only flexible and mobile, but also convenient to them since it is personalized and adaptive to their learning styles.

Since personalization is a crucial aspect, the system will identify the characteristics of learners in terms of their preferred styles for grammar learning. The learning styles will be used as a basis for the adaptive mechanism which consequently aims at providing learners with personalized grammar learning contents that are mapped to their preferences and fit to their profile. Many learning style models exist in the literature [30][31][32][33]. However, for the purpose of this study, Felder and Silverman's Learning Styles Model (FSLSM) is to be used due to the following reasons:-

- Applicability and compatibility to the principles of interactive learning system designs [34]
- Suitability with a hypermedia learning system that incorporate varying types of multimedia-based learning materials [35]
- Practicality and convenience for establishing students' dominant preferences in a mobile learning environment [36]
- Appropriateness and feasibility for language learning [37] [38]

The information about learners' learning styles will be gathered through mobile-based questionnaires designed to accurately identify the preferred learning styles within mobile environment. The questionnaires used to provide the profile of learners' learning preferences are adapted from the Index of Learning Style (ILS) questionnaire developed by Felder and Soloman [39] based on the Felder-Silverman Learning Style Model (FSLSM).

C. Designing i-MoL via ADDIE Model

The ADDIE model is used as an Instructional System Design (ISD) approach to guide the development and production of the i-MoL mobile learning system. The term 'ADDIE' is actually an acronym for the five phases involved in this process, namely "Analysis", "Design", "Development", "Implementation", and "Evaluation". ISD refers to the systematic process which involves needs analysis and the development of an effective delivery system to meet the identified needs [40]. Many models of ISD exist in the literature, such as ADDIE, ASSURE, and Dick and Carrey's [41]. However, researchers agreed that ADDIE is a commonly used instructional model [42][43][40] [44]. In fact, most of the models are actually spin-offs or variations of the ADDIE model [45]. The five

phases of ADDIE form a cyclical process; output from each phase will feed input to the subsequent phase [46]. Moreover, as Koneru [40] explains, ADDIE provides ample scope to integrate pedagogy, learning theories, and other instructional design principles. In this study, the researchers used the ADDIE model as an ISD approach to guide the development of the production design of i-MoL since it is the most generic, universal and simple ISD model that suits the purpose of a mobile learning system development [47]. Figure 2 illustrates the i-MoL system development framework utilizing the ADDIE model.

The first phase of ADDIE, i.e. Analysis, forms the foundation of the system design and development in this study. The Analysis phase is to define what is to be learned [48]. It generally involves a set of tasks, such as needs analysis and knowledge acquisition [46]. According to Zimnas et al. [43], the designer identifies the learning problem, goals and objectives, learners' needs, existing knowledge and any other relevant characteristics during this phase. In this study, the Analysis phase involves a needs analysis to identify system requirements for both system and content. It also includes students' learning style identification through questionnaires. By end of the phase, the i-MoL system requirement specification will be generated.

The second phase, i.e. the Design phase, receives outputs from the Analysis phase in order to plan for strategies in developing the instructional materials. Steps or activities in this phase may include tasks to write objectives, develop test items, plan instruction, and identify resources [49]. For the purpose of this study, the Design phase is divided into two stages, which are content design and system design. In the content design stage, the mobile-based grammar learning content is outlined to represent each type of learning style; while in the system design stage, the instructional materials comprising learning objectives, learning activities, and graphical user interface (GUI) of the system are planned according to the specific requirement of the mobile platforms.

The Development phase is where the design output from the previous phase is put to practice. According to Kulvietiene and Sileikiene [48], it is where the system designer or developer will author and produce the learning materials. The Development phase requires the designer or developer to use relevant software tools and applications for the production of the material, such as HTML editors, web-courseware, and web-authoring software [49]. It may also involve tasks of developing the GUI and user database [46], as well as preparing the multimedia components [51]. In this study, the Development phase comprises two tasks which are run concurrently. The first task is content development, whereby the designed grammar learning contents are produced in the forms of mobile-supported format. The mobile-based grammar learning contents are developed for each module of learning style. As for the second task, i.e. system development, the web-based portal and mobile applications are produced utilizing the relevant system development tool. The hardware components of the i-MoL server system will also be set up in this phase. The output from the Development phase will be a working prototype of i-MoL.

Implementation is the fourth phase of the ADDIE instructional process. In this phase, the designed and developed instructional materials are installed in the real-world setting. As Arkün and Akkoyunlu [51] noted, the Imple-

mentation phase is the process whereby the design is put into practice with the actual learners of the learning materials. In a 2011 study by Chen, Chen, and Tsai [52], the researchers distributed the training materials to the learners through the developed module platform and also conducted experimental teaching process during the Implementation phase. In this study, the Implementation phase involves the feasibility testing of the i-MoL prototype. The feasibility testing is for trial-running of the prototype in order to assess whether it is functional and feasible within the targeted audiences and specified learning objectives. In this phase, this study aims to identify the practicality of learning style elements and mobile-based grammar learning applications in the prototype.

The end of the Implementation phase leads to the final phase of ADDIE, which is the Evaluation phase. This phase determines the adequacy of the instructional materials [48] and verifies the extent that the materials are able to meet the specified learning objectives and learners' needs [51]. The Evaluation phase may be formative or summative and the tasks or activities may involve questionnaires, user focus groups, and interviews [50]. The Evaluation phase aims at evaluating the usability of the i-MoL prototype through questionnaires and focus group discussions. Then, the users' feedbacks are analyzed to determine the system's usability from various aspects. Technical strengths and weaknesses will also be identified for further enhancement of i-MoL. The output from this final phase would be the final and revised prototype of i-MoL.

IV. CONCLUSION

Based on existing literature, it is safe to say that this mobile learning project is the first of its kind: learning English grammar that is personalized to learning styles while 'on-the-go'. Mobile phones are now becoming people's most trusted personal devices and are receiving much attention by scholars, particularly educational researchers. For this reason, it seems like a natural progression to introduce such ubiquitous technology to benefit the younger generations in learning English language. i-MoL as proposed in this paper differs in such a way that it provides learning contents that are adaptive to students' preferred learning styles. It intends to deliver a personalized grammar learning environment that fits individual's learning style and the mobility needs of the students. The project is still in its content development stages. Once the system has been fully developed, it is hoped that i-MoL will be able to contribute significantly to the pedagogical aspects of mobile learning, particularly for the purpose of English grammar learning. Nevertheless, it is believed that i-MoL will be able to address many needs of a wider and more diversified community of learners; not just in learning English grammar, but also in other skills and competencies.

ACKNOWLEDGMENT

The authors would like to thank the Malaysian Ministry of Higher Education (MOHE) for the provision of the Prototype Research Grant Scheme (203/PHUMANITI/6740011) in completing this project.

REFERENCES

- [1] S.Y. Enxhi, B.H. Tan, M.F. Yong, "Speech disfluencies and mispronunciations in English oral communication among Malay-

sian undergraduates", *International Journal of Applied Linguistics & English Literature*, vol. 1, no. 7, pp. 19-32, 2012. <http://dx.doi.org/10.7575/ijalel.v.1n.7p.19>

- [2] S. E. Eaton, *Global Trends in Language Learning in the 21st Century*, Calgary: Onate Press, 2010.
- [3] G. Davies, P. Bangs, R. Frisby, E. Walton, *Setting up effective digital language laboratories and multimedia ICT suites for MFL*, The National Centre for Languages as Part of the Languages ICT Initiative, 2005, available at http://www.languages-ict.org.uk/managing/digital_language_labs.pdf
- [4] C. Alexander, "Language Labs: An Overview of the Trends", *Teaching English with Technology*, vol.7, no. 3, 2007.
- [5] Malaysian Communications and Multimedia Commission (MCMC), *Report on handphone users survey 2008*, 2008, available at http://www.skmm.gov.my/link_file/facts_figures/stats/pdf/Handphone_Users_Survey_2008.pdf
- [6] C.N. Bertolami, "Rationalizing the Dental Curriculum in Light of Current Disease Prevalence and Patient Demand for Treatment: Form vs. Content", *Journal of Dental Education*, vol.65, pp. 725-735, 2001.
- [7] J.Traxler, "Learning in a Mobile Age", *International Journal of Mobile and Blended Learning*, vol. 1, pp.1-12, 2009, available at <http://wlv.academia.edu/documents/0009/9949/ijmblproof01.pdfhttp://dx.doi.org/10.4018/jmbl.2009010101>
- [8] Quinn, C., "Get Ready for M-learning", *Training and Development*, vol. 20,no. 2, pp. 20-21, 2001.
- [9] MoLeNET, *Mobile learning myths*, 2010, available at <http://web.archive.org/web/20101015234706/http://www.molenet.org.uk/mobilelearinprac/myths>
- [10] L.Naismith, P. Lonsdale, G. Vavoula, M. Sharples, *Literature Review in Mobile Technologies and Learning*, Bristol: NESTA FutureLab, 2004.
- [11] A. Jones, K. Issroff, E. Scanlon, G. Clough, G., P. Mcandrew, "Using mobile devices for learning in Informal Settings: Is it motivating?" In *Proceedings of IADIS International conference Mobile Learning*, July 14-16, 2006.
- [12] N. Winters, "What is mobile learning?", In M. Sharples (Ed), *Big Issues in Mobile Learning* (pp. 1-34). Kaleidoscope Network of Excellence, Mobile Learning Initiative, 2006, available at <http://telearn.noe-kaleidoscope.org/warehouse/Sharples-2006.pdf>.
- [13] D. Laurillard, "Pedagogical forms of mobile learning: Framing research questions", In N. Pachler(Ed.), *Mobile learning: Towards a research agenda* (Vol. 1, pp. 33-54). London: WLE Centre, Institute of Education, 2007.
- [14] J.-H. Valk, A. T. Rashid, L. Elder, "Using Mobile Phones to Improve Educational Outcomes: An Analysis of Evidence from Asia", *The International Review of Research in Open and Distance Learning*, vol.11, no.1, pp.117-140, 2010.
- [15] A.Valenta, D. Therriault, M. Dieter, R. Mrtek, "Identifying Student Attitudes and Learning Styles in Distance Education", *Journal of asynchronous learning networks*, vol. 5, no. 2, pp. 111-127, 2001.
- [16] M. J. W. Lee, A. Chan, "Reducing the Effects of Isolation and Promoting Inclusivity for Distance Learners through Podcasting", *Turkish Online Journal of Distance Education*, TOJDE, vol. 8, no.1, pp. 85 - 105, 2007.
- [17] P. Gupta, *Short message service: What, how and where?*, 2011, available at <http://www.wirelessdevnet.com/channels/sms/features/sms.html>
- [18] A. Hashim, W. Wan Ahmad, R. Ahmad, "Mobile learning implementation: Students' perception in UTP", In *ICESSE 2010 : International Conference on Computer, Electrical, and Systems Science*, and Engineering, Feb 24-26, Pulau Pinang, 2010.
- [19] I. Ismail, R.M.Idrus, "Development of SMS Mobile Technology for M-Learning for Distance Learners", *International Journal of Interactive Mobile Technologies*, iJIM, vol. 3,pp. 55-57, 2009.
- [20] W.R. Penuel, J. Roschelle, L. Abrahamson, "Research on Classroom Networks for Whole - Class Activities", In *IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE'05)*, pp.222-229, 2005. <http://dx.doi.org/10.1109/WMTE.2005.56>
- [21] M. Freeman, P. Blayney, "Promoting interactive in-class learning environments: A comparison of an electronic response system

- with a traditional alternative”, In Proceedings of the 11th Australasian Teaching Economics Conference, July 11-12, Sydney, Australia, 2005.
- [22] S.Siraj, M.P. Saleh, “Aplikasi Teknologi dalam Pengajaran dan Pembelajaran Peringkat Sekolah Menengah:Jangkaan Masa Depan (Technology Application in Teaching and Learning at Secondary School: A Future Projection)”, *Journal of Educational Research*, vol.23, pp.123-139, 2003.
- [23] S. Siraj, “Pembelajaran Mobile dalam Kurikulum Masa Depan (Mobile Learning in Future Curriculum”, *Masalah pendidikan*, vol.27, pp. 128-142, 2004.
- [24] S. Mahamad, M. N. Ibrahim, S. M. Taib, “M-learning: A New Paradigm of Learning Mathematics in Malaysia”, *International Journal of Computer Science and Information Technology, IJCSIT*, vol. 2, no. 4,pp.76-86, 2010. <http://dx.doi.org/10.5121/ijcsit.2010.2407>
- [25] M. Mohamad, J. Woollard, “Bringing change in secondary schools: can mobile learning via mobile phones be implemented in Malaysia?” Paper presented at the 4th International Malaysian Educational Technology Convention, Kuala Lumpur, Malaysia, 2010.
- [26] T.Lim, M. Fadzil, N.Mansor, “Mobile Learning via SMS at Open University Malaysia: Equitable, Effective, and Sustainable”, *The International Review Of Research In Open And Distance Learning*, vol. 12, no. 2, pp. 122-137, 2011, available at <http://www.irrodl.org/index.php/irrodl/article/view/926/1738>
- [27] R. A. Rahman, M. H. M. Hashim, “Mobile learning in Malaysian Technical and Vocational Education (TVE): a qualitative case study”, In: *International Conference on Teaching and Learning in Higher Education 2011 (ICTLHE2011)*, November 21-23, Melaka, 2011.
- [28] M. Shuib, A. Abdullah, I. Ismail, S. N. A. Zahari, “The Feasibility of Teaching Grammar via SMS”, *SPECTRUM Studies in Language, Literature & Interpretation*, vol. 9, 2012.
- [29] Malaysian Communications and Multimedia Commission (MCMC), *Report on communications and multimedia pocket book of statistics 2011 Q2*, 2011, available at http://www.skmm.gov.my/skmmgovmy/files/attachments/Q2_2011_Eng.pdf
- [30] R.M. Felder, L.K. Silverman, “Learning and Teaching Styles in Engineering Education”, *Engineering education*, vol. 78, no. 7, pp. 674-681, 1988.
- [31] P. Honey, A. Mumford, *The Learning Styles Helper's Guide*, Maidenhead, UK: Peter Honey, 2000.
- [32] D.A. Kolb, “Learning Styles and Disciplinary Differences”, *The Modern American College*, pp. 232-255, 1981.
- [33] N.D. Fleming, C. Mills, “Not Another Inventory, Rather a Catalyst for Reflection”, *To Improve The Academy*, vol. 11, pp. 137-155, 1992.
- [34] J. Kuljis, F. Liu, “A comparison of learning style theories on the suitability for elearning”, In *Proceedings of the IASTED Conference on Web Technologies, Applications, and Services*, ACTA Press, pp. 191-197, 2005.
- [35] N. B. Ahmad, S. M. Shamsuddin, A. Abraham, “Granular Mining of Student’s Learning Behavior in Learning Management System Using Rough Set Technique”, In F. Xhafa, S. Caballé, A. Abraham, T. Daradoumis & A. Juan Perez (Eds.), *Computational Intelligence for Technology Enhanced Learning (Vol. 273, pp. 99-124)*: Springer Berlin Heidelberg, 2010. http://dx.doi.org/10.1007/978-3-642-11224-9_5
- [36] Kinshuk, & T. Lin, “Application of Learning Styles Adaptivity in Mobile Learning Environments”, *Third Pan Commonwealth Forum on Open Learning*, pp. 4-8, 2004.
- [37] N. Al-Jojo, *Teacher assisting and subject adaptive material system: an Arabic adaptive learning environment (Doctoral dissertation, University of Portsmouth)*, 2012.
- [38] L.Wang, “Variation in Learning Styles in a Group of Chinese English as a Foreign Language Learners”, *International Education Journal*, vol. 8, no. 2, pp. 408-417, 2007.
- [39] R. M. Felder, B.A. Soloman, *Index of Learning Styles questionnaire,1997*, available at <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>
- [40] I. Koneru, “Addie: Designing Web-Enabled Information Literacy Instructional Modules”, *DESIDOC Journal of Library & Information Technology*, vol. 30, no. 3, pp. 23-34, 2010. <http://dx.doi.org/10.14429/djlit.30.388>
- [41] A.L. Davis, "Using instructional design principles to develop effective information literacy instruction The ADDIE model", *College & Research Libraries News*, vol. 74, no. 4, pp. 205-207, 2013.
- [42] R. M. Branch, *Instructional design: The ADDIE approach*. Springer, 2008.
- [43] A. Zimnas, D. Klefouris, N. Valkanos. "IDEL-A Simple Instructional Design Tool for E-Learning", *World Academy of Science, Engineering and Technology*, vol. 49, pp. 366-372, 2009.
- [44] V. Soto, "Which Instructional Design Models are Educators Using to Design Virtual World Instruction", *Journal of Online Learning and Teaching*, vol. 9, no. 3, pp. 364-75,2013.
- [45] C.-Y. Lai, W.-C. Liou. "Rapid ADDIE Curriculums Design Model Based on the Heterogeneous Multimedia Information Integration." *Multimedia Workshops, 2007. ISMW'07. Ninth IEEE International Symposium on. IEEE*, 2007.
- [46] W. He, T. Means, G.Y. Lin, “Field Experience Tracking and Management in Teacher Development Programs”, *International Journal of Technology in Teaching and Learning*, vol. 2, no. 2, pp. 134-147, 2006.
- [47] P. Berking, T. Archibald, J. Haag, *Mobile learning: Not just another delivery method*, 2012, accessible at <http://www.adlnet.gov/wp-content/uploads/2012/12/12079.pdf>
- [48] R. Kulvitiene, I. Sileikiene, “ The blended learning delivery design model”, In *Proceedings of the 6th WSEAS International Conference on Distance Learning and Web Engineering*, Lisbon, Portugal, September 22-24, 2006.
- [49] S.J. McGriff, *Instructional system design (ISD): Using the ADDIE model*, Penn State University, 2000, available at <http://metalab.uniten.edu.my/~iskandar/project/july%2009/ADDIE.pdf>
- [50] K. Passerini, M. J. Granger, "A Developmental Model for Distance Learning Using the Internet", *Computers & Education*, vol. 34, no. 1, pp. 1-15, 2001. [http://dx.doi.org/10.1016/S0360-1315\(99\)00024-X](http://dx.doi.org/10.1016/S0360-1315(99)00024-X)
- [51] S. Arkün, B. Akkoyunlu, "A Study on the development process of a multimedia learning environment according to the ADDIE model and students' opinions of the multimedia learning environment", *Interactive Educational Multimedia*, vol.17, pp. 1-19, 2008.
- [52] Y.-T. Chen, T.-J. Chen, L.-Y. Tsai, "Development and Evaluation of Multimedia Reciprocal Representation Instructional Materials", *International Journal of Physical Sciences*, vol. 6, no. 6, pp. 1431-1439, 2011.

AUTHORS

Munir Shuib is with the National Higher Education Research Institute (NaHERI), sains@USM, 11900, Universiti Sains Malaysia, Penang, Malaysia (e-mail: munir@usm.my).

Amelia Abdullah is with the School of Educational Studies, 11800, Universiti Sains Malaysia, Penang, Malaysia (e-mail: amelia@usm.my).

Siti Norbaya Azizan is with the National Higher Education Research Institute (NaHERI), sains@USM, 11900, Universiti Sains Malaysia, Penang, Malaysia (e-mail: sitinorbaya49@gmail.com).

Thenmolli Gunasegaran is with the School of Educational Studies, 11800, Universiti Sains Malaysia, Penang, Malaysia (e-mail: gthenmolli@gmail.com).

This work was supported by the Malaysian Ministry of Higher Education (MOHE) for the provision of the Prototype Research Grant Scheme (203/PHUMANITI/6740011). Submitted 31 October 2014. Published as resubmitted by the authors 25 January 2015.