A Preliminary Study of An Authentic Ubiquitous Learning Environment for Higher Education

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Abstract: - Ubiquitous learning is a novel approach that integrates mobile technology, web services and context-awareness technology to overlay the real world with virtual information according to the situation or environment of the learner. In this paper, an interesting solution for promoting authentic learning is presented by integration of three web 3.0 technologies, namely, mobile blogging, mobile augmented reality and mobile tagging, in the design and development of a ubiquitous learning environment for higher education. Preliminary results show that u-learning environments holds promise in increasing students’ context-awareness and collaboration during learning as well as managing their cognitive load.

Key-Words: - Authentic learning, ubiquitous learning environment, mobile augmented reality, mobile tagging, mobile blogging, higher education

1 Introduction
The recent developments in mobile and wireless technology are revolutionizing the way we communicate. TNS, the world’s largest custom research company, reported that from the 34,000 respondents surveyed in 43 countries, the number of web users visiting social networking sites (supported by web 2.0 technologies) on mobile platforms has increased from 30% to 46% in 2011. The ownership of tablet computers has also grown; with intended rates of 31% is Asia and 28% in Europe [1]. In Malaysia alone, it is estimated that the number of mobile devices owned (30.4 million devices) is higher than the current population, which is 28.2 million people [2]. This shows a huge potential in implementing mobile and wireless technologies in the current global and local educational sector.

To date, a novel and interesting approach utilizing the advancement of global mobile technology is the ubiquitous learning (u-learning) approach. In this approach, sensors are embedded in mobile devices as well as in the environment in creating an immersive learning experience for students. During the learning process, the real world viewed via the mobile device’s camera, is overlaid with virtual information gathered from a combination of the current students’ surroundings, position, and environment as well as the Internet. This situation can provide students with context-aware learning in other words, real-time authentic learning [3,4,5,6].

Yet, the implementation of mobile, wireless and sensor technology in u-learning environments for higher educational is relatively new [3,4]. There is a need for developing curriculum that can adapt usage of mobile technology within and beyond traditional classrooms in reducing the gap between students and technology [7,8,9]. This study attempts to bridge this gap by introducing and implementing a u-learning environment by combining three Web 3.0 technologies, namely, mobile blogging, mobile augmented reality and mobile tagging, in current higher educational settings.

2 Problem Statement
In the past decade, educators have placed significance on the implementing “authentic activities” in learning. Authentic learning is learning that is presented in real-world context [10]. Scholars have argued on the foundation of learning authenticity in terms of cognitive authenticity and physical authenticity. In relation to physical authenticity, Savery and Duffy [11] emphasized the importance of relating concepts delivered in learning to the content domain, and suggesting problems to be “real”. On the other hand, Barab, Squire and Dueber [12] argued that learning does not occur solely on either the learner or the
environment, but occurs in the flow and interaction between both learner and its environment. In addition, Smith [13] observed that the “realistic problem-solving process” has more significance in learning compared to the “physical fidelity” of the learning material. Similarly, Herrington, Oliver and Reeves [14] concluded that cognitive authenticity of learning is more important than its physical authenticity.

In relation, authentic learning environments can be provided to learners by designing curriculum and learning modules that merge real-world and virtual learning environments [3]. The recent advancement of mobile and sensor technologies have opened up new ways for implementation of learning strategies by embedding virtual worlds with real-world learning environments. These technologies enable learners to experience “context-awareness” in learning by providing them with information that is tailored with their learning behaviors using sensor, wireless and mobile technology [3,5,15]. This new type of learning with combination of these technologies (mobile, wireless and sensor) is called ubiquitous learning or “u-learning” [3,16].

Although educators have realized the great potential of u-learning, yet, few learning environments and approaches have been developed for u-learning [3]. Moreover, without proper guidelines of learning activities and support, this new type of learning environment might become difficult for learners [5]. In relation, educators have also mentioned the importance of implementing learning technologies that make learning experience more effective, appealing and accessible to learners [17]. Research has indicated that among the technologies that have the potential to support accessible, effective and appealing learning and instruction are mobile and ubiquitous technology [3,5,16]. That is, in practical terms, to enable continuous accessibility to learning, learners need tools that they usually bring with them, which are mobile devices such as handheld phones and computers [18].

Thus, we have focused this study on developing a ubiquitous learning environment for higher education in adaptation of Web 3.0 technologies (i.e., mobile augmented reality, mobile tagging and mobile blogging) that increases learning authenticity through context-awareness and collaboration during learning while reducing cognitive load. In addition, this study aims to assess the environment’s impact and effect on students’ learning. Furthermore, this study attempts in achieving Universiti Kebangsaan Malaysia’s vision to engage its students with Learning 3.0 promoting the use of distributed computing and extended smart mobile technology.

3 Research Methodology
As the study is still in its early stages, the research methodology only focuses on the following aspects: (i) development of the conceptual framework, and (ii) the preliminary survey.

3.1 Conceptual Framework
The conceptual framework of this study is adapted from the Framework of the Rational Analysis of Mobile Education (FRAME) model [19]. The study’s conceptual framework is based on four aspects (four circles in Fig. 1) that are investigated in the study, which are: (i) Web 3.0 technology (mobile blogs, mobile augmented reality, and mobile tags), (ii) learner context-awareness, (iii) learner cognition, and (iv) learner social skills. The intersection between these four aspects is defined as the learning theories and approaches that are integrated in this study, namely: situated learning theory (for investigation of context-awareness), multimedia learning theory (to study learner cognition), minimalist learning theory (to study Web 3.0 technology), and collaborative learning (to investigate learner social skills). The overlap between these learning theories and approaches are further defined as constructs measured in this study, which are authentic learning, cognitive load management, collaboration and heuristics. The intersection between all the aspects results is the goal of the study, which is “authentic ubiquitous learning”, as illustrated at the center of Fig. 1.

![Fig. 1: Conceptual framework of study](image)

Adapted from Koole [19]

3.2 Preliminary survey
A survey was carried out on 53 undergraduate students from two local higher educational
institutions taking introductory courses in video production. The survey was conducted by using a questionnaire as the instrument. The questionnaire was designed based on the following elements: (i) learning theories implemented in the study (situated learning theory, multimedia learning theory and minimalist learning theory), (ii) potential technologies to be implemented (mobile blogging, mobile tagging and mobile augmented reality), (iii) existing learning settings, (iv) authenticity of learning content, where “yes” response were received for still image quality and management. In terms of knowledge construction (cognitive load), the majority of the respondents agreed to use online videos for explanation of concepts and techniques in the learning module (strongly agree – 38%, agree – 45%), and to have a real person as an author or presenter (strongly agree – 45%, agree – 36%). Furthermore, in terms of style of language preference, they preferred conversational style (62%) rather than formal style. The results also discovered that two-thirds of the total students (66%) have problems in production of video. Meanwhile, a smaller percentage was reported for problems with audio recording (36%) and editing still images (28%). The issues and problems received from open-ended responses are summarized and categorized according to video production, audio recording and editing still images, as in Table 1.

Section C investigated on collaboration. All of the respondents agreed that collaboration in groups increases their motivation in learning. From open-ended responses, respondents emphasized that collaboration in groups assist them in problem solving, reasoning and decision-making. They also stated that collaborating in groups provides the opportunity to exchange ideas leading to better understanding while increasing communication and interaction skills. Moreover, they indicated that collaboration is capable of improving self-assessment and sense of competiveness.

Nevertheless, a large number of respondents (70%) stated that they had problems during collaboration in groups. Among their responses were: (i) management difficult when group size is too large (more than 5 people), (ii) difficulty on

4 Preliminary Survey Results
The preliminary results are obtained from survey conducted in the analysis phase. The questionnaire consisted of closed (“yes” and “no” responses as well as 5-point Likert scaled responses) and open-ended questions.

In section A, responses were obtained on demographics as well as mobile device usage and experience of students. The demographics showed a relatively equal distribution among the respondents as 51 percent of the total 53 students consisted of females, while the remainder consisted of male respondents. Most of the respondents were aged from 20 to 24 years old (88.6%), while the remaining respondents were aged above 25 years old. For mobile device usage, more than half of the respondents (56.6%) have experience using smartphones or tablet computers and a relatively similar distribution of respondents (51%) was identified to have learning experience with mobile devices. Respondents were also inquired on their current and future perception of learning with mobile devices. Most of the respondents’ current perception of learning with mobile devices was neutral (32.1%) or satisfied (30.2%). As for their future perception of learning with mobile devices, the majority of the respondents were very likely (49.1%) and likely (39.6%) to be interested to learn with mobile devices in the future.

The initial questions in the section B focused on authenticity of the learning content, where respondents were required to answer predetermined responses as well as open-ended ones. For inclusion of scriptwriting and storyboarding into the lesson plan, the majority of the respondents regarded both elements as important to be included (scriptwriting – 100%, storyboarding – 85%). Subsequently, multiple-selection and open-ended responses were gained for future technologies that would assist respondents in scriptwriting and storyboarding.

Online videos, classroom lectures, and websites were among the platforms preferred in scriptwriting, while online videos and websites were the platforms preferred in storyboarding.

In relation, most of the respondents agreed on the importance of providing guidelines for error prevention in the video production learning module, where “yes” response were received for still image editing (92%), shooting video (98%) and recording audio (96%) for video production. Open-ended responses were also received from the respondents on recommendations or tips (for error prevention), which would help other students in editing still image, shooting video and recording audio for video production. The recommendations covered aspects such as: (i) video shooting and audio recording techniques, (ii) scene, location and time management, (iii) matching video genre with video shots, (iv) video and audio equipment, and (v) still image quality and management. In terms of

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Nevertheless, a large number of respondents (70%) stated that they had problems during collaboration in groups. Among their responses were: (i) management difficult when group size is too large (more than 5 people), (ii) difficulty on
gaining mutual agreement on decision-making, (iii) issues in collaborative space (e.g. difficulty in agreeing time for discussion among group members), (iv) lack of motivation and participation among group members, (v) difficulty in delegation of tasks and (vi) lack of technical skills.

Results also show that the majority of the respondents agreed (strongly agree – 15, agree – 23 people) that usage of blogs could help students in learning. Similar results were also found regarding “sharing comments in blogs improve learning” question, where most of them agreed to the statement. In addition, positive results were obtained for questions on whether blogs support self-reflection and peer-to-peer reflection. Furthermore, most of the respondents either strongly agreed (38%) or agreed (43%) that they would be interested in using mobile blogs for learning in the future.

Section D aims to identify potential learning activities and technologies that can be applied to u-learning. Results showed that most of the respondents preferred to the inclusion of out-of-classroom learning activities (strongly agree - 60%, agree - 32%). Similar results were also obtained for inclusion of guidelines before learning activities to reduce errors performed in the activity. Further questions were also inquired in relation with the concepts of two Web 3.0 technologies, namely mobile augmented reality and mobile tagging. Results showed that more than half of the respondents were not familiar with the concepts of mobile augmented reality (62%) and mobile tagging (66%). Moreover, most of them have never experienced learning with both technologies (mobile augmented reality - 70%, mobile tagging - 87%). However, for the perception of the technology, results showed that the majority of the respondents would consider using both technologies for learning in future. Furthermore, almost all of them (98%) agreed that these web 3.0 technologies (mobile augmented reality and mobile tagging) would enhance learning. Among the open-ended responses as to why the two technologies would enhance learning are as follows: (i) technologies would allow faster access to information and provide information on-demand (on student request), (ii) technologies would increase student’s motivation and engagement in learning, (iii) would make the learning process easier and more efficient, (iv) usage of authentic examples would help in understanding a concept, and (v) cause students to be immersed in learning. However, one respondent raised concerns on time consumption for familiarizing with the technologies.

5 Discussion of Preliminary Survey Results

In section A, results showed that the current perception of learning with mobile devices was only neutral (32.1%) or satisfied (30.2%), while in the future, the majority of them (88.7%) are interested in learning with these devices. This indicates a need in improving existing learning environments with the usage of mobile devices as learning tools. In addition, results from demographics showed that only half of the students have experience using mobile devices and using them for learning. This suggests that a training period be conducted to provide students in familiarizing with usage of mobile device before attempting to conduct learning activities with them.

Section B shows that the respondents have problems concerning cognitive load, learning authenticity and resource management in video production, audio editing and still image editing. This signifies the importance of implementing the multimedia learning theory for management of cognitive load, the situated learning theory for learning authenticity and addition of scriptwriting and storyboarding in the lesson content for resource management. Subsequently, findings also indicate the usage of learning platforms such as online videos and social networking websites in the video production module as well as usage of author or presenters using conversational style of

<table>
<thead>
<tr>
<th>Item</th>
<th>Problem</th>
<th>Indicator</th>
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<tbody>
<tr>
<td>Video production</td>
<td>Main message to be conveyed in video</td>
<td>Cognitive load, learning authenticity</td>
</tr>
<tr>
<td></td>
<td>Hard to produce video because no basic skills, video genre</td>
<td>Learning authenticity</td>
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<td></td>
<td>Time management, video length</td>
<td>Planning</td>
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<td></td>
<td>Issues with equipment, location, and lighting, problems using smartphones to shoot video</td>
<td>Resource management</td>
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<td></td>
<td>Video digitization, video format</td>
<td>Learning authenticity</td>
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<td></td>
<td>Video editing – addition of video effects, video transition, timing</td>
<td>Cognitive load</td>
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<tr>
<td>Editing still images</td>
<td>Selection of good images, image quality, size and format</td>
<td>Learning authenticity</td>
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<td>Image editing - software</td>
<td>Learning authenticity</td>
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<td>Audio recording</td>
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<td>Problems with equipment</td>
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<td>Issues with audio from surrounding environment</td>
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<td>Audio editing – timing, software</td>
<td>Cognitive load</td>
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<td>Audio format</td>
<td>Learning authenticity</td>
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Table 1: Problems identified in learning module
communication to ease the process of understanding and prevent excessive cognitive load. In addition, results show recommendation and guidelines are important for error prevention in learning activities.

Positive findings in section C indicate that learning activities involving collaboration increase students’ motivation in learning. Positive open-ended responses received (e.g., collaboration assist students in problem solving, reasoning and decision-making) from the respondents also signify collaborative activities have a positive impact towards learning in terms of reflection of learning, problem solving, reasoning, decision-making and communication skills. In solving the identified problems on group-size and difficulty of agreement on decision-making, formation of groups in the learning activities can be restricted to 4 to 5 people per group and a voting process can be introduced for decision-making. In solution to issues concerning collaborative space, a mobile blog can serve as platform for communication among group members. As for issues relating lack of motivation and delegation of tasks, an assessment based on group contribution can be introduced for increasing motivation and a leader for each group can be chosen to hold responsibility for delegation of tasks.

In section D, positive results for mobile blogging, mobile augmented reality and mobile tagging suggest that students believe that the implementation of these Web 3.0 technologies in the learning module would enhance their learning. They also have indicated their willingness to use these technologies in the future. In relation, the inclusion of out-of-classroom activities is believed to increase their motivation and engagement in learning. Thus, the study implements mobile augmented reality and mobile tagging as learning technologies as well as include out-of-classroom activities as learning activities.

5 The U-learning Module and U-learning Environment

In delivering the u-learning module, the problem-oriented project-based learning (POPBL) strategy is applied. POPBL is a variant of problem-based learning, was initiated in 1970, at Denmark, during the establishment of Aalborg University and Roskilde University Center [20, 21]. This strategy is a dynamic pedagogy due to the fact that it tackles students’ problems and issues in their related context and from their own areas of practice. POPBL requires students and instructors’ involvement in a thematic learning framework where learning activities are divided into parts: (i) coursework to facilitate core disciplines among students, and (ii) project work – engagement of students in collaborative research projects. The principles of POPBL as follows: problem formulation, enquiry of exemplary problems, participant control, joined projects, interdisciplinary approach and action learning [22].

POPBL is beneficial in terms of knowledge construction of the individual as well as shared understanding through group collaboration [20]. In addition, the strategy has been observed to assists students in organization of their work as well as help students in using ICT tools to construct knowledge [21]. Furthermore, findings from [22] indicated that this strategy has a positive impact on students’ learning in terms of knowledge construction, cooperation, learning intention as well as reflection.

In designing the u-learning environment, the following criteria are implemented [3]: (i) provide a learning environment that is context-aware (i.e., the environment is the real world environment); (ii) offer adaptive support to learner by sensing their behavior and context; (iii) provided personalized support in appropriate way, time and place; (iv) allow seamless learning even in the case of learner constantly moving learner places; and (v) provide learning content that can meet the learning tool’s functions.

Fig. 2 shows the overall u-learning module supported by the u-learning environment that is delivered by using the POPBL strategy. In a POPBL strategy, Dirckinck-Holmefeld [21] suggested that a learning environment adapting POPBL is consisted of three components: (i) coursework resources, (ii) lesson resources, and (iii) project work resources. In applying POPBL to a u-learning module and environment, the learning technologies identified in the need analysis survey (i.e., lectures, online video, websites, mobile blogs, mobile augmented reality, mobile tags, and social networking sites) are integrated. Lectures, online videos and websites are applied as coursework resources while cases for learning (i.e., problem-oriented project-based cases), mobile blogs, mobile augmented reality, mobile tags, and social networking websites, are utilized as project work resources. As for the lesson resources, the lesson plans, learning activities, and learning content are designed with several participatory design techniques with iterative feedback from students. This is conducted in ensuring students’ needs and requirements during learning are met in the earlier phases of design and development of the u-learning module and environment. In terms of the
learning tools used, the study focuses on two types of mobile devices, which are tablet PCs (personal computers) and smartphones. These devices are selected due to their capability of supporting ubiquitous technology and seamless learning [3] as well as their availability to students, where students usually bring these devices with them [18].

6 Conclusion
This paper presents an interesting solution for addressing the problem of implementing authentic learning in higher education through the integration of u-learning module and environment. Positive preliminary results from the analysis phase indicate the potential of integrating three web 3.0 technologies (mobile blogs, mobile augmented reality and mobile tagging) as learning technologies in u-learning environments to enhance and enrich the learning experience. In addition, the combination of these learning technologies with the appropriate learning module, learning models, theories and strategies holds promise in increasing students’ context-awareness and collaboration during learning as well as reducing their cognitive load. As implementation of the ubiquitous technologies in learning environments is relatively new, more researches have to be conducted in understanding the full potential and impact of u-learning environments and modules toward students’ learning. Future investigations can also be directed towards understanding the effects of u-learning technology towards instructors and pedagogy in ensuring the goals of learning are successfully achieved and the gap between students, instructors, pedagogy and technology is reduced.

References:

Fig. 2: The u-learning module and environment
Adapted from [21, 22]