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Preface

We are pleased to publish the *Proceedings of the Second International Conference on Open and Flexible Education* (ICOFE 2015). Openness and flexibility have become major trends in education, influencing a whole spectrum of institutions across the globe. Technological advances and breakthroughs are bringing about a paradigm shift in contemporary education. The modes of learning and teaching are becoming more open and flexible in terms of time, space, curriculum contents, organization, pedagogical methods, infrastructure and requirements.

These changes not only take place in open universities, but also conventional tertiary institutions. The rapid development of massive open online courses (MOOCs) is one example that manifests the global trend of open and flexible learning. With this background, the Open University of Hong Kong (OUHK) has organized an annual conference on open and flexible education, which characterizes the University's uniqueness and area of excellence: open and flexible education. This series of conferences aims to:

- provide a platform for sharing research, practices and views relevant to open and flexible education;
- facilitate networking and cross-institutional collaboration among researchers and educators in both open and conventional universities; and
- promote open and flexible education to enhance educational access and quality.

The theme for the Second International Conference on Open and Flexible Education — 'Making Learning Mobile and Ubiquitous' — highlights the approaches and means for adopting the latest technologies and innovations to cater for the diverse needs of different learning communities. It lays stress particularly on mobile technologies, which facilitate learning anytime and anywhere, in a flexible and personalized mode of education. The papers are grouped in this volume according to six subthemes:

- mobile learning and open/flexible education modes
- ubiquitous learning and open/flexible education modes
- use of technologies to enhance ubiquitous teaching and learning
- innovations in open/flexible curriculum development and pedagogy

- social media and ubiquitous learning
- open educational resources and ubiquitous learning.

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Editors
K C Li and K S Yuen

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Paper Presentations

Digital game-based learning:
A case study of a digital educational game in Hong Kong

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Abstract. This paper examines how the use of digital games in mathematics education can be beneficial to learning, if not more successful that traditional learning. With a view to helping local Hong Kong primary school students learn compass directions and bearings, Janet Lau, an education game designer, developed a free, open-for-all digital game package that assists young students in learning location, direction, and distance measurement on maps. In order to find out how useful digital game-based learning is to young learners, in May 2015, we invited forty primary four to primary six local Hong Kong students to participate in our case study. From the post-experiment survey and test performance, it was found that students of the experimental group showed more interest, curiosity, and motivation in the learning process. In this paper, we will analyze and discuss how game players achieve positive results and become active learners in a stress-free learning environment.

Keywords: digital game-based learning (DGBL), mathematics education, self-directed learning

1 Introduction

According to the current *Mathematics Education Key Learning Area – Mathematics Curriculum Guide (P1 – P6)* (2000) published by the Education Bureau of the Hong Kong government, 'Measures and Space Dimensions' is one of the key learning areas for both Key Stage 1 (P1 – P3) and Key Stage 2 (P4 – P6). As indicated in the framework of learning objectives developed by the Education Bureau, by Key Stage 1, students need to learn how to identify the four directions (north, south, east and west) and get involved in various measuring activities. Then by Key Stage 2, students should be able to identify the eight compass points, use measuring tools, and handle simple problems in measurement:

Table 1. A summary of the key learning area, 'Measures and Space Dimensions' for Key Stage 1 and Key Stage 2.

Key Stage 1 (P1 – P3)	
1	To identify the four directions
2	To choose and use a variety of non-standard units to record results in basic measuring activities
3	To understand the need to use standard units of measurement
4	To select appropriate measuring tools and standard units of measurement
5	To integrate knowledge of Number, Measures, Shape & Space to solve simple problems in measurement
Key Stage 2 (P4 – P6)	
1	To identify the eight compass points
2	To choose and use a variety of non-standard and standard units to record results in various measuring activities
3	To select and justify appropriate measuring tools and standard units of measurement
4	To recognize the degree of accuracy and the approximate nature of measurement
5	To inquire and use simple measurement formulae
6	To integrate knowledge of Number, Measures, Shape & Space to formulate and solve simple problems in measurement

While the fundamentals of compass points can be taught with traditional teaching methods in the classroom setting, true navigation goes far beyond rudimentary concepts such as ‘north is always up’ and ‘the sun rises in the east’. Navigation is a crucial part of orienteering, which requires the combined skills of map reading, compass skills, distance measurement and pace. In order to master this key learning area, students will need to be able to visualize the directions and estimate the distance on maps. What is at issue is: visualization, the creative ability to imagine and mentally manipulate images and ideas, can neither be taught in class, nor through math drill and tests. It can only be acquired and realized through authentic or/and simulated orienteering experience. With little or no orienteering experience, many math students show weak understanding of concepts due to visual-spatial organization deficits. As Garnett (1998) points out, this is also one of the most common math learning problems that students of all ages encountered.

In light of this, Ms Janet Lau, a didactical game designer, developed a free, open-for-all digital game package that enhances the learning of measures, space dimensions and directions. Modeling situations from real-life orienteering scenarios, the e-learning game package is meant to be a user-centred edutainment device for self-directed learning outside the classroom. It aims to provide simulated orienteering experiences for primary school students, so that young learners can develop their visual-spatial skills on their own, while enjoying and engaging in the fun and challenging tasks in the game. Since 2002, the mathematics game package has been listed as ‘educational material’ in the Hong Kong Education City, the largest educational online portal in Hong Kong.

With a view to examining the effectiveness of incorporating digital educational games in mathematics education, a contrastive study on digital game-based learning and traditional-based learning of primary school students was conducted in May 2015. This paper will, by comparing the learners’ performance and learning motivation in both learning approaches, report on the key findings of the case study in Hong Kong.

2 Digital Game-based Learning and Mathematics Education

Countless contemporary research studies have shown that the use of digital games, whether in formal or informal educational settings, was positively correlated with increased learning motivation and improved student mathematics achievement (Hubbard, 2000; Alagic, 2003; Hamilton, 2007; Ke, 2008; Park, 2008; Annetta et al., 2009; Carr, 2012; Rosen & Beck-Hill, 2012). However, digital games are not always educational, and digital educational games are not always effective. Below are three key features that an effective digital educational game should possess:

a. As in constructivist learning, the game should start with a challenging question, an interesting case, or an authentic scenario (Cooperstein et al, 2004). Rather than merely asking for factual recall and drill-and-practice, the game needs to simulate situations that will be encountered in real life, so that players can make meaningful choices (Baca, 2015). With clear goals to be accomplished, players can then learn by doing, learn from mistakes, get engaged in high-order thinking, building their problem-solving skills in a step-by-step fashion.
b. The game should encourage players to build new learning on prior knowledge. Winning should be based on conceptual understanding, connections between experience and new knowledge, and most of all, "application to real-world activities" (Pasquale, 2013, p. 52). While hints and feedback are given in response to each player's attempt, the game setting should rule out the possibility of finding the right answer through random selection (Meletiou-Mavrotheris, 2012).
c. The game should either allow opportunities for collaboration or support competition among players. It should be set as a social activity that contributes to the development of the players' social and emotional skills (Squire, 2005; Oblinger, 2004).

Despite the ever-changing learning environment, game's content and design and learner variables, the three key features of effective digital educational games stay unchanged. In the following, we will introduce the design of Lau's digital game, "Concepts and Measurement of Directions" a web-based e-learning package for the

Mathematics iWorld. We will also examine whether the digital game package can foster learning and promote intrinsic motivation of young learners.

3 Background of the Digital Game Package

To promote self-learning through the Internet, in 2000, the HKSAR Government established the Hong Kong Education City (www.hkedcity.net), an open e-learning platform under the Education Department. On this platform, various teaching and learning resources, including both private and public developed packages and tools, are provided. Lau's digital game package was one of the projects created and developed for the Hong Kong Education City. It is a free learning resource kit for primary school teachers and students in Hong Kong in 2002.

3.1. Aims of the Digital Game Package

Since the target users of the digital game package are primary school teachers and students in Hong Kong, the aims of the game package are:

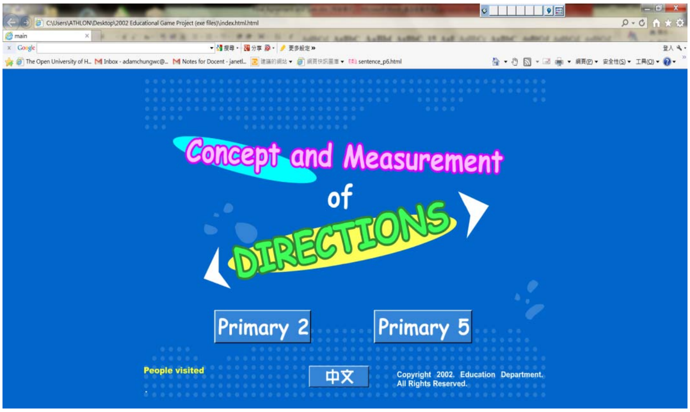
- To promote the application of IT in mathematics education;
- To help students read locations on virtual maps;
- To strengthen students' knowledge of the four/eight compass points;
- To demonstrate compass skills with a virtual environment; and
- To teach the concepts of distance with virtual measurement.

3.2. Key Game Design Features

Since the primary target users are P.2 to P.5 students, the interface design needs to be as user-friendly, interactive and attractive as possible to arouse users' interest. Animation and multi-media elements were created with easy and clear navigation tools. Multiple points of navigation and entry for opt-in and opt-out can be found on every page. To facilitate self-directed learning, all instructions were written in user-friendly and simple wording.

Users of different levels can choose the language of instruction (Chinese or English), the level of difficulty, and the game type on the home page as they see fit.

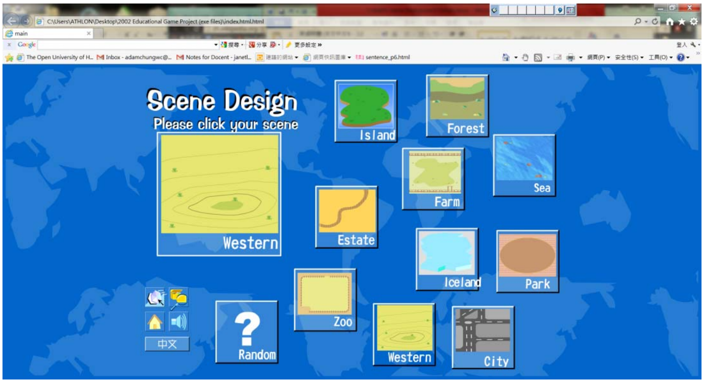
Illustration 1. Game players are allowed to choose the language and the level of difficulty.



Players can also choose to play the game individually or in pairs. The e-learning package includes three digital games, namely (A) ‘Simulated Scene Design’, (B) ‘Direction Game’, and (C) ‘Treasure Hunting’.

In the first game, ‘Sim Scene Design’, the player is given ten scenes, which include a jungle, a park, a town, a business center, etc.

Illustration 2. Scenes for selection in the scene design game.



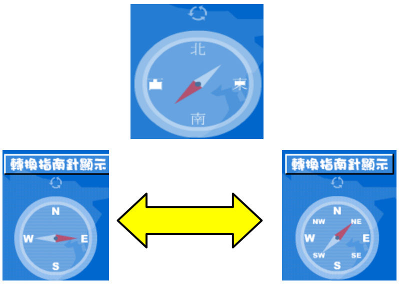
After a scene is selected, 15 relevant objects/locations are provided. The player can drag these items onto the selected scene.

Illustration 3. Scenes that can be chosen by the game player.

Illustration 4. The chosen scenes can be dragged onto the virtual map.

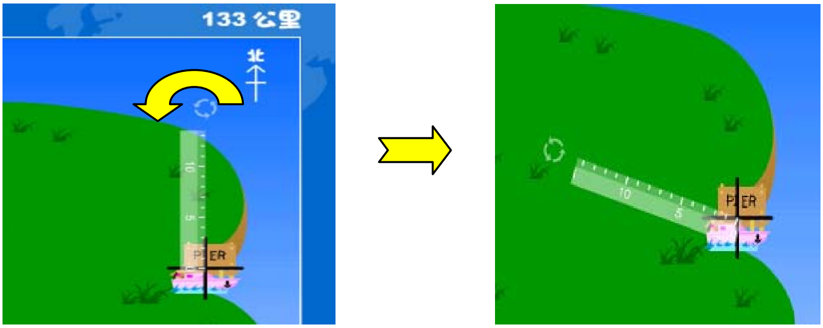
A virtual compass is provided to measure directions from different locations set in the scene. The direction sign can be changed to a four or eight compass point. The compass pole can also be adjusted according to the player's need.

Illustration 5. The compass point can be set according to the player's level.



On top of the virtual compass, an extensible virtual ruler is given to measure the distance between two locations in the simulated scene. The extensible ruler can be rotated, lengthened, or shortened to measure the distance between two locations.

Illustration 6. The extensible ruler for distance measurement on the virtual map.



On the other hand, the second game, ‘Direction Game’, include a set of interactive exercises that strengthen the player’s knowledge and skills in map reading, compass bearing and distance measurement.

Last but not least, in the third game, ‘Treasure Hunt’, the player(s) can apply the mathematics skills acquired from the first two games and hunt for treasure. The rules and regulations of the game are summarized below:

- The treasure hunt will take place on a 10x10 square chessboard.
- The chessboard will be filled with various obstacles.
- With the help of a compass, the player(s) will decide what step to take on the chessboard.
- Points will be granted to the player(s) each time a treasure item is achieved.

4 Research Method and Findings

To investigate the effectiveness of digital game-based learning in mathematics education, a control group and an experimental group were set in the case study. The control group consists of a class of 20 local Hong Kong students study P.4 to P.6, who were child members of the teens’ reading club at the Tsuen Wan Public Library. 19 out of 20 of the control group participants revealed that they had learnt to identify the eight compass points from the math lessons in school. Nonetheless, in the study, a 20-minute traditional-based, face-to-face lecture on map reading, compass bearing, and distance measurement was given to the control group on 2 May 2015 (Sat). After the lecture, all control group participants were given a test on compass bearing and distance measurement. They were also asked to fill in a questionnaire and write down their feedback about the session after the test.

The experimental group, on the other hand, consists of 20 local Hong Kong students who were junior members of the Scout Association of Hong Kong. 13 of the participants were P.4 to P.6 students, whereas 7 were P.3 students. Among the 20 experimental group participants, only 8 reported that they had learnt to identify the eight compass points from math lessons in school. 12 revealed that the topic of directions and distance measurement was new to them. On 17 May 2015 (Sun), the experimental group was first given a brief 15-minute lecture on map reading, compass bearing, and distance measurement. Then, each participant was given 5 minutes to try the digital game package developed by Lau. After playing the game(s), all experimental group participants were given a test, which tested their knowledge of compass bearing and distance measurement. Just as the control group, the experimental group was asked to fill in a questionnaire, writing down any remarks and comments they had about the session.

4.1 Learning Motivation in the Control Group and the Experimental Group

As indicated in the questionnaires, up to 55% of the experimental group participants agreed that they found the digital game package helpful in strengthening their understanding of the key learning area of directions and distance measurement. 40% stated that the digital game package was effective to some extent. Moreover, 80% agreed that learning was enjoyable and engaging when digital games were incorporated. In the written feedback, the adjective “fun”, “happy” and “interesting” have occurred multiple times.

Table 2. A majority of the experimental group participants found digital game-based learning effective and enjoyable.

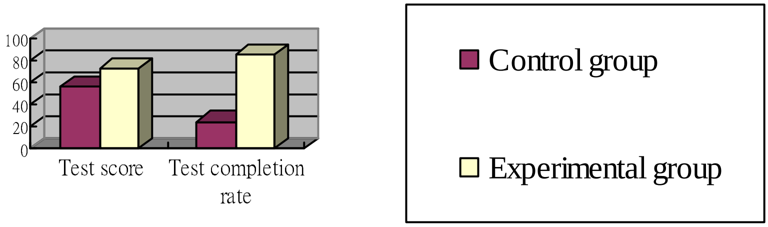
	Yes.	Yes, to some extent.	No.
1. Do you think the digital game-based learning session can help you understand compass directions and distance measurement better?	55% (11)	40% (8)	5% (1)
2. Do you think that the game-based learning session was enjoyable and engaging?	60% (12)	20% (4)	20% (4)

Yet, as shown in the survey data collected from the control group, only 40% of the participants replied that they found the traditional-based learning session enjoyable; 55% rated the session as “OK”; 25% reflected that the session could be improved if it could include games. Apparently, the digital game package did make learning fun for the experimental group. Digital game based learning can increase learner’s motivation.

4.2 Learners’ Performance in the Control Group and the Experimental Group

A positive correlation can also be noticed between the learners’ motivation and their performance. From the test results, it is shown that only 25% of the control group participants managed to complete all test questions, and the average score was 57 out of 100. The performance of the experimental group was found to be much better: 85% of the participants managed to complete all test questions, and the average score obtained was 72 out of 100.

Fig. 1. A comparison of the test score and test complete rate between the control and experimental groups.



The data suggest that digital educational games can indeed enhance young learners' motivation. Once motivated, learners tend to be more willing to spend time in learning, make an effort in completing challenging tasks, and eventually achieve better performance.

5 Conclusion

From the survey data, participants' written feedback, and the test results collected from this small-scale case study, we can conclude that the use of digital games for supporting learning in mathematics is not only useful in enhancing young learners' academic performance, but also powerful in making challenging topics such as measures and space dimension more engaging and enjoyable. The value of play and digital game-based learning should not be overlooked.

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A comparative study of the teaching effect in a ‘flipped’ MOOC class and a traditional class

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Abstract. Mooc and "flipping" class are new model of instruction and spring up in recent two years, they also are focused by educational circles all over the world. Now, we integrate the part of teaching method in “flipping class” with Mooc teaching platform, which is called “flipped” Mooc class. we wonder if can this new class promote the quality of instruction in college physical class and enhance the ability of student. So, two Sophomore college physical classes in Tongji University are randomly chosen as research subject, one class is in traditonal way and the other is in “flipped“ Mooc method. In order to guarantee a reliable foundation in the comparative of student’s learning effect between “flipped” Mooc class and traditional class, we analysis the rationality of teaching process and the evaluation method. By means of the comparative study of student’s learning effect that is expressed by school record in “flip” Mooc class and traditional class, and having these results to be correlation analyzed, We come to a conclusion that “flipped” Mooc class enhanced teaching effect and student’s learning grader in “flipped” Mooc class is better than traditonal class in traditional class. As we all know, In the progress of teaching, some unexpected problems and troubles are always there. So,we figure out that why they would be happened, and reflect how we will do if we want to promote the quality of instruction in college physical class and enhance the ability of student by this “flipped” Mooc class.

Keywords: "flipped" Mooc class; student’s learning effect; contrastive analysis; reflection

1 Research Basics

“Flipped Classrooms” and Moocs are new teaching model, rising in the US. Then they become a popular topic rapidly in the field of international higher education and educational theory. They respectively are elected as the important educational technology what affect deeply education in the near future by NMC Horizon Report in 2014 and 2013. In our contrary, “using national advanced educational concept and educational experience to promote reform and development of our education, elevate level, influence and competitiveness of native education in the national stage.” (National education reform and development of long-term planning programs, 2010, 19) And it also points that we should try new educational form in the information educational environment, and take much more new motive into carrying on educational informationization.

2 Research Status

“Flipped Classrooms” is beginning in the Rocky mountain forest park high school, Colorado, America. In 2011 Salmankhan and his Khan Acamemy is a milestone in “Flipped Classrooms” development process, From then, (Katie Ash, 2012) says that numbers of scholar knowing “Flipped Classrooms” in the, and according to (Yang Gang, 2012), very soon it is became a focus in the world of education. (Justin G. Gardner, 2012) points out that the studies of “Flipped Classrooms” in foreign are focus on how it is work when we use “Flipped Classroom” in our the educational practice, (Jeremy F. S 2012) emphasizes the study of comparing with traditional teaching mode, and (Gerald C. C, 2008) points out that explore educational effect when we connect the “Flipped classrooms” with other educational method and educational technology. Their research takes application as a important point, they also take a couple of years to test this educational model, accumulate some experience in practice and educational process, their practices are much more better. However, there are lots of different between Chinese and American in educational concept and teaching form, so we can’t just transplant their experience into our course. For this reason, if we want to success to apply “Flipped Classrooms” into class in china, it is a necessary stage to tack this new educational model into our course, compare with traditional education, and accumulate our own educational experience.

At first, Mooc originated from open courseware program "open education resources" in MIT. Three largest platforms (coursera, edX and Future Learning) are being used in 2012, which caused Mooc be a fashion in all over the world. And then in china, there also are lots of universities starting to organize their own Mooc course, such as Molecular biology of wuhan university, Flip classroom instruction from Beijing university, preventive medicine of Fudan university, college physics of Tongji university and so on. For support to progress this course, then online educational platform set up. For example, Shanghai Jiaotong university independent development the “good university online”, Tsinghua University takes the lead to found “Online course”, both Ministry of Education and Ministry of Finance are together to support the funding-icourse platform. And some platforms are designed by company.

According to (Zhang Y. J, 2012), the study and practice of “Flipped Classroom” in china are just beginning, and still at the stage of introduce, the paper about “Flipped Classrooms” are main about theoretical analysis, discussing this new educational model, implementation strategy and teaching design about “Flipped Classroom”. There is a little comparative study of teaching effect in “Flipped Classroom” and traditional class. There is much more introduce than research, theory much more than practice. Besides that, (Wang X. D, 2013) indicated in his research that the topics are involved in discussing about educational process of primary and middle school, it is little in application in collage.

Now, we combine “Flipped Classroom” with Mooc platform. It is because that functions of Mooc platform getting more and more great, which let education progress in a more open and free educational environment. The students get in the class naturally and spontaneously. Meanwhile, the discussing segment from “Flipped Classroom” could offset the disadvantage in Mooc that face to face teaching and solving-problem in time are impossible. So, we put a “Flipped classroom” class in the

Mooc platform, what is called “flipped” Mooc class. We will check out whether this new form of class can improve the grade of student or not.

3 Research Process

Here we will present the process of this research, how we chose our research object would be present at part A. In part B, we would contrast the educational process between “flipped” Mooc class and traditional education. Reasonability of evaluation in two different educational models is described in part C. we would show the contrastive analysis of teaching achievement in the part D.

3.1 Research Object

Un-major sophomore in two collage physical classes of Tongji University are chose as research object. We divide the student into class randomly according to the entrance scores, so we can make assumption that classes are just consubstantial and have no different in essence.

3.2 Contrast of Educational Process

In order to shown different in educational process between two classes more details and clearly, we make a chart for two educational process.

phase	time	"flip" Mooc class		traditional class	
		activity of teacher	activity of student	activity of teacher	activity of student
pre-class	a week before class	upload the necessary resource	Learning teaching video and teaching material, the basic teaching task and teaching requirements	Prepare the teaching content, teaching materials	Preview basic knowledge of educational contents
in-class	the first class	construe positively teaching contents, emphasis and difficulty	According to the teacher knowledge, to complete the teaching video, complete the online test and assessment	To complete the first part of contents	Complete the study mission, and homework after class
	the second class	According to the student'sfeedback in the process of online class and organize students to discuss the problem	Group discussion, reflect the problem in the online course to the teacher and solve them, actively help group members to solve problems	Through the interpretation of the second part'contents, and to solve the problems about lesson in the process of class	Reflect the problems in the first lesson to the teacher, complete learning tasks in this course
	the third class	Supplementary explanation, unriddling and homework	Correct the mistake in the discussing and before class, submit the network operation	Complete the course, summed up knowledge, and arrange homework	finish homework
after-class	a week after class	Online support	Students communicate with each other online about homework question after class	null	consolidate knowledge
platform		Network teaching platform, will be required for release study guides, learning resources and teaching video, online testing and test results of the real-time statistics, feedback		null	

Fig 1. The contrast of educational process between “flipped” Mooc class and traditional class.

We can see the educational process of “Flipped Classroom” in many papers, but there is very little different between them, and they don’t have any disparity in essence. Some educational stage is essential, that is “pre-learning content → discussing in the class→ teacher’s guiding and solving-problem→ summarize”. Which is different from educational process in traditional class, “prepare lessons before class→ teacher’s explain in class → exercise after class”. As present in figure 1, we use the educational process in “Flipped Classroom” in “flipped” Mooc class, but the different is almost 2/3 of the educational process taking place in Mooc platform. Before class, teachers upload the necessary resource into the platform. Students just learn the resource provided by teacher, and accomplish the test. In class, the major missions of teacher are organizing the discussion for student, supplementing explain misunderstanding-question and missing knowledge, assigning homework, While students discuss the question that they did understand in the pre-test cooperation with their teammates, modify the misunderstanding with the help of teacher. After class, the teacher can figure the undone problem out with students online, and they also can interact with each other in the platform. In the educational process of traditional class, teacher and student’s missions just like what we do every single day. Teachers give a lecture, and students just take part in it.

3.3 Reasonability of Evaluation

Here we show the standards of evaluation in fig. 2. Standard of evaluation is the method and basis of educational effect. So it is important to ensure the contrast of teaching result between “flipped” Mooc class and traditional class is reliable, the standard of evaluation what work the teaching result must be reasonability.

standards of evaluation						
	procedure			online		exam
	homework	attendnce	course(dicuss)	Participation	online- test	
“flip” Mooc class	10%	5%	15%	15%	15%	40%
traditional class	10%	10%	10%	null		70%

Fig. 2. Standards of evaluation

As presence in the fig. 2. in “flipped” Mooc class, Final scores = procedure scores*30% + online scores *30% + exam scores * 40%: procedure scores include homework, attendance and class. Participation and online- test comprise online scores. In traditional class, Final scores = procedure scores*30% + exam scores * 70%: procedure scores also include homework, attendance and class. Traditional class don’t exist online part, so exam sores take 70% of final scores. As shown in the figure 2, in procedure scores, the proportion of total score “flipped” Mooc class is the same as the proportion of total score in traditional class. But there is a little different in “flipped” Mooc class and traditional class about attendance and class. The reason is that for the attendance about 1/3 time is used online learning, therefore disparity between “flipped” Mooc class and traditional class is reasonable. For class, there is a discussion in “flipped” Mooc class, what is more educational part in “flipped” Mooc class than traditional class. Meantime, we also can see the proportion online of scores and exam scores in “flipped” Mooc class just equaling with the proportion of exam scores in traditional class. The reasonability is that online course take 1/3 time of total times besides, every single section have test. The data of test will be collected for a process evaluation and a supplement of the exam.

3.4 Contrastive analysis of Teaching Achievement

Examination paper used in two classes is the same paper, and no students know the details in the paper before exam. So this exam is reliable. We respectively analyse procedure scores, online scores, exam scores and final scores in two classes. All the data is disposed by SPSS and Excel.

In this section, we present the scores in fig. 3. and the scores of traditional class. Then we analyze difference between two classes in different item. In fig.5. we show the grade distribution statistics. T-test correlation analysis will be presented in fig. 6.

"fliped" Mooc class						
	highest score	lowest score	aveage score	population variance	sample variance	standard deviation
exam scores	94	35	71.75	191.53	193.66	13.91
final scores	94	29.8	79.59	139.29	140.83	11.86
online scores	100	33	79.4	353.04	357.01	19.01
procedure scores	97	9	86.7	142	143.4	14.9

Fig. 3. The score table of “flipped” Mooc class

Traditional Class						
	highest score	lowest score	aveage score	population variance	sample variance	standard deviation
exam scores	97	0	67.73	351.73	354.02	18.75
final scores	96.1	9.3	73.8	244.23	245.81	15.62
procedure scores	100	23	88	208.3	209.7	14.43

Fig. 4. The score table of traditional class

We respectively make analysis in highest score, lowest score, mean score and variance of exam scores and final scores between “flipped” Mooc class and traditional class. As figure 3 and 4 shown, the higher score of both exam scores and final scores in “flipped” Mooc class are 94, 3 and 2.1 better than the highest score exam scores and final scores in traditional class. The lowest score of exam scores 35 and the final scores 29.3 in “flipped” Mooc class, is much higher than the lowest score exam scores 0 and final scores 9.3 in traditional class. The mean score of exam scores in “flipped” Mooc class is 71.5 what is 4.02 higher than the mean score of exam scores in traditional class 67.73. As in front, the average score of final scores in “flipped” Mooc class is 79.59 what is 5.79 higher than the average score of exam scores in traditional class 73.8. in the figure 3 and 4, we can find out that variance in traditional class is higher than variance in “flipped” Mooc class. That is to say grade in traditional class are much more scatter.

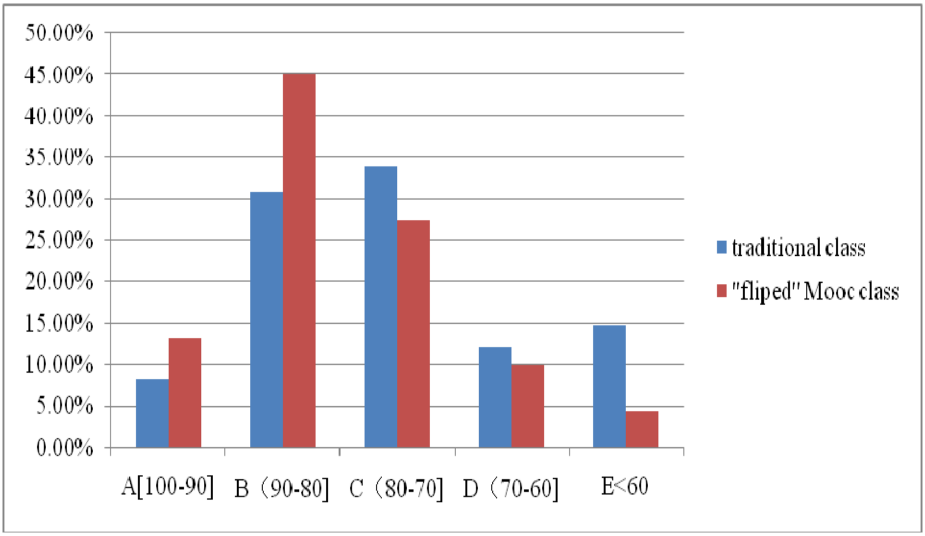

Fig. 5. The grade distribution statistics

We divide the student’s scores into five stages: A [100～90], B (90～80], C (80～70], D (70～60], E (60～0]. From the figure 5, we can figure out the percentage of five stages in “flipped” Mooc class respectively is 13.18％、45.76％、27.47％、9.89％、4.39％. In the traditional class, the proportion respectively is 8.33％、30.76％、33.97％、12.18％、14.74％. There is a 4.85％ higher in “flipped” Mooc class than in the traditional class at stage A. At stage B, the percentage in “flipped” Mooc class 15% much higher than the percentage in traditional class. The proportion of “flipped” Mooc class is 6.5% lower than the proportion in traditional class at stage C. At level D, there is a 2.29％ lower in “flipped” Mooc class than in the traditional class. Finally, the percentage in “flipped” Mooc class 10.35% much lower than the percentage in traditional class. So we can say, in the higher level, the educational effect in “flipped” Mooc class is much better than in traditional class.

	T double tail critical	P (T < = T) double tail	F single tail critical	P (F < = F) single tail
exam scores	1.97	0.046	1.816	0.0011
procedure scores	1.97	0.575	0.991	0.474
final scres	1.97	0.001	1.734	0.002

Fig. 6. T-test correlation analysis

We respectively make a correlation analysis for the exam scores, procedure scores, and final score. For exam scores, using analysis of variance methods do the significance test of homogeneity of variance analysis in two classes. F=1.816, p=0.0011, so analysis of variance has the homogeneity. After bilateral T test, t=1.97, p=0.046<0.05, difference is significance. Average exam score in “flipped” Mooc class is 71.75. Average exam score in traditional class is 67.73. Therefore, Average exam score in “flipped” Mooc class is much better than average exam scores in traditional class. For procedure scores, using analysis of variance methods do the significance test of homogeneity of variance analysis in two classes. F=0.991， p=0.474, so analysis of variance has the homogeneity. After bilateral T test, t=1.97， p=0.575 > 0.05, difference is not significance. Average procedure score in “flipped” Mooc class is 86.7. Average procedure score in traditional class is 88. So, average procedure scores in “flipped” Mooc class is little better than average procedure scores in traditional class. For final scores, using analysis of variance methods do the significance test of homogeneity of variance analysis in two classes. F=1.734， p=0.002, so analysis of variance has the homogeneity. After bilateral T test, t=1.97， p=0.001<0.05, difference is significance. Average final scores in “flipped” Mooc class is79.59. Average final score in traditional class is 73.80. That all can say average final scores in “flipped” Mooc class is much higher than average final scores in traditional class.

3 Conclusion and Reflection

In conclusion, average exam scores in “flipped” Mooc class is better than average exam scores in traditional class, after the t- test, There is significant difference between them. So does average final scores. On the contrary, here is not a significant difference in procedure scores. So, we say that comparing with traditional class, educational effect in “flipped” Mooc class is better. Two reasons are here, first one is student’s interest and learning involvement been acc. The other one is online course maybe extend the learning time.

There are 106 students in “flipped” Mooc class. Removing the student who not register online course, there are 91 students in “flipped” Mooc class actually, 85% of total. There are 163 students at beginning, except no-attendance students, there are 156 students in traditional class, 93.41% of total. Comparing with in traditional class, students in “flipped” Mooc class is more easily running off. There are a couple of possible reasons. First, some students resist new educational method and don't want to resign online course. Second, introduce of "flipped" Mooc is not clear so that part of students misunderstand with "flipped" Mooc process. Last one reason is that technology-problem in Mooc platform result in unregister.

In "flipped" Mooc class, not just knowledge but cooperation ability, self-management ability, communicational ability and organizing ability are learned by student. So, as far as I'm concerned, "flipped" mooc class will have a perfect prospect.

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Education for empowerment: The Arab Open University and Arab society

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Abstract:
Open universities in the Arab region are modern and technologically advanced centers of learning, rooted in solid educational and cultural foundations, allowing such institutions to play a pivotal role in the development of Arab societies by equipping their students with advanced education. The mission of the Arab Open University is to deliver up- to- date education, enrich human knowledge and accelerate the social and economic transformations of our society through the academic studies offered and the training of highly specialized personnel in basic and applied fields. Being the first in the Arab world to adopt open learning, the AOU aims at promoting an open system of higher education that provides opportunities for professional development and lifelong learning. It commits itself to supplying students with quality education, providing higher education to the widest possible spectrum of learners and furnishing society with leaders who can help promote the cultural, educational, and social aspects of life. AOU emphasizes independent learning, thus encouraging students to rely on themselves and sharpen their skills. This paper will focus on the educational strategies of AOU and its role in society, including solving the problem of educating large numbers of students by adopting open learning methods that save resources, cost, and time.

Arab Open University
Educational Strategies
Open Learning

1. Introduction

Open Learning is now a familiar terminology on the universities worldwide and is viewed by many not only as a revolution in increasing the access to higher education, but as reforming it (wright, D., D. DiBiase, C. Pancke, R.wright, K, Foote, 2002).

NCES defines open learning as "education or training courses delivered to remote (off-campus) location(s) via audio, video (live or pre-recorded), or computer technologies, including both synchronous and asynchronous instruction" ((NCES), 2002). By definition, then, open learning is a set of transactions among students and instructors who are located in different places - an arrangement that should be of special interest to geographers. Open education may also differ from traditional education by being asynchronous, where students and instructors are performing their roles at different times. Distance learners may work as individuals or in cohorts. Instructors may or may not be available for consultation ((NCES), 2002)(Slater, Pearson, Warren, and Forbes, 2015).

Educators are not of one mind about open learning. Some support the potential to expand access to higher education while others welcome the opportunity to enrich education for both on- and off-campus students by leveraging computers and networks to create a new, more active more student-centered pedagogy (wright, D., D. DiBiase, C. Pancke, R.wright, K, Foote, 2002), (Gil-Jaurena, 2013).

e-Learning in education has become a popular term. Anderson in 2005 pointed out that searching for the term e-Learning in the web would result in more than three million sites (Anderson, 2005). e-Learning has been defined in many different ways in the literature. The most common definition pointed out that e-learning in education is a technique to enhance learning and teaching experiences and used to educate students via various types of digital media (Christie M, Ferdos F, 2004) and can utilize many ICT information and communication technologies (Laurillard, 2004). Recently the educational institutes are concentrating on the online context of e-learning by using the Internet and the Learning Management Systems; LMS; to enhance education (Arabasz P, 2003) (Suman Ninoriya, P.M.Chawan, B.B.Meshram, 2011).

2. The Arab Open University

Arab Open University (AOU) is a non-profit, private pan- Arab university founded in 2002. The university occupies several campuses located across the Middle East, including Kuwait, Jordan, and Lebanon. In 2003 campuses were opened in Bahrain, Saudi Arabia, Egypt, and Oman. The latest campus was opened in Sudan in 2013 (Arab Open University), (Al-Sadi, 2012).

The university adopts the concept of blended learning whereby the traditional classroom face-to-face lecturing is blended with modern techniques of e-learning that maintain direct and constant contacts with students via Learning Management System (LMS), Student Information System (SIS), videoconferencing, multimedia and computing laboratories (Al-Sadi, 2012), (Abdin M. Sharif, Omer H. Ismail, 2010).

The university is accredited locally and internationally. It provides a rigorous curriculum with programs in English Language and Literature, Business Administration, and Information Technology and Computing; all licensed from the

UK Open University and taught in English (Slater, Pearson, Warren, and Forbes, 2015).

A joint degree from both universities is awarded to the student upon graduation. Another program in Education is offered in Arabic. Plans are now underway to expand vertically and horizontally, with new programs at the Master's level started in 2012 (Arab Open University).

The AOU aims to establish itself as a leading institute of open learning, offering opportunities for independent learning and creating a forum of lifelong learning. The AOU intends to promote human resources development that is compatible with the demands and challenges of current and emerging information technology platforms and international socio-economic developments. In particular, the AOU hopes to achieve a number of objectives and goals, including (Arab Open University):

- Offering opportunities of higher education to a large population of qualified students.
- Providing a forum of continuing education in various disciplines of knowledge.
- Providing opportunities for professional training in response to market demands.
- Providing special opportunities in education to particular segments of society, including females and those residing in remote areas.
- Participating, as a contributing partner, in promoting research and scholarly activities deemed useful in development areas of special concern to Arab society.
- Promoting humanistic and Islamic values and ethics.

As an institution of open learning, the AOU makes a solemn commitment to provide its prospective students with quality programs of study. Furthermore, it will endeavor to create a supportive environment of learning that aims at integrating students as proactive partners in the development and making of the institution.
The AOU welcomes prospective students as they explore their study opportunities with the university, and pledges to strive to serve as a gateway to further opportunities in their future careers. The Mission of AOU can be summarized in the following points:

- Adopt an open system of learning to serve local and regional communities with opportunities of higher education.
- Provide professional development and life-long learning opportunities in light of the highest standards of excellence.
- Foster an environment of intellectual development and pursuit of research dedicated to the service of the Arab and human societies.
- Offering quality distance education.
- Democratization of education in the Arab world.
- Enabling Arab citizens, irrespective of their age, gender, income, geographic location and employment to gain access to higher education.

- Training of students for the labour market.
- Playing a key role in the development of human resources in all fields needed by the labour market.
- Allowing the exposure to and use of modern technology and innovative learning environments.
- Upgrading the skills of many thousands of students and teachers in the Arab world.

The Partner: The Arab Open University's (AOU) headquarters are in Kuwait, with seven University branches in Kuwait, Lebanon, Egypt, Bahrain, Jordan, Oman and Saudi Arabia. A new branch has opened in Sudan in 2014, and it is planned that eventually all 22 Arab countries will be involved with the AOU. Young people under the age of 24 comprise more than 55% of the total Arab population, yet only 50% of high school leavers with appropriate qualifications are able to gain access to a university. A pan-Arab blended learning institution increases access for such groups. The AOU also provides a significantly increased opportunity for women to access higher education, particularly in those areas where a strict Islamic code is applied.

The Project: The Arab Open University is an approved partner institution of the UK Open University, delivering Open University undergraduate and postgraduate validated awards across eight branches in the Middle East. Students receive a local AOU award in addition to the OU validated award. The AOU also licenses Open University curriculum and contracts consultancy services to support the implementation of the curriculum and some student support services. The Open University has adapted learning materials to meet cultural and religious requirements within AOU territories. The total number of AOU graduates and students who have registered for an Open University validated award is in excess of 50,000. It is expected to expand the services and the branches to cover all the Arab world and Middle East region.

The Role of AOU: The AOU plays a key role in the development of human resources in all fields needed by the job market, as well as familiarizing students with modern technologies, contributing to the building of a science and knowledge society in the Arab countries. The AOU teacher training program aims to upgrade the skills of thousands of teachers in the Arab world.
As a matter of fact, Arab Open University seeks to contribute effectively and efficiently to a continuous and comprehensive Arab development by adopting flexible educational and learning methodologies.

3. The Philosophy of e-Learning

The philosophy of e-learning revolves around the idea of tutored-independent learning and the "supported e-learning" style. e- Learning is a flexible system that combines both traditional teaching methodologies and studying through e-Learning (including electronic online systems) which encompasses learning from written texts, classroom discussions, tutorials, talks, lectures, and audio and video posting. It has been noticed that students have become more experienced academically and in terms of their communication skills. The AOU has adopted the idea of group discussions and project work in a learning environment with a maximum student- tutor ratio of 25:1. E-Learning offers the learner flexible learning opportunities that suit his/her own goals of career building. The learner can work in his/her own time by reading course material; watching supporting materials on DVDs or CDs, reading from related websites and e-library, and working on course activities and completing assignments that help him/her consolidate what he/she has learned. The university utilizes multifaceted support resources that attempt to create an environment that is conducive to learning in a way that would integrate learners to be productive. The textbooks are accompanied by supplementary study materials, study guides, workbooks, CDs, DVDs, specimen examination papers, and on-line (internet-based) websites especially designed for distance learning; Learning Management Systems. The e-learning platform relies heavily on the tutoring process that aims at promoting faculty-student interaction. Students gain support from tutors, from the student services personnel as well as from online support such as the digital library and the internet. Tutorials are a required component to pass any course. Furthermore, face to face lectures provide students with a chance to meet their tutors who are experts in their fields and some other fellow students who are encouraged to be involved in dialogues, exchanging ideas and brainstorming. Tutorial support can be obtained via the following:

- Correspondence tuition: the tutor marks the course assignments and gives written feedback. This will definitely further the students' knowledge and develop their learning skills.
- Arranging tutorial support for a small group of students which may be face to face, online or by phone depending on the course type and the students' circumstances.
- Individual assistance by writing instant message via the LMS or by email.
- Microteaching: in which a small group of students meet with their tutors at their convenience to discuss ideas related to the course.

The courses are scheduled: each course operates in accordance with a time table which students receive in the "Course Plan" at the beginning of each semester. The Course Plan includes the plan activities for each week of the course, the deadline for submitting the assignment to the tutor and the dates for the exams. It is a good idea that students prepare ahead of their schedule if they plan to go on a holiday rather than trying to catch up when they return. If a student falls behind, he/she should contact his/her tutor who will help him/her decide how he/she could best plan his/her work to compensate for the lost time. The LMS is usually the main model to communicate with students (Nor Azura Adzharuddin, Lee Hwei Ling, 2013). The teaching methodologies are learning- and- learner centred. They provide independence for the learner and promote independent thinking. Some lectures are computer-based: prepared on CDs/DVDs or online. All the printed materials belong to the students who can use them in a way that suits them best. In addition to the Mid-Term Exam (MTA); and the Tutor Marked Assignment (TMA); students are expected to take final written or on-line examinations at the end of each academic semester. Students can also exploit the continuous online interaction with their instructors.

Students who have recently finished high school or who have taken a community college degree can join AOU. Studies conducted by university staff and specialists have shown that the majority of the students are interested in pursuing their undergraduate and graduate studies while they are working. Moreover, there are many degree holders who are interested in furthering their education in their fields of study or in corresponding fields. The problem resides in the fact that they cannot join the traditional universities for many reasons such as:

- High university tuition.
- Difficulties they encounter when they study while working to support themselves and their families.
- Women who have children and home to take care of, and willing to continue their education.
- Relatively high costs of education fees at other traditional universities.

To overcome these and other problems, the AOU is established to facilitate new opportunities for such students.

4. The Strategy Fundamentals of the Arab Open University

AOU adopts strategic planning which aims at developing all aspects of university activities as well as monitoring field implementation through operational plans. The essential intended goals behind designing this strategy aim at enabling the AOU to realise its strategic objectives in various fields (academic, administrative, financial, technical, quality, openness, and communication with its surrounding environment as well as community service) (Al-Nahas, 2004).

These goals are detailed below and their implementation requires defining the executive procedures, mustering University's human, technical, and financial resources as well as setting the time framework required for implementation, and adopting monitored and measurable performance indicators, as far as possible. The following goals represent the AOU strategy:

1. Increase the number of enrolled students at AOU to 50,000 at least by 2017, pursuant to objective indicators and factors (such as buildings capacity, conditions of Ministries of Higher Education) in countries where AOU operates its branches.
2. Recruitment of highly qualified faculty members in teaching, academic research and community service.
3. Academic curricula are subject to objective evaluation with warranted sustainability and local, regional and international accreditation.
4. To expand the preparation and production of academic material and to reduce the dependence on external sources.
5. To continuously update applicable learning and teaching systems at the university and to develop and diversify them so as to become accessible to all those who are interested in lifelong learning.
6. To improve the competencies of faculty members in the skills of independent learning, open learning, scientific research methodology and teaching methods and to motivate them to contribute to scientific research, continuing education and community service.

7. To focus on scientific research in domains of interest to the university, the job markets in the Arab countries and the institutions and scientific centers that will collaborate with the university.
8. To design and offer continuing education and community service programs in the Arab world especially in the countries where AOU branches operate on the basis of market needs studies.
9. To provide a suitable university environment and to improve the services offered to students in order to support their scientific and cultural achievement and to polish their skills and personalities.
10. To enhance the communication with alumni and to reinforce their role in the development of the university.
11. To provide administrative and financial services of an international caliber supporting the educational process, research activities and community service.
12. To develop the skills of administrative personnel at the university in technical and administrative areas, to improve their competencies and performance and to enable them to provide high quality services.
13. To complete the infrastructure of Information Technology at headquarters and all university branches so as to enable bridging the digital gap and using the information technology systems and programs in all university activities, and tracking the technological development especially as applied learning and teaching practices.
14. To commit to the highest international and local quality standards in all university activities and output.
15. To elevate media and cultural work at the level of university headquarters and branches to disseminate the university mission.
16. To look for diverse external sources to fund the university's various activities (scientific research – continuing education and community service – training and development).
17. To enhance the partnership and the means of collaboration with the Arab Gulf Program for Development (AGFUND) and other local and regional - governmental and private - centers and institutions that support open education, scientific research, development and community service in all Arab countries, particularly in countries where there are or will be university branches.
18. To develop the partnership between the Arab Open University and various international universities and institutions in various areas especially in scientific research, academic programs development, training and community service.

5. Optimizing Cost and Educate Large Number of Students

One advantage of open learning is its potential to teach large numbers of people. While traditional education methods are limited by physical constraints, such as the size of any given lecture hall, the virtual world has no such limits. A huge number of people can view the LMS, and online content and video lectures at any time and from anywhere. AOU is an example university that copes with increased student numbers and rising real estate prices, thus presenting an attractive solution. AOU takes into its consideration that physical resources are limited while digital resources are limitless. AOU prepares its staff to teach and to add value to content. The same applies to online courses. Most staff will find that their skills are required just as much, if not more, when they move online (Weller, 2004).

One of the motivating factors for AOU is to drive the development of e-learning initiatives to get benefit of the attractive potential cost for the long run. As we have discussed above, the increased student-to-tutor ratios, is not as easily realized as many may think (Jacqueline Bichsel, 2013). The cost benefits of creating large population courses are not as great as once imagined. The initial production cost of e-learning courses is high, but then the other logistic cost is low. However, once an online course is prepared, it is relatively cheap to when we re-offer the course for many times and for a large number of students, so the costs do not increase greatly with the number of students. Such high fixed costs require a number of students to reach a break-even point and are well suited to large population courses which run for several presentations (Weller, 2004).

6. Conclusion

In this paper we have presented an overview on Arab Open University as the first Open University in the region. The mission of the Arab Open University aims to enrich human knowledge and accelerate the social and economic transformations of our society through the academic studies offered by AOU and the training of highly specialized personnel in basic and applied fields. Furthermore, we presented the aims of AOU to promote an open system of higher education that provides opportunities for professional development and lifelong learning. AOU emphasizes independent learning, thus encouraging students to rely on themselves and sharpen their skills. This paper focused on the educational strategies of AOU and its role in society, as well as introducing strategic goals of the university including solving the problem of educating large numbers of students by adopting open learning methods that save resources, cost, and time.

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Towards a generic education pattern of software design courses: An empirical study

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Abstract. Software design plays an important role in software development process, which make it a fundamental and a mandatory topic in software engineering education. However, the diversity of design concerns and the wide range of activities involved with deign process bring great challenges to deliver software design topic effectively, especially when students have diverse culture and education background. To enhance the learning process beyond the classroom environment, we utilized a number of online open resources in our software design course for international students, including open source modeling tools, trial products, emerging research prototypes, various research papers in digital libraries and so on. Students are required to do intensive practices by using suggested open materials. Positive feedbacks have been received on stimulating students' interest.

To find a more generic education pattern using open resources for software design education, we conducted an empirical study based on the data collected during course delivery process. Students' class performance, assignment quality, assignment submission time, and education background have been analyzed with a data model to explore the potential correlations, and the results are visualized to discover learning patterns. In this study, we found that (1) students show interests in open materials related to their daily life such as requirement modeling for online role-play games; (2) students with various professional backgrounds differs in their study quality reflected in assignments performance; (3) scenario-based modeling practice can help students understand knowledge more quickly and easily. The results indicate the key factors towards an open and generic education pattern of software design courses. It also expected to be used on better software design course planning.

Keywords: Software Engineering Education, Software Modeling and Design, Learning by Doing, Empirical Study

1 Introduction

Software design is the process by which an agent creates a specification of a software artifact, intended to accomplish goals, using a set of primitive components and subject to constraints. (George Mangalaraj, Sridhar Nerur, RadhaKanta Mahapatra et al., 2014) It determines the quality of the software system to satisfy a variety of requirements, such as interoperability, security, and usability. Therefore, software design holds an important position among the courses of software engineering. However, there are so many aspects (e.g. compatibility, extensibility, security, and scalability) to consider in the process of designing a piece of software, what's more, large number of complicated activities are also involved in. (Baker, Alex, van der Hoek, Alex, Ossher, Harold et al., 2012) All these make it a great difficult to instill in the students a deep understanding for software design, especially when students have diverse culture and education background.

We set out to execute an exploratory study in order to investigate how to stimulate students' interest, which aspects attract their more attention, and what key factors impact on learning process. Students from the software design course have been chosen to be participants, whose weekly assignments were reviewed by the researcher. Statistical analysis of data collected from 85 students reveals the potential correlations between learning quality and culture and education background, which provide guidance on how to hence the learning process beyond the classroom environment and better software design course plan.

The purpose of this paper is to provide a generic education pattern for software design courses. We conduct an empirical study to explore key factors towards an open and flexible education pattern. In the next sections we describe our research process, its execution, results and conclusion. This is followed by our discussion on implications for research and practice and our evaluation of validity threats.

2 The Empirical Study Research Plan

2.1 Research Goal and Research questions

To understand how the teaching process happens and what influences it, we set out to answer the following research questions (RQ):

RQ1: What aspects stimulate students' interests?

RQ2: What aspects students can't understand well?

RQ3: Whether there is any relationship between quality and the culture and education background?

This research design followed Given, Lisa M. (2008) guidelines for systematic empirical investigation. As suggested, a quantitative research is a particularly suitable research method to situations in which (1) researchers are primarily interested to compare data or statistics systematically and test theories; (2) the results can typically be generalized about an entire population to predict or further examine cause and effect relationships. Drawing upon this, we expected the quantitative research method would make us earn a rich and contextualized understanding of key factors influence quality of software design course teaching behind the data collected, and the ways to makes the teaching process better.

2.2 Open educational resources utilization

We design a research process participating with 85 students from the same software design course. The course aims at teaching students (1) what modeling techniques exist, when we should use them, and what their limitations are; (2) how to construct models for a software system; (3) discuss emerging trends, challenges and innovations in software modeling and analysis. To enhance the learning process beyond the classroom environment, the professor utilized a number of online open educational resources in our software design course, especially for international students. Students are requested to submit weekly assignments in time. There are 3 individual assignments and 3 group assignments in all, which are designed to help students skillfully use open educational resources. Using open source modeling tools such as EA, Understand, and so on is helpful for students to have a better overall understand for this course.

Individual assignments are mainly reading assignments, students are required to read the research paper and related references, create a mind map to illustrate their understanding on the structure and key concepts of the paper, and write a summary about the paper, including (1) what this paper is about; (2) what aspects they like or dislike; (3) how to improve this paper. The individual helps students be familiar with seeking various research papers in digital libraries and so on.

Group assignments ask five students in one group to finish the system model task together. Professor will offer modeling assignment or tools demonstration task at the end of selected lectures. The group assignments aims at teach students use open source modeling tools, trial products, emerging research prototypes and so on.

2.3 The Empirical Research Process

Our study in this paper was carried out following the research protocol showed in the Unified Modeling Language (UML is a general-purpose modeling language in the field of software engineering, pointed out by Palash Bera, Joerg Evermann, 2014) activity diagram in Fig. 1. The following sections describe each activity of such protocol.

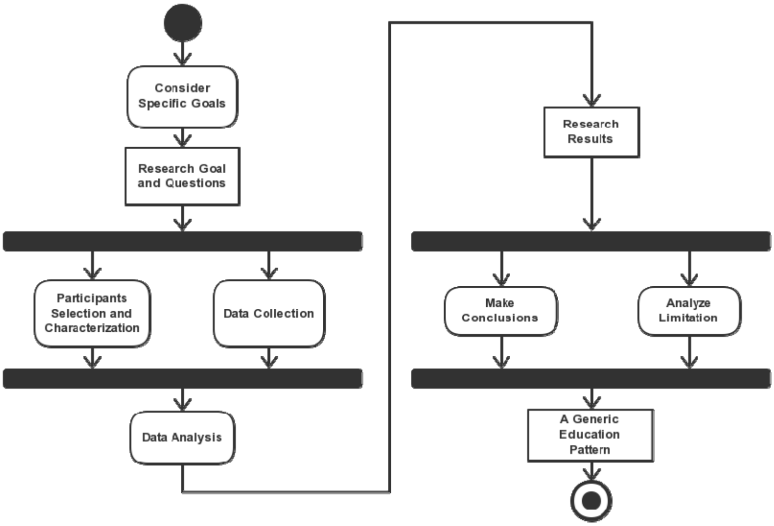

Fig. 1. Activities in our research protocol

Participants Selection and Characterization.

All the participants come from students of the course of software design, table 1 summarizes and characterizes information about participating students, such as their diverse education background and culture.

Table 1. Students' classification

Classification	Culture background	Education background
Target Group I	International	Computer science or software engineering
Target Group II	Chinese	Computer science or software engineering
Target Group III	Chinese	Other majors

Data Collection.

The systematic empirical investigation is based on the data collected during course delivery process. We collect detailed information related to the students and course in order to gain a model to analyze and explore the potential correlations.

The students' basic education background and culture listed in Table. 1 were collected as foundation data.

Weekly assignments were collected and reviewed by the researchers, and scored 10-point scale. Usually, the students' score was between 6 and 10. 6 and 7 mean the assignments are unsatisfactory and full of mistakes; 8 and 9 mean the assignments are satisfactory although there are a little mistakes, and 10 means the assignments are completed perfectly with almost few mistakes. All this scores were collected as the representation of student study quality of the course.

Each assignment submission time was also recorded as representation of the students' activeness for this course. The more early students submit assignment, the more passion the students have. We consider this type of students have enthusiasm, put a lot of energy to it, and finish it well. Thinking the situation of students are busy, all the in time homework is seen perfect, but there is although person late to this, which will be seen doesn't have positivity. Each assignment's detailed information was given in Table 2.

Table 2. Students' Assignments

Assignments	Classification	Detailed requirements
Assignment 1	Individual	Requirements Modeling for Online Games
Assignment 2	Group	Business Process Model
Assignment 3	Individual	Design Patterns
Assignment 4	Group	Design Model
Assignment 5	Group	UML profile (I-Ching Hsu, 2012)
Assignment 6	Individual	Evaluating a REST Architecture
Assignment 7	Group	ADL model (Ihn-Han Bae, 2014)

Data Analysis.

All the data collected in former section is quantitative data that is in numerical form, which will be hoped to yield an unbiased result that can be generalized to some larger population.

Researchers develop and employ mathematical models to analyze data systematically, explore the potential correlations via statistical, mathematical or computational techniques. The results are visualized to discover learning patterns, and be shown in the form of charts.

All the assignments are reviewed by the researcher and scored weekly, the scores are on behalf of the quality of studying and understanding of this course. The students' average scores of each assignment displayed in learning quality line chart to make a comparison among different types of students.

Each student's assignments submission subtracted with numeric value of deadline is recorded to the model, for example -1 means students submit one day before assignment deadline. The average submission time is displayed in passion line chart.

3 Results

This section puts our findings in the research presented in section 2 and 3, including (1) learning quality line chart analysis; (2) passion line char analysis. We used inductive reasoning in the discussing of research questions, and making a conclusion to the results.

3.1 Learning Quality Line Chart Analysis

The learning quality line chart given in Fig. 2 reveals students' learning quality for various assignments. As is illustrated in the chart, (1) students gain a higher score in assignments 2 compared with others; (2) target group I and II got much more points than target group III; (3) students did better in group assignments rather than individual assignments.

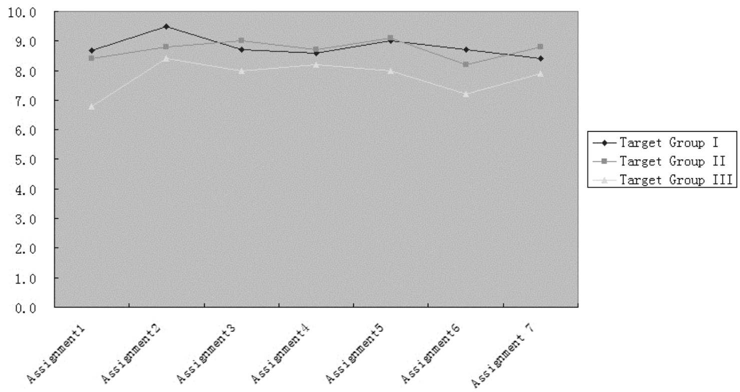

Fig. 2. Learning Quality Line Chart

We can find the results that, (1) students show interests in open materials related to their daily life such as business process modeling for smart home system, and do it more carefully and serious; (2) students with various professional backgrounds differs in their study quality reflected in assignments performances; (3) scenario-based modeling practice can help students understand knowledge more quickly and easily.

3.2 Passion Line Chart Analysis

The passion line chart shown in Fig. 3 indicates students' enthusiasm for various assignments. It can be seen from the chart that, (1) submission time of assignment 1, 3 and 6 are greatly early than other assignments; (2) average submission time of target group I and II is highly early than target group III; (3) individual assignment is finished early than group assignment.

According to the chart, we can inductively conclude that, (1) students show interests in open materials related to their daily life such as requirement modeling for online role-play games; (2) students with various professional backgrounds also differs in their assignments submission time, non-software engineering majors may find it confused to complete assignments; (3) students feel difficulty to finish scenario-based modeling practice rather than individual reading practice.

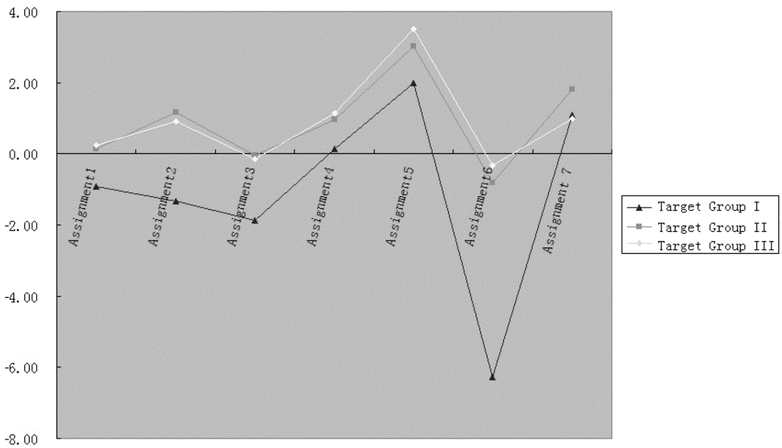

Fig. 3. Passion Line Chart

4 Conclusions and Limitations

This empirical study explicates what key factors influence students learning quality and how to enhance teaching process. We come to the conclusion inductively based on the results given in section 3, and provide guidance as followings: (1) Professor should stimulate students' interest, provide practice related to their daily life such games and coding; (2) Education not only happens in class, it is expected anywhere and anytime. Teaching the students how to use open educational resources outside classroom is of vital importance; (3) Students with various professional backgrounds differs in the understanding of the course, non-software engineering students may find it too abstract to understand concepts of software designing. Teaching students according to their aptitude, provide these students some practical exercises to gain related experience will improve the quality of this course; (4) Scenario-based modeling practice can help students understand knowledge more quickly and easily. Learning by doing will help the students get the skill soon. Paying attention to laboratory and practical exercise is essential and necessary; (5) Comparing with Chinese students, native English-speaking students usually have deeper understanding of the reading materials. Professor could offer more related papers to students who interested in, and train the students familiar with major vocabularies.

The research protocol proposed in this paper has a limitation related to the validation of hypotheses. So future work should include validation activities in the protocol. Furthermore, it is important to increase the number of students and assignments to make this research more believable. This research chooses quantitative methods to gather evidence for our study. We also intend to focus on mining the deep meanings of in-depth interviews, designing open-ended questions to increase understanding of the education pattern. Qualitative methods are expected to be combined with quantitative method applied to this research.

Acknowledgement

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Employing open educational resources (OER) to facilitate sustainable online 'communities of practice' for vocational education and training (VET)

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Abstract. Although the concept of Open Educational Resources (OER) has gradually being accepted by higher education institutions after the Paris OER Declaration (UNESCO, 2012), the attempt is relatively new to the Vocational Education and Training (VET) sector. Traditional education focuses on the contemplation of academic concepts, conversely, VET emphasises mastery of hands-on skills and "the teaching content of higher vocational education is much more complex and cannot be completely resolved by the general theories contained in general pedagogy" (Pan, 2007, p.16). Unlike most of the OER developed by higher education institutions, VET's OER requires a large amount of demonstrations, practices and interactivities for its specific needs. Furthermore, 'situated activity' is an important characteristic of VET, implying that learning takes place through participation in 'communities of practice' that are formed by groups of trade-specific practitioners and experts (Wenger 1991; Mullin, 2013). Learning is a social process in which learners participate in the lived-in world where authentic, trade-specific and generic competences such as communication, team-work, problem solving and transferability happen (Rauner & Maclean, 2008; Merrienboer, 2001; Bank, 2013; Avis, 2014). For the above reasons, VET depends heavily on workshop practices and industrial attachment rather than the use of lectures, literature review, tutorials and hence, the development of trade-specific OER remains a challenge. Articulating the concept of OER, this paper proposes an interactive self-sustainable online platform 'communities of practice' to accommodate the specific needs in developing OER for VET. The suggested platform aims to accompany the trade-specific OER with effective means of e-learning and technologies to enable VET's learners, teachers and mentors to co-develop, to share learning and teaching materials and practices. This study revealed there is a need to consider the instructional, practicable and technological aspects in developing OER for VET. In addition, the willingness to share out of trade-specific contents amongst stakeholders is another hurdle.

Keywords: Open Educational Resources (OER), communities of practice, self-sustainable online platform, Vocational Education and Training (VET)

1 Introduction

Although Open Educational Resources (OER) has gradually being accepted by higher education institutions, the participation of Vocational Education and Training (VET) institutions in OER is minimal. A study by Murphy (2013) conducted with 83 world-wide education institutions revealed that universities formed the biggest group of participants (64%, *n*=68) in the development of OER. There are only ten (9%, *n*=10) VET institutions that actively engaged in the development of OER. The issue is quite understandable. Traditional education focuses on the contemplation of academic concepts, conversely, VET emphasises mastery of hands-on skills and "the teaching content of higher vocational education is much more complex and cannot be completely resolved by the general theories contained in general pedagogy" (Pan, 2007, p.16). Unlike most of the OER developed by higher education institutions, VET's OER requires a large amount of demonstrations, practices and interactivities for its specific needs. Instead of having open courseware in the formats of Web-pages, PPTs, PDF files or other e-published materials, VET courseware requires a lot of videos, animations, interactive tools and instructional design to enable leaners to have a better understanding of the process and procedures of trade-specific skills. Because of the above, the investment in developing OER for VET is much higher than those in universities. The development of OER for VET on a large scale seems not to be possible without a strong support from governments. In the conference OERde, Berlin, 2014 held by UNESCO' International Centre for Technical and Vocational Education and Training, Ehlers (2014) expressed his view that more attention should be given on OER for VET because there is a high demand for "free" learning materials and curricular, but the question is, who is responsible for the development and promotion of VET's OER? Would it be individuals, institutions or governments? As early as 2000, with an aim to cope with the flexible learning and uphold the quality of Australia's VET learning and teaching materials, the government of Australia initiated The Flexible Learning Toolbox Project, a component of the Australian Flexible Learning Framework for National Vocational Education and Training System 2000-2004 (AFL Framework) (Australian Flexible Learning Framework, 2001). The Toolbox is a collection of web-based resources with suggested learning and teaching strategies and sets of generic customisable courseware for course providers to adapt and reuse (Oliver, 2001). In Cambodia, a platform TVET Academy providing instructional for online or offline materials use was a result and training project in Cambodia that was implemented by the NGO connected Schools (UNEVOC, 2015). Hong Kong, with her vocational education and training originated back in the 1970s and the establishment of the Vocational Training Council (VTC) in 1982 to provide award bearing programmes ranged from Diploma to Higher Diploma to Bachelor Degree in Vocational Studies, has become the single largest VET provider in the Greater China Region. Together with the other VET providers in Hong Kong, there are over 60,000 full-time learners. With the increasingly acceptances on VET's OER in Australia and other countries, surprisingly, Hong Kong's VET providers still have not put efforts in developing OER for VET to share innovative pedagogical practices and trade-specific examples of VET across institutions and industries. To uphold and standardise the quality of learning and teaching materials, it is desirable that a series of common VET modules' teaching and learning packages (TLP) be developed using the tools in the format of technology enhanced pedagogical practices, and be made available on an open platform for illustration of the pedagogy with examples as well as resources sharing among Hong Kong VET's stakeholders.

In view of the above, this paper proposes an interactive self-sustainable online 'communities of practice' platform to accommodate the specific needs in developing OER for VET with an aim to accompany the trade-specific OER with effective means of e-learning and technologies to enable VET's learners, teachers and workplace mentors to co-develop, to share and exchange learning and teaching materials and teaching practices.

2 Learning and Teaching in VET

While traditional education focuses on contemplation of academic concepts, VET emphasises mastery of hands-on skills, and pursues that learners acquire more generic and higher level knowledge together with work professionalism (Mohamad, Heong et al., 2012). Naturally, for effective delivery of VET, the education pedagogy has to go beyond the use of those that are heavily emphasised in traditional schooling such as lectures, literature review, tutorials etc.. VET promotes learning by doing and "exemplifies hand, mind and body working together" (Lucas, 2014, p.7). Competency in tackling a task as opposed to comprehension of the fundamental concept behind each process constituent is the target outcome of learning; and hands-on exposure to skills in workshops, in simulated work environments, and in real workplaces must be dwelled on. For the above reasons, the VET developed in Hong Kong has heavy emphasis on workshop learning and industrial attachment. Apparently, it is asserted that applying theories into practices through a competency-based training (CBT) approach in authentic work environment is exceptionally important in VET (Jiang, 2014). Rauner and Maclean (2008) asserted that "vocational education and training is characterised by the crucial importance of learning in the work process as a dimension of intentional and informal competence development" (Rauner & Maclean, 2008, p.15). Research revealed that most VET learners prefer to learn in groups and from mentors in workplaces rather than learning on their own. Collegial context for learning is the essence of workplace learning where learners learn in social environment assisted by peers and instructors (Sangster, Maclaran & Marshall, 2000; Smith, 2006). Workplace learning is an important characteristic of VET as it provides "a fertile opportunity for learners to appropriate knowledge that connects theory to practice in a realistic and efficient way" (Billett, 1996 c.f. in Smith, 2003, p.53). Workplace learning is a manifestation of Lave and Wenger's (1991) view of learning as "situated activity" (p. 29). In these authors' views, learning is a social process in which learners participate in the lived-in world and understand the world as they experience it. During workplace learning, learners experience the real, factual consequences of their doing and the ultimate aim is 'learning transfer': learners internalise the theories and skills and then export to the field of enterprises and connect their learning experiences so that an earlier learning process can enhance a later process in a positive way (Bank, 2013).

Learning is a series of discovery and exploration activities, answers are open and knowledge is constructed collectively and not bounded by groups and geographic locations. The framework of communities of practice would be able to deepen the levels of learners' engagement and collaboration so as to provide a coherent wholesome learning experience in workplaces. More importantly, an effective competency-based learning and teaching pedagogy is yet to be developed together with the learning and teaching materials to cater for the need of learners who are less inclined towards the traditional lecture hall-type of learning, and also to fit the constraints and needs of Hong Kong.

For the above reasons, VET depends heavily on workshop practices and workplace learning rather than the use of lectures, literature review, tutorials and hence, the development of trade-specific OER remains a challenge. Borrowing the concept of the Australian government's Toolbox Project to share, adapt and reuse generic customisable courseware; presumably, an interactive self-sustainable online 'communities of practice' platform to accompany the trade-specific OER would benefit Hong Kong VET's learners, teachers and mentors to co-develop, to share learning and teaching materials and teaching practices.

3 Employing Open Educational Resources (OER) to Facilitate a Sustainable Online 'Communities of Practice' for Vocational Education and Training (VET)

The concept of "Communities of Practice": different forms of interaction and collaboration amongst members, was developed by Lave and Wenger (1991), who suggested that communities of practice are formed by groups of people who share a concern or passion for something they do and learn how to do it better as they interact regularly. Lave and Wenger argued that a community of practice, which they define as a system of relationships between people, activities, and the world; develops with time, and relates to other tangential and overlapping communities of practice, is an intrinsic condition of the existence of knowledge. They also contended that "situated learning activity has been transformed into legitimate peripheral participation in communities of practice… it is motivated by the growing use value of participation and by newcomers' desires to become full practitioners" (p.122). In this sense, the original concept of communities of practice is developed to explain how learning takes place by practice. Rather than referring learning as the acquisition of certain forms of knowledge, Lave and Wenger have tried to place learning within social relationships which involves participation in a community of practice. And, that participation "refers not just to local events of engagement in certain activities with certain people, but to a more encompassing process of being active participants in the practice of social communities and constructing identities in relation to these communities" (Wenger, 1998, P.4). Communities of practice all share a basic structure which, according to Wenger (2002), is a unique combination of three fundamental elements: a domain of knowledge which defines a set of issues, a community of people who are care about this domain, and the shared practices that are developing by the community to be effective in its domain. Lucas (2014) also contended that in addition to the emphasis on workplace competencies, VET learners value the social dimension of learning between teachers and learners as well as learners to their peers. In sum, trade-specific learning and teaching materials and learning strategies especially designed for VET would set standard and generate exchanges and sharing between learners, teachers and workplace mentors for the benefit of better learning and teaching experiences and their ease of developing quality learning and teaching resources. However, coincide to the results of a few studies that "a majority of instructors in developing countries do not have expertise and experience to develop Open Educational Resources (OER)" (Unwin et al., c.f. in Metebe and Raisamo, 2014, p.250). Likewise Hong Kong, as a well-developed country, her VET's workplace mentors in some of the trades, i.e. Chinese culinary, hairdressing, metal works and jewellery, are mostly self-learnt masters. They seldom have any formal educational and training qualifications as well as knowledge and experience in developing educational resources. Furthermore, given that many of the workplace mentors do not have formal teaching and assessment training, their instructions in the workplace may be unclear, assessments may be inappropriate and learning outcomes may not be achieved. Hence, there is a pressing need to develop a series of common VET modules' teaching and learning packages using the tools in the format of technology enhanced pedagogical practices, and make them available on an open platform for illustration of the pedagogy with examples as well as resources sharing among VET's stakeholders.

However, there is a lack of common VET learning platform across institutions and industries in Hong Kong to enable sharing of good practices and exchange of learning and teaching resources. To make the above possible, the authors propose to establish a sustainable 'communities of practice' using an online learning and teaching platform to build network and establish a learning community, so as to initiate the practice of cross-institutional collaborations to share quality learning and teaching materials and practices between learners, teachers, workplace mentors and industry partners. Employing the concept of Open Educational Resources (OER), trade-specific educational resources could be adapted, reused and recycled in the formats of either print, multimedia, videos, digital and e-book versions to facilitate task-oriented learning and work-integrated learning strategies and activities together with mobile applications. This bundle of resources, teaching and learning strategies and activities will be uploaded to the online learning and teaching platform for access by learners, teachers and workplace mentors.

Riding on Cheung, Yuen, Li et al.'s (2013) experience and their proposed four stages on developing the open access textbook platform (a hosting platform, contents development, quality assurance and support for continuous cultural and capability building) to begin with, a task force involving learners and teachers across institutions, industry partners and workplace mentors is to be set up to give advice on curriculum design, the development of learning and teaching materials, the designing of instructional strategies and learning and teaching activities. The contributed teachers from different institutions and mentors across industries will discuss and take the responsibilities to develop a series of trade-specific learning and teaching materials that are responsive to the educational needs in VET. Such materials will include Teaching and Learning Packages (TLPs), e-learning materials of the most common VET programmes, i.e. hotel and catering, health care and community services, retailing and servicing. These materials will then be uploaded to the aforementioned online platform for sharing while additional modules will be developed and uploaded on a regular basis. The OER contributors and VET stakeholders will also play the roles to assure the quality of these educational resources and to promote OER for public's use and recognition. It is expected that by means of this well-designed system OER can be employed to facilitate a sustainable online 'communities of practice' for VET.

4 Implications: Open Educational Resources (OER): There is No Free Lunch, is There?

OER for VET is a brave new world for many teachers and mentors. Moreover, the proposed communities of practice is a rather ideal one, with different parties taking responsibilities to co-develop, share and exchange ideas and materials for better learning and teaching in Hong Kong's VET sector. It is expected that a few issues will be emerged during the implementation of the online platform. As indicated in literature, copyright, quality assurance, sustainability, willingness and intention to participate, effort expectancy, social culture and influence are the key global challenges (Oliver, 2001; Hylen, 2006; Yuen, Chow, Cheung et al., 2012; Murphy, 2013; Metebe & Raisamo, 2014). Following the proclamation on OER by the UNESCO and other educational institutions, and the establishment of Creative Commons (CC) licenses and implementation of the 'fair dealing' policy, teachers begin to realise the importance of OER's social meaning and commitment, therefore, the copyright issue has gradually been resolved. A number of studies have suggested to set up a quality assurance system that consists of a team of subject and instructional experts and the trade's 'community of practice' as well as the users as gatekeepers to monitor, comment, rate and make recommendation on the quality of the OER (Oliver, 2001; Yuen, Chow, Cheung et al., 2012; Murphy, 2013; Metebe & Raisamo, 2014). Sustainability of OER requires efforts and investment. It is not possible for individual teachers or institutions to take up the entire role of development, quality assurance and maintenance of the communities of practice without government's participation and investment. In such case, making reference to the Toolbox Project in Australia, the Hong Kong government should take the lead and assign project funds to support the OER for VET.

In general, teachers and mentors in Hong Kong are conservative in sharing resources with others. Human's nature revealed that it is easier to take than to give. There is a saying in Chinese that 'if we are not friends, there is nothing to share, if we are friends, we share 50% of what we know and if we are good friend, we share 80% of our knowledge'. It is interesting to know to what degree of friendship that we are able to get the other 20%? In Chinese culture, especially in trade-specific subject like Chinese culinary or in some instances, martial arts, the 20% rests with the masters and will never ever be released to outsiders. Such kinds of deeply rooted social culture and influence will raise anxiety and uncertainty of teachers and mentors about OER.

Changing entrenched mind-sets of teaching staff to buy-in OER's concept of sharing, reuse and adaptation for teaching effectiveness will release their worries of their teachings being replaced by the shared OER (Murphy, 2013; Metebe & Raisamo, 2014). To break the barrier, the proposed communities of practice may be the answer. Through rapport, friendship building, sharing and exchanges of educational resources and teaching practices, it is assuming stronger collaborations between institutions, learners, teachers and workplace mentors will be fostered. Although OER is still in its infancy and it is assuming that time would be the major solution to gain acceptances from stakeholders, it is unavoidable that people may ask "there is no free lunch, is there?"

5 Conclusion

For the betterment of learning and teaching of Hong Kong's VET, this paper proposed a common VET learning platform be developed across institutions and industries in Hong Kong to enable sharing of good practices and exchange of learning and teaching resources. This paper further suggested establishing a sustainable 'communities of practice' using an online learning and teaching platform to build network and establish a learning community to promote cross-institutional collaborations by means of sharing quality learning and teaching materials and practices among teachers, workplace mentors and industry partners. Making references to other countries and academics' experiences, this paper further proposed strategies for the implementation of OER for VET in Hong Kong. Last but not least, this paper also suggested apart from the social and cultural influences of employing OER between VET's stakeholders, the willingness to share out of trade-specific contents amongst stakeholders is another hurdle to be addressed for developing OER in VET.

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How to incorporate open educational resources (OER) into the infrastructure and pedagogy for promoting ubiquitous learning

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Abstract. Ubiquitous learning can be promoted with the proper usage of Open Educational Resources (OER). Of course, OERs are made in such a way with the help of audiovisual effects that they can support learning anytime and anywhere. In this paper, the author has tried to list down the various ways in which the OERs can be incorporated into the infrastructure and pedagogy for promoting ubiquitous learning. Steps have to be taken so that the different boundaries of education are removed. To involve the teachers for this is a challenge which can be met by providing them with the required technical knowhow and also training them professionally to newer paradigms in instructional designs and pedagogy which is required for ubiquitous learning. As a result of this change in instructional design the shift of the learners from knowledge receptors to knowledge actors happen. Research has to be carried out with varied learner profiles and their proactive participation in using various media and teaching-learning tools. Thereby the assessment tools have to be made in such way that it would provide useful and relevant formative and summative evaluative information to learners, parents and educators. Also, social platforms have to be used to build collaborative knowledge cultures. To achieve all this, we need to provide the requisite technical support to the learners as well. The internet connectivity is another challenge that has to be met with and provided to all. The digital divide has to removed and OERs to be provided for all. In a nutshell, we all should realize that investment in OER is the key to improvement in the teaching-learning environment. So OER and u-learning is the order of the day.

Keywords:OER, ubiquitous learning, pedagogy, instructional design.

1 Introduction

The concept of Open Educational Resources (OER) started in an UNESCO Forum on Open Courseware for Higher Education in Developing Countries held in 2002. Then, after ongoing online discussions, finally OER was defined as ‘technology-enabled, open provision of educational resources for consultation, use and adaptation by a community of users for non-commercial purposes.' Of course, OERs are freely available over the web or the internet, mainly for the teachers and educational institutions to support course development, but also can be used directly by students. OERs include learning objects such as lecture material, references and readings, simulations, experiments and demonstrations, as well as syllabuses, curricula, and teachers' guides (Wiley 2006). We should not confuse OER with online learning or eLearning. OER may be printable also.

OER describes any educational resources (including curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials that have been designed for use in teaching and learning) that are openly available for use by educators and students, without an accompanying need to pay royalties or license fees. OERs may be used as an integral method of communication of curriculum in educational courses (i.e. resource-based learning),The most important part is the ease with which OERs, when digitized, can be shared via the internet. Thus, an OER is simply an educational resource that incorporates a license that facilitates reuse, and potential adaptation, without first requesting permission from the copyright holder.

Creative Commons (CC) licensing framework (www.creativecommons.org) provides legal mechanisms to ensure that authors of materials can retain acknowledgement for their work while allowing it to be shared, can seek to restrictcommercial activity if they wish, and can aim to prevent people from adapting it if appropriate.

OERs are important for the expansion of ubiquitous learning. Open licensing of learning components is a precondition for supporting anytime, anywhere learning, whether the lessons are arranged as text, multimedia, videos, applications, games or in other electronic formats.

The recent shift on education is the availability, awareness and use of open educational resources (OER) which is essential for ubiquitous computing (Ubicomp). Cheap and efficient technologies are the need of the hour for the development of OER and EFA(Dourish and Bell, 2011).There has been a mismatch between technology affordances and pedagogical opportunities in higher education from the early promises of microcomputers in the 1970s to the internet in the late 1990s (Collis and Moonen, 2008). The higher learning institutes have not been able to fully utilize the pedagogical potential of the social web. Since the time computers have become portable, the concept of ubiquitous computing (Ubicomp) has arisen and there are no fixed locations for learning and teaching. Cloud-based, mobile learning and teaching, virtual WIL (work-integrated learning) as well as physical WIL placements, all are important for ubiquitous learning.

Thus we as educators have the responsibility to design programmes in such a way as to engage students and staff for multiple locations and multiple channels.

Also we have to see that the students are able to better manage their time and mix location and channel to match their current and future life circumstances.

2. Research on OER in education

From different researches in the adoption of OER for delivering courses (Naidu & Mishra, CEMCA 2014) it was seen that, designing the course using the Scenario-based Learning (SBL) approach was the most challenging task initially undertaken by the course team of OUSL for their teacher education course (Karunanayaka and Naidu, 2013). Also difficult was to design offline and online activities, for the active participation of the learners. Clarity in learning outcomes, which would be aligned to interesting learning activities, and finally assessment tasks was essential, as was appropriately integrating them with the learning experiences.

While designing the learning activities, providing variety, yet not overloading the students was a key challenge faced by the course team. The workload of the distance educator would increase as they would now have to support the distance learners who had to cope with new pedagogy as well as new technology. Another challenge to the course team would be to find out appropriate and relevant OER and integrate in the instructional design. Findings of these research studies helped the course team to make decisions on course improvements. The effectiveness of ICT and OER in enhancing learning will however depend on appropriate instructional design of the course content, learning experiences and learning resources. Integration of OER in the course was driven by the need to further support and enriches its teaching-learning process. The SBL pedagogical approach adopted in the course design supported integration of OER in a more meaningful manner. OER became an integral component within the instructional design. It was evident from feedback that significant capacity building has occurred among academic staff in relation to adopting the SBL pedagogical approach in course design, online course development and OER integration.

2.1 Open licensing and the emergence of OER

Within the above context, open content licenses have emerged in an effort to protect authors' rights in environments where content (particularly when digitized) can easily be copied and shared on the internet without permission. OER are part of this process, and allow for more flexibility in the use, re-use, and adaptation of materials, for local contexts and learning environments, while allowing authors to have their work acknowledged.

Although the user finds the OER 'free', institutions have to invest systematically in programme/course design and materials development and acquisition. Faculty time has to be invested in developing courses and materials. The greatest achievement would be to find appropriate OER (Banerjee, DEC project 2011), adapting existing OER, and negotiating copyright licensing (if material is not openly licensed). There are also associated costs such as procurement and maintenance of ICT infrastructure (for authoring and content-sharing purposes) and bandwidth.

Research has been also carried out by the course team of PGDEL, an innovative programme, at IGNOU. The programme development time and cost was considerably reduced by using available and appropriate OER. Obviously, in this case also, the workload of the faculty had increased significantly due to the online programme.

3. Ubiquitous Learning

By combining theory, research, and practice, a broad picture of the field of ubiquitous learning can be focussed on how to use theory and research to enhance technology integration to support teaching and learning through instructional design. Also, strategies for instruction, models and frameworks for course design, and applications of mobile and social media tools to create, implement, and deliver a ubiquitous learning environment can be found out. Thus research on OERs for u-learning would be of interest to researchers and graduate students in educational technology, information sciences, adult learning and other learning and performance fields, as well as university faculty, teachers, administrators, policymakers, and industry leaders. They can probe through their individual roles in education. Anyone who has the aim to improve their levels of teaching and student engagement though the use of technology, would certainly like to utilize the strategies for pedagogy, course design, and technology with respect to u-learning..

Recently, research issues have progressed from web-based learning to mobile learning (Chen, Chang, & Wang, 2008), and from mobile learning to context-aware ubiquitous learning (u-learning), in which the learning system can detect students' behaviors and guide them to learn in the real world with personalized support from the digital world (Hwang, Yang, Tsai, & Yang, 2009)

Ubiquitous learning does not only involve (mobile) devices – it is primarily related to the fact that the student is able to perform learning activities within various situations or contexts. In one context, the student may use a netbook computer or a smartphone on campus and during the lectures to verify certain activities demonstrated by the instructor. In another context, the student may do some homework at a home-based desktop computer while using VLE (Virtual learning environment) forums, instant messengers, and e-mail in order to collaborate with multiple friends at the same time. Research has been carried out to design a new and innovative technology, the so called Compendium Platform (henceforth CP), which was based on a new (revised) definition of the Compendium: a document with (open-access) references to (remotely) archived computations (including data, meta-data, and software) that allows the reader to reproduce, and re-use the underlying analysis. Unlike the old one, this definition allows us to specify new (and "ubiquitous") environments in which reproducibility of research results is guaranteed work because there is no requirement to store or compute anything locally – the only requirement is to have an active internet connection (Wessa 2008).

Ubiquitous learning is an extension of the idea of ubiquitous computing, a term which describes the pervasive presence of computers in our lives. Personal and portable computers have become an integral part of our learning, work and community lives, to the point where, if you don't have access to a computer networked with reasonable bandwidth you can be regarded as disadvantaged, located as a 'have not' on the wrong side of the 'digital divide'.

The concept of ubiquitous computing and u-learning goes beyond portable computers. As new technologies evolve and more pervasive forms of technology emerge, computers will become 'invisible' and will be embedded in all aspects of our life. They will be seamlessly integrated into our world in a phenomenon referred to as calm technology. Thus we will emerge in an era of wearable computers and embedded microchips. The telephone, television, PCs, the internet and mobile phones have been in our daily lives for quite some time now, and we have adapted them very well. The guest editors Liu and Milrad (2011) wrote in t*he Journal of Educational Technology and Society*, "One-to-one learning is based on the belief that people learn differently as a result of owning personal handheld computing devices (Chan et al., 2006). The attributes of these devices, including portability, connectivity and context sensitivity combined with sound pedagogical ideas can transform learning from being a merely productive knowledge acquisition process to an active social interaction activity."

Meanwhile, many other devices are becoming more computer-like, or have computer power built in: mobile phones, televisions, global positioning systems, digital music players, personal digital assistants, video cameras, still cameras and game consoles, to name a few. These devices are everywhere. They are getting cheaper. They are becoming smaller and more portable. They are increasingly networked with each other. This is why we find them in many places in our lives and at many times in our days. New media and technologies, in particular, Web 2.0 technologies, enable learners to be creators, co-creators, and owners of their learning and communication environments (Lin, 2008).

Most classrooms are still strikingly not a part of the information age even by the most basic of measures—students' access to digital learning content and work spaces. And when students have access to these environments, the curriculum content and student work practices are often unimaginatively conventional (content transmission, lock-step sequencing, standardized curriculum, discrete item assessment). Student learning results are disappointing. So it is time to ponder on how technologies are having a marked and transformational impact on learning and communication *outside* the classroom.

And another qualifier: 'affordance' means you can do some things easily now, and you are more inclined to do these things than you were before simply because they are easier. The technology becomes an invitation to do things better, often in ways that some people have been saying for a long time they should be done. You could do collaborative and inquiry learning in a traditional classroom and heritage institutional structures, but it wasn't so easy. Computers make it easier. Desirable social learning practices which were at times against the grain for their idealistic impracticality, become viable. Thus there is a major shift of learning activities from the classroom to outside the classroom – the coffee house, the home, the social network, the gaming environment, the media and popular culture, the workplace – reflecting back on a set of changed expectations on the part of young people about what their learning experiences inside the classroom should look like. The entire learning processes, motivations, and relevance to the practical contexts of ordinary life have thus had a paradigm shift, as is the need for the school and classroom to reimagine themselves in relation to these other learning environments. This is the revolution we describe as "ubiquitous learning."

From an instructional standpoint, research in a variety of disciplines has suggested that incorporating technology into classroom instruction in meaningful ways increases student interest and raises academic achievement.

In the new environment of u-learning, more documentation on learning processes are required so that teachers can share their lesson plans or learning resources with the teaching community. So there is collaboration among the teachers and the schools become knowledge hubs. Thus the transactions which were taking place inside the closed doors of the classroom are now becoming publicly visible to peers, to the educational organization, to parents and communities.

Thus ultimately in the long run, the extra work of organizing knowledge should create less work. This is the basis of the 'learning organization' the sum of whose knowledge is greater than the individual components of knowledge in the heads of individuals (Kalantzis and Bill Cope, 2009)

Another term which has arisen along with the development of OER are the OCW – open courseware. MIT was one of the first universities to introduce OCW, announced its intention in the New York Times in 2001, formed the OpenCourseWare Consortium in 2005, and by 2007 published virtually all its courses online.MIT Open Courseware (http://ocw.mit.edu) currently makes available 1,900 courses on the Internet at no cost for non-commercial purposes. Many other institutions followed. Lecture notes, reading lists, course assignments, syllabi, study materials, tests, samples and simulations, all fall under the umbrella of OCW (www.ocwconsortium.org):The OpenCourseWare Consortium is a collaboration of more than 200 higher education institutions and associated organizations from around the world creating a broad and deep body of open educational content using a shared model and it envisages to enhance worldwide education through opencourseware. Most recently The Cape Town Open Education Declaration mentions the variety of openly licensed course materials, including lessons, games, software and other teaching and learning materials that contribute to making education more accessible and help shape and give effect to a 'participatory culture of learning, creating, sharing and cooperation' necessary for knowledge societies. It goes on to provide a statement based on a three-pronged strategy designed to support 'open educational technology, open sharing of teaching practices and other approaches that promote the broader cause of open education. The open education movement and paradigm has arrived: it emerges from a complex historical background and its futures are intimately tied not only to open source, open access and open publishing movements but also to the concept of the open society itself. University OCW initiatives, content creation initiatives, subject specific OCW and OCW search facilities, these OER sources provide a useful starting point with regard to the extent of content publicly available. For example online catalogue maintained by OER Africa accessible at www.oerafrica.org/FindingOER .

4.Future trends

4.1 Developments in OER worldwide

Another important repository is the Multimedia Educational Resource for Learning and Teaching Online (MERLOT), which provides free and open resources designed primarily for faculty andstudents of higher education (www.merlot.org). In addition, some OCW institutions such as John Hopkins Bloomberg School of Public Health are using Opensource Opencourseware Prototype System (OOPS), a program that translates educational resources into Chinese. In India, a number of institutions are also digitizing their course materials and a good number of open courseware have been established. The Consortium for Educational Communication (CEC) is an inter-university centre on electronic media, established by the University Grants Commission (UGC). CEC's Learning Object Repository (LOR) houses educational resources in different subjects such as Archaeology, Biology, Botany, Chemistry, Commerce,Computer Science, Economics, Education, English and Fine Arts. The National Programme on Technology Enhanced Learning (NPTEL) aims to enhance the quality of engineering education in India by developing curriculum based video and web courses. This is being carried out by seven premier institutions as a collaborative project. Also, articles, Open Access Journals and books are coming up in a big way. Users are able to search for textbooks by licensing (and can therefore access OER textbooks).

iTunes U is another important content-sharing initiative which has gained immense popularity. Launched in 2007, Apple's iTunes University allows Higher Education institutions to make audio and visual content freely available for download (as well as making provision for subscriptions for those wishing to sell content). Although the content is free to use, still, each institution that sets up an iTunes U account can specify certain parameters and conditions for further use (with many opting to use a Creative Commons licence).

OpenLearn (http://openlearn.open.ac.uk), this Open University is one of the world's most successful distance education universities. The OpenLearn website gives free access to Open University course materials. As a catalyst for further research Open Educational Resources have a significant part to play. The rigidity of the educational components are creating pressure in the education system and so OER will possibly be the future trend of teaching-learning.

The Open University of Hong Kong (http://freecourseware.ouhk.edu.hk), being the major local provider of distance education, offers free opportunities for interested students to have a genuine experience of distance education. The National University of Columbia (www.virtual.unal.edu.co) provides a lot of choice for Spanish speaking students. Examples of African OCW initiatives include the University of Western Cape (http://freecourseware.uwc.ac.za) and the recently established UCT Open Content (http://opencontent.uct.ac.za), which allows users to accessing open teaching and learning content from the University of Cape Town (UCT).

4.2 Subject-Specific OCW OER

There are also various subject-specific OER initiatives in Higher Education. An African subject-specific initiative is the Teacher Education in Sub-Saharan Africa (TESSA) initiative (www.tessafrica.net), which brings together teachers and teacher educators from across Africa. It offers course design guidance for teachers and teacher educators working in Sub-Saharan African countries, and has produced a range of OER in four languages to support school-based teacher education and training.

5. Conclusion

We need to realize that when we invest in OER and u-learning, we invest in better teaching and learning environments, not a function of investing in OER. All governments and educational institutions in all education sectors, regardless of their primary modes of delivery, need to be making these investments on an ongoing basis if they are serious about improving the quality of teaching and learning. Within the framework of investing in materials design and development, though, the most cost-effective approach is to harness OER. This is because:

- No duplication of effort arises by building on what already exists elsewhere;
- Costs of copyright negotiation and clearance are removed; and
- Over time, it can engage open communities of practice in ongoing quality improvement and assurance.

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Formative evaluation of Hong Kong's first open textbooks

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Abstract.

As the first set ever developed in Hong Kong, 12 open textbooks for the local school curriculum were just completed in 2015. During the development process, the formative feedback was gathered from trial users, i.e. teachers and students who tried out some units of the draft version of the primary and secondary textbooks developed for the project. The evaluation was for the improvement of the open textbooks being produced. This paper reports results of the formative evaluation which included a questionnaire survey administered on the teachers and another on the students.

Keywords: open textbooks, open license, textbook evaluation, open educational resources

1 Introduction

In 2012, the Open University of Hong Kong (OUHK) obtained funding from a charity through the support of the Government of Hong Kong Special Administrative Region to develop an open textbook system for Hong Kong. The deliverables of the project include open textbooks at tertiary, secondary and primary levels. This included the development from scratch of 12 open textbooks covering the formal school curriculum for the English language subject for all primary and secondary levels. (Yuen & Li, 2012)

The project started in January 2013, and by mid-1015 the development of 12 open textbooks for primary and secondary schools was completed. Feedback from teachers and students were gathered during September 2014 to April 2015 when the books were in their developmental stage. (Li, Yuen & Wong, 2015) Data were collected mainly through two surveys, one on teachers and another on students. This paper reports the survey results for the formative evaluation.

2 The Open Textbook Project

One major motivation for the project was to offer a solution to alleviate the problem of high textbook prices, a perennial problem for Hong Kong (Ref. Consumer Council, 2001, 2012; Li, Yuen, Cheung & Tsang, 2012). There is also a need to allowing teachers to tailor textbooks to fit their individual learner groups' needs. However, commercial textbooks already printed for the market offer no possibility for adaptation. Copyright license of electronic versions of textbooks does not allow tailoring for repurposing contents.

There is recognition on the part of the Education Bureau (EDB) of a role for e-learning resources in education. Yet, even learning material in their associate website generally do not use open license, such as Creative Commons. So teachers do not have materials at hand which they can adapt to suit the needs of their group of students. So even though EDB launched in 2012 the E-textbooks Market Development Scheme (EMADS, see Education Bureau 2012), teachers are not able to make changes to the e-textbooks under the scheme to cater for their needs. To promote wide practice of e-learning, availability of free access e-learning resources which also allows free adaptation is essential.

Seeing these, a group of senior staff at the Open University of Hong Kong believe that 'Open Textbooks' is a solution to solve the problem of escalating textbook prices, to allow quick updates and tailoring of the learning resources to suit their needs, and to have easily accessible electronic resources for e-learning.

As in the case of other open textbooks around the globe, the project (entitled 'Open Textbooks for Hong Kong') offers many advantages. Those particularly relevant to schools in Hong Kong are as follows:

- The price of the printed textbooks is greatly reduced. With the use of the Creative Commons license on the textbooks, teachers, parents and students only pay for basic printing costs for the printed copies, through our recommended on-demand printer or using their own means. We estimate that our open textbook will cost less than 30% of an average textbook in the market.
- Where necessary, rapid revisions and timely updates of the contents of the textbooks can be made efficiently.
- Teachers are able to select and customize the open textbooks to cater for the specific needs of particular groups of students.
- The e-versions of the textbooks are free of charge. The multi-media elements of the content greatly enrich students' learning experience. Since they can be easily downloaded or accessible online for active and flexible learning, such versions of the textbooks are conducive effective e-learning.

The open textbooks have been designed to be closely aligned to the syllabi set by EDB. The books will encourage active and flexible learning and we are mindful of students' interests, needs and expectations. The textbooks do not only contain text-based content; but they also include interactive learning contents, and are hyperlinked to useful online resources for students' further enrichment.

3 Methods

We began our formative evaluation the open textbooks while some of the early draft units were being tried out. After our continuous promotional work on the Open Textbooks project, 43 schools (19 primary and 24 secondary) joined the trial of the textbooks in the 2014–15 school year. Some schools used the textbooks in the first term (starting September 2014), and others used them in the second term (starting February 2015).

In the tryout of the textbooks, most teachers just used the printed copies. In some cases, the e-versions were also used for demonstration in the classroom. Many teachers used the open textbooks to replace existing textbooks, and the others used them as supplementary materials. This practice is different from our earlier survey on teachers' expectations of the open textbooks, when the majority of teachers said they would just use the open textbooks as supplementary to their existing textbooks.

The teachers were all asked to join an evaluation study after they had used the textbooks. A questionnaire was devised to collect teachers' feedback on the textbooks, and another was separately designed for students. Both questionnaires were designed with reference to EDB's evaluation for assessing the quality of textbooks. The teachers' and students' questionnaires can be found at: http://www.opentextbooks.org.hk/resources.

By the end of May 2015, teachers and students from 34 schools (14 primary and 20 secondary) provided to us their feedback on the open textbooks they have used. The return rates are given in Table 1 below.

Table 1. Number of teachers and students participating in the tryout scheme

	Questionnaires sent out (schools)	**Number of responses**	**Response rate (%)**
Questionnaires for primary students	1875 (14)	533	28%
Questionnaires for secondary students	2889 (20)	1077	37%
Questionnaires to primary teachers	79 (14)	34	43%
Questionnaires for secondary teachers	113 (20)	72	64%

4 Feedback by Students and Teachers

Students' feedback on the open textbooks

There were nine questions in the students' questionnaire. Students were asked to indicate their agreement to the statements in a Likert scale: strongly agree, agree, no comment, disagree, and strongly disagree.

Primary students

The first seven questions are about students' views on the textbook. For six of the seven questions, close to one half of the students strongly agree with the statements (see Table 2). The majority of the students (strongly agree + agree) like the books (81.05%); they find the pictures lovely (79.55%); the reading in each lesson is interesting (67.54%); the textbook gives them a sense of satisfaction after they complete the main task (63.42%); the book is convenient to carry as it is printed in separate booklets (72.04%); and the book makes them interested in studying English (72.23%). This is good indication that our open textbooks are deemed to be quite satisfactory among students.

Table 2. Feedback from primary school students

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
I like the book.	292	140	56	18	21
	54.78%	26.27%	10.51%	3.38%	3.94%
The diagrams in the book are lovely.	285	139	55	26	26
	53.47%	26.08%	10.32%	4.88%	4.88%
The readings are interesting.	234	126	80	33	29
	43.90%	23.64%	15.01%	6.19%	5.44%
The listening tasks are interesting.	142	53	235	30	37
	26.64%	9.94%	44.09%	5.63%	6.94%
The main tasks give me satisfaction after I work on them.	228	110	124	28	33
	42.78%	20.64%	23.26%	5.25%	6.19%
The booklet format is convenient for me to carry.	276	108	69	22	46
	51.78%	20.26%	12.95%	4.13%	8.63%
The book makes me interested in studying the subject.	284	101	61	31	37
	53.28%	18.95%	11.44%	5.82%	6.94%

However, for the statement, 'the listening task is very interesting', nearly half of the students respondents (44.09%) indicated that they have no comment; only 36.58% agree with it. We were quite concerned about this feedback. We examined the audio component of the electronic textbooks and did not find major problem with it – the narration can be played with ease, and it is the sound is quite audible. We contacted some teachers and asked why so many students had no comments on the statement. And aha, many teachers said they did not use the narration or the sound effect of the books in the tryout! So students did not use the narrations. We also examined the proportion of students disagreeing with the statement, and found that the percentage is not particularly high. So we believe there may not be a major problem with our listening task.

Table 3. New things that primary students have learned

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I have learned new vocabulary from the book.	304	127	52	14	30
	57.04%	23.83%	9.76%	2.63%	5.63%
I have learned different text-types from the book.	246	99	134	16	25
	46.15%	18.57%	25.14%	3.00%	4.69%

Two questions were then asked about students learning (Table 3). The feedback was that they have learned vocabulary (80.87%), and different text-types (64.72%).

Students were then asked to add any comments they wished to say. Some qualitative comments given by primary school students are very graphical and cute. Statements made in Chinese by students include: ‘I very much like this book!’, ‘I like the book so much; I hope there are more such books’, ‘The diagrams are lovely’, ‘I think it is very interesting’, ‘Add more exercises!’, and ‘I love reading the book’.

Fig. 1. Figure 1: Primary students’ scripts

Secondary students

Secondary schools students also indicate their fondness of the textbooks, but not as much as primary school students (see Table 4). For six of the seven questions, close to one half of the students ‘agree’ with the statements. The majority of the students (strongly agree + agree) feel that the content of the lessons relate closely to their lives (71.13%); they are interested in reading the texts of the lessons (58.31%); the difficulty level of the books suits them well (64.72%); the letter font size is well chosen, so the text is easy to read (72.33%); the book is convenient to carry as it is printed in separate booklets (69.73%); and the book makes them interested in studying English (54.14%). This is good indication that our open textbooks are deemed to be quite satisfactory among students.

For the statement, ‘the page design of the book is attractive; the diagrams raise my interest in study’, close to one half of the students (41.23%) had no comment, and 46.80% agree or strongly agree with the statement. This is the statement which receives the least support from students. The writing team will bear this in mind and try to improve the diagrams to assist learning.

Concerning the impact of the open textbooks on their learning, as shown in Table 5, secondary school students agreed that the textbooks increase their knowledge of text-types (65.74%), English grammar (61.46%), vocabulary (72.70%), and ability to read (59.24%). Many of them were neutral about the effect of the textbooks on writing skills (42.53%), listening ability (45.59% agree), ability to speak (46.98%), and knowledge about elective modules (45.87% agree). We asked the teachers if they knew why this was the case. The answer we got from the teachers was that their classes did the vocabulary and grammar tasks more than other tasks!

Table 4. Feedback from secondary school students

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The content of each lesson is related to my everyday life.	178	588	257	35	15
	16.53%	54.60%	23.86%	3.25%	1.39%
I am interested in reading the texts.	117	511	355	61	30
	10.86%	47.45%	32.96%	5.66%	2.79%
The layout and design of the book are nice.	139	365	444	84	41
	12.91%	33.89%	41.23%	7.80%	3.81%
The difficulty is pitched at the right level for my study.	172	525	292	55	29
	15.97%	48.75%	27.11%	5.11%	2.69%
The font size is suitable for reading.	267	512	248	33	12
	24.79%	47.54%	23.03%	3.06%	1.11%
The textbooks are printed in small booklets; this makes them easy to carry.	294	457	270	32	19
	27.30%	42.43%	25.07%	2.97%	1.76%
The content of the book makes me interested in studying the subject.	132	451	397	48	40
	12.26%	41.88%	36.86%	4.46%	3.71%

Table 5. New things that secondary students have learned

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The book helps me learn different text-types.	n	130	578	297	43	19
	%	12.07%	53.67%	27.58%	3.99%	1.76%
The book increases my knowledge in grammar.	n	120	542	337	50	21
	%	11.14%	50.32%	31.29%	4.64%	1.95%
The book helps me learn new vocabularies.	n	203	580	249	27	12
	%	18.85%	53.85%	23.12%	2.51%	1.11%
The integrated task has increased my writing ability.	n	96	433	458	59	13
	%	8.91%	40.20%	42.53%	5.48%	1.21%
The integrated task has increased my reading skills.	n	126	512	355	40	10
	%	11.70%	47.54%	32.96%	3.71%	0.93%
The integrated task has increased my ability in listening	n	88	370	491	61	20
	%	8.17%	34.35%	45.59%	5.66%	1.86%
The integrated task has increased my ability in speaking.	n	81	364	506	77	24
	%	7.52%	33.80%	46.98%	7.15%	2.23%
The 'elective' has increased my knowledge of the 'elective modules'.	n	81	389	494	55	17
	%	7.52%	36.12%	45.87%	5.11%	1.58%

At the end of the questionnaire, secondary school students also gave qualitative comments on the textbooks. These comments include, 'Very good', 'The content is way too easy for Secondary 5 students', 'I hope there are more such books in future; they can be cheaper too', 'There is no need to print them on glossy papers; can you use ordinary papers to print them?', 'This is a good textbook for learning English. It is easy to take to users [*sic*]', 'I know if the electronic version of the textbook is used in teaching, students will be more engaged (in learning)', 'I hope we can use the tablets in the classroom in future', and 'I think the book is good. The topic is quite easy for the form five students. It can provide more exercises for students to practise'. (See Figure 2 for students scripts.)

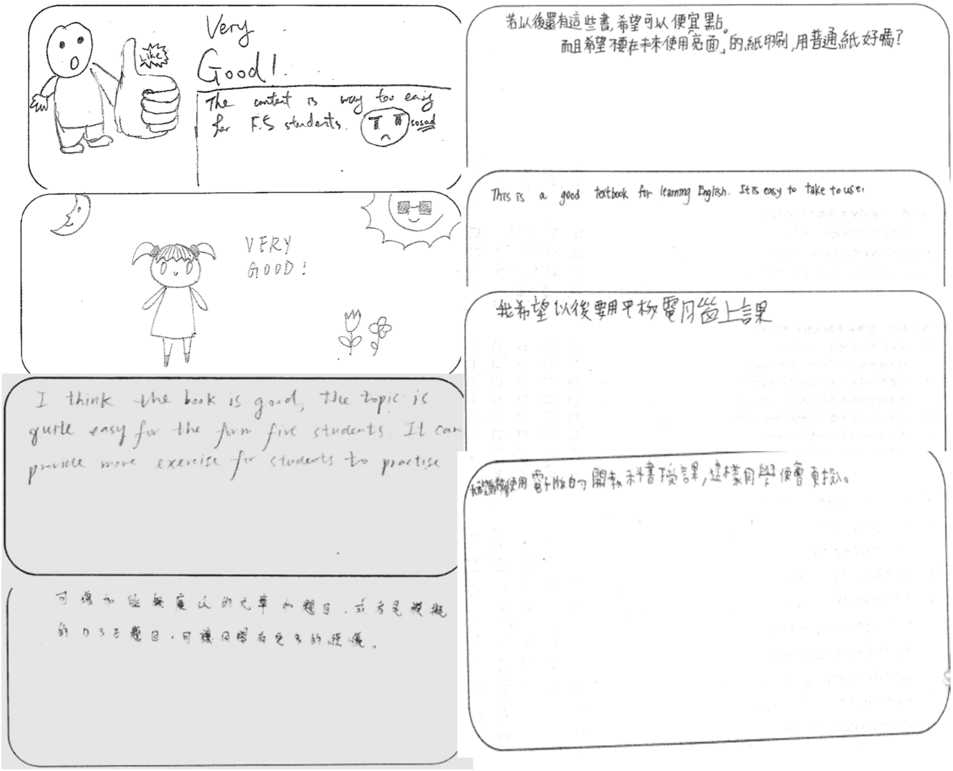

Fig. 2. Secondary students' scripts

Teachers' feedback on the open textbooks

In the teachers' questionnaire, there are 20 statements about the open textbooks which we asked teachers to indicate the extent to which they agree. In all the questions, the majority of teachers agree with the statements which state that the content is interesting, relevant to students' daily life and effective to meet curriculum requirements; the level of difficulty of the tryout units is appropriate; the learning activities in the tryout units can help students to achieve learning targets; the tryout units facilitate students to integrate, practice and apply new knowledge; the tryout units motivate students to learn; the instructions in the tryout units are clear; the organization of the content is logical; the use of table of content, headings and outlines is appropriate; the overviews and summaries of the tryout units can facilitate students' learning; the language used in the tryout unit is of appropriate level of difficulty, familiar; interesting language is used in the tryout units; and the language used in the tryout units is accurate.

More secondary school teachers disagree with the statements than primary school teaches, but in general, more than 70% of teachers indicated that the open textbooks are of good quality. (See Tables 6 and 7 below.)

Table 6. Feedback from primary school teachers

		Totally agree	Agree	No comment	Disagree	Totally disagree
1.1	The content is interesting.	2	27	5	0	0
		5.9%	79.4%	14.7%	0.0%	0.0%
1.2	The content is relevant to students' daily life.	5	29	0	0	0
		14.7%	85.3%	0.0%	0.0%	0.0%
1.3	The content is effective to meet curriculum requirements.	3	31	0	0	0
		8.8%	91.2%	0.0%	0.0%	0.0%
1.4	The level of difficulty is appropriate.	2	31	1	0	0
		5.9%	91.2%	2.9%	0.0%	0.0%
2.1	The learning activities can help students to achieve learning targets.	1	28	5	0	0
		2.9%	82.4%	14.7%	0.0%	0.0%
2.2	The units facilitate new knowledge integration, and application.	0	28	5	1	0
		0.0%	82.4%	14.7%	2.9%	0.0%
2.3	The tryout units motivate students to learn.	2	26	6	0	0
		5.9%	76.5%	17.6%	0.0%	0.0%
2.4	The instructions in the tryout units are clear.	2	27	1	4	0
		5.9%	79.4%	2.9%	11.8%	0.0%
3.1	The organization of the content is logical.	0	32	1	1	0
		0.0%	94.1%	2.9%	2.9%	0.0%
3.2	The use of table of content, headings and outlines is appropriate.	0	31	3	0	0
		0.0%	91.2%	8.8%	0.0%	0.0%
3.3	The overviews and summaries can facilitate learning.	0	24	10	0	0
		0.0%	70.6%	29.4%	0.0%	0.0%
4.1	The language used is of appropriate level of difficulty.	1	29	2	0	0
		2.9%	85.3%	5.9%	0.0%	0.0%
4.2	Familiar and interesting language is used.	0	25	3	4	0
		0.0%	73.5%	8.8%	11.8%	0.0%
4.3	The language used is accurate.	1	28	3	0	0
		2.9%	82.4%	8.8%	0.0%	0.0%
5.1	The layout is logical and consistent.	0	31	1	0	0
		0.0%	91.2%	2.9%	0.0%	0.0%
5.2	The use of space and margin facilitates easy reading.	1	27	3	1	0
		2.9%	79.4%	8.8%	2.9%	0.0%
5.3	The Illustrations facilitate students' learning.	2	25	4	1	0
		5.9%	73.5%	11.8%	2.9%	0.0%
5.4	Appropriate print font size and style.	5	19	2	6	0
		14.7%	55.9%	5.9%	17.6%	0.0%
5.5	The paper used for the	3	22	7	0	0

	textbooks is light-weight and durable.	8.8%	64.7%	20.6%	0.0%	0.0%
5.6	The tryout units used non glossy paper for easy reading.	11	17	4	0	0
		32.4%	50.0%	11.8%	0.0%	0.0%

Table 7. Feedback from secondary school teachers

		Totally agree	Agree	No comment	Disagree	Totally disagree
1.1	The content is interesting.	7	55	7	2	0
		9.7%	76.4%	9.7%	2.8%	0.0%
1.2	The content is relevant to students' daily life.	18	50	2	1	0
		25.0%	69.4%	2.8%	1.4%	0.0%
1.3	The content is effective to meet curriculum requirements.	8	58	3	2	0
		11.1%	80.6%	4.2%	2.8%	0.0%
1.4	The level of difficulty of the tryout units is appropriate.	5	49	4	13	0
		6.9%	68.1%	5.6%	18.1%	0.0%
2.1	The learning activities can help students to achieve learning targets.	4	52	5	9	0
		5.6%	72.2%	6.9%	12.5%	0.0%
2.2	The tryout units facilitate new knowledge integration and application.	6	41	13	10	0
		8.3%	56.9%	18.1%	13.9%	0.0%
2.3	The tryout units motivate students to learn.	3	44	14	10	0
		4.2%	61.1%	19.4%	13.9%	0.0%
2.4	The instructions in the tryout units are clear.	3	57	7	4	0
		4.2%	79.2%	9.7%	5.6%	0.0%
3.1	The organization of the content is logical.	2	59	4	4	2
		2.8%	81.9%	5.6%	5.6%	2.8%
3.2	The use of table of content, headings and outlines is appropriate.	5	57	7	2	0
		6.9%	79.2%	9.7%	2.8%	0.0%
3.3	The overviews and summaries of the tryout units can facilitate students' learning.	7	44	15	5	0
		9.7%	61.1%	20.8%	6.9%	0.0%
4.1	The language used in the tryout unit is of appropriate level of difficulty.	6	51	4	10	0
		8.3%	70.8%	5.6%	13.9%	0.0%
4.2	Familiar and interesting language is used in the tryout units.	6	45	14	6	0
		8.3%	62.5%	19.4%	8.3%	0.0%
4.3	The language used in the tryout units is accurate.	4	62	2	3	0
		5.6%	86.1%	2.8%	4.2%	0.0%

5.1	The layout is logical and consistent.	3	58	5	4	0
		4.2%	80.6%	6.9%	5.6%	0.0%
5.2	The use of space and margin facilitates easy reading.	7	44	6	13	0
		9.7%	61.1%	8.3%	18.1%	0.0%
5.3	The Illustrations facilitate students' learning.	9	48	7	7	0
		12.5%	66.7%	9.7%	9.7%	0.0%
5.4	Appropriate print font size and style.	9	51	1	10	0
		12.5%	70.8%	1.4%	13.9%	0.0%
5.5	The paper used for printing of the textbooks is light-weight and durable.	13	48	10	0	0
		18.1%	66.7%	13.9%	0.0%	0.0%
5.6	The tryout units used non glossy paper for easy reading.	19	46	6	0	0
		26.4%	63.9%	8.3%	0.0%	0.0%

Teachers also made very useful interesting qualitative comments on the perceived impact of the open textbooks on the evaluation questionnaire. Most of them complimented on the quality of the textbooks but some good suggestions are provided to enhance the textbooks. These are summarized in Tables 8 and 9.

Table 8. Qualitative comments of primary teachers

School 1	For the above average class : - Probably because my students have learning the basic English skills in using New Magic, when they approach the Open English, they have a high sense of satisfaction. Parents are also satisfied with the open textbooks possibly because they are produced by the Open U. Average class: - Students are able to complete the exercises, and they have a good sense of satisfaction. - Students are very much fond of the rhymes and the poems; they tend to read the poems aloud in the class. Remedial class - There are only two study units in one booklet; the learning load is light, and the learning objectives are clear.
School 2	The books have positive impact on students: The Supplementary exercises help students approach different types of questions; they can find the answers much quicker when they see a question. Students can very quickly use the vocabularies they have learned; this increases students confidence in using the language.
School 3	Students show progress after using the textbooks - They made very few mistakes in the exercises provided by the textbook; they show higher referring skills; this may probably be due to the fact that students can find the answers quite easily due to the layout of the book, but students' interest and confidence in learning English are much enhanced when they give correct answers often.

School 4	Students show progress in learning English: - They are quicker in learning vocabularies. My students are SEN students, and their level of English varies. It will be good if I can revise the content myself to tailor for their needs.

Table 9. Comments of secondary teachers

School 1	I would like to suggest that: - For writing: provided three different versions for three different levels of students: easy, average and challenging tasks - For vocabulary: provide more language support about vocabulary. - For grammar; the exercises should be graded, so that students can progress from the simple drills to contextual exercises.
School 2	According to my observation during lessons, the open textbooks are able to achieve the following: - In composition, students often refer to the text of the lesson, and make use of the key words and sentence structures; although they may not always use these correctly, they are often able to do so in the theme-based exercises. - The context of the lesson are quite relevant to students' everyday life, so students are now more willing to write long texts, and express their opinion in English. - Students' knowledge about the theme and the vocabularies is strengthened.
School 3	I suggest that the vocabularies can be included in the texts of the lesson. Students can first learn the vocabularies, or take a short paragraph from the whole text and use it as an example for skimming and scanning. Then it will be easier for students to learn the vocabularies in the text. The formats of the exercises can include more variety. For example, multiple choice questions and true/false questions can be added. Questions should be graded, i.e., going from the easy to the more difficult. I also suggest that more diagrams and pictures be used to illustrate the concepts in the text. More internet contents and links should be included, for example, links to videos – it will be wonderful if English subtitles can be added if there are not any.

5 Discussion

Students' feedback on the textbooks is in general very positive. We are now more confident about the quality of the books we have produced.

The majority of primary schools students have a 'neutral' response to the 'listening tasks', but this was found to be due to the fact that many teachers have not asked students to download the e-version for their own study. A large percentage (41.23%) of secondary school students are 'neutral' to the statement 'the layout and design of the book are nice'. As well, nearly half of secondary school students were neutral to the statements that say the books help them improve on their writing, listening, and speaking abilities. These are the areas which we need to seek improvement in future update of the books.

Teachers were also quite positive about the content and presentation of the open textbooks.

The majority of the teachers indicated that there was not much difference in their teaching strategies when open textbooks are used, as the open textbooks were not much different from commercial textbooks. This in a way reflects the ease and comfort of the teachers in using the open textbooks for the first time.

In our discussion with teachers, we found many teachers seemed to own the textbooks. ‘Post-it’ tags were used to bookmark the books, which were themselves heavily annotated. They were aware that they can modify the books in future if they wish. This sense of ‘ownership’ of the open textbooks is exactly what the open textbooks project wishes to instil in teachers. It is only when teachers see themselves as the owners of the open textbooks that they will start to get involved and collaborate in further enhancing the open textbooks for the teaching community to share. We believe with more contributions from teacher users, the quality can be further improved.

Many teachers noted that students are happy to have the books because they are free — this is a strength of the open textbooks which we should not overlook. Free to use is an important selling point (and motivation for adoption) of the open textbooks and this is confirmed by initial feedback from teachers and students.

Notwithstanding student excitement over free textbooks, being free of charge does not necessarily mean that teachers were equally interested in using them. Teachers’ choice of textbooks depends on a variety of factors other than costs, as revealed in our study. In our earlier study, we found that the most important factor in selecting textbooks is the quality of content, followed by the effectiveness of their application in teaching and learning, the level of difficulty and the provision of support resources, with textbook prices being the least important factor. The provision of supplementary exercises is also necessary, though this may only be applicable to textbooks on languages. Training in the use of hardware and software associated with the open textbooks is also needed to increase the desire of teachers to use them.

6 Conclusion

Feedback from users of Hong Kong’s first open textbooks is positive. This is a strong indication that our textbooks are of the quality well received by users (students and teachers). It is very encouraging for the planners and administrators of the project.

It is encouraging to note that most teachers who have used the open textbooks have developed a sense of ownership over the books. Ownership is the first step for teachers’ involvement in future modification the open textbooks. The improvement on the quality of the open textbooks depends on many teachers participating in contributing to the open textbooks project.

The findings of the present study are in line with those of open textbooks projects in other countries. For example, a study (Petrides *et al.*, 2011) on the Community College Open Textbook Project (CCOTP) found that a major advantage of the project was the cost reduction that removed a significant obstacle to success in college education. We find similar results in our survey — students welcomed the 'free' textbooks they were provided with.

As well, online textbooks can lessen the students' burden of carrying heavy copies of the books to and from school (Petrides *et al*., 2011). In our case, this feature was also realised, as the printed textbooks are produced in separate modules, so each booklet is light in weight.

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A study of the relationship between instant messaging communication and student assessment results

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Abstract. The use of instant messaging is very popular among local undergraduate students. The situation when instant messaging is used in tutoring undergraduate students is studied in this paper. These students need to submit an essay assignment as the overall assessment by the end of a university course. A large group of university students who are tutored under two teaching methods are covered and the instant messages exchanged with their tutor are recorded. The collected data are compared to the final assessment results obtained by these students. It was found out that those students who incline to exchange instant messages with their tutor are those more capable as well as those less capable ones. Besides, the gender of students is also found to be an influencing factor on exchanging instant messages.

Keywords: Flexible Teaching and Learning, Instant Messaging Communication, Feedback

1. Introduction

The possession rate of mobile phones is very high in Hong Kong. According to the Office of the Communications Authority (The Government of Hong Kong Special Administrative Region), there are now more than 17 million mobile subscribers (out of a population of around 7.26 million by the end of 2014) in Hong Kong. The mobile phone penetration rate of about 240% is very high in the world. In fact, the use of mobile digital devices (such as smartphones) is very popular among undergraduate students in Hong Kong. The rapid advancement of information communication technology enables more flexible teaching and learning in higher education. Timely communication between teachers and students is considered to be important in achieving better learning experience. This applies to students in both open universities and conventional tertiary institutions.

Many students use instant messaging (IM) software communication tools such as WhatsApp for communication purpose. There have been some researches done on studying the use of instant messaging in enhancing the teaching and learning experience of local students. However, the focus of these researches is on the students' views on using instant messaging communication tools. Besides, the target participants of these researches are mainly those students who worked on individual dissertations or small-group projects.

This paper aims to study the effect of using instant messaging communication on the assessment results obtained by a larger group of students studying for a university course. The group of students who have involved in instant messaging communication with their tutor is focused. A statistical study of the relationship between assessment results and the extent of using instant messaging communication as well as other factors like gender of students and teaching method is conducted.

2. Relevant research

Formative assessment of student learning is made as the student progresses through the course. It is widely accepted that students should receive feedback on how they have performed on formative assessment before any summative assessment. Summative assessment is usually held in form of a final examination for most university courses. However, these summative examinations usually provide little or no feedback to students on how they have performed.

Learning and feedback

Bruner (1970) points out that learning depends upon feedback given to the learner, and several factors such as location and timing of feedback can affect whether feedback is useful to the recipient or not. Another researcher Jacobs (1974) proposed that there are two important properties of feedback: the informational and hedonic components. The first component enables the recipients of feedback to change and improve their performance while the second component influences the recipients' motivation. Besides, there are two important types of feedback: positive and negative. Positive feedback can reinforce the likelihood of repeating desirable behavior, while negative feedback can affect the reception of feedback information and subsequent action(s) of the recipient. Jacobs (1974) further discusses the advantages and disadvantages regarding the order of receiving positive and negative feedback.

Role of teachers

Bangert-Drowns *et al.* (1991) emphasize that feedback plays an important role in the mutual influence between the learners and their environments including the teachers who provide feedback. Other researchers Jonassen & Grabowski (1993) suggest that there should be an alignment of feedback with the learner's characteristics. They point out that learners differ in their abilitiy to interpret feedback and apply it to new situations. Falchikov (1995) considers the importance of feedback in assessing student performance. He points out that effective learning depends on feedback to the learner. The provision of quick and helpful feedback is very beneficial to students. Cowan and George (1997) and Cowan (1998) consider the role of teacher in the formative assessment. They point out that the teacher can understand the learning progress of learners during the teaching and learning activities conducted. In the distance education context, Stone (2012) considers the important relationship between teachers and students. A positive relationship enables better students' academic achievement. In the similar context, Yates *et. al.* (2014) suggest that staff members should be more student-centered so that students' course completion rate could be improved.

Effective feedback

Hedberg and McNamara (1985) identified two types of learners: field dependent (FD) and field independent (FI) learners. FD learners make fewer errors when their errors are explained and they are given advice to correct them. FI learners make fewer errors when they are told whether their answers are correct or not. Mory (1996) indicates that feedback can play an important role in the aspect of learning and instruction. Mason & Bruning (2001) point out that effective feedback aims to: (1) help learners in identifying their misconceptions and inadequacies; (2) help learners to establish performance expectations and understand their learning progress; (3) support learners to achieve their learning goals.

Bangert-Drowns *et al.* (1991), Mason & Bruning (2001), Mory (1996) study different types of feedback and consider the level of verification and elaboration of information provided in the feedback. Other researchers like Sales (1993) and Jackson, Krajcik & Soloway (1998) introduce the concept of adaptive feedback in which learners choose the feedback that suits their needs or preferences. They emphasize on the need to provide customized or personalized information instead of generic feedback to learners. In their study, Arroyo *et al.* (2001) found out that male learners benefit more from brief and concise explanations, while female learners can understand explanations and perform better if the feedback is clear, structured and interactive. Gouli, *et al.* (2006) propose an adaptive feedback framework (AFF) providing personalized feedback accommodating learners' individual characteristics and needs in the context of computer-based learning environments.

In the distance learning context, Stone (2012) considers the important relationship between teachers and students, and points out that a positive relationship enables better students' academic achievement. In the similar context, Yates *et. al.* (2014)

suggest that staff members should be more student-centered so that students' course completion rate could be improved.

Feedback and instant messaging

The use of instant messaging can enable the sending of customized feedback by teachers to students. The issue has been discussed by Yue (2014a). He examines the students' reaction to the use of a typical IM tool in supervising dissertation students. He finds that students are very positive towards the use of IM and that female students are more active in exchanging instant messages in the undergraduate dissertation context. Yue (2014b) further his work on the measurement of student engagement aspect. In a paper relating to the present study, Yue (2015) considers the issue of using instant messaging in tutoring a larger group of students enrolled in a typical university course.

3. Methodology

The target participants of this study are students who enrolled in one information systems (IS) course. These students are studying for an undergraduate Accounting programme offered by a British university in co-operation with the City University of Hong Kong. The teaching involves a 15-hour lecture followed by a series of 6 weekly tutorial classes each lasts for 1.5 hours. The face-to-face tutorial classes are conducted by a male tutor. Students are supposed to prepare for the tutorial sessions by undertaking the tutorial exercise questions and tasks set out in advance. It is expected that students will learn how to complete the assignment after attending all six tutorial classes.

Regarding assessment, the students are required to submit a course assignment which is an essay not exceeding 2500 words. The essay is a formal piece of work and accounts for 100% of the overall assessment for the course. The essay is an individual assignment and each student is required to work on one of the three assigned

IS-related topics: Supply Chain Management, the Internet, Customer Relationship Management, relating to a business organization (and its related information system(s)) selected by the students. The assignments are marked according to the performance on the following aspects: topic and business organization chosen; business analysis of strategic challenges and opportunities that the IS addresses; presentation of assignment report, etc. The common submission deadline of assignment report for all students is about three weeks after the last tutorial class scheduled.

There are 11 tutorial groups of 243 students enrolled on the course. There are two different teaching (tutoring) methods: tutor-centered (Method A) and student-centered (Method B). For Method A, there are 5 tutorial groups of 113 students attended the tutorial classes without the need to presenting the tutorial questions orally. These students attended the tutorial classes involving a minimal amount of group discussion. The tutor played an active role and presented the answers to the tutorial questions in details following some brief class discussion. Regarding Method B, six tutorial groups were involved. Each of six selected tutorial groups (totaling 130 students) consists of around 20 students and is divided into 6 teams with 3-4 students each. Each team of students is required to present their prepared answers orally once during the whole 6-week tutorial period. The students who presented the tutorial questions played an active role for the first half-hour of tutorial class time followed by the comments and discussion initiated by the tutor.

During the first face-to-face tutorial class, all students are invited to contact their tutor when they would like to consult him on questions relating to the course. The students are welcome to send electronic mail/ instant messages or telephone their tutor direct. The details of such contacts with the tutor are recorded for analysis purpose.

4. Findings

Throughout the 6-week tutorial period, only a few face-to-face contacts and electronic mails were exchanged between the tutor and students. Instant messages (using WhatsApp) were only exchanged between the tutor and students after the tutorial classes ended. About 18% of students (44 students out of 243 students) contacted the tutor using WhatsApp before the assignment submission deadline on 29 September 2014. These messages relate to: (1) choice of essay topics; (2) choice of appropriate business organization and its information system; (3) details of various sections in the assignment ; (4) assignment submission arrangements, etc.

The number of issues (each issue involves a number of IM exchanges) raised in the IM exchanges for each student ranges from 1 to 10 and the average is 2.52. The average number of days that such IM exchanges for a student is 6.77 days. Most students started to exchange IM with the tutor after the last scheduled tutorial class and continued till the assignment deadline. The average number of days that students started to exchange instant messages with their tutor is 14.9 days before the assignment submission deadline.

Some other statistics are compiled as listed in Table 1. The average attendance rate (of attending tutorials) for those who have exchanged IM with their tutor (5.39) is higher than that (4.57) of those who have not done so. Besides, the correlation coefficient (0.009) of assessment marks and attendance rate for those students who have exchanged instant messages with their tutor is very close to zero and is much weaker than that (0.243) for students who have not done so. Regarding the assessment marks obtained by students, 37 is the lowest marks while 71 is the highest marks awarded. It can be seen that the average assessment marks are higher for female students than those for male students for the four IM-Method combinations except the last one as shown in Table 1. On the other hand, the average assessment marks obtained by those students who have exchanged IM with their tutor is 56.09 which is higher than that (54.83) obtained by those students who have not done so. For those students who have exchanged instant messages with their tutor and are taught using Method A, the average assessment marks (60.00) is the highest among all four IM-Method combinations as indicated in Table 1. On the other hand, for the those students who have exchanged instant messages with their tutor and are taught using Method B, the average assessment marks (52.52) is the lowest among all four IM-Method combinations.

Table 1. A table showing assessment marks obtained under different combinations of IM and teaching method.

		IM-Method Combination					
		WhatsApp (YES)			***WhatsApp (NO)***		
		Method A (Tutor-centered)	***Method B (Student-centered)***	***Sub-total***	***Method A (Tutor-centered)***	***Method B (Student-centered)***	***Sub-total***
	Overall	**(1)**	**(2)**		**(3)**	**(4)**	
Number of students	**243** **105 (M)** **138 (F)**	**21** **4 (M)** **17 (F)**	**23** **6 (M)** **17 (F)**	**44** **10 (M)** **34 (F)**	**92** **43 (M)** **49 (F)**	**107** **52 (M)** **55 (F)**	**199** **95 (M)** **104 (F)**
Average attendance (Out of 6)	**4.72** **4.30 (M)** **5.04 (F)**	**5.62** **5.75 (M)** **5.59 (F)**	**5.17** **5.67 (M)** **5.00 (F)**	**5.39** **5.70 (M)** **5.29 (F)**	**4.58** **4.12 (M)** **4.98 (F)**	**4.57** **4.19 (M)** **4.93 (F)**	**4.57** **4.16 (M)** **4.95 (F)**
Average assessment marks (Out of 100)	**55.06** **53.89 (M)** **55.95 (F)**	**60.00** **59.25 (M)** **60.18 (F)**	**52.52** **51.83 (M)** **52.76 (F)**	**56.09** **54.80 (M)** **56.47 (F)**	**55.17** **52.88 (M)** **57.18 (F)**	**54.53** **54.54 (M)** **54.53 (F)**	**54.83** **53.79 (M)** **55.78 (F)**

Correlation between assessment marks and attendance	**0.217** **0.239 (M)** **0.138 (F)**	**-0.332** **0.440 (M)** **-0.363 (F)**	**-0.074** **-0.031 (M)** **-0.056 (F)**	**0.009** **0.110 (M)** **0.023 (F)**	**0.376** **0.404 (M)** **0.199 (F)**	**0.140** **0.137 (M)** **0.155 (F)**	**0.243** **0.241 (M)** **0.174 (F)**

Note: M stands for male students and F stands for female students.

5. Conclusion

In this study, students who have exchanged instant messages with their tutor can understand the requirements of the assignment better. Their completed assignments are of better quality and therefore obtain higher marks than those students who had not contacted their tutor using IM. Among those students who have exchanged instant messages with their tutor under Method A scored higher in their assignments than those under Method B. This could be due to the fact that, under Method A, more explanations were given by the tutor within the tutorial class period than under Method B. Under Method B, the students' oral presentations took up some class time and leaving lesser time for the tutor to elaborate the somewhat more "correct" answers to the tutorial exercise questions. Some comments received from the students revealed this situation. It is of interest to take note of the observation that, in the present study, tutor-centered teaching method (Method A) rather than the student-centered method (Method B) leads to better average assessment marks for the Accounting students under this study.

The above-mentioned two Method A and Method B situations correspond to the highest and lowest average assessment marks indicate that more capable students as well as those less capable students are more inclined to exchange instant messages with their tutor. Based on the results of this study, another observation is that the female students are more active than the male students in exchanging instant messages with their tutor. Furthermore, the female students scored higher than the male students in the assignment. This observation is similar to that made by some researches done in studying the use of instant messaging in the supervision of some undergraduate business students on their dissertation..

This paper considers the situation when there is no summative examination for a course. The students under study focus mainly on the completion of their assignment which accounts for 100% of overall assessment. This situation is very common in the offering of courses via the open and distance teaching mode. Further research in this area is of interest. Another line of research that justifies further work is for other university course situation in which there are both continuous assessment and a final examination for formative and summative assessment respectively.

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The impact of mobile technology on the learning of management science, and the development of problem-solving skills

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Learning is the construction of knowledge. E-learning is the application of information and communication technology (ICT) to make education accessible to learners who are physically not on-site. It is ubiquitous, enabling learners to study whenever they prefer and from wherever they are in the world. In the learning of problem solving skills through the subject of Management Science, the mobile technology plays an important role in enhancing students' understanding and learning. This paper presents part of research findings of a sample of 15 students who are undergraduates and four facilitators in the class of Management Science. With the introduction of wireless and mobile technologies, the respondents have mixed opinion about the efficacy of mobile learning whether it could enhance or retard their learning of MS. The implications of the study are suggested.

Key words: mobile technology, management science, e-learning, problem solving skills.

1.0 Introduction

The advent of new generation of smart phones has changed the lifestyles of people dramatically. The third-generation mobile networks, or 3G, was introduced in to the U.S. in 2003 which has a minimum consistent Internet speeds of 144Kbps. It was equipped with "mobile broadband", but the capacity of 3G connection now has improved by ten times to an Internet speed of more that 400Kps, with more network capacity for more data per used, and better voice quality. However with the emergence of 4G phones in 2015, it is considered a 'heaven' for users who like to surf the Web and especially stream video. If connected to a laptop to the mobile link, the 4G makes huge difference in transferring large amount of data (Cassavoy, 2015; Segan, 2014). Mobile technology, whether 3G or 4G, has dramatically changed the methods of learning, communication and information access among students via e-books, e-learning, Face book. You Tube, mobile blogging, MySpace, PLS, Moodle, and other digital tools. The mobile generation stays connected with their peers via SMS, WhatsApps, chat rooms, and emails messages, and expect the teachers or institutions to be connected in the same manner. This new wave of communication has created the need for educators to be more knowledgeable and savvy with the use of mobile technology such as virtual-classroom learning experiences.

The discipline of Management Science (MS) came into existence due to the need to solve problems. Problem solving is regarded by many educators as the most meaningful and important way of learning and thinking. It is also regarded as one of the educational objectives in the international education system (OECD, 2004). Moreover, most of MS problems are real world problems but complex in nature. Studies reported that MS methods have been increasingly used for tactical, operational and organizational decision making in Malaysia and many other Asian countries (Chang & Hsieh, 2008; Munisamy, 2012). However, in Malaysia, studies (Mahavera, 2014; HRDF, 2011, PISA, 2012; PISA, 2014) periodically reported that fresh graduates generally lacked problem solving skills when they started on their careers. Problem solving skill is one of the critical skills sought-after by the employers.

In the learning of problem solving skills through the subject of Management Science, it is envisaged that the mobile technology could play an important role in enhancing students' understanding and learning. Firstly, mobile technology enables students to learn anywhere and at any time (Ching, 2009; Watson & White, 2006; Attewell, 2005; Wentzel, Lammeren, Molendijk, Bruin, & Wagtendonik , 2005). Siraj and Nair (2008) reported that students from digital generation prefer self-accessed information, which allows self-paced learning and discovery of learning interesting topics. Ten years ago, Prensky (2005) envisioned that there was a need for education system to take heed of the pervasiveness of mobile technology, and to embrace it into the pedagogical practices.

In Malaysia, many higher education institutions, whether public and private, have invested on e-learning to enhance student's performance by incorporating mobile technology (Manimekalai, 2014). While several studies (Adkins, 2011; Rosli, Ismail, Idrus, & Ziden, 2010; Ragus, 2006) have shown that mobile learning offers convenience to students because of easy access to information anywhere at any time, Abas, Chang, & Mansor (2006) found that 44.09% of students of Open University of Malaysia were less willing to subscribe to mobile learning. Therefore, the purpose of this research is to explore the behavioral intentions of MS students in adopting mobile-learning. The technology adoption model (Hassan, 2009; Davis, Bagozzi & Warshaw, 2009) has been used as the basis of the research.

2.0 Methodology

The main objective of the study was to investigate to what extent had the MS students adopted to use mobile-learning in solving problems in MS. In order to probe the 'real-world' issues on adoption of mobile-learning in solving problems in MS, a phenomenographic approach was used to gather detailed and rich qualitative data. Accordingly, a phenomenography such as this, has allowed the researcher to examine students' learning experiences that had happened in their natural situation while solving the MS problems.

This case study was conducted on 15 MS students in a private education institution in Malaysia. It was considered important that students who participated in this study were matured enough to make informed judgments about the adoption of mobile learning. Furthermore, these MS students were chosen because they were in the second and third year of their bachelor degree, and were supposed to be familiar with mobile learning approaches. Before the interviews, the students were asked to fill a questionnaire to seek their perceptions on mobile learning. Individual face-to-face interviews were subsequently conducted and the interview questions were guided by the responses from the questionnaires. This was to allow the researcher to probe the 'real-world' issues and enrich the data on the adoption of mobile learning in solving MS problems.

3.0 Results and Discussions

In this study of 15 MS students, majority, (80.0%, 12) of them were females. They were the age-group of 20-22, and due the attendance requirement of the programme, attended the face-to-face lecture.

3.1 Perceptions of Respondents on M-learning

Table 1 presents the perceptions of participants on M-learning gathered through the questionnaires, indicate that they agreed to 'Relevancy' but were neutral on 'Helfulness'. But they disagreed on the fact that M-learning was able to substitute the instructor, and able to accelerate their problem solving skills in MS. They further lamented that M-learning was time consuming and therefore resorted to not making use of M-learning.

Table 1: Perceptions of Participants on M-Learning in Solving MS Problems

Rank	Details of Items	Mean	Std.dev.
1	Relevancy	3.57	0.54
2	Helpful	3.43	0.79
3	Substitution	2.57	0.79
4	Slowness	2.14	1.06
5	Time Consuming	1.29	0.49
6	Frequency of Use of M Learning	1.14	0.38

Based on their perceptions, and as active participants in their own learning, it would be interesting to interview these students to listen to their 'voices' in adapting and adopting the M-learning in solving MS problems.

3.2 The Voices of the Participants on M-learning in Solving MS Problems

Individual interviews were conducted to fathom deeper, the reasons for using the M-learning approaches among the participants. Their voices are to enrich their responses to their perceptions in the survey. These responses were typical answers to specific questions.

Do you understand what is meant by mobile technology?

A bit, not so much, for accessing notes directly. I still preferred paper notes. (P1, Female)

Yes, such as learning system on-line. (P2, Male);

It could be inferred that most of the participants had a 'rough' notion of mobile technology, but not the depth and importance of it.

Do you find it useful in helping your learning (the subject MSM)?

It helps you learn. Easier to find info, quicker & more efficient if only to search for one piece of info. No need to open the computer, it is very distracting. (P15, Female)

A bit, not so much, for accessing notes directly. I still preferred paper notes. (P13, Male).

The results seem to suggest mixed-feeling of the efficacy of M-learning in helping the participants in their learning. Their responses indicated that M-learning is time-consuming.

Do you find M-technology change your learning style?

Yes, go to library less often. Even go to library, will borrow lesser books.(P13, Female)

No, I still like to read hard copy. Reading on the screen has a lot of radiation and make my eyes very tired, can't read long, still prefer print out. (P11, Female).

Whilst the participants acknowledged that M-learning reduced their time to visit the library, they were not acceptable to read the on-screen notes, and preferred hard copy materials.

Do you find e-learning useful in your learning?

Yes, go to Library less often. However, I still like traditional printed materials. I preferred class. (P10, Male)

Depends on the subject. For MSM, I can study by myself, not necessary to attend class, preferred to learn it by my own pace. I focus on areas which are different from the lectures. I can't focus on the class. Usually I will chat with my friends in the class. (P8, Female).

Being exposed to other subjects, the participants preferred to study on their own, being reinforced by their friends and printed materials.

Is the e-learning enough to replace the face-to-face class?

I still need table, chair and printed books. E-learning is just supplement. (P2, Male)

No substitution. I found I can learn better in the classroom environment. (P8, Female).

Practically all participants preferred to attend the 'traditional' classroom environment in learning the MS subjects.

These interviews had fathomed an in-depth knowledge on the reasons participants adopted or reluctant to adopt M-learning in solving the MS problems.

Based on the survey and interviews, it could be summarized that whilst M-learning is an innovative change to learning, the participants in this study were not prepared for these changes. They preferred to the traditional face-to-face teaching and interaction in delivering the lessons. Similar findings were also reported by Zainab (2003) and Manimekalai (2014) in that new technologies for learning and teaching need time to be accepted by the users.

4.0 Conclusion

The findings presented in this paper are from the 'voice' of participants studying the MS programme. The findings provided in this study could help educators the need to educate the learners and instructors on the efficacy of M-learning in the modern classroom. It is important to note that the efficacy of M-learning described here needs to be addressed not only for the sake of current situation and students, but also in the light of implementing M-learning in MS subjects as well as across the undergraduate curriculum as well. After all, problem solving is seen as most meaningful and important way of learning and thinking. The ability to aptly apply cognitive skills in problem solving is considered as the fundamental and crucial aspect in a human life

It is hoped that the findings will stimulate further development and improvements in advocating the successful implementation of M-learning in advocating problem solving skills amongst Malaysian students, especially in MS.

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Game on, science: How game technology may help physics to tackle visualization challenges

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Abstract: By studying several popular animation techniques in their respective fields, which are html5, flash and unity3D, we have drawn a conclusion that the game industry(unity3D) develops ever more advanced technologies to improve rendering, image quality, ergonomics and user experience of their creations providing very simple tools to design new games. In physics science, some experts with specialized know-how have been able to design interactive visualization applications to tackle visualization challenges. But there are some limitations of both picture performance and platform portability about the applications. Due to the problems, our work is to explore the use of these applications and integrate Unity3D game engine to develop a physical model of visual interactive APP so that students can dowload it to mobile devices to study.The development of angular momentum ,as an example, combining this viewer with 3D physical models from experimental data, could provide unprecedented opportunities to gain insights into the conformation–function. Publishing the model to native-APP can break the limitation of time and space, allowing learners to access learning materials by mobile phone or pad to have ubiquitous learning.

Keywords：Unity3D；physical model；multi-platform；ubiquitous learning

1 Introduction

My tutor, as a general physics teacher in Tongji University, with his research team, has developed a large number of physical models about the textbook to assist teaching. These models make views easier and more vivid, but abstract theory is difficult to achieve. They use virtualization technology in three-dimensional graphics technology, namely C ++ builder and OpenGL, to achieve a three-dimensional simulation in the mechanical optical electromagnetic etc, interactive operation. They applied these models to teaching by inserting them into PPT, uploading to relevant network platforms as a learning resource for students to download. After teaching practice, we found that these models are of great value in teaching because of their strong sense of reality and faster computing.

The learning theory of constructivism emphasizes student-centered strategy, considering the student is the subject of cognition and can actively construct knowledge. These models indeed have certain educational value, but they can only run on pc. Due to the limitation of platform, they can only serve as a teaching tool for teachers, while students can not personally be involved in presentation during the teaching process. The purpose of this paper is to solve this problem, helping to play the main role of students by transplanting these models to their own mobile devices. The developments of mobile technology for mobile devices make transplantation more possible. More importantly, for a student majoring in educational technology, this paper must introduce new technologies and build new models from an educational point, instead of blindly following the trend. In this paper, by comparing current mainstream technology with own characteristics, we choose the most appropriate technology, namely Unity3D, to realize the goal, hoping more educators can use technology to support their teaching as well.

2 Introduction of Mainstream Technology in Physics Teaching

2.1 Applications of Flash: Virtual Laboratory

The development of virtual experiment in China is at high speed and has entered a very mature stage now. Dalian University of Technology was the first to establish a virtual laboratory on Physical Chemistry by using VB(Li, 2006).The virtual laboratory was a stand-alone mode at early time. Based on flash technology, virtual laboratory turned into online version of the simulation lab with strong interactive capabilities and thus spread easily in the network.

The project of Science and Technology Innovation in Northwest Normal University used tools of author-ware and flash to develop virtual laboratory for junior high school in physical education. The project belongs to "High School Information Technology Education Experimental Zone" (Song, 2009) .The laboratory simulated 22 physics experiments in the textbook of junior high school. Each experiment involves experimental purposes, experimental principle, experimental procedures, and laboratory exercises and other aspects. For the typical important experiment, the laboratory also offers equipment and animations of experimental operations.

2.2 Applications of Html5: Web-APP

The reason why smart devices have been able to rage, in addition to its smooth touch-screen experience, is that they have large number of software applications. Whether in Apple's App Store or Google Play, the number of applications is rapidly growing. Although Native SDK has many advantages, it can't support cross-platform using.
Developers need to develop different versions of the same application for different devices, costing more significantly. However, HTML5, as a Web-based development tool, can solve the problem of cross-platform. A single write by Html5 can meet three mobile terminals (Android, IOS, Windows) with the same experience. The Webkit-based Web browsers can support Html, JavaScript, CSS(Tang, 2012). Therefore, the

Web-APP begins to emerge, which can be scanned based on web browsers. Html5, as one latest technology, with its significant advantages, has been used in wider areas. In 2014, it was used in physical education by the form of web-APP to illustrate spring.

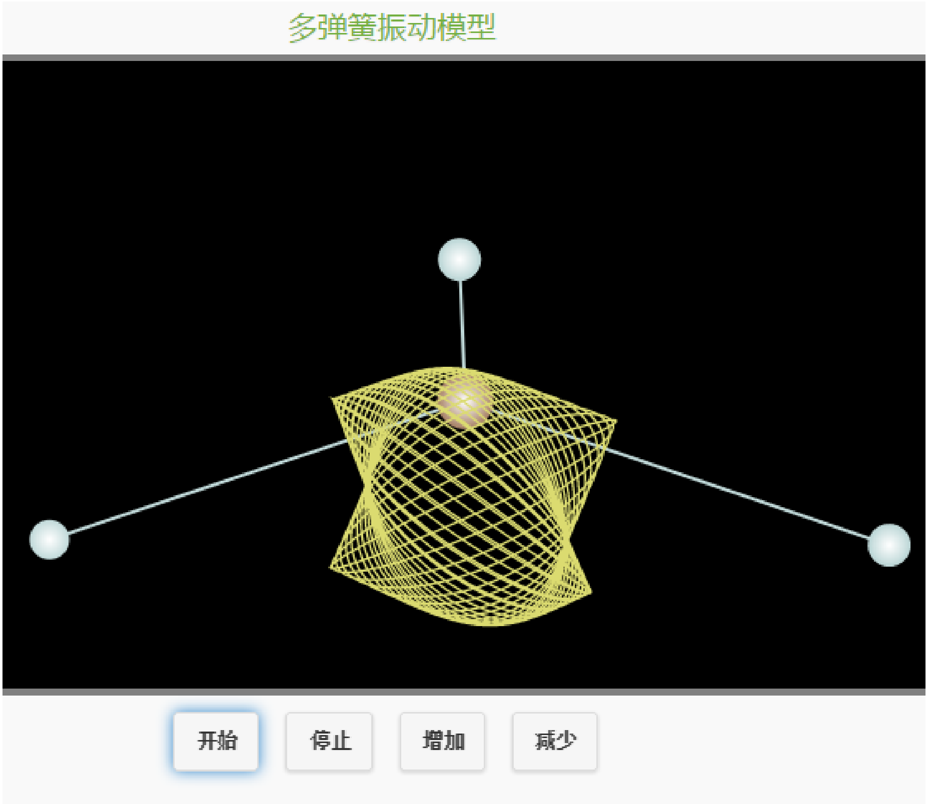

Fig. 1. Multi-target model renderings rocker(Yan, &Wu, 2014)

2.3 Applications of Unity3d: Education Game

These engines have been shown to be useful for other applications, such as simulation research(Brad, 2012). In China, there is a great educational game recently, "Rangers Bear". The object of "Ranger Bear" is intended to associate English words learning with the desire and satisfaction in playing game, which can achieve conversion of motivation and stimulate students' interest (Li, &Wang, 2015). "Ranger Cubs' is developed with Unity3D, a popular Game engine. By this 3D game engine, we can easily create terrain, tree, water, etc. It also supports import of 3D models from 3Dmax and Flash.

3 Analysis of Their Respective Characteristics

3.1 Stability

Flash: Flash is a cross-platform. It does not matter what the operating system and browser are, and whether you use the old IE or the latest Chrome. As long as there is Flash Player platform, you can make it.

HTML5: HTML5 has been developing all the time. The drawbacks are: even if you have done nothing, your works may still have potential possibility to crash because of upgrading or a different browser.

Unity: Unity's web player has the same advantages with Flash. Also, the Unity plug-in is cross-platform.

3.2 Mobility

Flash: Until today, I can say that flash plug-ins, besides iOS platforms, are great support for mobile platforms.

HTML5: As Html5 is more and more supportive for mobile devices and iOS5, have witnessed a significant improvement in its performance.

Unity: Considering the strengthen of Unity3d lies in the compilation of native mobile applications, it has the best mobile features.

3.3 3D Effects

Flash: Flash Play 11 introduced Stage 3D which is essentially OpenGL 2.0. Adobe has done a standard work to realize it, but there are still many notices.

HTML5: We are here to talk about WebGL, which is technically similar to Stage 3D. However, drawbacks still exist in many important fields, such as failure of full screen, absence of mouse capture (Flash Player 11.2 can do), lack of multiple render targets and instance drawing deficiency.

Unity: Unity still supports 3D. Among limited tests, the results are perfect so that it is the best solution of 3D game at present.

4 To Assist Physics Instruction for Teacher, Which One is More Appropriate?

To assist physics instruction and learning, and solve visualization problems, which is more appropriate? So, the standard of a better technology is whether a teacher's positive motivation can be stimulated and the students would like to use their products. Through the above comparison, Flash, HTML5 or unity3d is of teaching value in some way， and html5, unity3d may be two major trends in the future. However, we

must consider whether the technology is easy or not. An easily studying software with powerful functions should be the best choice. This is because the teachers know how to teach but they can't program. It would discourage teaching staff's activity to develop difficult technology when they need technology to solve their problems.
Html5 is difficult for the majority to learn according to investigation, because of its complex underlying code. However, Unity 3d, as an excellent game engine, has many integrated functions for use.

4.1 Abundant Modules

Various GUI and NGUI modules in Unity3D enables users to conveniently create their own interfaces. There are also many well developed plug-ins. What you only need to do is to import these plug-ins to achieve different functions

4.2 Physical Engine

A physical engine can simulate real-world physics, such as collision of two objects and free-fall object. PhysX of NVIDA in unity can render critically realistic images. For example, rigid body is a very important module in physical engine. When a rigid body is added to an object, it possesses many properties, such as mass, frictional force and collision, and thus reacts to all effects in physical engine.

4.3 One-click Publishing into Native APP

Unity3D has the function of one-click publishing into APP. One model can be published several times, and every time we can choose the version you want. Main versions are Android and iOS versions. The process of publishing is very convenient and simple.

Download and install the sdk

You'd better download the latest version of the SDK on official website of Unity3D.The reason why you have to do so is that when you unpack the root directory, you will find that there is a well-done configuration for your development environment. As a result, the SDK can be used directly, which will greatly simplify the tedious process to configure a development environment on your own computer. But still you need to download the virtual machine, which is also very simple to operate. Just click on SDK Manager.exe in the root directory of your downloaded file.

Complete entering more details about APK

Select "Edit" on "Menu" after opening Unity3D, then click "preference". Enter installation path of your SDK at "External Tools" on the new window when clicking "preference", and close the window at last.

Set specific properties of your APK

The final step is to set APK information by clicking "Edit-project setting-player" and customize details of the APK, such as the app icon, the resource version, supported API version and so on.

5 Case Study——Angular Momentum: Developing Physical Models with Unity3d

Furthermore, game engines have previously been used for large simulation researches where they are proven to work well in several different disciplines(Jeremiah, &Zhou, 2014).

5.1 Design of Physical Model

Model is for undergraduate students, who have curiosity and independent thinking. Therefore, a combination of demonstration and test, can mobilize the enthusiasm of students to explore.

The model is consistent with the knowledge in textbook, with the goal of visualizing abstract formula by actual object. By separately simulating each variable, students can change the value of a single variable by slider, observing movement change. The model includes clearance problem for students who must answer the questions correctly before operating another slider.

5.2 Model Development

Build the scene

By "GameObject", you can new a cube, cylinder and so on. Adjust the size, position until it looks like wheel precession

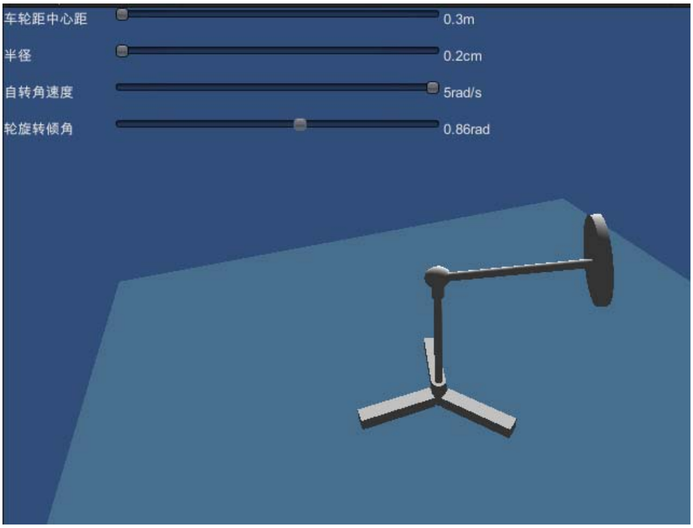

Fig. 2.:the model view

Key Code

The distance from the wheel to center ：

```
transform.localPosition
```

Rotation rate:

```
dlObj.transform.RotateAround(gunObj.transform.position,new Vector3(0, 1.0f, 0), 2.3F * Time.deltaTime*Q )
```

Rotation angle Wheel:

```
dlObj.transform.rotation = Quaternion.Euler(a*10,0,0)
```

5.3 Installation of the Model to Mobile Device

Release the model as apk or ios native APP by very simple process.
Then install the APP at mobile terminals so that users can study at idle time without WIFI.

5.4 The Core Methods to Simplify the Development Process

As we control the father object rotating, the goal to rotate child objects will come true. However, other technology like OpenGL will draw the scene in every frame because of its development mechanism, which is extremely complicated. Consequently, Unity3D will be very attractive to teachers who have little ability to programming.

6 Summary

Unity3d has a great effect of 3D and physical engine to simulate some real-life physical phenomena that cannot be observed in reality, such as the distribution of electric field lines, the special theory of relativity relative motion, Brownian motion, etc. On the other hand, models can be published into native App and further installed on different mobile terminals. So far, Unity3D is more applied to education games. We hope that there are more teachers involved in the application to assist their instructing in the future.

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Optimizing the learning of the analytics process using a reinforcement learning framework

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Abstract. Learning analytics (LA) is a relatively new research field concerned with analyzing data collected from various sources so as to provide insight into enhancing learning process and teaching. As suggested by Campbell and Oblinger (2007), a complete LA process typically involves five distinct, yet interrelated, stages (namely, capture, report, predict, act, and refine), which form a sequential decision process. Thus far, research efforts have been mostly focused on studying independent research questions involved in individual stages. It is therefore necessary to have a formal framework to quantify and guide the whole LA process. In this paper, we discuss how reinforcement learning (RL), a well-understood sub-field of machine learning, can be employed to address the sequential decision problem involved in LA process. In particular, we integrate LA stages with RL framework consisting of state space, action space, transition function and reward function, and illustrate with example how the three most studied optimality criteria: finite horizon, discounted infinite horizon and average reward model, in RL can be applied to LA process. The underlying assumptions, advantages and issues of the proposed RL framework are also discussed.

Keywords: Learning Analytics, Learning Analytics Process, Reinforcement Learning, Machine Learning, Optimization

1 Introduction

In recent years, the proliferation of learning management systems (LMS) and digital devices has captured sheer amount of data on learning activities. An emerging research field called learning analytics attempts to apply analytics techniques (e.g. data mining) to the collected data so as to enhance the learning experience. One of the most successful applications in learning analytics is Course Signals (Arnold & Pistilli, 2012), which applies learning analytics to increase students' success rate.

According to the definition adopted by the 1st International Conference on Learning Analytics and Knowledge (Long, Siemens, Conole, & Gaševic, 2011), learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs. Learning analytics is also considered as the endeavor to enhance teaching and learning via the targeted analysis of student demographic and performance data (Fritz, 2011). Campbell and Oblinger (2007) propose five stages – capture, report, predict, act and refine – to model LA process systematically. Clow (2012) later enriched the process by closing the feedback loop and developed Learning Analytics Cycle. Specifically, the cycle begins with *learners* whose information and learning activities are logged, and then the captured *data* are processed into *metrics*, based on which *interventions* are taken so as to affect the learners' learning. Clow (2012) also pointed out that the speed and scale of the intervention is of paramount importance to the effectiveness of the feedback cycle. It is therefore necessary to have a formal framework that can quantify, automate, and guide the whole LA process efficiently and effectively.

From the perspective of control theory, the LA process can be viewed as a sequential decision task, which refers to the class of problems that need to decide and perform a sequence of actions so as to achieve a goal with a clearly defined and quantifiable measure. For instance, a quantifiable goal for a university student could be to complete a degree with either a minimum study time or a maximum grade point average (GPA). It should be noted that the sequence of actions to be taken could have both short-term and long-term effects on the sequential decision tasks. In other words, a strategic plan must be carefully considered as it is sometimes necessary to take an action that sacrifices an immediate reward such that a larger reward can be obtained later. Following the previous example, a student may need to take a sequence of courses so as to satisfy a degree requirement. If the student would like to graduate with the shortest possible study time, he or she may tend to take as many courses as possible at a time and complete each one with the minimum passing grade. However, the student may soon find it difficult to pass other high-level courses due to the poor foundation laid. As a result, the student may need to retake some courses and eventually spend even longer time to complete the degree.

The ultimate objective in a sequential decision task is to find a policy that provides a response to react in each possible situation encountered such that the best result for the quantifiable goal is guaranteed. However, solving sequential decision tasks by human effort could be challenging. Due to the enormous number of possible situations and the uncertainty involved in real-world problems, it would be extremely difficult, if not impossible, to manually specify the optimal action for all possible states. Instead, reinforcement learning provides a theoretical framework to optimize this decision task.

2 Reinforcement Learning Framework

Reinforcement learning (RL), a mature sub-field of machine learning, has been addressing the sequential decision tasks for a few decades. Modern RL originates from Markov decision processes (MDP) (Puterman, 1994) but it is also closely related to psychology, control theory and operations research. RL methods have been widely adopted in many real-world applications such as planning and control, robotics, and among many other problems, due to its generic framework and efficient algorithms for solving sequential decision problems. Generally speaking, RL is a paradigm that enables an agent to learn how to react in an environment with only numeric feedback signals and uncertain effects on actions. The goal of the agent is to perform a sequence of actions that optimizes (i.e., maximize or minimize) the total feedback (i.e., rewards or penalties) in long term. Modern RL problems are usually formulated into an MDP without any prior knowledge about the parameters of MDP. Specifically, an MDP consists of four components – a state space (S), an action space (A), a transition function (T), and a reward function (R), as detailed below.

2.1 State Space

A state (denoted by s) is an observable situation that provides sufficient information to perform an optimal action. In the notion of RL, the set of all possible situations forms a state space (denoted by S). While states can be either discrete or continuous, most studies in RL are concerned with discrete state space. In learning analytics, states could consist of information from various sources such as student demographics, grades in other courses, learning activities and logs in LMS, and class attendance.

2.2 Action Space

An action space (denoted by A) is a collection of actions. In learning context of learning analytics, actions (denoted by a) represent the set of available responses (interventions) during the learning analytics process. It could be an article suggested to a casual learner, a supplementary exercise for a student, or an alert to the teachers calling for learning support.

2.3 Transition Function

In the real world, uncertainty often occurs. An action taken during the LA process may have many possible outcomes or even could fail somehow. For example, if the LMS suggests a reading to a student, the student may have various levels of understanding about the content or may simply not read it. In such a case the resulting state could be different even if the same action is taken at the same state. The transition function indicates the probability from one state to another after taking an action. In the previous example, the transition function prescribes the chance that the student can achieve a given level of understanding after completing the suggested reading. Mathematically, the transition function is denoted as: $T : S \times A \times S \rightarrow [0,1]$. Or equivalently, $T(s,a,s')$ represents the probability of transferring from state s to state s' after performing action a in state s. Note that T is a probability distribution function. In other words, $T(s,a,s') \geq 0$ and $T(s,a,s') \leq 1$ for all states s and s', and all actions a. In addition, $\sum_{s' \in S} T(s,a,s') = 1$, for all states s and all actions a.

2.4 Reward Function

The reward function (denoted by R) quantifies the feedback or reward sent back to the system or learners in the form of numeric number, i.e., $R : S \rightarrow \mathbb{R}$. Typically a reward (denoted by r) is between 0 and 1, but it is also possible to have negative values to represent penalty.

2.5 Optimality Criterion

The optimality criterion defines precisely what is going to optimize. There are three common types of objective functions studied by RL community, namely finite horizon, infinite horizon and average reward model as shown in Figure 1.

$E\left[\sum_{t=0}^{h} r_t\right]$	$E\left[\sum_{t=0}^{\infty} \gamma^t r_t\right]$	$\lim_{h \to \infty} E\left[\frac{1}{h}\sum_{t=0}^{h} r_t\right]$
Finite horizon model	Infinite horizon model	Average reward model

Figure 1: Three commonly used optimality criteria in RL

The *finite horizon model* optimizes the expected rewards in the next h steps. In the above formulae, E[·] is the expectation over the stochastic rewards r_t, where t is the time index. Normally, h will be set to the lifespan of the RL problem, such as the maximum duration allowed for completing a degree. When h is not known beforehand, the *infinite horizon model* can be used to optimize the long-term expected rewards. The discount factor γ, where $1 > \gamma \geq 0$, guarantees the total rewards received to be finite, even with the infinite number of time steps. From the LA perspective, the discount factor can be interpreted as memory retention rate during the learning process or the possibility of continuity of study in the next time step. In the case that no natural discount factor exists, such as maximizing a student's GPA, the *average reward model* can be considered. It can also be viewed as the infinite horizon model when the discount factor is approaching to 1.

2.6 Solving RL problems

After the RL problem is defined, one may employ model-based or model-free RL algorithms (van Otterlo & Wiering, 2012) to obtain the optimal policy (i.e., a mapping from any given state to action) that assures the best performance with respect to the chosen optimality criterion. The optimal policy is basically a state-action lookup table that specifies what to do (action) in any given situation (state) such that the best result for the given LA problem is guaranteed.

3 Illustrative Example

Consider the following simple LA problem. Suppose an LMS would like to guide a student to learn two concepts (A and B). Initially the student does not have any knowledge about both concepts. There are two types of study materials, including notes (N_a and N_b) and readings (R_a and R_b) for concepts A and B, respectively. An LMS may choose any one of four study materials and present to the student for study. The goal is to facilitate the student to acquire both concepts as quickly as possible. The key question is whether the student should learn concept A before concept B or vice versa. Assuming that both concepts can be learned independently but not at the same time and their learning sequence may have different effect on the learning, we can formulate and solve the problem using RL framework as follows.

Step 1: Define the objective functions

The goal is to guide the student to learn both concepts as quickly as possible (i.e., minimizing the total learning time). Suppose there is no time limit for the learning and the student will eventually learn both concepts. In such case, the infinite horizon model without discount (i.e., $\gamma = 1$) can be adopted. Formally, the objective function is to minimize $E\left[\sum_{t=0}^{\infty} \gamma^t r_t\right]$, where r_t is the study time required to learn each concept given by the reward function.

Step 2: Identify the state space

The concepts acquired by the student after studying the notes and readings would be the states of the problem. So, the state space consists of four states in this example – *None*, *A*, *B*, and *AB*. Note that the state *AB* is called the goal state (or absorbing state) and the learning process ends when reaching the goal state. The following figure illustrates how these states are related to each other.

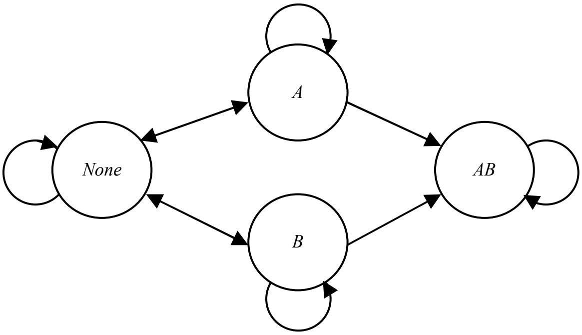

Figure 2: 4-state learning analytic problem

Step 3: Identify the action space

As specified in the problem, the student must study the notes and readings in order to acquire the relevant concepts. So, the action space consists of four actions – N_a, N_b, R_a and R_b. We also assume all study materials will be followed by a quiz to examine the student's understanding on the specific concept.

Step 4: Define the transition function

Data are collected from the LMS based on other students' learning history on concept *A* and *B*. The transition probabilities $T(s, a, s')$ are presented in the following table.

Table 1: The transition probabilities $T(s, a, s')$ of 4-state learning analytics problem

a	N_a R_a / N_b R_b	*s'*: *None*		*A*		*B*		*AB*	
s	*None*	0.3	0.1	0.7	0.9	0	0	0	0
		0.4	0.2	0	0	0.6	0.8	0	0
	A	0.1	0.05	0.9	0.95	0	0	0	0
		0.2	0.05	0.3	0.1	0.1	0.1	0.4	0.75
	B	0.3	0.2	0.1	0.1	0.4	0.2	0.2	0.5
		0.2	0.1	0	0	0.8	0.9	0	0
	AB	0	0	0	0	0	0	1	1
		0	0	0	0	0	0	1	1

The transition function can be interpreted as follows. By presenting notes N_a to a student who do not have any knowledge on concepts *A* and *B*, there is a probability of $T(None, N_a, A) = 0.7$ that the student successfully learns concept *A* and a probability of $T(None, N_a, None) = 0.3$ learning nothing. State *AB* is the goal state (also known as absorbing state as indicated by the transition probabilities). Based on the transition probabilities, we may note that concept *A* is easier to understand by studying reading R_a and acquiring concept *A* first helps learning concept *B* because $T(A, N_b, AB) > T(B, N_a, AB)$ and $T(A, R_b, AB) > T(B, R_a, AB)$.

Step 5: Define the reward function

The reward function $R(s, a)$ specifies the study time required to learn each concept by presenting a specific study material as given in Table below.

Table 2: The reward function $R(s, a)$ of 4-state learning analytics problem

$R(s, a)$ Study time (days)		a			
		N_a	R_a	N_b	R_b
s	*None*	3	5	4	6
	A	1	2	2	3
	B	2	3	1	2
	AB	–	–	–	–

(Note that state *AB* is a goal state so that there are no effects on any actions taken.)

Step 6: Solving the RL problem

After the RL problem is formulated, the optimal policy can be obtained by using offline model-based learning RL algorithms such as value iteration. Based on our computation, the optimal policy can be found in 24 iterations and the optimal expected learning time is 8.835 days with an error less than 9.17×10^{-6}. The optimal policy is shown in the following table.

Table 3: The optimal policy of 4-state learning analytics problem

State	Action
None	N_a
A	R_b
B	R_a

The optimal policy indicates when a student has no prior knowledge on both concept *A* and *B*, notes N_a should be provided to the student for study in order to obtain the best learning result. If the student has already understood concept *A*, reading R_b should be presented instead. In the case that the student has acquired only concept *B*, reading R_a should be suggested for study.

4 Discussion and Conclusion

Reinforcement learning provides a rigorous and yet flexible model for formulating the learning analytics process. It serves as a mathematical tool which utilizes data collected from various sources and suggests an optimal action to perform at any given situation during the learning process. As such theoretical optimality can be obtained through existing RL algorithms. There are a number of advantages of using RL framework for modeling learning analytics. First, RL defines a quantitative measure for learning objective and offers actions (interventions) that optimize the learning objective. It also allows both deterministic and probabilistic effects on the actions taken. Second, formulating LA as RL problems can often be solved with theoretical optimality effectively and efficiently. RL and related problems have been studied for decades and many efficient algorithms have been developed. The underlying MDP can be solved by online or offline algorithms with optimal policies or approximated solutions depending on resources such as computation time. In addition, the model allows comparison of the quality of policies and learning performance in a quantifiable measure. Third, the characteristics of various RL models are well understood and previous research effort in RL could shed some light in understanding LA problems. There might also exist some research problems that are unique to LA and have not been thoroughly considered before by the RL community. It would be interesting and beneficial to see the exchange of ideas and the joint effort in both communities.

Despite the promising future, there are also some issues in applying RL framework to LA. First, the huge amount of data collected from various sources implies the size of state space to consider could be enormous. As a result, the sizeable state space may greatly affect the effectiveness of the RL algorithm and this problem is known as the curse of dimensionality in RL community. Second, in order to learn the optimal policy, an RL agent must first collect sufficient data about an environment. However, the data collected from LMS could be bias and the complete dynamics about an environment may not be always available. In particular, some actions taken on a state may be rare in LMS data and its effect is therefore not certain. It is related to the issue of exploration-exploitation in RL. Finally, MDP assumes the so-called Markovian property where all information required determining an optimal action is captured by the current state. In reality, states may not be fully observable and need to be inferred through a series of observations. In such cases, the RL model should be extended to partially observable MDP (Spaan, 2012).

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Tools and techniques for creating compelling mobile learning content

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Abstract. In this paper, I will elaborate on various tools and techniques that are commonly used to create E-learning content. Ubiquitous E-learning content that can be easily consumed using mobile devices can also be easily produced using commonly available consumer gadgets such as video cameras, voice recorders and smart phones. A wide selection of software also exists today, such as Camtasia, PowToon and VideoScribe which can be used to generate compelling video content for the purpose of mobile learning. In addition, there are also a wide variety of apps such as Recordium, Typorama, WordSwag and Phoster that can be used to assist educators in getting their messages across to students.

Keywords: mobile learning, video creation, video animation

1 Introduction

In this paper, I will be introducing various tools and techniques that can be used to create E-learning content in the form of text, images, audio and video. Creating E-learning content for students can be done fairly efficiently by busy lecturers and teachers using methods that are straightforward and easy to master.

The Institute for Financial Literacy (2015) is a collaboration between MoneySENSE (2015), a national financial education programme for Singapore and Singapore Polytechnic. Since 2012, I have been working as the IT Manager for this Institute and have created 20 online courses for people to learn financial literacy concepts. The online courses are based on material used in the regular face-to-face courses. Much of the material exists in the form of Powerpoint slides. I have found that an efficient and straightforward approach of creating E-learning material is to record voice narration for each Powerpoint slide and publish these in video format. Over the last year or so, we have also experimented with the usage of VideoScribe (2015) and PowToon (2015) to make our videos more interesting and engaging. These video animations have been generally well received.

The result of this is that we have managed to attract about 57,000 online students (as of May 2015) to our online MOOC platform, namely, Udemy (2015). I hope that through this paper, you will be able to learn about various tools and techniques for creating engaging E-learning content that can be used both in the classroom as well as online.

2 Mobile Content Formats

There are basically four main formats for delivering online mobile content. These are text, images, audio and video. In this section I will be elaborating on the advantages and disadvantages of these formats. I will also discuss various tools and techniques of creating mobile learning content in these formats. The ultimate aim is to produce an interactive multimedia learning experience for the learner. Blanchard (2013, p.237) defines interactive multimedia as follows: “Training using interactive multimedia (IM) integrates the use of text, video, graphics, photos, animation, and sound to produce a complex training environment with which the trainee interacts”.

2.1 Text

Delivering mobile content using text is one of the most straightforward and easiest methods. This involves typing in text content using a keyboard and publishing it to your Learning Management System (LMS).

The advantage of using text to deliver content is that text, which is published online can usually be easily edited as necessary. Text content also allows the readers to read the content at their own pace. For example, Fig. 1 shows how text is used in the LMS used by the Institute for Financial Literacy to communicate the concept of setting S.M.A.R.T. financial goals.

Text is a ubiquitous method in which information can be shared using mobile devices. This can be evidently seen from the popularity of Short Messaging Service (SMS) and many other messaging apps that are available such as WhatsApp (2015). Text content is efficiently transmitted through electronic means. Besides transmitting text content, WhatsApp is also able to transmit images, audio and video.

The disadvantage of text content is that it may take more effort and concentration of the part of the reader to consume the content in comparison with images, audio and video content. Text content is also less engaging than multimedia content.

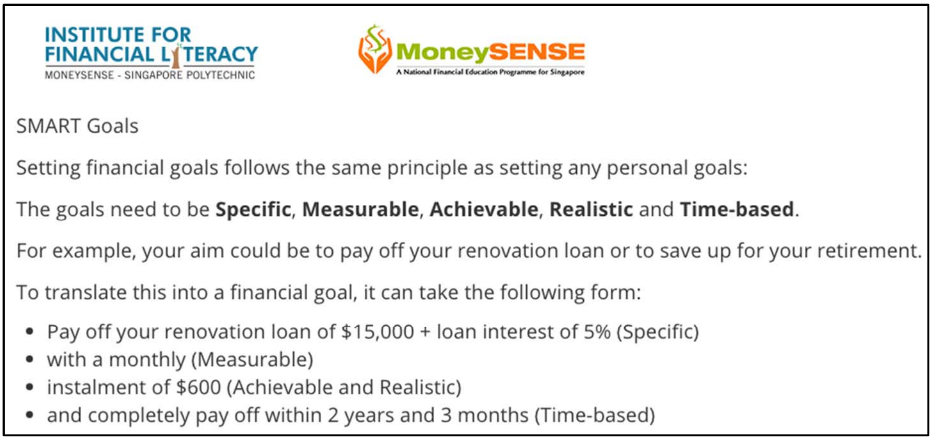

Fig. 1. Using text content in a Learning Management System

2.2 Images or Graphics

Another very common method of delivering mobile content is through the use of images or graphics. Savage (2014, p.122) defines the term graphics as “a wide range of pictorial representations from simple line drawings to blueprints, charts, graphs, logos, paintings, photos, and the individual frames of animations and movies”. Mobile phones with cameras can easily be used to capture photos and produce images, which can be also used in an E-Learning context.

The advantage of using images to deliver content is that images are inherently more interesting to look at than text alone. They can be used to convey ideas and emotions in a manner that is more effective than text alone. For example, Fig. 2 shows a page from the My Money Book publication from MoneySENSE (2015). Notice how the cartoon illustrations convey the feeling of sadness when one encounters a situation of taking on too much debt.

There are also a wide variety of Apps that can be used to edit images and add attractive typographical text before publishing the image at a click of a button. For example, Fig. 3 shows an image that was taken using a mobile phone and edited using the **Word Swag** App (2015). Typographical text was added in to convey a message of “Avoid The Debt Trap”.

A wide variety of typographical styles exist on this mobile app which allows any non-technical person to easily add in attractive typographical text to images. Two other Apps which have similar affordances are the **Typorama** (2015) and **Phoster** Apps which are available on the iOS platform. Another example is shown in Fig. 4 which was created using the **InstaQuote** App (2015) which allows quotations to be quickly rendered as an attractive image which can be shared through mobile devices. Indeed, a “Picture Is Worth A Thousand Words”.

The disadvantage of images is that they require more bandwidth to transfer using mobile devices. There is also the danger of abusive, defamatory or pornographic images. It is best for educators to warn their students about posting these images online which will inadvertently get them into trouble.

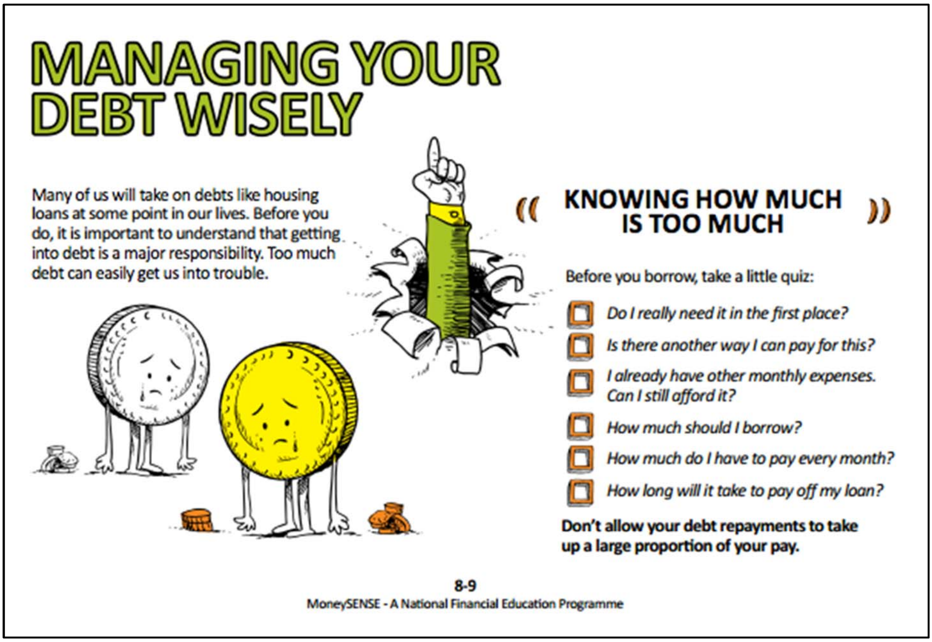

Fig. 2. Using images together with text

Fig. 3. Image taken with mobile phone and edited with WordSwag App

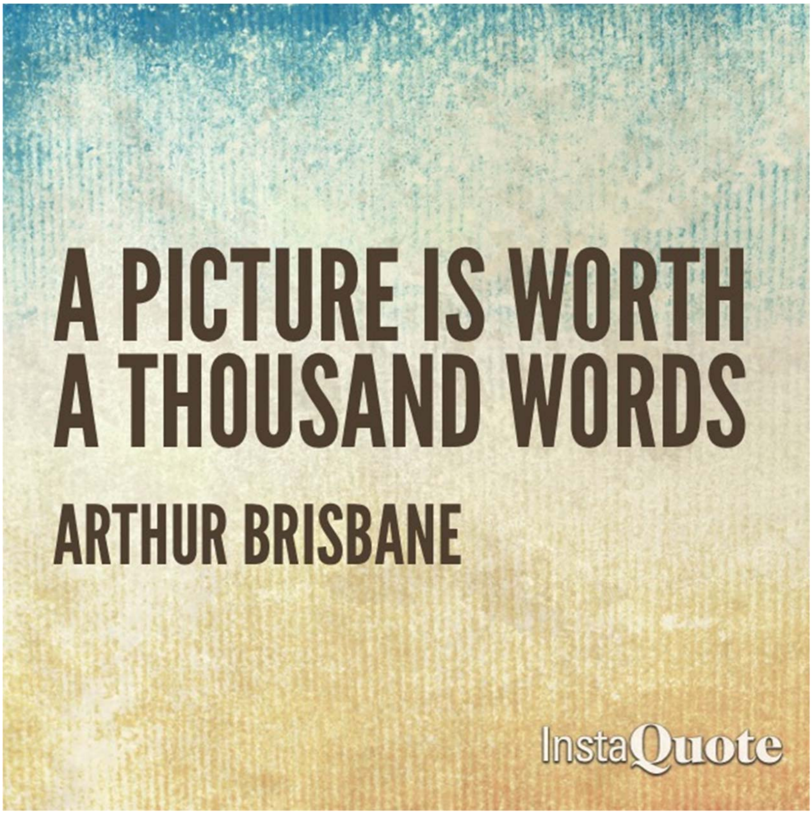

Fig. 4. Image of a quote created directly from the InstaQuote App

2.3 Audio

Good quality audio is an essential part of creating quality E-learning material. In this section, I will discuss ways of recording good quality voice narrations for creating E-learning material.

Having good audio recording equipment is indispensible. Fortunately, such equipment need not be costly. For example, I regularly use the Zoom H1 Handy Recorder (2015) to record audio narrations. These audio narrations are then used as the basis for creating engaging video animations. Audio can be captured as either uncompressed WAV files or as high quality MP3 files.

The Zoom H1 Handy Recorder can either act as a stand alone audio recorder or it can act as an audio interface when connected to a computer via a USB cable. Newer models such as the Zoom Q3HD Handy Video Recorder allow for both audio and video recordings.

I have also experimented with audio recording Apps such as **Recordium Pro** App (2015) which runs on iOS devices. The quality of the audio recording produced through the microphone of my mobile phone will not match the quality of the Zoom H1 Handy Recorder. Nevertheless, it is a convenient alternative.

It is possible to make long MP3 recordings of lectures using such devices. However, simply recording an entire lecture and publishing it as an MP3 file may not be the best practice. To capture and hold the attention of students in a distracting online environment, it is best to create short clips of between 1 to 3 minutes. Each clip should have a focused, targeted message so as to maintain the attention of the listener. Enders (2014, p.8) has corrected observed that most of the time, mobile devices are used "for short bursts of activity. Five minutes here, ten minutes there to perform a specific task".

In practice, I have not published MP3 files alone as E-learning material but I have added in a visual element using tools such as PowToon and VideoScribe which I shall describe in the next section.

The disadvantage of audio is that modification of audio recordings takes more effort than editing text or images. Content in the voice narration cannot be easily changed apart from re-recording the entire clip.

2.4 Video

With the advancement of mobile phone technology, video can be played back on most Smart Phones. Video is a combination of the audio and visual elements and is arguably the most engaging medium that you can use to publish E-learning material. As Udell (2015, p.78) has rightly observed, "In many situations, video can be used as an excellent learning tool. When being able to visualize a task or view a series of steps is easier and more efficient than a text description or static photos, videos can work extremely well."

The Institute for Financial Literacy, Singapore, has been using the Udemy platform to publish many courses related to financial literacy. In order for an online course to be approved by Udemy to be released on their online marketplace, one of the requirements is for the course to consist of at least 60% video content. Udemy also requires the video to be clear, well lit, and high definition.

Many of the online courses created by the Institute for Financial Literacy exceed the minimum requirements set by Udemy. Some of our courses are composed of 80% or more of video content. In this section, I will elaborate on the various methods that have been used to create the E-learning video content.

The disadvantage of video is it takes more time and resources to create. Modifying videos that have already been created is also generally more difficult than modifying text or images.

Recorded Powerpoint

This is one of the easiest and most cost effective ways of producing E-learning material in video form. It involves getting a script ready before launching a screen capture program to record the Powerpoint slides together with voice narration. Fig. 5 shows how a recorded Powerpoint can be published as a movie file on the Udemy E-learning platform.

There are many screen recording software that can do the job of capturing the screen display together with voice narration. One example is **Camtasia** (2015), another is QuickTime. Note that the screen recording function is only available on the Mac version of QuickTime.

In practice, I have found that a good approach of recording Powerpoint is to record slides one at a time. Sometimes if may take several attempts before a good recording is made from a single Powerpoint slide. Also, recording the slides one at a time will allow for easier editing at a later stage in the event that any content from the slides need to be modified.

Fig. 5. Example of Recorded Powerpoint published on Udemy

Recorded Demonstrations On Screen

Screen capture programs can capture whatever activity is happening on your computer screen. Besides Recording Powerpoint, it is also possible other software such as your Internet Browser or Microsoft Excel for example.

Fig. 6 shows an example of a screen recording where the concept of compounding interest is explained using Microsoft Excel. Viewers are able to see in a dynamic way what happens when the interest rate changes.

Fig. 7 shows an example of a screen recording where the usage of the Retirement Savings Interactive Calculator which can be found on the Singapore Central Provident Fund Board website (2015) is explained.

It is up to you to choose whatever software or website is relevant to the subject matter to record.

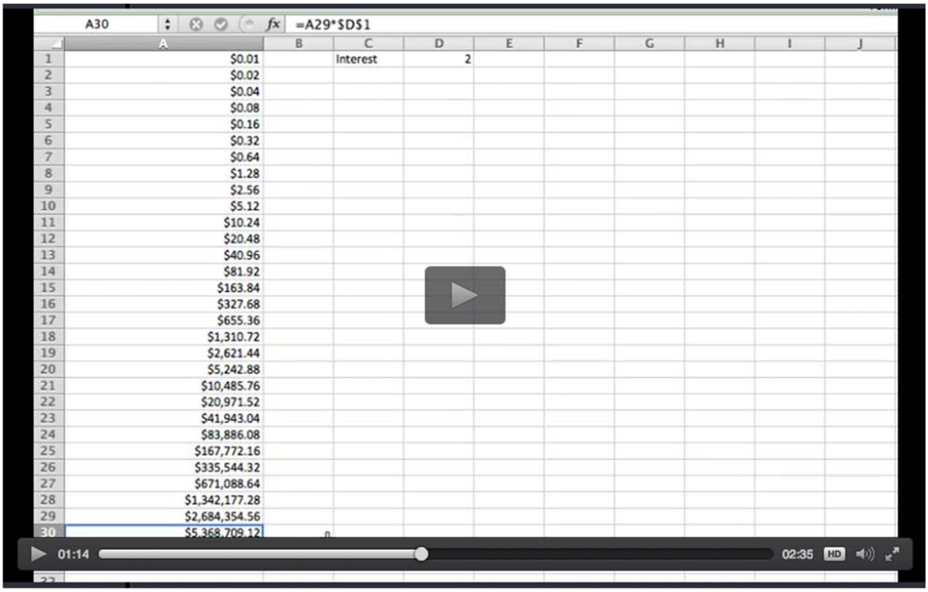

Fig. 6. Recorded Microsoft Excel demonstration

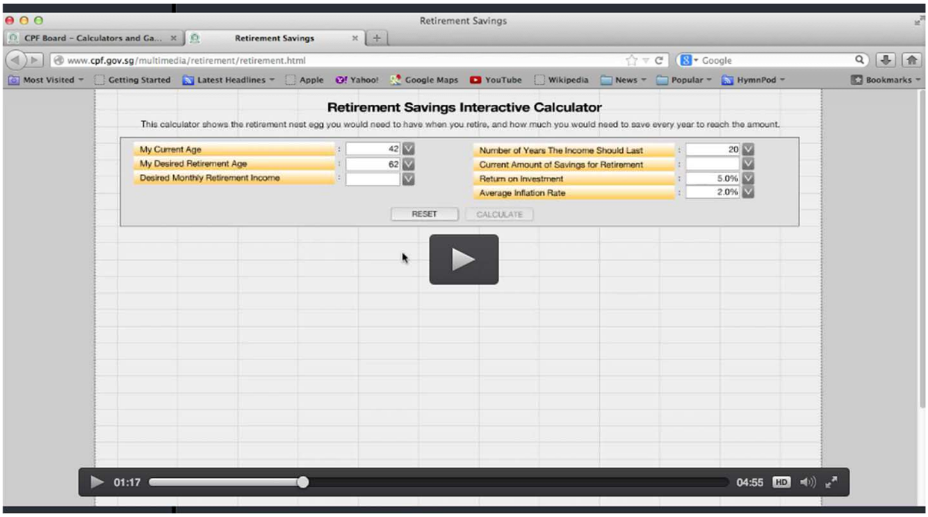

Fig. 7. Recorded demonstration of the Retirement Savings Interactive Calculator

VideoScribe Animations

VideoScribe is a software that allows anyone to create engaging whiteboard style animations with little design or technical know-how.

Fig. 8 shows an example of a VideoScribe animation which is titled "Where Did Your Money Go?". This video explains the importance of tracking one's expenses. It also explains the concept of "Paying Yourself First".

The general approach that I adopt when creating VideoScribe animations is to first prepare a script. This is following by recording and producing an MP3 file containing the voice narration of the script. After this, the voice narration is imported into the VideoScribe software. Text objects and images are placed on the screen following the timing of the voice narration closely. After everything is done, a background music track can be added in, and the movie is published.

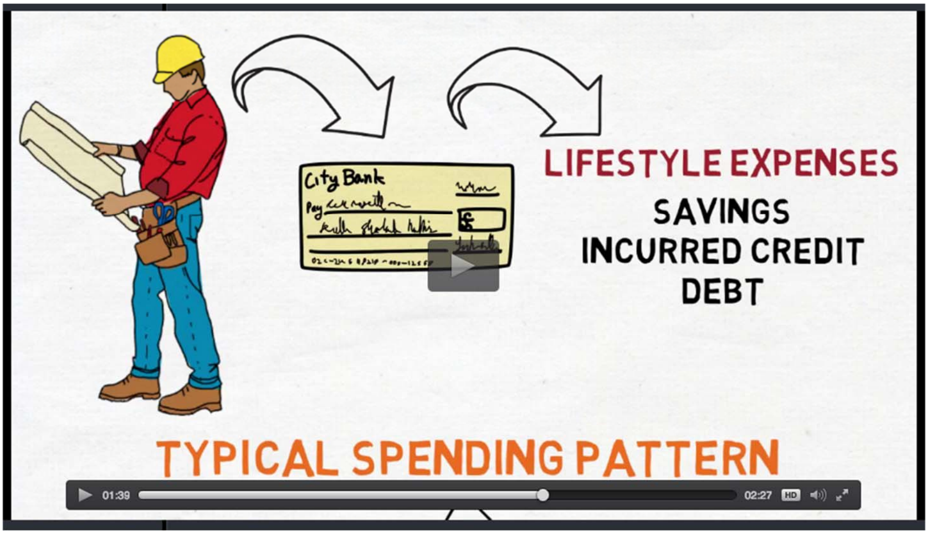

Fig. 8. VideoScribe animation

PowToon Animations

PowToon is an online platform that allows users (PC or Mac) to create engaging cartoon-like animations and publish them in video format. Technically, it is not difficult to create PowToon animations as it is simply a matter of dragging objects on the screen and using timeline to adjust the timing of the various objects.

Fig. 9 shows an example of a PowToon animation which is titled "The Real Cost Of Instalment Plans" which aims to convince the viewer than it is often much more expensive to pay for items through instalment plans rather than to pay the full upfront costs.

My preferred method of creating PowToon animations is also to record the voice narration first and use the voice narration to time the entire animation.

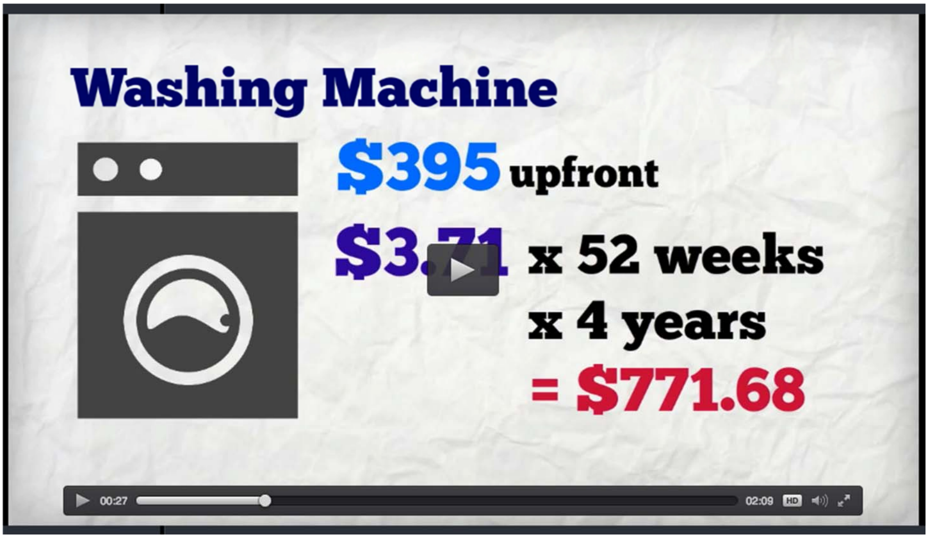

Fig. 9. PowToon animation

Videoing the Instructor

Another method of creating E-learning material is to video the instructor directly. This involves setting up a video camera as shown in Fig. 10.

The instructor needs to be confident enough to look at the camera and explain the concepts as best as possible. In practice, it is often necessary to make several takes before the getting the finalized video recording.

The advantage of this method of generating E-learning videos is that there is a more personal touch where a human face and voice is seen and heard. The disadvantage of this approach is that editing or changing the contents of the video may be time consuming and laborious.

The equipment used to the video recording need not be expensive. Even your smart phone can be used. As Tasner (2015, p.137) observes, “the video quality on a mobile phone continues to improve with each and every phone that comes out. What’s even better is that you already have this device on you wherever you go, so you can easily record ‘in-the-moment videos’”.

Fig. 10. Videoing the instructor

3 Survey Results And Feedback

A simple online survey was carried out to gauge the effectiveness of the Institute for Financial Literacy's E-Learning system. The results of the survey are shown in Fig. 11. Most participants found that our system is easy to use and well structured. Most participants also felt that they were about the grasp the key concepts presented online and that they were able to learn independently.

There were a few people, however, who felt that improvements could be made on the presentation styles to make it more interesting and engaging. Hopefully, with the introduction of more animated videos created using software such as PowToon and VideoScribe, improvements will be made in this area.

Indeed, the survey results do seem to indicate that people who consume E-learning content are looking for high quality animated videos with clear audio narrations.

Question 01 Please rate our e-learning system (*Mandatory*)

Answers 22 (100%) Skips 0 (0%)

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	AVERAGE
I find it easy to use the e-learning system	17	5	0	0	0	1.23
I am able to grasp the key concepts presented	12	10	0	0	0	1.45
The content is presented in a well-structured and logical manner	12	9	1	0	0	1.5
I am able to learn independently using the e-learning system	15	7	0	0	0	1.32
The content is presented in an interesting and engaging manner	12	6	3	1	0	1.68

Fig. 11. Survey Results

We also received some qualitative feedback as listed below:

"I think that the system is just fine. **Material is presented well** - concise, logical, and understandable. Whether or not one learns is up to the individual."

"Useful MOOC for a quick reference and understanding of key concepts."

"The materials are well presented. **The diction needs a little improvement**. Overall this is such a excellent course."

"**I like the video that bring us to the CPF website and show us how to use the CPF LIFE Payout calculator**. The video explaining the difference between the 2 CPF Life plans is also very informative. Thank you all for the nice and free course."

"I haven't completed course yet but from what I completed there is simply reading of whatever written. **There should be more pictures and other stuff cause just reading things on written material gets little uninteresting**."

4 Conclusion

In this paper, I have elaborated on the four main ways in which E-learning material can be created and used by students. These are text, images, audio and video. I have also mentioned various tools and techniques in which text, images, audio and video can be created for E-learning purposes. With the development of more sophisticated video creation tools such as PowToon and VideoScribe, it is definitely possible to improve the overall engagement level and quality of mobile learning content.

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A study of high school students doing physics experiments with Arduino and other data logging devices

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Abstract. Traditional high school physics labs rely on manual data logging or logging devices with slow data acquisition rate and low precision. This study aims to design data logging devices and a modeling tool for high school physics labs with low-cost modern electronics, including smartphones, Lego Mindstorms NXT, and Arduino equipped with an ultrasonic. For NXT and smartphones, experimental data were first recorded in the devices and then manually copied to personal computer for data analysis. For Arduino, experimental data were transmitted to a PC via BlueTooth in real time. With the data in a PC, each student used a modeling tool on a web browser to try to find an equation that fitted the data with a small error. The equation was a function that related a variable to another. For example, in a free fall experiment, the equation expressed distance as a function of time. With each submitted equation, the tool plots the model against a background of lab data with a measure of error. Based on the visual plot and the error information, the student can then try to reduce the error by revising the equation. Results indicated that both students and instructor enjoyed using the modern data loggers and using the acquired data to find equations that fit the data well.

Keywords: Physics labs, data logging, Arduino, Lego Mindstorms NXT, smartphones, mathematical modeling

1 Introduction

In the physics laboratories of high schools in Taiwan, there are two problems in general. First, many students still log data manually or by using logging devices with slow data acquisition rate and low precision. Second, they follow step-by-step instruction to get data to fit known equations of physics laws. To many students, this approach to confirming known laws takes away the fun of scientific exploration from lab work. This study proposes to address these two problems with modern low-cost, easy-to-access mobile devices and with an approach of model building (e.g., White and Fereriksen, 2000; Papert, 1980; Lesh & Zawojewski, 2007).

In physics classes, textbooks are often too abstract for many students to comprehend and might result in students' negative feelings towards the physics subject. In contrast, physics labs would be a perfect solution because they are fun to work on with measurements taken on the attributes of concrete objects. Moreover, interesting experiments can train students to think critically, solve problems, make decisions, and develop positive attitudes towards (e.g., Kaya and Boyuk, 2011; Shih et al., 2012). In studies by Kuhn and Vogt (2013), Monteiro et al. (2014), and Martinez & Garaizar (2014), smartphones, which were embedded with sensors, were used to log data in scientific experiments. However, smartphones evolve quickly and different brands and models of smartphones generally use different sensors with varying sensitivity and precision. Also, the specifications of these sensors are often not revealed due to commercial reasons. These issues sometimes cause difficulties for smartphones to serve as general data loggers in a physics class.

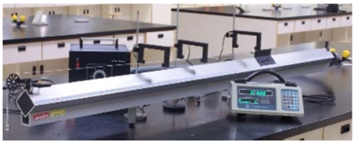
In a study by Church et al. (2010), Lego Mindstorms NXT were used in several physics projects in high school curricula. For example, a sound sensor was used to explore sound waves. The loudness of a sound wave was related to a wave's amplitude, energy, power, and intensity. One issue of using NXT in physics labs in high school is its price tag. In this study, we focus on the use of Arduino development board, whose sensors are more affordable in general, in several labs.

The mobile devices this study uses include smartphones, Lego Mindstorms NXT, and Arduinos. In this study, a restricted form of model building is used. Students first do physics experiments and collect data with the mobile devices. After the data are plotted, students are asked to find an equation to fit the data as best as they can. The target equation is not reviewed to the students until after all students finish finding their equations. The model building process is restricted because both the independent and dependent variables of the equation are pre-determined by the instructor so the students can focus on the function finding, i.e., data fitting, process.

Some earlier studies have tried out different mobile devices in a series of empirical studies (e.g., Wong et al., 2015). In these studies, students needed to transfer acquired data, after the running of each experiment, from the mobile devices to PC so that model building can be done on a web page with Internet access. Some students experienced problems in data transferring due to equipment problems or lack of experience. Also, some students experienced wiring problems on Arduino boards. In order to fix these problems, a low-cost data logging device based on Arduino is custom-made with the help of a vendor. Then an empirical study was done to find out more about the experiences of students in using this new device and other devices, and to the model building approach to doing physics labs.

Figure 1 shows three physics labs on motion: free fall, slope motion, and Newton's second law. In these labs, traditional data logging methods are used. In the free fall experiment, a digital video recorder recorded the images of a free fall body, which looked blurry, resulting in low precision of the distance measurements. In the experiment of slope motion, the ticker tape timer is time consuming and difficult to set up properly. In the experiment of Newton's second law of motion, three photogates are setup to capture the times at which the cart passes them. Since the distance between each pair of neighbor photogates are already known, three pairs of distance-time data are measured. In these three cases, the measured data generally suffer from one or more of three problems: low precision, low sampling rate, and few data. Low precision means each distance measurement might be accurate to up to 1mm instead of 0.1 mm. Low sampling rate means the number of data measured in one second. For example, in the third experiment, only three data points are measured in 0.2 second. Though some modern ticker tape timer might have higher sampling rate, e.g., 50 dots per second, most high school physics labs might not want to get such modern timer due to budget constraint.

Figure 1. Physics labs with traditional data logging methods

		
Free fall With digital video recorder	Motion on slope With ticker tape timer	Newton's second law of motion With photogates

To address the above problems, the authors proposed to use low-cost, accessible modern electronic devices to serve as data loggers in the above physics experiments, including smartphones and Lego Mindstorms NXT, and Arduino development board. Smartphones and NXT are very handy as data loggers since no wiring is needed for the smartphones and sensor connecters are ready to use. However, Arduino development board needs some wiring work to connect to sensors through resistors. In a preliminary study, the students using the Arduino development experienced some setup problems due to wiring and loose connection. In order to fix these problems, a custom-made logging device using an Arduino board is made with the help of a vendor. Thus this study conducted a more thorough empirical study using smartphones, NXT, and an Arduino data logger.

The Arduino data logger had ATmega328 processor with 2KB SRAM and 14 I/O pins. NXT had an ARM7 AT91SAM7S256 processor with 256K Flash and 64K RAM, three output ports and four input ports. The smartphone was an HTC one S with 80M pixels and slow motion video capture. This study attempted to compare the strengths and weaknesses of these three logging devices.

Figure 2. Three data logging devices

Arduino data logger	Lego Mindstorms NXT	HTC one S

2 Literature Review

2.1 Simple Harmonic Motion with Arduino

In a study by Galeriu et al. (2014), the researchers used an Arduino Uno board with an ultrasonic sensor to measure the simple harmonic motion of a mass hanged on a spring freely swaying up and down. The distance between the sensor and the mass was recorded by the sensor. A plot of position versus time with ORIGIN showed a simple harmonic graph. The first author was a college instructor and the other two researchers were instructors in a vocational high school. They wrote their programs and did the wiring to connect all the needed hardware components. Their hardware cost about USD $37.77 and the sampling rate was 100 data per second.

If students have to set up the same equipment and wiring, they have to spend much time in fixing many hardware problems. In order to minimize the wiring problem, we custom-make a data logging device based on Arduino Uno. Moreover, in Galeriu's setup, the UNO board was connected to the PC with USB. This might cause a problem in our experiments, where the data logging device might be too far away from the lab equipment that a common USB cable is too short. The data logger in this study is equipped with a Bluetooth transmitter that can send data wireless from the data logger to a PC with a Bluetooth dongle.

2.2 Mobile Devices and a Modelling Tool for Physics Labs in High School

In a study by Wong et al. (2015), an Arduino Mega ADK2560 development board with a MX2125 accelerometer, an NXT with a gyro, and a smartphone with an embedded gyro were used as data loggers in a pendulum experiment. Each data logger also served as the bob mass of the pendulum hanging on a light, thin flat long piece of wood. Each of three groups of students did the pendulum experiment with a particular logger. After acquiring the data, they plotted the data on a web page. A good set of data showed a simple harmonic motion graph with decreasing amplitude. Then from a plot, each student took 10 measures of period, which could be measured by the distance of two neighboring maxima, and obtained an averaged period. Each group of students did six trials with pendulum with six different arm lengths. After six trials, each student got six data points of length versus period. Then with a modeling tool called InduLab, each student tried to find an equation to fit the data with minimum error. If the equation found was a quadratic equation with 10% error or less, then the model was considered a success. The success rates for the three groups of students were 80%, 20%, and 50% respectively.

In this previous study, a development board of Arduino ADK Rev3 was used as a data logger. This board was based on an ATmega2560 processor with 54 I/O pins and 8KB SRAM. In short, this board computed faster than the Arduino Uno board used in this study. There are two reasons for using a slower board. First, the labs in this study did not need the fast computation supported by ATmega2560. Second, the Uno board is at a lower cost, which is an important factor since a lower cost could attract more high schools to use this data logger. Moreover, sensors are provided to work with this data logger so that students need not do any breadboard wiring so that hardware problems of accidental loose connections can be avoided.

3 Empirical Study

This study conducted an empirical study in a 10th grade physics lab elective course in a high school. Twenty eight students took the course and they were divided into six groups. In four groups, there were five members in each group. For the other two groups, there were four members in each group. In eight weeks they did two labs: free fall and motion on a slope (Table 1). Each lab took four weeks and was supervised by the physics teacher and one of the authors Mr. Guo. Each week, two consecutive lessons are used for lab work. In the first week, Guo explained and showed the students how to set up the equipment and run an experiment. In the second week, the students did an experiment with one type of data logger. In the third week, the students did the same experiment with another type of logger. In the fourth week, for the first lesson, each student found equations to fit two set of data (obtained with two different loggers), one set at a time. In the second lesson, the physics instructor explained what their findings meant with textbook theories.

Table 1. Labs and their data logging devices

<table>
<tr><th colspan="2">Lab</th><th>Free fall</th><th>Motion on a slope</th></tr>
<tr><td rowspan="3">Mobile device</td><td>Arduino</td><td colspan="2">PING ultrasonic distance sensor</td></tr>
<tr><td>Smartphone</td><td>Slow motion video capture</td><td>N/A</td></tr>
<tr><td>NXT</td><td>N/A</td><td>Ultrasonic distance sensor</td></tr>
<tr><td colspan="2">Data modeling tool</td><td colspan="2">InduLab</td></tr>
</table>

3.1 Free fall

In the lab of free fall, an Arduino logger was also used. The other logger was an HTC One S smartphone equipped with a camera that could take slow-motion video with 8 megapixel, backside-illuminated senor. In a free fall experiment with the Arduino logger, a ball was to fall down a transparent acrylic tube (Figure 3). The logger, with an ultrasonic facing down, was placed a few centimeters directly above the top of the tube. As the ball fell, its distance was recorded by the logger and transmitted to a PC simultaneously. A different setup was used for the smartphone logger. A paper scale was taped to a wall, where a ball was to fall in front of the scale. The falling ball was video recorded in slow motion by the smartphone. The slow motion would reduce the blur considerably compared with a video recorded with regular motion speed. Then a student manually checked the position and the time of the ball frame by frame in the video played on a PC with avidemux, which was a free software. The textbook theory of a free fall mass is given below, where S is the distance travelled, t is the elapsed time, v_0 is the initial velocity, a is the gravitational constant:

$$\mathrm{S} = v_0 t + \frac{1}{2} a t^2 \tag{3-1}$$

$$\text{if } v_0 = 0 \rightarrow \ \mathrm{S} = \tfrac{1}{2} a t^2, \ \tfrac{1}{2} a t^2 = \mathrm{k} \rightarrow \ \mathrm{S} = \mathrm{k} t^2 \tag{3-2}$$

Figure 3. The setups of a free fall body with an Arduino logger and a smartphone logger

	
Arduino	Smartphone

3.2 Motion on a slope

In this lab, Arduino and NXT were used as data loggers. A cart ran on a tilted track, which was a common equipment in a physics lab. At the top of the track, an Arduino data logger was mounted with an ultrasonic facing the cart about to slide down the slope (Figure 4). A vertical board was fixed at the end of the cart so that the ultrasonic signals can be reflected back to the ultrasonic sensor. The distance data logged were simultaneously transmitted to a PC equipped with a Bluetooth dongle. In another set up with NXT, the NXT logger with its ultrasonic sensor just replaced the Arduino logger at the same location. In contrast to the Arduino logger, the NXT can keep the logged data in its memory. After all data were logged, the data file would then be copied to a PC via a USB cable. The textbook equation for the motion on a slope is shown below, where S is the distance travelled, t is the time, g is the gravitational constatnt, h is the height of the highest point of the track, and l is the length of the track:

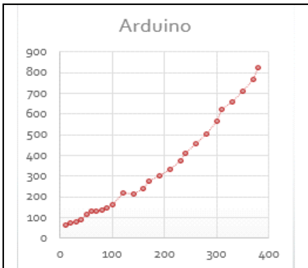
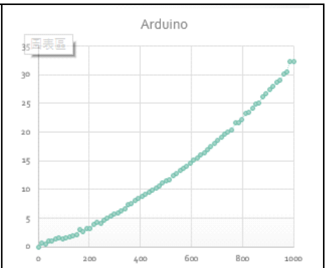
$$S = \frac{1}{2} * \frac{h}{l} * gt^2 \tag{3-3}$$

Figure 4. Motion data on a slope acquired by an Arduino logger

4 Data Modeling

After the data of an experiment was acquired on a PC, Excel could be used to plot the distance against its time. In the free lab or the slope motion lab, the data plot looked quadratic.

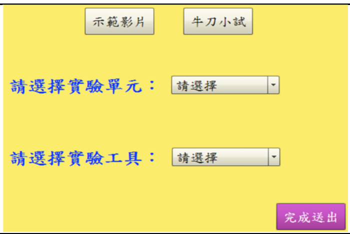
Figure 5. Data obtained by the Arduino logger were plotted with Excel

	
Plot of free fall data	Plot of slope motion data

4.1 Mathematical modeling

After the lab data were ready on a PC, each student used a web browser to connect to a modeling tool called InduLab we designed. The student then picked the proper lab and the logger type she used to collect the data. Then she entered 30 data points of time and distance. After the data were submitted, a data plot appeared. Then the student entered an expression on the right side of an equation, given that the left side of the equation was S (the distance travelled). In the example on the bottom right of Figure 6, the student first entered S=t*t/2, resulting in an error of 26.0. Then she entered S=t*t/1.5, resulting in a smaller error of 17.3. The model S=t*t/1.5 was plotted on a background of data points in order to give the student some visual clue of how good the model-data fit was.

Figure 6. A Modeling Tool InduLab



First page

Data submission

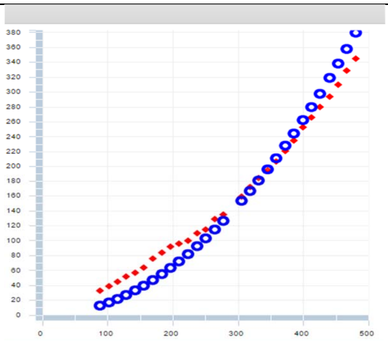
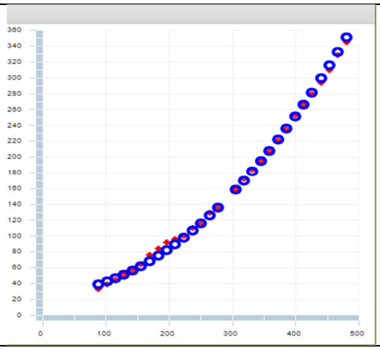
Data model and data plot

Model and data plots

4.2 An Example of Modeling

Another example of data fitting was shown in Figure 7. On the left side, the student entered a model S=4/2430t*t+1/1000t, resulting in a fitting error of 10.8. On the right side of the figure, the student revised the model to be S=4/2855t*t+1/1000t+28, resulting in a small error of 1.9. This reduction in fitness error matched the intuition of comparing the two plots. Clearly, the new model fitted the data much better than the old model. Both the visual cue and the numeric error feedback were helpful for the student to revise and improve the model to reduce the fitting error. All models entered by the student were recorded in a data base that can be used for later analysis by the researchers.

Figure 7. Sample model revision for a slope motion lab

Data plot and model plot		
Model	S=4/2430t*t+1/1000t	S=4/2855t*t+1/1000t+28
Fitness error	10.8	1.9

Since the sampling rate of a data logger affected the quality of the acquired data, which in turn affected the quality of the model entered by the student, it is important to compare the sampling rates of the data loggers (Table 2). In the free fall lab, the Arduino logger offered a sampling rate of 60 data per second, which was better than the 30 data per second for the smartphone. In the slope motion lab, the Arduino logger offered a sampling rate of 70 to 80 data per second, depending on the steepness of the slope, which was better than 30 data per second for the NXT logger.

Then the success rate of modeling for different types of data loggers were compared. A final model confirmed by a student was considered successful if it was quadratic. Table 3 shows the success rates for students using data recorded by different loggers. For the free fall lab, the models for the data of the Arduino logger achieved a success rate of 92.59%, compared with that of 96.3% for the data of the smartphone. For the slope motion lab, the models for the data of the Arduino logger achieved a success rate of 92%, compared with that of 87.5% for the data of the NXT logger.

Table 2 Sampling rates of the data loggers

	Arduino	Smartphone	NXT
Free fall	60/s	30/s	N/A
Slope motion	70 – 80/s	N/A	30/s

Table 3. Success rates for the data of different logger types

		Arduino	NXT	Smartphone
Free fall	Success	25	N/A	26
	Total no. of students	27		27
	Rate	92.59%		96.3%
Slope motion	Success	22	21	N/A
	Total no. of students	25	24	
	Rate	92%	87.5%	

Table 4 compares various features of the three data loggers used in this study. The Arudino logger costs about US$313 (which included the acrylic tube shown in Figure 8), while NXT costs more, and the smartphone less. But Arduino and NXT are more expandable since more sensors can be added to the logger kit. Moreover, Arduino's simultaneous wireless transmission of the logged data was a desirable feature since it saved time and the trouble of copying data with USB cable. Also, the ultrasonic sensor of the Arduino's has a smaller error rate (±2.71%) than the NXT logger (±9.38%). The above consideration showed that the Arduino logger would be a better choice than the other two for labs involving ultrasonic sensor.

Table 4. Comparison of the features of logger types

Logger	Arduino	NXT	Smartphone
Cost（USD）	$313	$469 - $625	Less than $313
Sampling rate	High	Medium	Medium
Data collection procedure	Easy (wireless)	More steps	More steps
Expandability	High	High	N/A
Error rate of ultrasonic data	±2.71%	±9.38%	N/A

Figure 8. Arduino Experimental Kit

5 Conclusion

At the end of this study, the physics teacher of the class made a few comments about the use of the data loggers in the two labs:

“Traditional experiments of physical body in motion often suffer from data of low accuracy. This study showed that modern data loggers can obtain accurate digital data automatically, which can then be plotted visually and analyzed numerically with minimum effort. The data loggers were great tools for scientific exploration.”

The students reacted to this study with great enthusiasm too. They enjoyed using modern, familiar technology for learning. At first, they might feel a bit clumsy in handling these loggers. But after some training, they could use the loggers and the modeling tool with little difficulty. After this study, they had more ideas on how to use these loggers in other experiments. They also wished they had more time to work on the labs and wished that the researchers could design more labs for them.

6 Acknowledgment

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The impact of the ‘Internet of Things’ on engineering education

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Abstract. The rapid advancement of Information and Communication Technologies (ICTs) in the last decade has created a new paradigm of Internet, known as Internet of Things (IoT). This new paradigm providing anytime and anywhere access to information in novel ways and contexts, brings people, processes, data and things together in unprecedented ways. Today IoT touches every facet of our lives, opening new opportunities for growth, innovation and knowledge creation. Through interconnection of people with many things (media, photos, information, etc.) and nowadays with physical objects too (RFID, sensors, actuators, robots, etc.), the IoT application in education has the potential to drive new ways of teaching and learning and transform the experience both for students and educators. Therefore, this paper analyses the influence and application of IoT technologies on teaching system in engineering education through practical and methodological approach. The results of the research have shown that the introduction of new methods and strategies of teaching and learning may raise the quality level of the entire engineering educational process, and guarantee the delivery of long lasting knowledge and skills that are applicable to real world problems solving.

Keywords: Internet of Things; engineering; education

1 Introduction

The Internet of Things (IoTs) is a new paradigm which provides a large number of devices connected to the network, enabling “anytime, anywhere” access to information. It implies that these devices can be managed from the web and in turn, provide information in real time, allowing the interaction with people who use it (Gomez et al., 2013). As a phenomenon which has more profound impacts on our society than most others, the IoT can be viewed in all industries, transportation, security, energy consumption, agriculture, healthcare, education, and many other domains (Fig. 1).

Education, as one of the most significant activities in society, has not been immune to this phenomenon. The rapid computer and communication technology development have dramatically influenced the educational process in recent decades. Therefore, it is noticeable that technological innovation has now changed the approach of how the universities teach and students learn. Educational activity with technology is about knowing how to successfully integrate the best tools into the teaching process (when and where it makes sense).

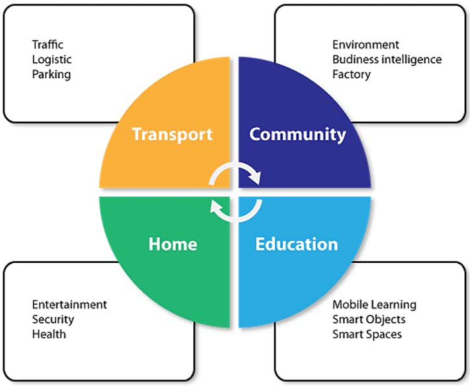

Fig. 1. The IoT applications

The IoT provides a virtual space where objects are represented, and access to their actions is provided virtually from anywhere. This integration of the two worlds, virtual and physical, involves issues such as: connection methods, intelligence, and self-configuring abilities (Costa Pereira, 2014). Therefore, the application of IoT in education purposes can provide a virtual, shared and intelligent experimental teaching environment. When students are using technology as a tool or a support for communication with others, they are in an active role rather than the passive role of recipient of information transmitted by a teacher, textbook, or broadcast. In this way the student actively makes choices about how to generate, obtain, manipulate, or display information. In other words, in an environment based on IoT which can connect the real world with the virtual world, and by using the technology as a tool to perform authentic tasks, the students are in the position of determining their goals, making design decisions, and evaluating their progress. On the other hand, the teacher in this case plays the role of facilitator, setting project goals and providing guidelines and resources, suggestions and support for student activity. Therefore, it can be stated that the traditional method of teaching that's persisted for hundreds of years nowadays acquires inferior results when compared with the more advanced and revolutionary teaching methods that are available for use in schools today (Vujović et. al, 2014).

2 Internet of Things in Engineering Education

What makes engineering education different from other disciplines is science and mathematics based feature. Traditionally, engineering education has been content-centered and design-oriented where students attend classes on a full-time basis and carry out the laboratory experiments at the universities which forms an important part of the overall course requirements. Until recently, online teaching of engineering subjects was the most difficult because of the need for laboratories and equation manipulation (Cavus and Ibrahim, 2007). Bourne et al. (2004) defined following requirements needed to be satisfied in order to make an engineering education broadly accepted and utilized:

- The quality of online courses must be comparable to or better than the traditional classroom;
- Courses should be available and be accessible from anywhere by any number of learners;
- Topics across the broad spectrum of engineering disciplines should be available.

The above three attributes – quality, scale, and breadth, nowadays can be fulfilled with a help of IoT. Developing new forms of scalable education that accommodate large numbers of students around the world, attracting potential students with various interests, and delivering an innovative curriculum that reflects the radical changes in computing technology are the potentials of IoT applications in engineering education (Selinger et. al, 2013).

The IoT is a collection of a large number of smaller, more specialized things - devices and sensors connected (often wirelessly) to each other and to the Internet. These things expand existing Internet applications and services and enable new ones. The IoT application in education aims to build an ecosystem where students and educators can acquire a deeper, empirically-based understanding of their environments and can actuate change through the use of the IoT (Joyce et. al, 2014). Atzori et al. (2010) define an IoT as a bond of middleware, sensors and knowledge. Similar, Gubbi et al. (2013) propose the architecture of an IoT consisted of three segments:

- The hardware segment (the interconnection of sensors or any embedded communication hardware);
- The middleware segment (a cloud environment which is responsible for data storage, computation and data analytics), and
- The presentation segment (visualization of the result of data analytics or data interpretation in an easy and understandable format).

Furthermore, an IoT must have the capabilities of communication and cooperation, addressability, identification, sensing, actuation, embedded data processing, localization and user interfaces (Mattern and Floerkemeier, 2010). Gomez et al. (2013) in the same way define the first segment as Mattern and Floerkemeier (2010), while the second segment presents the infrastructure level which corresponds to the connectivity capacity for Internet access. The third segment is defined as applications and services level. This level also includes the interaction with people, making in such way life easier and more efficient all the time. Based on IoT presented architecture, Gomez et al. (2013) propose a system that allows students to interact with a set of physical objects in the environment as well as their interactions with executed applications. Each of used objects has associated one (or more) virtual object which provides information that allows the student to reach a learning achievement, as how they work, how it can be used and so on. The aim is to let the students to manipulate the objects (both physically and virtually) in order to increase their understanding of the subject. The case study was a pilot experience with the students enrolled in the course “Introduction to Systems Engineering”, at the Faculty of Systems Engineering of the University of Cordoba, Colombia. The obtained results show improved student academic performance. In other words, using real objects and associating them as a learning resource through the IoT, facilitates meaningful learning, as it allows linking specific knowledge to a real context. According to data flow and process mode in the network, Yang (2012) divides IoT architecture applied in educational purposes into three layers: the perception layer, the transport layer and the application layer. The proposed teaching platform architecture based on IoT is further subdivided into (Fig. 2):

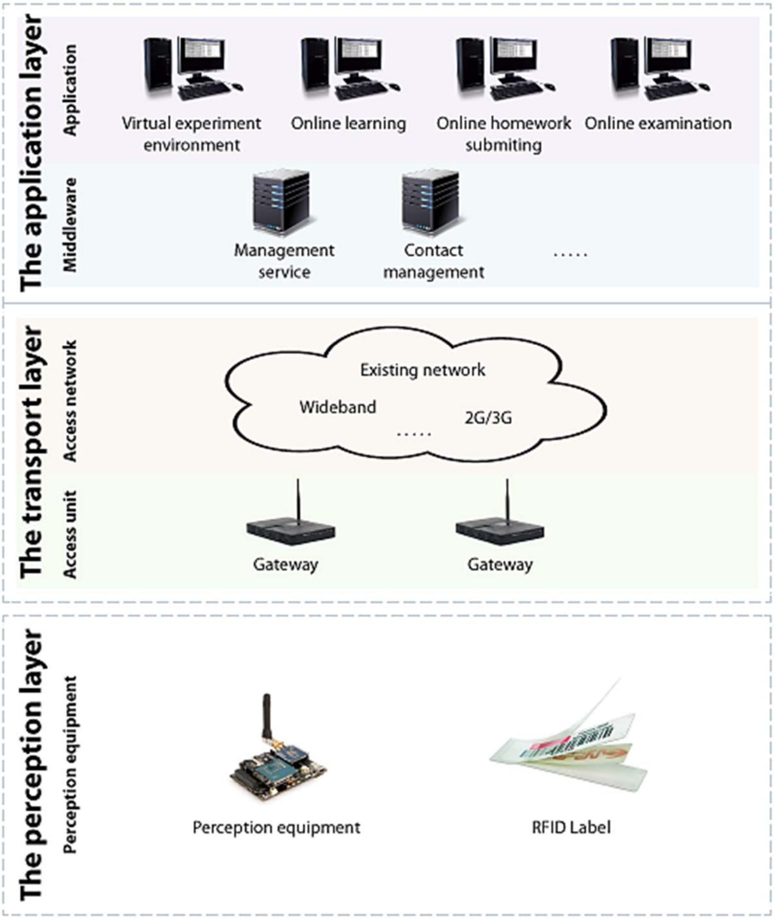

Fig. 2. The teaching platform architecture based on IoT

- Perception equipment (sensors, wireless sensor networks, data collection equipment);
- Access unit (data terminal equipment for data transmission from sensors directly to communication network and IoT gateway equipment which can connect wireless sensor network and communication network);
- Access network (the existing communication network, including 2G/3G and cable broadband, etc.);
- Middleware (basic public service ability for IoT application); and

- Application (various forms of teaching application based on IoT, including virtual experimental environment, online learning, online examination and online homework submitting, etc.).

Kortuem et al. (2013) also present the usage of the IoT in educational purposes as a way to teach computing principles and key skills, such as programming, to students with no prior experience in computing. In that purpose they developed a completely new IoT teaching infrastructure, which consists of: an embedded networked sensor device, developed visual programming language and programming environment and a cloud infrastructure that connects the sensing boards of all students together, enabling in such way wide collaborative sensing and actuation applications. The presented IoT teaching infrastructure resulted in a very small number of issues being raised by students and was key for the overall success. Dlodlo and Smith (2011) presented a way of IoT technologies integration into education and specifically in the design of a remote-controlled laboratory. The proposed system consists of a remote laboratory, an Internet connection, and a computer co-located with the user. In such way instructions can be sent to the remote laboratory and sensor data plus a video stream can be returned to the learner by using the open standard TCP/IP protocol.

2.1. Propositions of IoT based learning in Electrical Engineering Education

For building an IoT based learning solution, an analysis of key requirements must be performed. Kortuem et al. (2013) defined their unique requirements for IoT adoption in engineering education:

- Low cost: lower hardware costs are necessary in order that every student receives a complete IoT box;
- Scalable manufacturing: manufacturing hardware in large quantities on a reliable, regular schedule;
- Extremely simple tool chains: In online education, where students use the hardware and software at home, slight variations in students' setups and minor technical problems can be very time consuming to diagnose and fix, and hence expensive to support.
- Long-term future: The sensing board and programming environment should be designed to be used in education for several years.

IoT based learning solutions can be applied in two typical applications:

- For reading and detecting elements of interest like voltage, current, power, resistance, etc. in fully customized and automated laboratory; and
- In measuring a natural phenomena which depend on geographic location (temperature, humidity, water point and quality, etc.)

In order to fulfill above defined requirements and to provide support aforementioned use, a custom solution must be built. In both cases, the solution is based on microcontroller, which today can be replaced with a small, powerful, low cost, hackable computer board like Raspberry Pi, Adruino, Udoo, etc., and sensing unit. A comparative analysis of IoT prototype platforms is performed in Maksimović et al. (2014) and based on proposed criteria, it is concluded that Rasperry Pi is very suitable for applications in IoT concept. The advantage of Raspberry Pi lies in its flexibility and endless possibility of its usage, enabling at the same time end-users to program it according their needs and budgets. The usage of Raspberry Pi for building a custom IoT home automation solution from scratch is presented in Vujović et al. (2015). It has been shown that Raspberry Pi can be connected with various sensor devices and provide a RESTful Web services for accessing and manipulating sensor data. These features accompanied with low hardware costs, implies that the Raspberry Pi is our primary choice for building an IoT based learning system.

A simple exercise of fundamental of Electrical Engineering is given in Fig. 3. This exercise represents simple Ohm's law, and for traditional approach a DC source power, potentiometer, and two multimeters (one for measuring voltage, and second for measuring current) are needed.

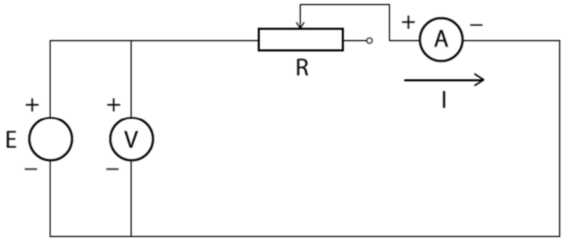

Fig. 3. Ohm's law circuit

In traditional approach the circuit is not accessible through the Internet. Therefore, the student must be physically present to perform measurements. This can result in a limited time for doing an exercise and can't provide an e-learning and lifelong learning strategy. Because of that, one possible solution of IoT based fully automated laboratory exercises is given in Fig. 4.

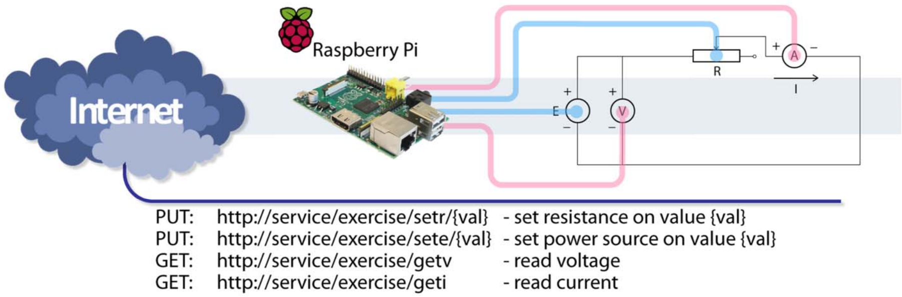

Fig. 4. IoT solution of Ohm's law circuit

In this example, Raspberry Pi provides an IoT solution through RESTful Web services for data accessing and setting. Using the elements, like digital potentiometer, AD/DA converter and resistors it is possible to build a circuit which can be programmatically controlled over the Internet. In this case, students have easily access to IoT services, and can adjust elements and read needed values.

Second case where IoT based learning solutions can be applied depends on geographically limited region, where sensor elements measure parameters of interest.

In the traditional way, this can be done over local sensor networks through the gateway where sensor unit is not visible to end users. Fig. 5 shows an IoT solution which represents a set of IoT nodes, and can be accessed directly over IP address or over Broker service. Broker service can also store values in the database for later processing and access.

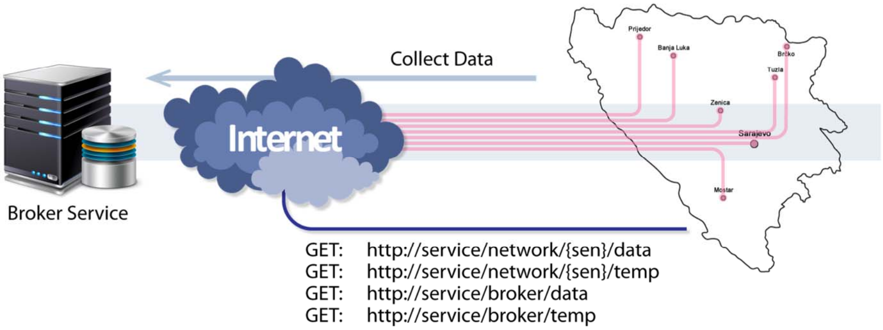

Fig. 5. IoT based solution of the sensor network appliance

In both presented cases, information access is done over simple HTTP protocol, and results are exchanged in XML or JSON format which can be easily processed by clients' independence of the platform. A programmatic evaluation can be done and in this way teachers gather information about students, their assignment and results.

3 The advantages and challenges of Internet of Things usage in Engineering Education

Kortuem et al. (2013) identified several concepts as fundamental for the IoT and essential for their course. However, these concepts may be also regarded as fundamental in engineering education in general:

- The merging of the physical and digital realms;
- Physical objects that become first class entities on the Internet;
- The huge increase in the number of Internet-connected devices, objects, sensors and actuators;
- The huge increase in the amount and value of data;
- The emergence of novel embedded device platforms below the level of personal mobile devices; and
- Novel applications in energy, transport, health, business and daily life.

The examples presented in a previous section prove the possibilities as well as justification of IoT usage in engineering education purposes. Researches show that access to real-time information and engagement with experts truly impacts learning. Therefore, the benefits of the IoT based engineering education can be summarized into:

- Students obtain an exciting, investigative learning experience, share ideas, discuss research/the latest developments in their area of study, and develop increasingly connected communities of practice. The IoT based teaching programs have possibility to teach the skills demanded by leading employers through the same tools that the industry uses. The IoT vision together with the development of open source hardware and software platforms for unrestricted prototyping and experimentation also enables DIY (do it yourself) projects.

- Universities' reputation improvement is provided by an IoT education that is relevant to industry demands, ensured gainful employment of its alumni and developed future innovators and entrepreneurs.
- Teachers approach to teach students how to utilize the software and lets them concentrate on their field of study is significantly improved. By including e-learning curriculum and example applications, students learn how to quickly utilize the software, thus freeing up the class period to do hands-on applications, IoT projects, entrepreneurial activities, etc. Professional development for teachers who may adopt new learning models, as data about their practice is collected through student feedback, teacher achievements, and video recordings, are additional benefits of IoT based teaching process.

Selinger et al. (2013) point out the Internet of Everything (IoE) as the next step in the evolution of smart objects - interconnected things in which the line between the physical object and digital information about that object is blurred. According to Cisco, IoE brings together people, process, information, and things to make networked connections more relevant and valuable than ever before. Turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunities for businesses, individuals, and countries are the main features of IoE paradigm. The New Media Consortium Horizon Report (2013) predicts that smart objects will become ubiquitous in higher education by 2017. The expected developments and benefits of IoE support in educational purposes in 2017 are presented in Selinger et al. (2013):

- Scale teachers and best quality of instruction-any device, anywhere;
- Scale content recordable and replicable instruction any time, any venue;
- Learn at your own pace, focus on relevant content only, richer interactive content;
- Access to crowd-sourced content, ability to customize curriculum;
- Data driven decision making and continuous improvement.

It is evident that IoE has huge potential in education. However, three main factors must be addressed to ensure its widespread and successful adoption:

- Privacy and security;
- Data integrity, including its accuracy, authenticity, timeliness, and completeness; and
- Policies.

In addition, students and teachers face with following challenges:

- The student must change from being a passive listener to becoming an active participant in the environment with the little or no face-to-face classroom contact. This requires maturity, self-discipline and motivation.
- The teacher must develop meaningful learning activities, and more importantly, can adjust to the individual learning styles of students in an Internet environment.

- A fundamental matter is also to preserve the communication and interaction among students, between the students and the teacher, and the student to other resources like books and online reference materials

Despite aforementioned challenges, it can be concluded that IoE, as well as IoT, has potential to make education more relevant, by engaging and motivating learners.

4 Conclusion

The Internet of Things supported learning changes fundamentally the way in which knowledge is delivered to students. Using real objects and associating them as a learning resource through the IoT, brings tremendous benefits in engineering education, such as student-centered teaching approaches accompanied with enhanced student-to-student and faculty-to-student communication. Therefore, the major impact of the IoT based learning environments is that the traditional teacher and student roles change significantly.

Students can access to their course or laboratory exercises at any time, from anywhere they can log on. In this way, the online training is immediate, cost effective and easily affordable. Furthermore, they can review lectures, discussions, explanations, and comments or share notes with each other to help facilitate community learning. In this way, the key to success is in students' ability to concentrate and to effectively use their time.

On the other side, teachers become resources, facilitators and students guide in problem-solving efforts. They can accommodate the individual learning styles of students in an Internet environment, as well as provide students with opportunities for exploration and encourage additional rehearsal time. In addition, via online assessment tools teacher can quickly and easily build, distribute, and compile information, and therefore successfully implement the students' evaluation.

Scalability, easy access and timeliness as major benefits of IoT based learning in engineering education are consequently followed by cost reductions what is extremely desirable in today's economic climate. Therefore, it can be summed up that despite the existing challenges, the IoT supported learning in engineering education is convenient, flexible, and cost effective, and as a such has potential to make education more revolutionary.

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Designing smart apps to enhance the learners' engagement with online learning

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Abstract. In the contemporary China's mainland, the majority of today's online learning cohorts of students are the digital natives, and there also exist many digital migrants, including the mid-ages and retired professionals and senior citizens. Using social media apps has for the recent years become a trendy movement in every walk of life with dynamic and vibrant markets of large screened smart phones.

According to an informal survey, people tend to use mobile phones or tablets to communicate with their friends by keying in words and use apps to browse the internet for news, blogs and conduct learning activities on some specific websites. And according to the fiscal reports by the three telecommunication network giants in China, the mobile phones with larger screen sell well. Moreover, 4G network has joined the wireless service throughout the nation. Therefore, it is the high time for the online learning universities to integrate the mobile learning into the traditional online learning based on desktop/laptop computers with the Internet. The working adult learners can access to the internet through their wireless devices anytime anywhere without any constraint of locations.

In this paper, we first address the relative concepts and context of the current online learning in our university and then dwell on the design of the apps for smart learning to enhance the students' engagement with online learning after the survey of learners' needs. Finally we discussed the action of smart apps of our university and then look to the potential benefits of adopting this new alternative route to the learning platform with expectation of more engagement with learning activities, learners' satisfaction and versatility.

Key words: smart apps online learning mobile learning

1 Introduction

In the contemporary China’s mainland, the majority of today’s online learning cohorts of students are the digital natives, and there also exist many digital migrants, including the mid-ages and retired professionals and senior citizens. With the quick expansion and penetration of internet, people, old and young in the mainland, prefer to log in, browse websites for accessing information they need, of course, needless to say, not all the information they accessed on the webs are texts. Videos and entertainment websites have been frequented by the netters. Computer-mediated education with internet has been considered to be an appealing cake for investment from the internet corporates and some training organisations. Online education is the buzzword in China’s mainland.

Using social media apps has for the recent years become a trendy movement in every walk of life with dynamic and vibrant markets of large screened smart phones. According to an informal survey, people tend to use mobile phones or tablets to communicate with their friends by keying in words and use apps to browse the internet for news, blogs and conduct learning activities on some specific websites. And according to the fiscal reports by the three telecommunication network giants in China, the mobile phones with larger screen sell well. Moreover, 4G network has joined the wireless service throughout the nation. Therefore, it is the high time for the online learning universities to integrate the mobile learning into the traditional online learning based on desktop/laptop computers with the Internet. The working adult learners can access to the internet through their wireless devices anytime anywhere without any constraint of locations.

In this paper, we first address the concepts of the ubiquitous and mobile learning and then context of the current online learning in our university and then dwell on the design of the apps for smart learning to enhance the students’ engagement with online learning after the survey of learners’ needs. Finally we discussed the action of smart apps of our university and then look to the potential benefits of adopting this new alternative route to the learning platform with expectation of more engagement with learning activities, learners’ satisfaction and versatility.

2 Ubiquitous and Mobile Learning Mode in the Digital Age

The internet has penetrated into the daily life of our society in diverse ways. The Internet has changed the ways we live, work and communicate as living beings in the world. In this digital age, the information communication technologies provide abundant opportunities for people to gain access to knowledge and information anywhere at any time. Learning is not confined at the space of walls with the format of a classroom in which students gather together. It is the rapid change of technologies that bring changes in the societies, the economy (Tsinakos and Alley 2013, Alley, 2009)). The modern technologies created the ubiquity of learning and blurred the divide of the formal and informal learning in education (Sampson, Isaias, Ifenthaler and Spector, 2013; Kinshuk and Huang 2015). Facing the challenges of high technologies, traditional educational institution should be aware of the changes in this digital age: 1. People open up themselves, express themselves, prove themselves with the rich media such as texts, videos and photos for entertainment. 2. With the internet, people in developed, developing or underdeveloped countries can access and share the information with each other, thus the digital gap of information can be filled in a certain sense. 3. People can take control of their own life, not satisfied with being arranged or given by other agents, just like such a small thing: holding a remote controller to switch on/off a channel .4. People feel worried about not knowing the causes or the truth about the issues or events happened. 5. People in the internet are in a state of being confused and apprehensive, tending to seek soul mates via the internet. 6. People in the community of the internet tend to exchange, disseminate or share information. 7. People born in the years of prosperous and peaceful 1980s or 1990s make up the bulk of the netters, who are then named as digital natives,.

Mobile learning or sometimes ubiquitous learning mainly refers to the provision of education services with handheld devices. With the integration of handheld devices and education, learning can happen anytime, anywhere with wireless and internet technologies. Mobile technologies do not only bring mobility, and ubiquity, but also impacts on the pedagogies of the traditional educational institutions (Pachler, Bachmair, and Cook 2010; Unhelkar, 2006). As to the smart education with smart mobile devices, we can find out six dramatic changes and impact on the future education: mobile devices can be considered as the extension of human organs, more appropriate properties to human beings, and more viable to real personalised learning; learning moves from closeness to open-up, not confined in a physical classroom; learning time, location, courses, knowledge, activities etc. can be fragmented, not necessarily prefabricated; texts, sound, videos, rich media, AR, holograms can connect the classroom with outside world; the individual in closure can use internet to connect and establish diverse communities and the access to knowledge does not longer rely only on the instructors because of the explosion of the information in the age of internet.

3 Learners’ Engagement

In the digital age, the traditional educational context has dramatically changed. It is not an evolution but a revolution to the traditional learning. Teaching in higher education in China has become tougher for the academics. Students with the knowledge accessed from the internet dislike the slow and boring lecture-based classroom instructions. Demand for multi-layered delivery of high-tech media become stronger than ever before. As to the online courses, they are still text-based, dotted with prefabricated video lectures and audio learning materials. Therefore, engaging the learners to do the ‘meaningful learning is a profound and ongoing challenge’ (Barkley, 2010, p.xii) to the online course providers and designers.

However, there exists a prevailing misunderstanding, that is, engaging students in learning equals to entertain them in learning. They are not younger learners in schools, they are adult learners. They come to learn something pragmatic to be used in their profession. They have prior learning experiences and work experiences. They will bring with them in the learning their experiences, ideas, insights and attitudes.

Problems remain for the course providers to solve are how to motivate the learners, how to facilitate their learning desires, how to reshape their expectation for success in learning outcomes.

Smart apps might be the solution to fulfil this task: enhancing the learners’ engagement in online learning with ubiquitous use of smart phones connecting peer students in a social community. In the learning community they set up, the learners will have fostered a sense of belonging (Brown and Mbati, 2015; Herrington, Herrington, Mantei, Olney, and Ferry 2009). They will feel comfortable to communicate with peers: raising questions and seeking answers, seeking feedback from the peers, exchange or share some comments from the tutors, confirming some important information or issues concerning learning activities (Wakefield, McNally, Bowler, and Mayne, 2007). The learning community with the smart apps will keep them away from the sense of isolation or alienation as the distance learners often felt in the traditional distance learning.

4 Context for Use of Internet and Mobile Technologies in China’s Mainland

China is a big country for manufacturing smartphones and the biggest market for smartphones. Growth in the use of mobile phones in China has been quite rapid, and has been accompanied by the availability of relatively inexpensive smart phones.

According to Xinhong Zhang (2013) in the report titled Report on the Digital Gap in China, by the end of the 2012, netters in China's mainland reached the amount of 564 million and the population of access to internet is around 42.1%.

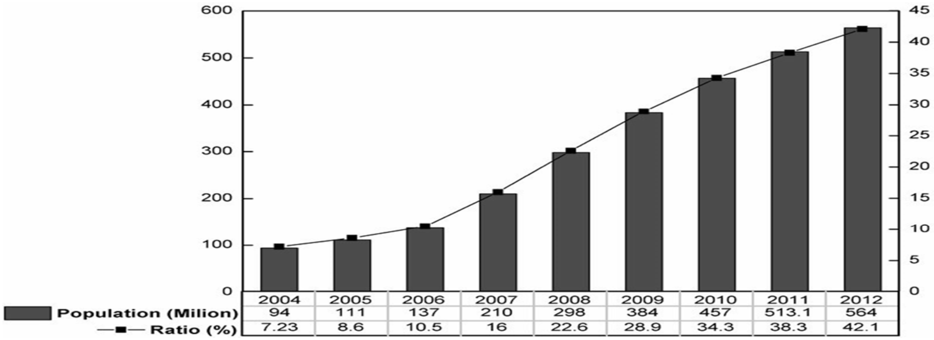

Fig. 1 Internet users in China (Zhang, 2013)

The access to internet and wireless network have brought boom in using mobile phones logging in internet. By the end of 2012, the population of mobile netters reached 420 million. The figure shows that the mobile netters outnumbered the computer netters for the first time. The chief reason for this quick expansion is that since 2009, more than 100 million mobile users increased each year, the market for smart apps poses a bright future, newly designed smartphones attracted more buyers young and old. And above all, the wireless technologies are really helpful to the people on the move, including rural residents, temps in the cities and towns. Compared with the desktop computer, smartphones in China's mainland cost much less with advantage of easier access to internet and apps. And according to the fiscal reports by the three telecommunication network giants in China, the mobile phones with larger screen sell well. Moreover, since 2014， 4G network has joined the wireless service throughout the nation.

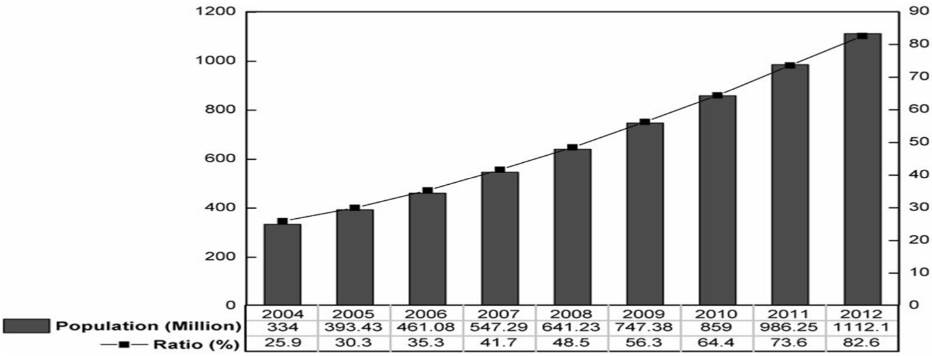

Fig. 2 Mobile phones users in China (Zhang, 2013)

The rapid development of internet and mobile technologies trigger huge expectation and potential impact on education. Varieties of shifts occur in the discourse of mobile technologies in the digital age for education: 1. Instructional development shifts 2. Technical integration shifts. 3. Use interface shifts and 4. Learners' experience shifts.

5 Online Learning Mode of the Open University of Jiangsu

The Open University of Jiangsu, formerly named Jiangsu Radio and Television University, was a traditional education institution, which replayed and provided distance courses based on traditional media. The online presentation of learning materials was just a complement to individual learning or face-to-face classroom tutorials with the BBS forum. Since 2012, the year it has been transformed into a 'new type' of university, namely the open university approved by the central government, the Open University of Jiangsu has abandoned the traditional distance delivery of courses through logistics to learning centres around the province. Instead, a new multi-functioned learning platform has been designed and operated with registering, teaching and learning, assessment, discussion forum, learners' communities with video and audio lectures. The contemporary practice by the Open University of Jiangsu has received positive and complementary responses and feedback the faculty, students and staff in the university.

In the presentation of some courses, QR codes have been used to support the mobile learning, for instance, scanning some QR codes, the students can download the video lectures into their big screen smartphones to watch. However, it is not the common practice. At present, according to one survey conducted by www.medu.org.cn that the proportion of the having smart phones encompasses the 80% of university students, this anticipates that there is a growing and prosperous market for mobile leaning in the near future With the cost of wireless communication reduced, it is the right time to plan a mobile learning system with smart apps to assist seamless learning (Aberdour, 2013).

6 A survey on the Learners' Needs for Ubiquitous and Mobile Learning

According to Bates (2015, p. 3), 'our educational institutions were built largely for another age, based around an industrial rather than a digital era.' The traditional distance education institutions are faced with a massive change of students' cohorts. They are called digital natives. In what way the online course providers can make sure the contents have been delivered to the learners in the way that best suits these digital natives? This is the key point that should be taken into consideration for the education institutions to design online programmes.

Ubiquity of the internet creates the potential to provide learning to new cohort of learners, to 'ease capacity constraints, and to capitalise on emerging market opportunities' (Rinear, 2003). The online computer-mediated platform should integrate the wireless devices into the existing scenarios, mapping out site plans to make sure that wireless will "working a typical learner environment, device selection, possible support for multi devices, and devices management issues such as synchronization, connectivity, and scalability" (Bielawski and Metcalf, 2003).

An informal survey has been conducted before planning the mobile learning system design to accumulate the needs from the younger students of our university. The questionnaire has been issued into a special website which the students can log in and respond the relative items. The website summarises the responses and do the statistics automatically. Around 384 students fulfilled the task of questionnaire online.

Summaries of the Survey:

Table 1. Main factors affect the online learning

1	contents of the courses rather boring.	76%
2	online learning and mobile learning hold the privileges over other formats of learning. Multi platforms and seamless learning apps are what the students cherish for.	70%

Table 2. Factors affect the desire for mobile learning

1	students do not want to learn	24%
2	lack of mobile learning awareness	37.17%
3	not easy to use and less function needed	62.83%
4	dry contents, not appealing to students	61.06%
5	slow linking speed	46.90%
6	less promotion	38.94%
7	others	15.04%

Table 3. Problems encountered by the mobile learners

1	no strong desire	44.25%
2	complicated operation of apps	24.78%
3	lack of genius developers of apps	35.40%
4	lack of funding	18.58%
5	lack of initiatives	1.77%

Table 4. Future of the online and mobile learning

1	mobility and ubiquity	77.88%
2	big data	64.60%
3	intelligence	53.10%
4	socialising	46.90%
5	seamless learning	37.17%
6	high efficiency	37.17%
7	gamification	52.21%
8	hybrid learning	46.90%
9	take the place of traditional education partially	53.98%
10	replace the traditional education	3.54%

Table 5. Attitudes towards mobile and traditional online learning

1	both has its own advantages	71%
2	mobility will surpass the online learning	16%
3	mobility will not surpass the online learning	9%
4	Nn connection between the two formats	4%

Table 6. The weaknesses of the mobile leaning (open questions)

1	not so convenient for keying in text on the mobile device screens
2	most of the screens are not big enough
3	the limitation of the width of the broadband

According to the above summary of statistics of questionnaire, the students have already some senses of mobile learning. Smartphones, especially the big screen smartphones are rather popular among the students. And in the new learning platform, the social media apps have been integrated with the virtual class. The students can access the learning communities by desktop/laptop computers or simply their smartphones. The prerequisite for the smart learning apps is there, what is waiting to be done is the decision making.

7 Design for the Adult Learners on Move

The department of the learning technologies of the university set up a team to work with some high technology firm to develop mobile learning system with smart apps which composites mobile learning together with the online learning. Mobile learning system encompasses: course learning, educational training, educational management, educational information collection, outdoor learning support, mobile Q & A genie, education blogs, educational games modules. The mobile learning system is a multiplatform compatible for android and IOs.

The following functions of mobile learning platform have been considered:

- ✓ Small, delicate, specific, low cost learning mode
- ✓ Free, flexible learning mode, easy to fragment the learning process
- ✓ Break the limits of time, places, easy to learn anytime, anywhere for any purposes
- ✓ Integrate pictures, texts, sound and videos to enhance the efficiency of learning
- ✓ Revolutionise the mode of assessments, conduct statistics smartly, improve the management of learning
- ✓ Embedded with social media apps such as Wechat or QQ to set up learning communities.

- ✓ Synchronic live webcast/recording, VOD, synchronic directing the webcast, automatic tracing learning activities of the learners.
- ✓ Special signup system for the learners to make the learners keep better learning habits

With this mobile learning system, the users are expected to post, upload information, notices etc.; making the trees of knowledge in details but in branches of categories; contact the instructors/tutors; watch the short videos clips; browse for the data needed; learning management and learning support.

8 The Plan for Implementation of the Ubiquitous Learning System

Up to date, the core designs of the mobile learning system have been completed and the smart apps for course learning and assessment have been developed and tested among the students of civil engineering. The students of the civil engineering will be the first cohort to enjoy the benefits of ubiquitous and mobile learning system. The reason is quite obvious: they are scattered around the country in diverse worksites, away from the reach of internet for months. Learning the fragmented knowledge in the fragmented time will surely facilitate their engagement in learning.

The action plan has been initiated and submitted to the senate of the university to be approved for implementation. The action plan will be executed in three phases: pilot phase, trying out the smart apps in the civil engineering programmes; modification phase, modify or redesign some apps to be applied in other three programmes of humanity disciplines and the last phase: overall implementation of the smart apps in all the programmes of Baccalaureate and Associate degrees. All the phases will be completed in one year. The evaluation report on the implementation will be published after that. We would like to emphasis this point again: the smart apps are not designed for one course or one programmes. They will bridge the online learning platform and mobile learning system to create a seamless learning system.

9 Conclusion

By the time the authors prepare this paper for ICOFE 2015, the Ministry of Education proposed an initiative to promote online learning, which depicts the bright future for the education institutions getting involved with open and distance learning. In China’s mainland, big screen smart phones sell pretty well. And this tendency prophets the ubiquitous and mobile learning will have a massive expansion in education and a massive market for education. Smart phones with smart apps will benefit learning whether formal , non-formal or informal.

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Guidelines for utilizing technology to enhance art learning in art museums and galleries in Thailand

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Abstract. The purpose of this research was to propose the guidelines for utilizing technology to enhance art learning in art museums and art galleries in Thailand. The specific objectives were: 1) to study the current state of technology enhanced art learning in art museums and galleries, and 2) to propose guidelines for utilizing technology to enhance art learning in art museums and galleries in Thailand. The focus group discussion included 6 experts and 78 participants. The research instruments included the review of online resources via content analysis concerning the survey of technology enhanced art learning such as website, social media, and mobile application. The outcomes of this review were used to retrieve suggestions from experts by means of a focus group discussion together with a list of topics related to utilizing technology to enhance art learning. The opinions and suggestions of experts and the participants were recorded during a group discussion. The results of this study reveal that art museums in Thailand have used website and social media to present exhibition contents. However, Thai art museums provided very little learning contents, research contents, and online activities. Moreover, Thai art museums didn't utilize mobile applications. The experts suggested that today's technology plays an important role and benefits for presenting contents as well as publicize the art museums. Art museum technology should allow the audiences to download exhibition contents, education contents, and allocates the appropriate contents for the audiences, as well as the art educators should have more participation in the art museum knowledge management. The outcomes of this research concerning guidelines for utilizing technology to enhance art learning in art museums and art galleries in Thailand will be discussed.

Keywords: Online Resource, Technology utilization, Art Learning, Art Museum

1 Introduction

Recent advances in information and communication technology play an important role and produce a variety of learning resources that is not limited to teaching and learning in the classroom only. The United Nations Educational, Scientific and Cultural Organization (UNESCO) recognizes the importance of creating educational network, and promote the use of open educational resources to expand access to education at all levels, both formal and non-formal education in view of lifelong learning, and recommends that countries are contributing to the environment conducive to the use of information technology. Open Educational Resources (OER) provide a strategic opportunity to improve the quality of education as well as facilitate policy dialogue, knowledge sharing and capacity building." (UNESCO, 2011)

Thai nation has importance to the development of open educational resources and support to educational technology is used, as defined in Thailand National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545 (2002)) in Chapter 9 Technologies for Education, Section 63 The State shall distribute frequencies, signal transmission devices, and other infrastructure necessary for radio broadcasting, television, telecommunication radio, and other media of communication for use in provision of formal, non-formal, and informal education and enhancement of religious, artistic, and cultural affairs as necessary. Section 64 The State shall promote and support the production and refinement of textbooks, reference books, academic books, publications, materials, and other technologies for education through acceleration of production capacity; provision of financial subsidy for production and incentives for producers; and development of technologies for education. In so doing, fair competition shall be ensured. (Office of the National Education Commission 2003) And information communication technology (ICT) offers a cost-effective way of expanding access to quality education in the developing world. (Daniel, 2010)

The importance of using information technology to support collaborative learning, which is a key element of the learning society towards a share. Keep educational institutions and learning sources, such as library, museum, and art gallery have presented information to support learning through information technology, in particular the importance that museums to enhance the audience's experience. Using technology to organize, display, and use technology to provide information of the museum through websites, social media, and including the mobile applications, visitors can keep track of news of the museum. As the Benaki Museum (2013) in partnership with the American Embassy and the British Council in Greece, has found that the use of technology and social media as means of transforming museum education and affect the educational programming and exhibits of the museum as well. Of which online technology media, including websites, social media and mobile applications makes cooperation between the institutions in order to exchange information and to increase the audiences. The museum will need to consider the data analysis of visitors to design educational activities and the format of the exhibition, which will require updating and summing up. Create interaction as part of the audience to participate and exchange information that exhibits the interaction not only helps to promote learning, but also appreciate. Inspire and attract an audience favorite with this technology media, which causes to learn endlessly.

Using media technology has made the role of museums as something for someone to become a museum open to the public. To attract more visitors to the learning development through the museum's information.

As Kris Wetterlund and Scott Sayre (2009) conducted art museum education program survey, was found that social media and online innovation have exploded onto the scene for museums and educators. In 2009, 60% of the respondents reported having Facebook pages for their museum, while the number of museums with websites remained the same between 2003 and 2009. Social media tools like Facebook and Twitter, which are free to use, don't require the same amount of resources as creating web pages, perhaps adding to their current popularity.

> *"The metaphor of the primary assumption of [this problem] is that Thailand only has the hardware which is the collections, buildings, and facilities, but lacks of the software or programs to draw the public to the museum—the links between art and general public"* (Rojanatanti, 2011, p. 63)

With this saying in mind, the authors aim to see the ways to improve the situation particularly in the aspect of utilizing technology for educational purposes. Technology has helped to accelerate the rapid change, retooling nearly every aspect of our daily life, from how we communicate, to how we shop, to how we receive medical care. (Duncan, 2015)

2 The utilizing art museums and art galleries to enhance art learning in Thailand.

The definition of a museum has evolved, in line with developments in society. Since its creation in 1946, ICOM updates the definition of a museum in accordance with the realities of the global museum community. According to the ICOM Statutes, adopted during the 21st General Conference in Vienna, Austria, in 2007: A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment. Therefore, education and learning are regarded as an important goal of the museum.

In Wilaikeaw's (2000) investigated the development of Thai museum: A case study of the national museums, found that at present there are 40 museums located in 29 provinces. Twenty-nine museums were initiated by the Department of Fine Art, and 11 are extensions of temple collections.

Initially, national museums in Thailand developed from the royal private collections of King Rama IV. In the reign of King Rama V, museums became public and adopted the concept of museum, and management techniques from Europe, especially France and England. Foreign experts were hired and the local staffs were sent to be trained abroad. The turning point of museums occurred in the reign of King Rama VI. At that time King Rama VI introduced the ideology of nationalism to Thai people. As one of his strategies, the archives in the museum were praised as symbols of nationalism, and hence, the museum played an important role representing national identity in Thai history. From that time on, the role of museums was static and the museum paradigm has never been shifted. As a result, the museums role for the benefit of the public did not thrive, a fact indicated by the small number of visitors each year. This can be interpreted as follows: the presentations and display of the national museum can not meet the interest of the public while the Fine Art Department ignores the traditional institutions, particularly the role of the temples which traditionally function as a learning place for the communities. For the Fine Art Department, it is crucial to understand the traditional role of the temple, and its meaning for the people, in order to make the museum to be a place of informal education "for purposes of study, education and enjoyment".

As Sanserm (2000) found that the educational role of the Museum in Thailand consists of the aesthetics and art appreciation, the art historical, the interdisciplinary and humanities, social education. Particularly, Thai art museum should have a role as a source of valuable artwork that is regarded as a center of academic resources. Moreover, Rojanatanti (2011) found that museums have the responsibility to serve the public as well as preserve and disseminate information about the cultural properties of the community. Through proper programming, visitors can have both a learning opportunity and an enjoyable experience.

However, Thai art museums and art galleries still face the management problems. In terms of the management system, the government influences in managing the budget and as well as management systems. Prevented the development of an organization according to the work plan, which is intended to establish a corporate focus on the collection, accumulation and exhibits contemporary art only, and the lack of participation of the community in relation to the audience in the local organization. Create a policy of cooperation and networking between organizations, and the lack of a clear public relations plan. Including the dissemination of information is limited in scope to the museum. (Faculty of Fine and applied art, Bangkok University) As well as in the study of Chantaworn (2012), she explained that the public do not have access to art circles and do not understand contemporary art are the problems and obstacles in the management of Thai art galleries.

Chantaworn (2012), concluded that the use of museum and galleries for informal education in the Thailand, there are still problems in the management prevent the effective non-formal education resources. Especially the use of learning technologies in the art museums and art galleries, have not yet been studied seriously. The authors have made a study of guidelines for utilizing technology to enhance art learning in art museums and galleries in Thailand.

Although, the review above may show rather slow progress in terms of development of art museums and galleries in Thailand, currently there are several positive movements. The government claims that the introduction of technology to enhance visitors' experiences at the Learning Center of the National Museum and at various National Historical Parks has successfully raised the number of visitors by 50 %. (Pattayamail, 2015) Some other movements are the government considers extending the working hours and to initiate the online system for buying entrance tickets. Moreover, some major sites having outstanding antiques exhibitions would produce video clips to accompany the antiques. These are the plan to attract young visitors and to hold special activities. (Thainews, 2014)

Keene (2014), examined the use of electronic and digital media particularly in the forms of online, onsite, and on mobile in 4 national museums in London: The Science Museum, The National Gallery, The Museum of London and Tate Modern, found that digital technology has been used in the museums (onsite) consist of movie clips, video, touch screen, art software, etc. Concerning the online technology, include websites in which contain information of museums' collections, education information, research information, online activities, games, virtual museum, and others, as well as using social media to displays information of the museums. The part of media technology on mobile phones, the application is used to provide information and guide to visit the museum.

3 Objectives

The objectives of this study were:

1 To study the current state of technology enhanced art learning in art museums and galleries; and
2 To propose guidelines for utilizing technology to enhance art learning in art museums and galleries in Thailand.

4 Procedures

This qualitative research collected data from related literature, the components of online information resources that enhanced art learning of art museums and art galleries, such as website, social media, and mobile application, in Thailand and other countries. The opinions and suggestions of 6 experts and 78 participants were recorded during a group discussion.

5 Instruments

The review of online resources via content analysis concerning the survey of online technology enhanced art learning such as website, social media, and mobile application. The outcomes of this review were used to retrieve suggestions from experts by means of a focus group discussion together with a list of topics related to utilizing technology to enhance art learning. The discussion also included other topics to aid in development of the guidelines.

6 Findings

Data was collected from related literature, the current state and the components of online information sources that enhanced art learning of art museums and art galleries in Thailand and other countries, along with suggestions from the focus group discussion. The results are summarized as follow:

1 The findings from exploring the current state of Thai and other countries online resources of art museums and art galleries reveal that:

Art Museum and Gallery use website to provide information of the museums. With the main information that are contained in websites are visit, about the museum, museum collections, exhibition, activities, and contact. The part of information about the education, research and media of the museum will not be available in every website. In addition, the art museum and art gallery have also used social media such as Facebook, Flickr, Twitter, YouTube and Instagram to publicize exhibition information and interaction with visitors. The use of mobile applications to provide information of the museum there are quite a few.

The utilizing technology to enhance art learning in art museums and galleries in Thailand, entire website and social media is to present information about the exhibition. Thai art museums provided very little learning contents, research contents, and online activities. Moreover, Thai art museums didn't utilize mobile applications. The information in websites of Thai art museums and art galleries is mainly used Thai language in the presentation of data.

2 The framework of educational information on the websites of art museums.

Websites of the art museums and art galleries have been providing information for education, consisting of 5 main components are online media including video, multimedia, online activities; as well as research contents, museum collections contents, museum information for download, and the contents that have been made to suit the visitor groups according to age, level of education and managing learning for people with physical disabilities. The details of the education information of the art museum website are as follows:

Media: The media on museum website that provide educational information to the visitors consists of the major media in the following:

- Online media of websites that provide information on web page which contain the online contents, information retrieval, and educational contents.
- Video media of websites which the visitors can select video media that interest from the websites.
- Multimedia of websites which the visitors can interact with the media, as the museums have prepared.
- Online activities and online courses which the visitors can participate in activities via the websites.

Research: The Museum's research information in the website, which contain the research contents, research articles, research, library, research, and information that is beneficial to the research, website viewers can find online information easily and can download the research information in accordance with the rules of the museum.

Collections: Information and pictures of the museum's collections, the visitors can find the collections information of interest by searching on the websites and the museum collections provide images and contents about the artworks. By some Museum visitors can view the details of the objects.

Download: The websites of museums, allow the visitors to download information for education, which includes both information that is the subject matter as .DOC, .PDF, and .PTT file, which those interested can use immediately, and can also download video files over the Internet.

Participation: The websites of the art museums have also allocate the education contents for the audiences in each age interval: the contents for kindergarten kids to secondary school, the contents for higher education, the appropriate contents for general audiences, and educational facilities for those physically defective.

Table 1. An overview analysis of best practice art museums and art galleries internationally and locally in utilizing technology

Museum	Country	Website												Language	Virtual	Social Media							Application	Remark
		Home	Visit	Exhibition	Collection	Learn	Activity/Event	About	Calendar	Press/Media	Contact	Support	ETC.			Facebook	Twitter	Instagram	Flickr	Youtube	Pinterest	ETC.		
Louvre	France	*	*	*	*	*	*	*	*	*	*	*	Online Media, Databases, Shop	FR, EN, CH	*	*	*	*	*	*	*	Dailymotion	*	-
MoMA	USA	*	*	*	*	*	*	*	*	*	*	*	Shop, MoMaPS1, E-News	English	-	*	*	*	*	*	*	foursquare, RSS feed	*	-
Princeton	USA	*	*	*	*	*	*	*	*	*	*	*	Participate E-Newsletter	English	*	*	*	-	-	-	-	-	-	University
Harvard	USA	*	*	*	*	*	*	*	*	*	*	*	Renovation, Index Magazine, Shop	English	-	*	*	*	*	*	*	Vimeo, RSS feed	-	University
Islamic	Malaysia	*	*	*	*	*	*	*	-	*	*	*	Conservation, Shop, Newsletter	English	*	*	-	-	-	-	-	Tripadvisor	*	-
TAEC	Lao	*	*	*	*	*	*	*	*	*	*	*	Newsletter, Shop, Resource	English	*	*	-	-	-	-	-	Tripadvisor	-	-
PSU	Thailand	*	*	*	*	*	*	*	*	*	*	-	Research, Networks	Thai, English	-	*	-	-	-	-	-	-	-	University

Table 2. An analysis of best practice art Museums and art galleries concerning educational matters

Museum	Media				Research	Collection	Download		Participate		
	Online Media	Video	Multimedia	Activities			DATA	Video	University	K12	Community
Louvre	*	*	*	*	*	*	*	*	*	*	*
MoMA	*	*	*	*	*	*	*	*	*	*	*
Princeton	*	*	*	*	*	*	*	*	*	*	-
Harvard	*	-	-	*	*	*	*	-	*	*	*
Islamic	*	-	-	*	-	*	*	-	-	*	*
TAEC	*	-	-	*	*	*	*	-	-	-	-
PSU	*	*	-	-	*	*	*	*	-	-	-

7 Discussion

Expert's opinion and suggestions for developing guidelines are:

1 The reflections of experts on the utilizing technology to enhance art learning in art museums and art galleries in Thailand.

All experts have mentioned that the current technology is even more important and useful to present information of art galleries, due to the variety of implementations, has many channels and use the small budget. In particular, websites, social media site and mobile applications to provide information of the museum so that viewers can learn anywhere and anytime. Do not limit the scope to learn to increase the audiences, the viewers can learn in connection with his or her own experience and knowledge exchange through the media technology world-wide. Causes of learning across the disciplines and cross culture. And cause to cooperate through the Museum's learning network. Consistent with the conceptual framework of learning in the 21st century, which give priority to information knowledge skills. Communication and technology skills, communication skills, social skills, and collaboration and learning across cultures. As Dede (2004) explained that emerging devices, tools, media, and virtual environments offer opportunities for creating new types of learning communities for students and teachers. The defining quality of a learning community is that there is a culture of learning, in which everyone is involved in a collective effort of understanding. Transformational learning of 21st century skills requires a strategy of infusing learning communities throughout students' lives, orchestrating the contributions of many knowledge sources embedded in real world settings outside of schools. The technology supports learning in the art museum can promote learning skills in the 21 century as well, but need to manage contents in media technology, don't let the audience too much guidance and using technology to attract the audience to see the actual work.

2 The use of online technology to offer educational information.

The experts proposed that the galleries should have a public relations and online technology for usage in education, and invite the audience into galleries. The art galleries should allow the audience to download exhibition contents and educational contents, which those interested in other countries, can access information without charge. As Public Catalogue Foundation has prepared a Web site in Art Detective topic that aims to improve knowledge of the UK's public art collection. It is a free-to-use online network that connects public art collections with members of the public and providers of specialist knowledge in a series of public discussions. Anyone, not only art historians, can participate and provide valuable clues. Regard as online technology to knowledge sharing.

The focus issue of the experts is to enhance perceiving experiences and to appreciate the value of art. Because of the Thai nation not yet give priority to promoting the comprehension of artistic values, with the notion that art is a matter of entertainment and enjoyment purposes only. As Rojanatanti (2011) found that one major barrier for the visitors of art institutions is their lack of knowledge about visual art, which undermines their confidence in patronizing them. Therefore, art educators have to play an important role in knowledge management and the promotion of artistic value apprehension, including participation in the environment and the technology that support art learning in the galleries. And encouraging the public to have a positive attitude in the art museum and galleries.

3 Guidelines for utilizing technology to enhance art learning in art museums and galleries in Thailand.

The experts proposed that it should give priority to education as a menu on the website. In the website should contain the contents to enhance art learning, which consists of the media that provide educational information such as online information, video media, multimedia, and online practice that are consistent with the exhibition topics; the research contents, and the museum's collection contents. Including art museum technology should allow the audiences to download exhibition contents education.

This is consistent with Tiranasar and als. (2014) The website for art teachers should have links to the online database that collected the information related to Thai culture such as the history books and archival material, etc. This is to facilitate to those who interest in searching for information, especially teachers who can bring knowledge to be applied in their own teaching.

In addition, educational data should be allocated, with appropriate contents for the audience in each age interval: information for kindergarten-secondary school, information for higher education, information for general audiences, to be able to learn more effectively. In accordance with the Smithsonian American Art Museum engages many audiences interested in learning about American art from many perspectives. Adults participate in docent-led tours and discussions. Students learn about American history through American art with engaging and reflective interactive tours and real-time video conferences. The contents of the website, social media, and mobile applications should have a responsible administrator to update information, as well as answer questions and interaction with the audiences. In order to be able to cause to learn most effectively.

8 Conclusion

The findings and guidelines from this research should be implemented to develop utilizing technology to enhance art learning in Thailand. The use of technologies aim to be the open educational resources and the learning management supports, according to the informal education, in art museums. The art educators play an important role in knowledge management and organize the learning contents in media technology. As well as the utilizing technology to enhance art learning in art museums and galleries in Thailand.

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Using the experience of API to track learning in a mobile and flexible learning environment

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Abstract. The purpose of this paper is to investigate how the xAPI (Application Programming Interface) can be used to track learning in a mobile and flexible learning environment. The xAPI is a new open source based learning technology specification. It allows one to capture data about a person or group's activities from many technologies, either online or offline. There are advantages in using the xAPI. Firstly, xAPI takes e-learning outside of the browser. Secondly, it allows for both informal and formal learning. Thirdly, the xAPI focuses on tracking learning activities. Fourthly, xAPI can be used to track learning via games, simulations, virtual worlds, social learning, self-directed learning, collaboration and team-based learning. The xAPI allows software programs to read and write data statements in the form of "I did this", or "actor verb object". Data statements like "I attended Conference C" are stored in the LRS (Learning Record Store).

Keywords: Experience API, Learning Record Store, learning activities, informal learning, formal learning

1 Introduction

When computers were first invented in the late 1940s and early 1950s, they were developed and used mainly for the military, government and large corporate users. It was only in 1960 that the first computer-based training (CBT) programme was introduced (Bersin, 2004). This was the PLATO, or Programmed Logic for Automated Teaching Operations (Lombat, 2011). It was originally designed for the University of Illinois students but ended up being used in schools throughout the area (Epignosis LLC, 2014). Technology-based training (TBT) and teaching using technology accelerated after personal computers were introduced by IBM in the early 1980s. Subsequently, many courseware titles were developed and delivered via CD-ROMs and laser disks. These gave way gradually to the learning management systems (LMSs) when computer systems became more powerful and could store more contents. It was the AICC (Aviation Industry CBT Committee) which released the first specification for the LMS. This specification allowed students' scores to be tracked on the computer system he was using. When the Internet became a world-wide sensation in mid-1990s, Web-Based Training (WBT), virtual classrooms and e-learning in general became fashionable. At about the same time, several learning standards consortia were founded. These included the IMS Global Learning Consortium (IMSGlobal Learning Consortium, 2015) and the Advanced Distributed Learning (ADL) Project (Advanced Distributed Learning, n.d.). SCORM (Shareable Content Object Reference Model) was released by the ADL Project in the year 2000.

SCORM is the de facto specification for packaging learning content is a standard format which allows the package to work in different LMSs. However, SCORM is tied very closely with the LMS. It will not work outside of the LMS and the browser.

1.1 Shortcomings of present LMS-centric and content-centric e-learning

So far, the approach in e-learning is to deal with how the content is to be structured, packaged and moved from one system to another. This is a very LMS- and content-centric model. SCORM is thus very LMS- and content-centric and hence it has many restrictions.

For example, multiple-choice quizzes are used widely in the LMS-centric model. These quizzes are usually of the single-answer assessments. Questions with single answers do not reflect real world situations in which there might not be single-solution answers. Learners also could guess the answers. The materials provided in the LMS are mostly textual in nature although occasional video and animation clips were used. The LMS-centric model will always have the teacher as the knowledge dispenser. Participants in an LMS-centric model do not share much. In addition, contents from other devices (e.g. smartphones, tablets and social media) were difficult to be consolidated with those on the LMS. The LMS must be connected to the Internet all the time in order for learning interactions to take place. On the other hand, smartphones are not always connected to the Internet. Finally, it is difficult to ascertain how much learning the participant has done if he or she uses multiple devices to access information (Advanced Distributed Learning (ADL) Co-Laboratories, 2012).

1.2 What led to the development of the xAPI?

SCORM was first released in 2000 (Glahn, 2013). It has served its purpose of achieving interoperability in different LMSs. But since then the landscape has changed tremendously. Firstly, there is an extensive worldwide proliferation of mobile devices and the mobile app ecosystem. People are now using different mobile devices to receive information, communicating, learning and collaborating amongst themselves. At the same time wireless and Wi-Fi coverage are increasing everywhere. People everywhere engaged in games, whether on the web, using the console or mobile devices. Applications in augmented reality and simulations are spreading not only on the desktop computers but on mobile devices like the iPADs. People are also communicating extensively using social media tools like Facebook, Twitter, Instagram and blogs. Open source movement is gaining widespread use with people everywhere (Hruska, 2013).

A person might be texting one moment. Next moment, he used a desktop computer to access an LMS to do an online quiz. After a while he might be in a restaurant discussing business deals with his client. For this, he used an iPAD. Later in the afternoon, he could be attending a 1-hour webinar using his Android smartphone.

All these activities show that very little online learning happens on the LMS! The LMS is used only as a repository of learning materials.

Subsequently, the ADL of the US Department of Defense engaged Rustici, an e-learning software company, to work on a new proposal for the new generation of e-learning specification. After extensive consultations with the e-learning community, Rustici developed the Tin Can API in 2013. The ADL later renamed it xAPI, for Experience API. Version 1 of this specification was released in April 2013. It is now at version 1.0.3 (GitHub, 2015).

2 What is the xAPI?

The Experience API forms part of the Training and Learning Architecture (TLA) that the Advanced Distributed Learning (ADL) Project is working on (ADL website on Experience API, 2012). This API (also known as the Tin Can API), is an open source e-learning software specification (Bowe, 2013). The specification makes it possible to collect data about the learning experiences a person has achieved either online or offline. Learning experiences are recorded in a Learning Record Store (LRS). LRSs can exist within traditional Learning Management Systems (LMSs) or on their own (Brusino, 2012).

The Experience API is commonly considered the successor to SCORM (Sharable Content Object Reference Model) (Tillet, 2012). Since 2000, SCORM has been the de facto e-learning standard for packaging e-learning content to be delivered to LMSs. (Training Industry Magazine, 2014). However, there are several drawbacks to SCORM. (Whitaker, 2012; "Saltbox Developers Discuss Online", 2012).

This API is stewarded by ADL. xAPI focuses on how the activities people do are evidence of a learning experience. It is a Representational state transfer (REST) web service. As for the data format, it uses the JavaScript Object Notation (JSON). The web service allows software clients to read and write experiential data in the form of "statement" objects. Statements are in the form of "I did this", or more generally "actor verb object". (Tillett, 2012). More complex statement forms can be used.

With the xAPI, e-learners can take e-learning outside of the browser (eLogic, 2012). In addition, xAPI allows e-learning to execute in native mobile applications (Brandon, 2012). Thus, there is more control over the learning content should the xAPI specification be used (Tillett, 2012). Not only that, there is better security using a technology called Oauth (Project Tin Can Phase 3, 2011).

Another use of the xAPI is that of platform transition; e.g. an e-learner starts e-learning on a mobile device and finishes it on a computer (Project Tin Can Phase 3, 2012). Other possibilities include those of tracking games and simulations (Brusino, 2012), tracking real-world performance (Gautam, 2012), tracking team-based e-learning (Brusino, 2012) and tracking learning plans and goals (Downes, 2012).

Another use of the xAPI is that of platform transition; e.g. an e-learner starts e-learning on a mobile device and finishes it on a computer (Project Tin Can Phase 3, 2012). Other possibilities include those of tracking games and simulations (Brusino, 2012), tracking real-world performance (Gautam, 2012), tracking team-based e-learning (Brusino, 2012) and tracking learning plans and goals (Downes, 2012).

2.1 xAPI statements

The xAPI is a web service. A web service supports applications on the World Wide Web (WWW) and makes use of the HyperText Transfer Protocol (HTTP). As a web service, the xAPI allows for statements of experience, typically learning experiences, to be delivered to and stored securely in a Learning Record Store (LRS).

The web service allows clients to read and write experiential data in the form of "statement" objects. In their simplest form, statements take the form of "I did this", or more generally "actor verb object". xAPI also provides facilities for more complex statement forms (Rustici Software 4, 2014).

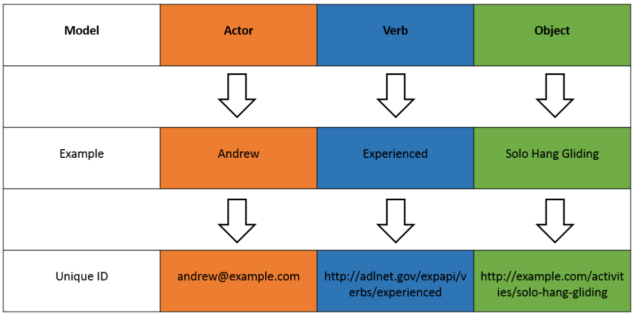

Fig. 1. The basic elements and structure of an xAPI statement

In the example, "Andrew experienced 'Solo Hang Gliding'", we recognize that "Andrew" is the actor, "experienced" is the verb, and "Solo Hang Gliding" is the activity. The statement object itself would take this structure in JSON (JavaScript Object Notation) format:

```
{
    "actor": "Andrew",
    "verb": "experienced",
    "object": "Solo Hang Gliding"
}
```

This is a simple example. How do we know which Andrew we mean? Which 'Solo Hang Gliding' activity was it? Was it one that was part of military training, or the one from a commercial enterprise, or something self-directed? Here is a valid xAPI statement:

```
{
      "actor": {
            "name": "Andrew Downes",
            "mbox": "mailto:andrew@example.com"
       },
       "verb": {
            "id": "http://adlnet.gov/expapi/verbs/experienced",
            "display": {"en-US": "experienced"}
            },
       "object": {
            "id": "http://example.com/activities/solo-hang-gliding",
            "definition": {
                  "name": { "en-US": "Solo Hang Gliding" }
            }
       }
}
```

A structure has been added here to ensure that we can uniquely identify the component parts. This helps to correlate statements about the same person, activity, or verb. There is also a structure added to provide information about the objects, like name. Other descriptive fields are available (Experience API, 2015).

We can also add a lot more to a statement, in the form of statement context ("Andrew completed 'Solo Hang Gliding' in the context of 'Army Training Level 1'" or "Bob completed 'Truck Driving Training Level 1' on his Android phone, under the instruction of Dan") or you can attach results to a statement ("Bob passed 'Truck Driving Training' with score 90%"). You can even declare custom fields on a statement, in the form of extensions (Rustici Software 4, n.d.).

2.2 Learning Record Store (LRS)

A Learning Record Store (LRS) is a place to store learning records. The LRS is a new system that goes together with the xAPI. As xAPI-enabled activities generate statements, they are sent to an LRS. The LRS is simply a repository for learning records that can be accessed by an LMS or a reporting tool. An LRS can live inside an LMS, or it can stand on its own. LRSs record all of the statements made. An LRS can share these statements with other LRSs.

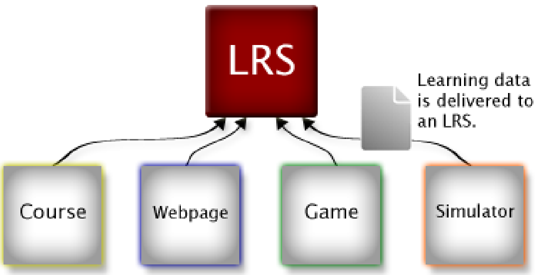

Fig. 2. Learning Record Store (LRS)

The data stored in an LRS can be accessed by LMSs, reporting tools, or other LRSs. The data can be stored as individual learning records and/or entire transcripts. An LRS can limit who can read and write learning records.

SCORM and other e-learning standards only store a certain amount of learning data. xAPI allows for the LRS to store nearly everything. This means better reporting and a much more accurate picture of learners.

An LRS can live inside an LMS and use the LMS's reporting tools to make meaning of the LRS's data. Or it can live on its own with its own reporting tools.

LRSs can share data amongst themselves, so learners and data can be transferred from one organization to another. Statements can also be sent to multiple LRSs (e.g. "I want to record my training in my own personal LRS as well as my employer's LRS.")

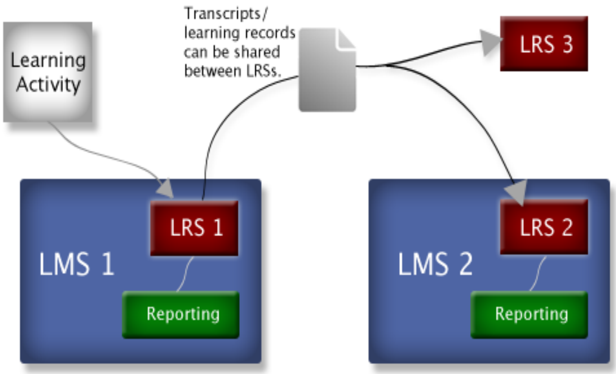

Fig. 3. Sharing data among LRSs and LMSs

3 Examples of xAPI applications

Since the xAPI specification was first released in April 2013 it has received much support from the industry. Many vendors have jumped onto the bandwagon. There are now more than 100 vendors with software systems and authoring systems that conform to the xAPI specification (Rustici Software 5, n.d.). At the same time, many developers have developed their xAPI applications. As an example, an application on how xAPI statements can be pushed and pulled in two different LRSs will be explained. This will be known as the Tin Can (xAPI) in Moodle.

There are other interesting example applications such as an application that creates awareness of kinaesthetic learning using the xAPI (Corbi and Burgos, 2014), the PDF Annotation in the Cloud (Werkenthin, 2014) and the TREK Learning Experience Manager (LEM) (CognitveAdvisors, 2015).

3.1 Tin Can (xAPI) in Moodle

In this first example, a Moodle LMS was set up with Tin Can (xAPI) plugins installed. The Golf Prototype (as an example of formal e-¬learning) was launched from Moodle, tracking statements into the Learning Locker LRS. These statements were then pulled into the Watershed LRS as an example of sending statements in one direction from one LRS to another. Moodle was configured to fetch the statements from the Watershed LRS to display to the learner, thereby completing the loop.

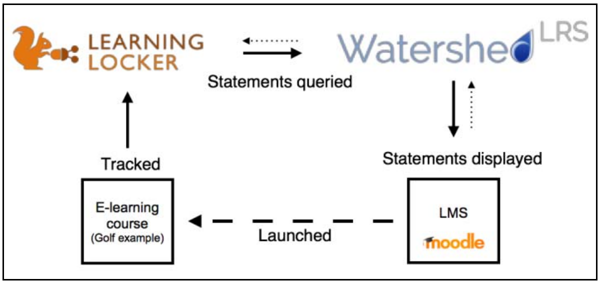

Fig. 4. Design of xAPI test with an LMS and two LRSs

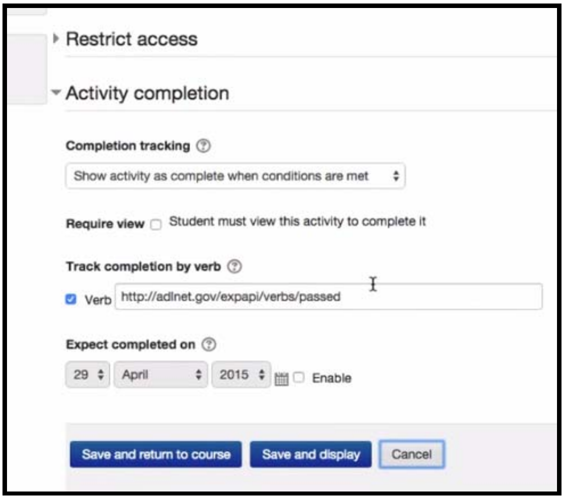

Fig. 5. Upon the successful completion of the Golf Prototype course, the verb "passed" was generated and sent to the LRS.

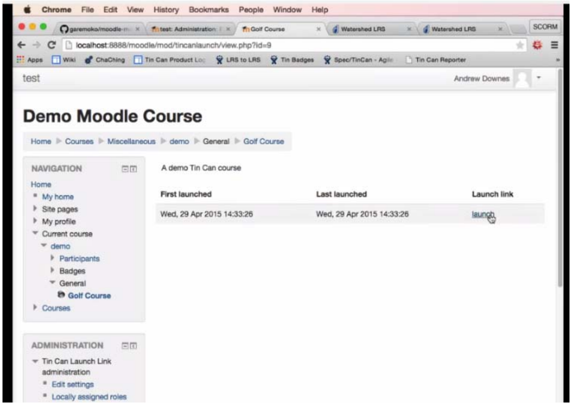

Fig. 6. The Golf Course was launched in Moodle. This course could be taken from an iPAD, for example.

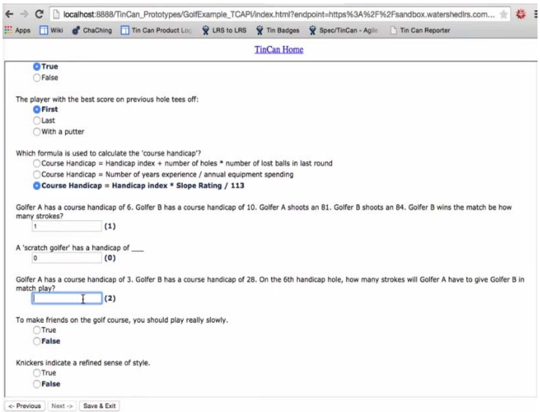

Fig. 7. This is the multiple-choice quiz (MCQ) of the Golf Prototype course.

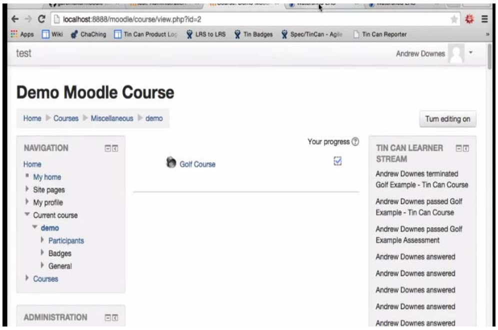

Fig. 8. The LRS indicated that the user, Andrew Downes, has completed the Golf Prototype course. Note the tick (√) below the words, "Your progress" label.

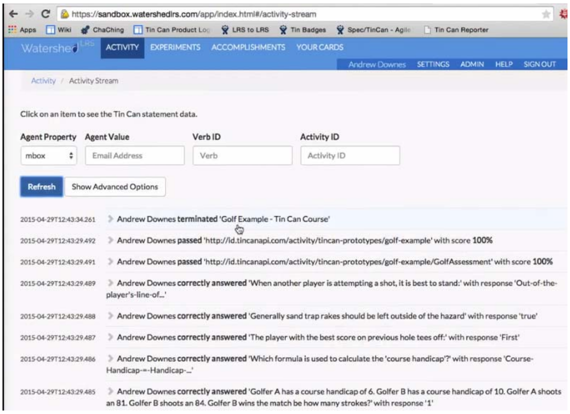

Fig. 9. xAPI data was pulled into the Watershed LRS (which is an external LRS).

This example is significant is that firstly it demonstrated that different LRSs can exchange the xAPI data. Secondly, the Moodle LMS can push or pull the xAPI data to the LRS. Thirdly, there are available xAPI plugins for LMSs. Some of the plugins are open source whilst others are commercially available. Fourthly, the user can use any mobile device to go through the course materials. The push and pull of the data can be done any time when there is network connection. This avoids the necessity of maintaining Internet connection all the time. Finally, the e-learning content can be tracked depending on the parameters like completion of quiz and access.

4 Conclusion

There is no doubt that xAPI continues to enjoy growing adoption by many LMS vendors, e-learning system and authoring system vendors. This can be seen from the growing list of xAPI adopters (142 as at 9 May 2015 from Rustici's website at http://tincanapi.com/adopters)

The xAPI technology is simpler to implement as compared to the SCORM technology. Focusing more on learning activities, xAPI statements support mobile and flexible technology.

It also appeals to human resource managers as they can now link learning activities to competency achievements (Silvers, A., 2014).

Management staff can use xAPI to link activities in sales training and the tasks sales professionals accomplish in CRM (Customer Relationship Management) systems.

Sales teams are making advances on designing using xAPI. Feedback to sales trainers allows the company to tweak the training approach to influence better outcomes.

The xAPI offerings report analytics on how the content is being used in more detail than SCORM provides. In other cases, organizations are developing job aids and other forms of performance support using xAPI. For example, Corbi and Burgos explained about the xAPI and LIME (**L**earning, **I**nteraction, **M**entoring and **E**valuation) model case study which helped them to monitor their students (Corbi & Burgos, 2014) and make recommendations in their studies.

Some organizations use xAPI within their CRM systems to translate lead generation, time-to-close, and other streams of activity—all in an effort to gain a better sense of the relationship between changes in training and changes in performance.

In time to come, more xAPI based educational applications will be developed.

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Information management requirements for precision education

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Abstract. This paper addresses the information management requirements of a new approach to curriculum design – called *precision education*. The new approach aims to provide accreditable but highly targeted and customizable curricula. To be accreditable, a standardization of the Intended Learning Outcomes (ILOs) is proposed. Issues of delivery and vehicle are separated from the ILOs. For example, a course on object-oriented programming can be delivered online or face-to-face (delivery) and using Java or C++ (vehicle). It could also be taught using a variety of textbooks, development environments, problems and examples. Courses and programs can then be validated by only considering how they meet their ILOs. In order to overcome the potentially high resource requirements that can arise due to the customizability requirement of this approach, a new model for IT-mediated inter-institution collaboration is proposed as an integral part of a new methodology.

Unlike career planning, which has been criticized for its rigidity in response to rapid changes in domain knowledge, especially in the technological fields, the new approach is incrementally adaptable and incorporates the general interests of the students, their varying and evolving backgrounds, their aptitudes, and their broader career goals.

The new approach is inspired by precision irrigation and borrows concepts of Service Oriented Architectures (SOA) in software engineering. Precision education represents a new curriculum design model that incorporates elements of both product-oriented and process-oriented models as presented by their champions Ralph Tyler, Benjamin Bloom and Lawrence Stenhouse. The paper outlines the requirements of the core information system infrastructure needed to support this approach: curriculum customization, student enrollment, program accreditation, and industry involvement in study plans and to coordinate the delivery of the content across multiple institutions.

Keywords: precision education, curriculum model, virtual university, precision irrigation, Service Oriented Architecture (SOA).

1. **Introduction**.

While there can be general agreement on some basic core knowledge and skills that all students of a given discipline should learn, much of the remaining knowledge will be open for debate. For example, in post-secondary computer science education, there is agreement about such topics as data structures, algorithms and programming skills, but much is left open for various specializations within the discipline. New tools, languages, protocols and standards arise due to evolving technological trends (TOIBE Software, 2015).

Designing highly customized curricula will have to account for evolving individual interests and backgrounds, career goals, personal aptitudes, anticipated technological and workforce requirements and trend. Two recognized key questions to ask in order to evaluate any potential topic for inclusion in a curriculum are (Sullivan & Higgins, 1983):

QA_1. Will the contemplated topic lead to the acquisition of new knowledge or skill likely to be used by the student in the future?

QA_2. Will the contemplated topic be needed as a prerequisite to some other knowledge or skill that the student is likely to use in the future?

Unfortunately, answering those two questions individually for each student is difficult and is especially challenging in a fast changing world. In addition, they ignore a key aspect of successful education which is the student's interests and aptitudes? I propose a revised list of questions as follows:

QA. Will the contemplated topic, directly or indirectly, support the student's career goals and objectives?

QB. Does the student have the requisite backgrounds and aptitudes to make good use of the proposed topic?

QA embodies the two previous questions QA_1 and QA_2, while incorporating the student's interests and goals. Question QB takes the prerequisite knowledge and aptitudes into account.

It is to be noted that the answers of all he above questions are likely to be dependent on time. For rapidly evolving fields, both from knowledge and career perspectives, obsolescence can come quickly. This will require continuous realignment and repair of the initial curriculum.

2. Previous Approaches and Existing Practices

Most academic programs nowadays address such questions by providing career advising, academic advising, personal development planning, multiple majors, minors, tracks and elective courses to choose from.

Career advising / counselling can be quite helpful in guiding the students to articulate and sort out their interests, goals and objectives, and to also better understand their own capabilities. However, it has no impact on the design of a customizable curriculum to better suit the student's needs and objectives.

Academic advising helps the student enrolled in a particular program make better informed selection decisions from among the available courses, tracks and minors.

However, academic advising plays almost no formative role in determining what the student's curriculum will include to target a specific career or career line

Personal Development Planning (PDP), is similar to career advising, but can be more long term (setting a 5-year personal development plan is common), and is done a bit more formally using the concept of a portfolio. It also extends in time scale beyond university studies, into employment, but it too has no direct influence on available offers.

Offering multiple majors, minors, tracks and elective courses to choose form allow a certain degree of customization of the existing curriculum. However, merely selecting from available offers does not help if none of the available majors, minors, tracks or electives fit the student's needs well.

3. Precision Education

This paper proposes a new approach – called *precision education* – that aims to provide focused education that targets the student's individual needs and maximize the degree of fitness of the program to current career requirements. The term *Precision Education* is partly inspired by *Precision Irrigation*, an engineering approach to provide plants with precisely the amounts of water and nutrients it needs using computer control (Kamel, El Shafie, Sharaf, & Youssef, 2012).

To achieve its goals, precision education offers a new model for inter-institution collaboration that can allow more learning options to be provided for students. This is achieved by capitalizing on the resources of multiple institutions. Crucial to the success of this approach is the availability of top notch information management infrastructure, whose requirements the current paper aims to outline.

Precision education, however, is not merely a proposal for inter-institution collaboration. It aims to achieve more *separation of concerns*, more *dynamicity*, and more *student centricity*.

By providing a low coupling between discipline benchmark standards and career and needs, a virtual *separation of concerns* is achieved. This separation of concerns offers a significant educational advantage. It will allow accreditors to accredit a much wider-scoped degree than is currently practiced. They will be accrediting a customizable degree – not a rigidly fixed one – along with the customization rules that ensure that academic standards are complied with. An added bonus to the separation of concerns is an increased level of *dynamicity* of courses and programs on offer. This means that programs and courses can change more rapidly in response to advances in knowledge and career requirements, while remaining within the bounds of the accreditation conditions.

Perhaps the greatest foreseeable advantage of precision education from the student's point of view is its *student centricity*. Involving the students more in determining the contents of their programs and making the relationship between their interests, career goals and job requirements will no doubt have a beneficial effect on student motivation and satisfaction.

To achieve student centricity, precision education includes an educational component intended to raise the level of awareness of the student about career awareness, discipline awareness, personal self-awareness and personal development planning. Such component can be viewed as a cornerstone of educational professionalism which requires a professional to "be clear in the use of language". In this case it is the jargon about the field of the student's studies, to which the student is still among the laity.

The new curriculum design model that this approach represents combines elements from both *product-oriented* and *process-oriented* models as presented by their champions Ralph Tyler, Benjamin Bloom and Lawrence Stenhouse.

As a curriculum design model, precision education adopts all 4 steps of the Tyler rationale (Finder, 2004) and (Tyler, 1969):

1. Defining appropriate learning objectives.
2. Selecting suitable learning experiences useful in attaining these objectives.
3. Organizing those experiences in the best possible way.
4. Evaluating the effectiveness of learning experiences.

Typically, in applying the product model, an educational professional is entrusted with the task of defining the appropriate learning objectives of the program (step 1), It is also up to the program designers to select and organize suitable learning experiences, usually in the form of a sequence of courses, project work, or work experience (steps 2 - 3). Those learning experiences, along with their organization then become frozen in time until the next program review event, usually one program cycle later. Finally, the effectiveness of learning experiences (step 4) is evaluated by a variety of means including student evaluations and various program statistics.

Precision education makes a shift in the manner in which steps 2 - 4 are carried out.

First, aided by the precision education information system, students and academic advisors will be heavily involved in selecting and organizing the suitable experiences that meet the appropriate learning objectives.

Second, each such experience, be it a course, project work, practical training, or whatever else is available, will be designed and approved by the accreditors only in as much as they are seen to fulfill their own declared learning objectives. This approval will also consider the particular practices in the institution and the program in which it is offered. In contrast, current validation and accreditation practices leave it unclear which parts of the curriculum form part of the accreditation "contract" and which parts can evolve while maintaining the accreditation status?

This approach is also in line with the process model of curriculum design (Stenhouse, 1975) which advocates more learner involvement in deciding what they learn.

Note that while the ILOs of a learning experience represent its post-conditions, its pre-conditions must also be well specified. Whereas this is done typically by specifying prerequisites, it will be done in the form of what may be called Intended Learning Incomes (ILIs). Hardwiring specific courses as prerequisites and then assessing the equivalences in case of a transferred student is inefficient and represents an impediment to learning mobility. Basing all pre-conditions on ILIs is a more flexible approach that is part of the precision education methodology.

As described above, precision education will be dependent on an effective information system that will be able to support the customization of study plans, enforce the accreditation constraints, and coordinate the delivery of the content across multiple institutions. This information system is based on the concept of Service Oriented Architecture (SOA), discussed next.

4. The Precision Education Service Oriented Architecture

SOA (W3C Working Group, 2004) is a relatively recent development in information system architecture. It is a way to structure the three basic components of architecture (*services, directories and requestor*) to facilitate discovery and use of services. SOA service providers publish descriptions of their *services* on web *directories*in a standard form. Such standard form is akin to the familiar yellow pages of any business. *Requestors* of those services are provided with a standard web interrogation facility that allows them to discover available services that fit their needs and to find out exactly how to use those services. They can then use those services.

As an example, an e-commerce site that accepts foreign currencies may wish to use an online service that converts among currencies using up to date exchange rates. You can then use SOA to automatically find such services and use them on your site. Should one of those services become unavailable, then switching to another service can be done automatically. Fig. 1 illustrates the SOA architecture of precision education system.

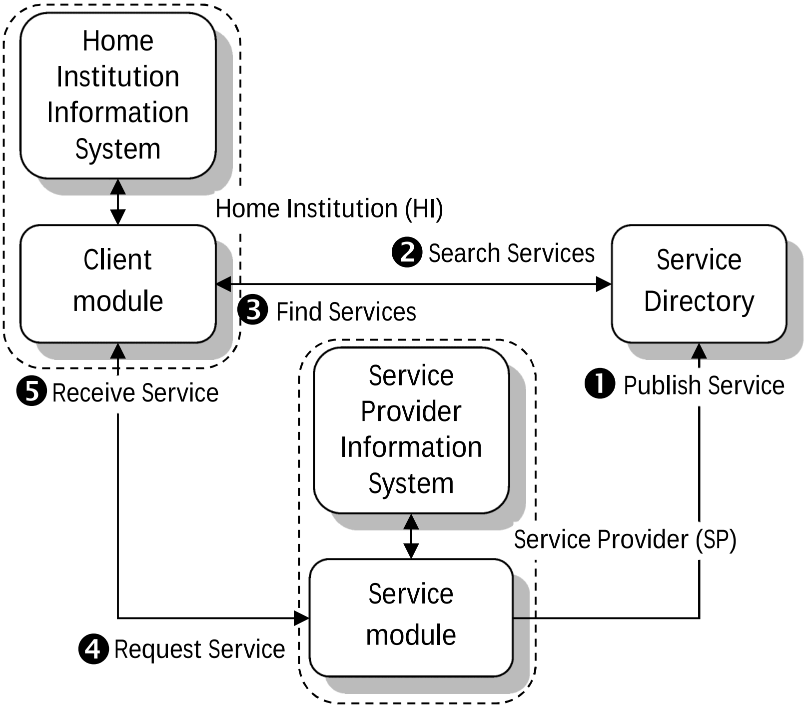

Fig. 1. An overview of the service oriented architecture of the precision education system

The precision education information system consists of three major modules that mirror the SOA components: the *client module*, the *service module* and the *service directory*.

The *client module* contains all the functionalities needed to search for, find, request and receive educational services on the student's behalf. It is linked to the information system of the home institution in which it is installed.

The *service module* contains all the functionalities needed to publish the details of its educational services (e.g. courses) to service directories. It is also responsible for receiving and responding to service requests received from client modules. The service module is linked to the information system of the service provider in which it is installed.

The *service directory* of which there could be many is a network of online directories similar to the *Domain Name Server* (*DNS*) network. It maintains the details of all available precision education services. It is responsible for accommodating all service publication requests from service modules and for receiving and responding to all service search requests from client modules.

Two critical components in this architecture are the interfaces between the home institution information system and the client module on one hand, and between the service provider information system and the service module on the other. One way to approach the development of these interfaces is to view the information systems of the home institution and of the service provider themselves are complex services to be accessible by the applications as clients. These complex services are called *orchestrating services* or *layers* (also referred as *choreographing services*).

This is how the proposed system will work:

Students join a *Home Institution* (*HI*) whose role includes:

1. Admitting the student in a degree program
2. Maintaining all personal and background details about the student upon entry
3. Acting as a precision education portal on behalf of the student
4. Coordinating the student progress
5. Keeping track of and maintaining historical records about the student's progress in the system (transcript)
6. Issuing the final degree to the student

Students will receive content (educational services) from *Service Providers* (*SP*) whose role includes:

1. Authoring and publishing contract-based educational services
2. Receiving and serving educational service requests from home institutions
3. Providing the educational content to the students
4. Reporting back the results of the educational services provided to the student's home institution.

There will be three types of educational institutions in relation to the role they play in the precision education system:

1. *Home institutions* will provide no educational content. Instead, they specialize in designing accreditable degree programs and coordinating them. They also fulfill all the traditional roles of an educational institution, except that they rely completely on educational service provider for content. This type of institution is expected to emerge as a result of the precision education approach.
2. *Service providers* offer no degrees of their own, but specialize in offering accreditable content. They provide all the needed facilities to support the process of offering content, but depend entirely on home institutions for couching their learning experiences in suitable accredited programs. Currently, institutions offering courses with no accredited degrees can

participate in the precision education service system as service providers. This could include a rather large number of Massive Open Online Course (MOOC) providers.

3. *Mixed institutions* play both roles. They act as both home institutions and service providers. Traditional universities joining the precision education initiative will be expected to be in this category.

We will turn our attention to the requirements of the precision education information system next.

5. Key Requirements

There are two categories of information requirements for precision education: information categorization requirements and information processing requirements.

The *information categorization requirements* relate to the need of having a common classification of Learning Objectives (LOs), which include both ILIs and ILOs. This classification is needed for two reasons:

1. In order to achieve a *common language* among multiple providers, employers, accreditors and students. This will allow easier recognition of synonyms and the disambiguation of homonyms found in the specifications of objectives.
2. Using higher level objectives that consist in turn of simpler objectives permits a *more efficient* way of assessing and specifying learning objectives. So, a hierarchical taxonomy is needed. What is meant here is not merely an abstract taxonomy like that of Bloom, but a more concrete taxonomy of all fields of learning.

An excellent starting point for this categorization is available through the subject benchmark statements published by accreditation agencies. For example, the Quality Assurance Agency (QAA) has published over 60 subject benchmark statements that are available from their website (The Quality Assurance Agency for Higher Education, 2015). Typically the subject benchmark will outline in broad terms what skills would be expected of a holder of a degree in this field in terms of subject-related cognitive, practical and transferable skills.

In addition, Subject benchmark statements make reference to the body of knowledge that students would be expected to know. There are also usually additional expectations, for example benchmark standards, teaching, learning, and assessment methods, as well as the learning environment, needed resources and how to enhance the student experience (motivation and satisfaction).

The precision education approach reveals an almost universal weakness in the current curriculum design practices. Practically all curricula specify course dependencies using prerequisites. However, this practice ties the curriculum to a single institution, the one that offers that prerequisite. There are situations when this practice causes gross inefficiencies:

1. If the student is a transferee from another institution the student background must be examine manually by an expert to determine whether or not the prerequisite has been satisfies using some other course
2. If the prerequisite course is cancelled, then an equivalent course must be determined that has the exact same ILO and indicative content as the cancelled course, which defeats the purpose of cancelling the course in the first place.

In precision education, all courses come with *service contracts* that specify all contractual pre- and post-conditions. The pre-conditions consist of Intended Learning Incomes (ILIs) and intended Vehicle Incomes (IVIs). The post-conditions consist of Intended Learning Outcomes (ILOs) and Intended Vehicle Outcomes (IVOs). ILIs, IVIs, ILOs and IVOs all consist of expected knowledge or skills. However, ILIs and the ILOs specify a different type of knowledge than those specified by the IVIs and the IVOs. One can think that the former focus on the ends while the latter describe the means. Academic institutions tend to focus on the former while the practical job market also requires the second.

Another advantage of this way of contractual thinking is that students can tap more easily into the ever increasing volume of excellent expert online learning materials, videos, and free courses. In as far as we can test the student knowledge of and skills of both core and vehicle materials accurately, we can better account for the student's background in the precision education approach, regardless of how this background was achieved.

The *information processing requirements* relate to the required capabilities of precision education information system. The remainder of this paper will provide an outline of these requirements in a standard software requirements template, loosely based on the *Volere* methodology.

1. *Purpose*. We wish to implement the new precision education approach that will support a network of educational institutions according to the precision education methodology. Each participating educational institution is expected to have its own, possibly pre-existing information system which must be linked with the proposed information system, in a standard way.

2. *Potential Customers*. Current educational institutions of higher learning as well as new startups participating either service providers or home institutions.
3. *Users of the system*. Students, graduates wishing to upgrade their knowledge and skills, academic advisors, degree program developers, and educational services (e.g. courses and training programs) developers and employers.
4. *Development constraints*. The system should be web based and should be easily integrate-able with existing educational institution information systems. To achieve this, the system should comply with SOA standards.
5. *Scope*.
   - 5.1. The system will support the complete cycle of the SOA approach, by implementing all necessary components and their interactions. It should allow users to search for, find, request and deliver educational services as part of accredited home institution programs.
   - 5.2. The system will implement the client module, the service module and service directories and all necessary interactions among them in accordance with the Service Oriented Architecture (SOA) approach.
   - 5.3. The system will also provide all the necessary user interfaces to its own added services, and should interface with the information systems of existing institutions through a single sign-on (SSO).
   - 5.4. The system scope shall not include any financial transactions between the client and the service provider. Students finalize all financial requirements directly with the service providers. The system will only provide fee information to the client through appropriate screen.
   - 5.5. The system scope shall not include any interactions between educational institutions and students that are not unique to the precision education approach.
6. *Functional requirements*. The system shall:
   - 6.1. Allow home institutions to register their accredited programs into the precision education system
   - 6.2. Provide students with career and job analysis tools that will facilitate the process of curriculum customization
   - 6.3. Provide the students with a learning opportunities guide that will help them choose available degree programs, courses, and training programs.
   - 6.4. Allow students and academic advisors to customize accredited programs offered by home institutions based on the student's interests, aptitudes, background, career goals, and current job requirements.
   - 6.5. Coordinating and schedule the student attendance in different institutions, including honoring all prerequisites.
   - 6.6. Provide program designers with tools that will help them design courses that meet current job requirements.

6.7. Allow accreditors to review and register their accreditation decisions for each program and each educational service.

7. *Non-functional requirements*.

7.1. Look-and-feel requirement.

7.1.1. The system will have its own style with the logo of the approach and will provide a uniform look throughout all its screens

7.1.2. All forms should fit on one screen and should not be too cluttered

7.2. *Usability requirements*.

7.2.1. The system should be user friendly

7.3. Accessibility requirements

7.3.1. The system should support the Web Accessibility Initiative (WAI) for the majority of expected users with disabilities

7.3.2. the system should be accessible from web browsers

7.4. *Performance requirements*.

7.4.1. The system will respond to most user requests within 1 second

7.4.2. The system will be able to complex user requests that require online searching in less than 10 seconds

7.4.3. The system should not be unavailable for more than 10 minutes per week (three 9s)

7.4.4. The system should support a typical maximum load during registration peak times.

7.5. *Operational requirements*.

7.5.1. The system should operate within the existing infrastructure of educational institutions

7.5.2. The system should not be dependent on the particular platforms of each educational institution

7.6. Service requirements.

7.6.1. Services and clients for those services should follow a well defined contract according to the Design by Contract (DbC) principles. All contracts should be documented clearly.

7.6.2. Services should be independent of each other (loosely coupled)

7.6.3. Services should encapsulate their internal logic and only interact with their callers through a well-defined interface.

7.6.4. Services should be highly autonomous within the bounds of their contractual agreements with clients.

7.6.5. Service contracts should specify the minimum period during which the service provides is guaranteed to be available.

7.6.6. Service contracts should specify the expected effort and time expected of the student to complete the provided service.

7.6.7. Service contracts should clearly define the required pre-conditions and post-conditions for providing the service.

7.6.8. Services will only maintain a minimal amount of state information for each service rendered. The main responsibility of maintaining the service states is to be borne by the client.

7.6.9. Services are enriched by detailed meta-data that will facilitate searching and service discoverability

7.6.10. Services are expected to come in a variety of granularities in terms of effort, knowledge, skill and duration. The system should permit services of any granularity.

7.6.11. Service location should be irrelevant to providing the service, except of the effects of distance when physical presence is required.

7.6.12. Location transparency: This refers to the ability of a service consumer to invoke a service regardless of its actual location in the network.

6. Conclusions

Precision education is a contract-based course and curriculum design methodology that aims to facilitate the development of accreditable and customizable curricula. A curriculum is thus viewed as being composed of a set of interdependent learning objectives, not a set of interdependent courses. Those learning objectives can be met by any set of approved learning experiences provided by a wide array of complying education service provides. The contractual relationship between the service providers and the home institution is based on clearly defined pre- and post-conditions for each service rendered.

Two categories of objectives are distinguished: learning objectives, which focus on the ends, and vehicle objectives, which focus on the means. This distinction allows the separation of concerns of accreditation requirements and career requirements resulting in more flexibility curricula. This tailoring can be done through inter-institutional collaboration to produce a more precise fit of curriculum to its needs.

The precision education model is both service oriented and relies on an information system having a service oriented architecture. In this architecture, service providers publish their services in standardized contractual forms in special directories. Students can search those directories online to discover the most suitable learning services that they can incorporate within their accredited curricula.

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Learner interviews for flexible education in a Japanese tertiary curriculum

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Abstract. This study outlines a series of face-to-face semi-structured interviews conducted in a Japanese tertiary English classroom. It begins with an explanation of the background search underlying the chosen interview process and how the interview data was analyzed, followed by a description of the major characteristics of the students' responses, and then an investigation into how their comments - especially those regarding teaching methods and materials - changed over the course of the academic year. The findings illustrate the importance of providing students with opportunities to express their honest opinions openly and directly with their instructors, so that their instructors are better able to determine how they might improve their teaching methods and materials, and shape their curricula.

Keywords: interviews, flexible education, Japanese teaching methods

1 Introduction

Qualitative interviews have been utilized by researchers and educational professionals as one of the most effective assessment tools to collect students' comments and opinions on various aspects of their learning activities (Gilliland, 2015; Ajayi, 2015). In many educational institutions, various types of research instruments have been used to collect such information from students. For example, questionnaires, which are useful in analyzing data statistically, are frequently used for the purpose of assessing teaching qualities and students' degree of satisfaction. In contrast, other structured instruments, including requests for written evaluations, often produce low response rates.

Unlike these tools, interviews, especially semi-structured interviews, are suitable for collecting data from small numbers of respondents and examining various issues through back-and-forth discussions among students and their instructors. In addition, unlike 'interactive diaries' (Gary, 1998) and blogs (Amir, Ismail & Hussin, 2011; Ducate & Lomicka, 2005) these small-scale interviews are effective in providing respondents with enough time to think about the questions are given and in locating specific problems which are not easily noticeable in the classroom. Close personal contact between interviewees and interviewers and interviewees' gestures and other visual clues are also of great benefit to interviewers. At the same time, students can learn more about their instructors, building better student-teacher relations. Thus, semi-structured interviews are valuable in assisting instructors in understanding their students' needs and in determining appropriate revisions to their lesson plans and teaching methods. However, there is a lack of research regarding how to best structure these interviews, and how to utilize them to bring about maximal constructive, positive change.

2 Purpose of the Study

The purpose of this study is to examine Japanese undergraduate students' feedback on their English studies - especially regarding teaching methods and materials. This study focuses on how students' determination of perceptions change over the course of the academic year.

2.1 Research questions

1. What are the distinctive characteristics of their feedback in terms of teaching methods and materials?

2. How do students' perceptions change over the course of the academic year?

3 Japanese Students

Japanese education employs a teacher-centered approach, which encourages teachers to provide information and students passively to take notes. Students rarely express strong personal opinions and instead value harmony and cooperation in groups. They have difficulty in speaking up for themselves. They often remain silent when asked questions, even in Japanese. This prevents them from having smooth communication in language courses. Since this behavior isn't normal in the classrooms of Western countries, instructors from these countries are often confused by their students' silence (Korst, 1997) In addition, in secondary school they are trained to suppress their personalities in order to promote self-discipline (Sugawara, 2013). They lack confidence in self-expression and are anxious about whether their ideas are different or not from those of other students (Harumi, 2011). Japanese students' silence is often seen as a lack of initiative or a refusal to respond or cooperate (Anderson, 1986, quoted in Harumi, 2011, 260).

In the school curriculum there are few group activities such as debates and discussions. Instead, schools implement exam-oriented drill exercises, such as fill-in-the-blank exercises, graded on a point-deduction scoring system, which results in students having an extreme fear of making common mistakes and being forced into a counterproductive pursuit of performance (Sugawara, 2013). These cultural influences prevent students from speaking their honest opinions in interviews.

4 Methodology

4.1 Setting and Student Profiles

The subjects of this study are 22 Japanese university students aged 18 to 20 years. 86% of them were male. All of the students previously had studied English for six years and the student survey carried out at the beginning of their course indicated that they had attained a lower-intermediate level of proficiency. These students were majoring in Japanese literature, law, economics and engineering. The course in this study was English course with an instructor-directed, face-to-face learning environment. Students were accustomed to teacher-centered language learning in a large lecture-type classroom; their secondary school English-learning experiences were examination-oriented.

The aim of the course was to help students develop their communication skills in English. Students learned how the language works by understanding various notions such as *time*, *direction*, *size*, and *frequency*, as well as communicative functions such as *making a request*, *asking for directions*, *expressing opinions*, *checking information*, and *making complaints*. Sociolinguistic and contextual meaning was of high importance. In order to help students to become more competent at both communicating and analyzing the language, Data-Driven Learning (DDL) activities using analytic approaches were introduced into the classroom. DDL helps students to more easily understand the meaning of utterances by deriving meaning more from context than from words and sentences in isolation. These courses were offered weekly for ninety minutes in a computer classroom.

Before the project started, the instructor went over the basic concepts and techniques students needed to understand it. In order to fill the gap between students' previous learning experiences in secondary school and this innovative DDL approach, the instructor provided clear examples of how to read concordance lines. The students were required to look at some words located on the left and right of the key words in concordance lines, and identify lexical patterns and the meaning expressed by them. Based on learned phrases and patterns, students also did role-play exercises.

4.2 Semi-Structured Interviews for This Study

After each role-play exercise, the instructor used a dictaphone to interview each group about the DDL activities and the dialogues they created in the exercise. Before the interviews were conducted, the instructor explained the goal of the interview, its length and the topics to be discussed. The instructor also asked them for their verbal consent and reminded them that their comments would be kept confidential and used for research purposes only.

The interviews were conducted in Japanese so the students could understand the questions and express their honest opinions without any language impediments. The average duration of each interview was 10 minutes. Of primary interest to this study was how well students were able to create their dialogues and perform them, as well as how much of a contribution DDL made.

Prior to the interviews, the instructor developed semi-structured questions to provoke discussion. The questions were broadly divided into four topics: *role-play exercises, creating dialogues, DDL activities* and *others*. The basic questions for each category were as follows.

Role-play exercises:
How was your performance?
Did you enjoy your performance?
Compared with your last performance, did you see any differences?

Creating dialogues:
What made it difficult for you to write your script?
How much time did you spend creating dialogues?
How did you feel about writing a script in English?

DDL activities:
When you wrote your script did you refer to the concordance lines I gave?
What did you think about the concordance lines?
Was it easy for you to understand patterns and phrases in the lines?

Others:
Do you have any requests for your next assignment?
Would you like to work with other students?
Do you think your English skills have improved?

The questions the instructor asked were open-ended and there were no specific rules regarding the number and kinds of questions asked in the interviews. The recordings were then transcribed into English and what the students said was summarized.

5 Findings

The feedback obtained from the interviews was useful for the instructor to determine what students thought about the activities and their relevant performances. The major findings gained from the interviews, together with sample the interview extracts, are as follows.

At first students didn't have enough confidence to express themselves, especially during the initial interview, students often remained silent when they were asked a question as follows.

Instructor: Did you have any difficulties writing your script?
S1: I didn't think it was that difficult.
Instructor: How much time did you spend creating dialogues? *Instructor asked everyone.

Everyone doesn't say anything.
Instructor: About two hours?
S1: Yes, that's about it.

After the Instructor asked about how much time students spent creating dialogues, everyone waited to see how things went in order to maintain group harmony.

Instructor: I think you had a 4,500 yen coat and an 8,000 yen coat, but later you only had a 7,000 yen coat. I was wondering what happened to the first two coats.
S2: *Doesn't say anything.*
Instructor: What did you think about the concordance lines? Were they useful for your English study?
S2: *Doesn't say anything.*
Instructor: Was it difficult for you to read the lines?
S2: Yes, it was difficult.

Student 1 didn't answer according to the Instructor's expectations. Although students learned how to answer questions as a basic skill in their previous English learning experiences, silence in response to a question frequently occurred throughout the course. Instead of saying anything to the Instructor's questions, students often made a gesture to demonstrate their opinion as follows.

Instructor: You still don't know how to use these concordance lines?
S3 and S4: *Don't say anything.*
Instructor: I see. OK. Are there any requests you want to make for the next semester? Are you going to take my course in the second semester?
S3 and S4: *Nod "Yes."*

However, as the course progressed, students asked the instructor to adjust her teaching style as follows.

S2: Well, a benefit of DDL includes the fact that we can clearly understand the patterns of the keywords. And, the problem is that the words in the lines were too small to look at. It's hard to read.
Instructor: Are the words too small? Oh dear, I'm sorry.
S2: It's completely all right for me to have two pages to look at, so could you make the words bigger, please?
Instructor: With a space between lines, right?
S2: Yes.
Instructor: OK, I'll think about that.

As the course progressed, the Instructor's approach towards respondents changed. For example, during the first interview, the instructor asked only conventional, closed-ended questions. It is interesting to see the instructor even asked a question about a point-deduction scoring system. For example,

Instructor: Well, first of all, how was your performance? What score out of 100 points do you think you can give to your performance?
S5: I would say, 60 points.
S6: 50 points.
Instructor: Are you sure you're going to give only 50 points?
S6: Yes.

Compared to the first interview, in the second interview the instructor tried to empathize with how the students felt about their assignments, including performances and activities. For example,

Instructor: Do you feel embarrassed with you make a mistake when you do your performance?
S7: Yes. I feel embarrassed or sorry for what I've done wrong during a performance. It's up to everybody to remember his own part, so I feel terrible when I don't remember my own lines perfectly.
Instructor: I understand what you mean. But my policy is this: as long as you can use the required words and phrases, and communicate with your group members using them, any mistake is acceptable. I don't want to call any of your lines or words mistakes. I don't believe you need to memorize your lines perfectly. You don't have to follow your script as long as you communicate with your group members using the required words. I'm not a strict teacher. But, I know, if you write a script, you're more likely to try to follow it, aren't you?
S8: Yes, you're right.

In addition, in comparing the first interviews with the third interviews, the instructor clearly asks more specific and elaborate questions about the way the students utilized the materials. For example,

Instructor: Do you understand the difference in meaning between 'have an appointment' and 'make an appointment?'

Instructor: When you read the instructions including the keywords and key phrases, did you instantly realize that these words and phrases were written in the textbook?

As the course progressed, the students had the opportunity to think critically about what they had learned.

S9: I feel I've gained something from this course. This course is worthwhile.
Instructor: Worthwhile… Good. S10?
S10: I think I became to convey the meaning of the words I learned more effectively in conversations. I can use the right expressions in the right situations now.
Instructor: Good. How about you, S11?
S11: Compared with the beginning of this course, I can speak English more smoothly.

Instructor: OK.

In order to avoid the pace of instruction being slowed down and the Instructor being waiting for an answer, the Instructor kept asking different questions or sharing her comments with the students. If necessary, the instructor asked further related and more detailed questions. In addition to the main interview questions, the instructor explored various topics of interest in a relatively casual and friendly manner.

S3: It's hard to convey the meaning of what you want to say even when you speak Japanese, isn't it?
(Everyone laughs.)
S12: It sounds like we're watching "Project X."*
*Project X is a famous TV documentary series.
(Everyone laughs.)
S3: Is this going to be a documentary? No, making a documentary is by no means possible in this course.
(Everyone laughs.)
Instructor: If you want, S3, I'd be happy to do that.

6 Discussion and Conclusions

The sample size of the project outlined in this study is too small to allow any generalization of Japanese students' responses during an interview process. However, the characteristics of their responses represented in this study provides interesting insights and implications as to how semi-structured interviews can be used to elicit students' opinions on their language learning, as well as their needs and preferences with regard to teaching methods and materials. One of the major benefits of semi-structured interviews is the fact that, as Roulston (2014) claims, this retrospective method allows students to express their views on the materials, activities and teaching approaches in their own terms openly and directly. In addition, this study clearly indicates that such an approach promotes smoother communication between the instructor and students and therefore contributes to a productive teaching environment.

The above findings also suggest students' attitudes towards having a discussion and exchanging ideas are strongly influenced by their cultural backgrounds. It was clear that at the beginning of the course, students' cultural norms, which avoid social confrontation and maintain harmony with other students, simply discouraged them from expressing their own opinions. In addition, students were often silent either from embarrassment or an unwillingness to draw attention to themselves. However, it became clear that if students were provided with an environment conducive to expressing their opinions and sufficient time to get used to it, the level of their anxiety about expressing their opinions was lower. The findings also show that, as the course progressed, students were sensitized to the importance of verbalizing their feelings and thoughts. Since students' readiness and confidence to express their opinions markedly increased after several interviews, enough opportunities to express their opinions should be provided in the course of language studies.

From the instructor's perspective, conducting interviews in a language course was time consuming. In addition, interviews often require the instructor to be patient in dealing with students' pauses and silences, which often slowed the interviewing pace. However, the findings have indicated that, compared with structured interviews where the degree of freedom is limited (Smith, 1995), the partly open-ended format of semi-structured interviews is a more efficient and practical way of gauging data for the instructor regarding how students critically reflect on what they have studied in the classroom. These interviews helped enhance the instructor's awareness of how to maximize students' potential in learning a utilize interviews effectively and maximize their potential in learning a foreign language. There is no doubt that semi-structured interviews are useful methods to encourage mutual communication between the instructor and students and help instructors better develop their teaching methods and materials, and shape their curricula. Further research with a larger sample size should be conducted to determine how the instructor should act as a facilitator in conducting interviews in order to improve students' language proficiencies. It is also essential to provide students with an environment which enables them to talk beyond the confines of their culture norms, and thereby enhancing their confidence and flexibility in learning languages.

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Teacher design teams: Building capacity for flexible and learner-centred course development

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Abstract. Blended Learning, a mix of face-to-face learning and online learning, has been growing in popularity in universities as a means of introducing distance e-learning to its students and faculty. It is also a way to promote innovative instructional approaches and accommodate various learning styles. By fostering learner-centered course design that includes a wide variety of learning activities (such as classroom instruction, virtual meetings, online books, mentoring, self-paced study, simulations and assessments) schools can more efficiently utilize learning resources while allowing students more learning flexibility. Thus, there is now a need to train the faculty on how to design their course for blended learning. The University of the East used Teacher Design Teams to ensure high quality course design and provide support for the course developers/faculty. This paper explores the techniques and processes employed by the university to ensure that our blended learning courses are learner-centered, flexible and are aligned with output-based education goals. Instructional designers and educational technologists were employed to help the course developer/faculty design their course. A quality assurance team was also put together for each course in order to ensure that all aspects of the course (content, instructional design, technology and language) are of the highest quality. The resulting Blended Learning modules show that the use of Teacher Design Teams can improve the quality of the course materials and the faculty's perception of e-learning.

Keywords: blended learning, teacher design teams, course development, e-learning

1. Introduction

Blended Learning, a mix of face-to-face learning and online learning, has been growing in popularity in universities as a means of introducing distance e-learning to its students and faculty. It is also a way to promote innovative instructional approaches and accommodate various learning styles. According to Friesen (2012), "“Blended learning” designates the range of possibilities presented by combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students."

The online sessions can be synchronous or asynchronous. It all depends on the teacher or the organization's policy on how much of the course's schedule will be face-to-face and how much will be online. By fostering learner-centered course designs that include a wide variety of learning activities (such as classroom instruction, virtual meetings, online books, mentoring, self-paced study, simulations and assessments) schools can more efficiently utilize learning resources while providing students a flexible learning environment. With this approach, not only is technical media a supplement but it is an integral part of instruction (Keegan, 1980).

The faculty is essential in achieving this environment. It is quite well known that blended learning usually requires more preparation for the faculty to re-design the course (Diaz and Brown, 2010). In that study, Penn State University identified the following competencies for blended learning:

- Active learning
- Course administration and leadership
- Active teaching, teaching presence and responsiveness
- Multimedia technology
- Classroom decorum
- Technological competency
- Policy enforcement

In addition to this, redesigning, rewriting and rethinking the content of the course is also a major competency needed for blended learning (Arinto, 2013). Taking into account all these competencies that faculty need to have in order to develop a course for blended learning, the task seems daunting. But with a team of teachers, each member with their own area of expertise, the task can become uncomplicated and the goal is quicker to achieve.

2. The Case for Teacher Design Teams and Blended Learning

Literature has shown that effecting change in a teacher's way of teaching is difficult to say the least. With the establishment of a new program such as blended learning, there are many competencies that a teacher must already have or learn in order to design and teach a course online. Teaching in the 21st century is now a different scenario, requiring complex roles and skills of the teachers (Teräs and Herrington, 2014). In the Technological Pedagogical Content Knowledge (TPACK) framework of Mishra and Koehler (2006), the technological, content and pedagogical competencies of teachers must all be utilized in the design of technology-supported learning. TPACK research shows that the teachers realize that the interactions among these three competencies are important in designing technology-supported learning and not just one or the other. The TPACK framework below shows the interaction and collaboration among the three.

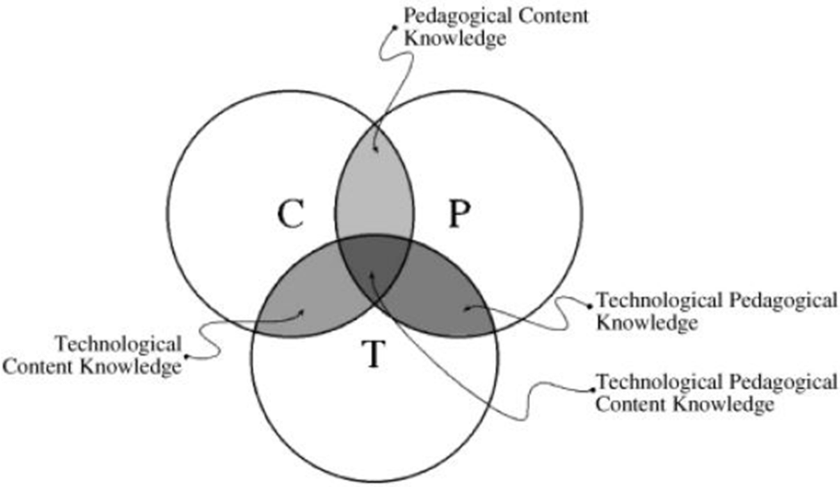

Figure 1. Pedagogical Technological Content Knowledge. The Three Circles, Content, Pedagogy, and Technology, Overlap to Lead to Four More Kinds of Interrelated Knowledge (Mishra and Koehler, 2006).

When we introduce technology into teaching, our instinct is to teach the technology skills alone and the content and pedagogy remain the same. In fact, we should not be teaching technology skills only but we must show the teachers how technology, content and pedagogy intersect to form a cohesive knowledge core that will allow them to create scholastic blended learning course materials (Polly, 2012). One way to go about this is by using Teacher Design Teams with members that are experts in or practitioners of each competency or field. The members of the TDTs can then teach other and collaborate to create scholastic BL course materials.

Teacher Design Teams (TDTs) are creative spaces that allow teachers and various pedagogy and technology experts to work together (Simmie, 2007). In this publication, Simmie states:

> "The TDT concept provides teachers with a creative space to reconsider the teaching of their subject, the intellectual stimulus of working together and the challenge to move the thinking forward…Working with teachers in this way, empowering them to design, to learn and to change, develops not only the teaching of the subject but also the leadership capacity of the teachers themselves."

Handelzalts (2009) adds that Teacher Design Teams are composed of "a group of at least two teachers, from the same or related subjects, working together on a regular basis, with the goal to (re)design and enact (a part of) their curriculum (Handelzalts, 2009). The above definitions emphasize the broad activities of TDTs as:

1. Instructional Design and
2. Collaboration of several teachers of the same or related subjects

The team "would bring course design and development process specialist knowledge in the design of a range of study materials for distance education" (Naidu, 2007).

Tondeur (2012) identified key themes in the development of TPACK in pre-service teachers that show that Teacher Design Teams are significant in helping teachers develop technology-supported course materials. The key themes relevant to the study are:

1. Using teacher educators as role models
2. Learning technology by design
3. Collaborating with peers
4. Scaffolding authentic technology experiences

Teacher Design Teams encourage collaboration, which can increase reform where reform would otherwise be slow. According to Levin (2010), teacher collaborations increase teacher learning. This in turn can benefit their teaching strategies and consequently, the learning of the students. Within the TDT, one of their main tasks is instructional design. The team "would bring course design and development process specialist knowledge in the design of a range of study materials for distance education" (Naidu, 2007).

3. Effecting Change in Faculty Course Design

The University of the East regularly holds capacity-building seminars for faculty to generate interest and identify potential blended learning (BL) course developers. When faculty members apply and are approved to develop BL courses, they are given an orientation on what is expected of them. The course developers are then given sample modules that they can pattern theirs on. The module format consists of:

1. Introduction/Advanced Organizer
2. Learning Outcomes
3. Lecture (a short one)
4. Learning Activities
5. Assessment

The course developers (as they are now called when they are BL course developers) are then given time to develop the course materials on their own. Course development consumes the most time in this process. Various factors influence the pace of course development. Some of these are instructor's motivation, number of modules, and instructional design training (Comas-Quinn, 2011; Ellis, Steed, Applebee, 2006; Muñoz Carril, González Sanmamed, and Hernández Sellés, 2013). When the BL program started, one-on-one mentoring sessions were conducted to assist and refine the faculty member's course development. This was the beginning of the Teacher Design Team. As the BL program progressed and more people were managing it, the one-on-one mentoring sessions became Teacher Design Teams (TDTs). The roles in TDTs are instructional technologists, instructional designers, media specialists and course developers themselves. Each role may be assumed by one or two people. Meaning to say, the instructional technologist can also be the instructional designer or they can be assumed by two separate people. Same goes with the other roles. In keeping with the description of TDTs, all the members of the team are faculty of the university except for the consultant for BL.

The team meets at least once a semester but regular follow-ups are done by the team members. During a session, the team works on:

1. Improving the learning outcomes of the module/s – learning outcomes have to be higher-order skills and thinking based on Bloom's taxonomy
2. Developing learner-centered learning activities and assessment – activities/assessments need to be engaging and require the students to apply the knowledge learned
3. Ensuring that the learning outcomes and the learning activity/assessments are aligned – all learning outcomes must be achieved through the learning activities/assessments

Below is a table of the various roles and their activities within the TDT:

Table 1. Roles and Activities within a TDT in the university

Role	**Activity**
Instructional Designer	• Create/revise learning outcomes • Suggest appropriate learning activities and assessment tools • Ensure that the course syllabus is aligned with output-based education • Ensure that the topics picked for online sessions are appropriate for online learning
Instructional Technologist	• Look for appropriate technology for the course • Look for appropriate content on the Internet • Ensure that all technology associated with the course is working and updated
Media Specialist	• Create the learning activities and assessments tools as needed • Upload the course materials

Course Developer	• Create the content • Write the lecture (a short summary of the content) • Create the quizzes and other traditional assessment tools

It is important to note that even with the team in place, it is still the course developer's responsibility to integrate all the suggestions from the other team members. After the TDT meetings and follow-ups, the course developer consolidates all the input from the team members and completes the modules for BL course.

When the course developer finishes and submits the first draft of the modules, the modules are then passed through the Quality Assurance Committee (QAC). The QAC is composed of four experts, an instructional design expert, language expert, content expert (specific to the course) and technology expert. Any revisions suggested by the QAC are given back to course developer. The final and approved version of the modules will then be uploaded by the Program Coordinator for Blended Learning.

4. TDTs and the Transformation of Course Design

As detailed above, the course design process in the university is very rigorous. To alleviate any apprehension from prospective course developers, the university has put into place an excellent support system by way of the TDTs. The BL courses that were developed involving TDTs are more learner-centered, by creating learning activities and assessment tools that allow the student to reflect on the knowledge acquired and/or construct their own knowledge. It is constantly the goal of the TDT members to design learning activities and assessment tools that allow the student to apply the knowledge they have acquired. The BL courses are likewise better aligned with outcomes-based education and to the prescribed module format. These were all achieved with the help of a TDT. The BL course developers, who are only experienced with face-to-face teaching methods, have acquired more teaching techniques and skills in course design. They experienced first-hand how it is to design a course for online learning. They saw the different aspects that are vital in designing an effective online module. These skills and experiences are not limited to their online sessions but can also be applied in the face-to-face sessions. This is an unexpected result of implementing a TDT that was not anticipated but nevertheless opportune. The TDT members, apart from the course developer, have seen a positive shift in the perception of the course developer towards BL. This goes to show that given the proper support, change can be effected.

5. Conclusion

When the University of the East, Philippines implemented a Blended Learning Program, part of the plan was to put support systems in place in order to reinforce and promote the program. One of these support systems was the Teacher Design Teams, composed of an instructional designer, instructional technologist, media specialist and the course developer. The TDTs have produced a positive change in the course quality and perception of the course developers towards BL. It is the goal of the university to increase the use of these TDTs and diversify the team members. TDTs can be employed in other Programs to facilitate course development or curriculum change.

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Assessing academics' needs for research support: The experience of the Open University of Hong Kong

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Abstract. Research support plays a crucial role in the research capacity development of an institution. To provide proper research support services, it relies on an effective channel for collecting feedback from academics on their needs.

This paper presents a needs assessment study conducted by the Open University of Hong Kong to identify its academics' needs for research support. The study aims to identify the extent to which current research support of the University is adequate for the academics and whether other kinds of support are preferred by them. It includes three sessions of focus group discussions, covering academics from a broad range of disciplines and at different levels of activeness in research. Following the Researcher Skill Development framework (Willison & O'Regan, 2008), the needs of participating academics in different facets of research, from initiating a research study to presenting research findings, were shared and discussed systematically in the focus group sessions.

Results show the diverse needs of academics at different levels of activeness in research. There were needs highlighted by research-active academics such as activities for generating research ideas and identifying partners for research collaboration. Academics who were previously not actively in research also expressed wishes to have more activities for experience sharing of research and successful funding applications. There were also suggestions made by all groups of participants, such as provision of training on research software and quantitative data analysis. Based on their feedback, new or refined research support services have been provided to cater for academics' research needs.

Keywords: needs assessment, research support, Researcher Skill Development framework

1 Introduction

Research support is an integral part of the research capacity development of a higher education institution. To deliver proper research support, it must take into account the diverse needs of academics in research. There has to be an effective channel for collecting feedback from academics on their specific needs.

This paper reports a needs assessment for research support of the Open University of Hong Kong (OUHK). As a university featuring provision of open and flexible learning, OUHK has planned to systematically develop its research capacity. It is expected that its academic staff members, through engaging more in research, will keep themselves abreast of the developments of their disciplines and transfer new knowledge into teaching and learning. The diverse profile of academics, however, presents challenge in formulating policy of research support. For example, there are research-active academics, experienced teachers not having involved in research for many years, as well as junior academics without much research experience.

The needs assessment attempted to identify the various needs of academics in research. It covered a wide range of areas related to the research environment of OUHK. Academics participated in the study shared their views and provided suggestions on aspects such as the research culture, infrastructure and resources of the university, and needs of research support. Findings of the study will facilitate formulation of appropriate research support policy and provision of relevant services, that may be applicable to institutions in virtually all parts of the world sharing similar background.

2 Related studies

There have been a wide number of needs assessment (or needs analysis) reported in literature, usually conducted together with programmes related to research development. As stated in Zaščerinska and Melnikova (2015), "needs analysis provides the crucial information to ensure that education and/or professional development is purposeful, appropriate, valid and relevant" (p. 216). Bazeley (1994) also expressed that it is necessary to "identify first where staff felt they were 'at' with regard to research, and what their research development needs were" (p. 122), before devoting resources to the development of a research culture and research capability of academics.

Previous studies of needs assessment have suggested a broad range of dimensions for identifying academics' needs of research development. For example, they can be used to examine participants' perception of their development needs. Wood (1990) reported how academics conducted and perceived their research, for determining the issues for development of a research policy. Conrad (1998) presented a needs analysis which came together with a research development programme. It consisted of interviews with senior faculty members to determine their perceptions of staff development needs and seek advice on how the needs might be met.

Needs assessment helps to determine the motivation factors and resources required for research promotion. For example, Gething and Leelarthaepin (2000) illustrated a needs assessment as the first step to promote research participation. It explored the proportion of work time academics spent on research and their self-evaluation on their level of research skills. The results served as a basis for the development and implementation of a series of strategies to promote research. Akerjordet, Lode and Severinsson (2012) examined the participants' interest in and motivation for research, and identified the management and organisational resources required in order to improve their research capacity.

It also serves to identify the training needs of participants. For instance, Lee, Gowers, Ellis and Bellantuonoa (2010) assessed the training needs of researchers and claimed that such assessment is important to “establish what skills should be improved and as a benchmark to relate back when measuring progress” (p. 270). Ekeroma, Kenealy, Shulruf, Nosa and Hill (2015) also presented a needs analysis to inform and refine the objectives and curriculum of a training workshop.

These needs assessments were shown to be part of development programmes. They inform the programmes the specific needs of participants. Their dimensions covered were taken into account in the present study.

3 Framework

This study adopted the seven-level Researcher Skill Development framework (RSD7) (Willison & O’Regan, 2008). The framework addresses the needs of researchers at different stages of research. It is designed as “a conceptual tool for diagnosis and planning, promoting understanding and interpretation of … research skill development” (Willison & O’Regan, 2007, p. 401). The framework covers six facets of research:

- Embark and clarify — Respond to or initiate research; and clarify or determine the knowledge required.
- Find and generate — Find and generate the information or data required using appropriate methodology.
- Evaluate and reflect — Determine and critique the credibility of selected sources, information and data, and reflect on the research processes.
- Organize and manage — Organise the information and data to reveal patterns and themes; and manage research teams and research processes.
- Analyse and synthesise — Analyse the information and data and synthesise new knowledge.
- Communicate and apply ethically — Write, present and perform the processes, understandings and applications of the research, and respond to feedback, accounting for ethical, social and cultural issues (Willison & O’Regan, 2008).

In addition to RSD7 for identifying the needs of academics in research, the research culture, research infrastructure and resources of the university were also included as part of the needs assessment.

4 Research method

The study aimed to explore the following questions:

- To what extent is current research support of the University adequate for academic staff to conduct research?
- What kinds of further research support are preferred by academics?

There were altogether three focus group sessions conducted in January 2015, with a total of 17 full-time academic staff members participated. Each session consisted of five to six participants. All the participants were at the rank of assistant lecturer or above, from the four schools of OUHK.

The participants were categorised into three groups based on their activeness in research, according to their number of submission of research funding applications in the past three years:

- Group 1 (active in research) — submitted two or more research funding applications, with at least one to the Research Grants Council (RGC) of the Hong Kong Government;
- Group 2 (semi-active in research) — submitted one application to the RGC, or one or more applications to OUHK's internal research funding;
- Group 3 (inactive in research) — did not submit any research funding application in the past three years.

This categorisation helps us to understand various needs of research support among academics from diverse background, with different degree of prior experience in research.

The participants shared views and opinions regarding (1) the research culture of the University, (2) the infrastructure and resources for research, and (3) the research support services preferred. The RSD7 was adopted to understand participants' needs of research support in different facets of research.

5 Findings

5.1 Research culture

As summarised in table 1, the participants shared their views of the research culture of the university, which revolves around the areas of teaching, collaboration, funding and administrative support.

Teaching

All groups of participants expressed their concern about teaching duties, which is regarded as a major challenge to promote the research culture of the university. As a teaching-oriented institution providing various education modes, academic staff of OUHK are well-prepared to devote most of their time in teaching. Some of them have to teach both full-time and distance-learning courses throughout a year, without a substantial period of time in a year (e.g. summer break) for them to concentrate on research. Given this background, most participants presented the challenge to reallocate their work time to conduct research. Some academics shared their experience that it is hard for them to attend the seminars or other training activities for research development.

Participants also raised their concern to achieve a balance between teaching and research. Academics from the inactive group expressed their worry that putting more effort in research may affect their teaching quality.

Collaboration

Academics from the active and semi-active groups in general appreciated the research environment of OUHK that, being a relatively small-scale institution, they can easily reach and find colleagues as collaboration partners across disciplines.

For those from the inactive group, they suggested that intra-unit research teams could be formed to encourage academic staff to engage in research.

Funding

All groups of participants recognised the increasing availability of research funding available to apply, which is conducive to promote research participation. As the amount of internal funding may not be sufficient for time-consuming tasks such as interviews and transcriptions, the availability of external funding would serve as a substantial support for research. Updated information and promotion of these funding were regarded as important by the participants.

Administrative support

The academics raised enquiries about research funding policies. For example, some of them were not familiar with the differences between policies of various funding on issues such as recruitment of research support staff. This suggests a need to strengthen relevant administrative support to assist academics to be familiar with the research funding policies.

The participants from the active and semi-active groups also indicated their insufficient familiarity with the administrative procedures relevant to research, such as recruitment of student helpers and purchase of equipment and experimental tools. Further administrative support for this aspect is needed.

Table 1. Academics' views of research culture

Category	*Subcategory*	*G1*	*G2*	*G3*
Teaching	• Teaching load	✓	✓	✓
	• Teaching quality			✓
Collaboration	• Collaborations across disciplines	✓	✓	
	• Establishment of research teams			✓
Funding	• Sufficiency of research funding	✓	✓	✓
Administrative support	• Research funding policies	✓		✓
	• Administrative procedures	✓	✓	

G1: active in research G2: semi-active in research G3: inactive in research

5.2 Research infrastructure and resources

Table 2 summarises the participants' opinions of their needs for research infrastructure and resources, which are grouped into facilities, IT resources and library resources.

Facilities

All groups of participants agreed that one of the major challenges is the work space for research support staff. More research support staff are expected to be hired as a result of the university's increasing engagement in research. Some research-active participants commented that more storage space is needed for physical research data and documents such as completed questionnaires, as such records have to be kept for a number of years. For laboratory space for research, it was recognised that it is very limited. Staff members have to share the facilities with students.

IT resources

All groups of academics raised that provision of computers and software licences were needed for research. At present, some academic staff may have to share their computers with their research support staff due to the limited number of software licenses. Academics conducting computation intensive research may need more powerful computers for heavy data processing.

Library resources

As academics of the university are conducting more research, they have a greater need for library resources. Participants from the inactive group indicated their need to have access to academic journals and field-specific resources which are currently not subscribed nor provided by the library.

Table 2. Academics' views of research infrastructure/ resources

Category	*Subcategory*	*G1*	*G2*	*G3*
Facilities	• Work space	✓	✓	✓
	• Storage space	✓		
	• Laboratory space		✓	✓
IT	• Sufficiency of computers and licences of research software tools	✓	✓	✓
	• Computing power	✓	✓	
Library	• Library resources			✓

G1: active in research G2: semi-active in research G3: inactive in research

5.3 Research support needs

Table 3 summarises the research support needs raised by the participants, which are grouped following the various facets of research in the RSD7 framework.

Embark & clarify

Academics from the research-active group would like to receive notifications of the updates of library databases. Participants from the semi-active and inactive groups preferred to have further support, such as seminars sharing research ideas in various disciplines, and research software tools and relevant trainings (e.g. EndNote for bibliographic management).

Find & generate

It was suggested that approaches of data collection in various disciplines could be introduced. For example, participants from the field of drama education presented the challenge of conducting research in their field. They wished to know how data could be collected from activities such as drama plays.

Evaluate & reflect

Academic staff reflected that they would like to have more information and training of research software for both qualitative and quantitative studies, such as software for transcription and that for statistical analysis.

Organise & manage

Academics from the semi-active group would like to have consultation service on research project management. They also wished to have a platform for research discussion and collaboration across disciplines, and identification of potential research partners.

Analyse & synthesis

Participants from all groups suggested that they need support in quantitative data analysis especially statistical modelling. The inactive group participants wished to have experience sharing of field-specific qualitative research.

Communicate & apply ethically

Participants of all groups showed a strong desire to have language editing service. They indicated the needs to have manuscripts edited following convention of language use in specific disciplines, and formatted for requirements of different publications. Participants would like to have activities for experience and skills sharing of writing proposals and applying research funding.

Table 3. Academics' research support needs

Category	*Subcategory*	*G1*	*G2*	*G3*
Embark & clarify	• Notifications of updates of library databases	✓		
	• Sharing research ideas of various disciplines		✓	✓
	• Provision of and training in software for referencing		✓	
Find & generate	• Approaches of data collection in various disciplines		✓	
Evaluate & reflect	• Information/training of software for transcription	✓	✓	✓
	• Information/training of software for statistical analysis	✓	✓	
Organise & manage	• Consultancy on research project management		✓	
	• Platform for research collaboration		✓	
	• Identification of potential research partners		✓	
Analyse & synthesis	• Consultancy on statistical modelling	✓	✓	✓
	• Field specific sharing of qualitative research experiences			✓
Communicate & apply ethically	• Language editing	✓	✓	✓
	• Skills sharing of constructing high quality proposals		✓	✓
	• Experiences sharing of successful funding applications		✓	✓

G1: active in research G2: semi-active in research G3: inactive in research

6 Discussion

This study has revealed the diverse needs of academics at different levels of activeness in research, which contribute to determine proper research support services. Its importance can be showed from the findings. The academics who were previously not active in research also expressed wishes to have more activities for experience sharing of research and research funding applications. This suggests that they may be willing to engage more in research when proper research support services are provided.

The diverse needs of academics also present how provision of specific research support is necessary to cater for their needs. For example, for generating research ideas, the research-active academics preferred to have updates of library databases, while the inactive ones (who are mostly junior academics in this study) wished to have activities for sharing research ideas in various disciplines. The academics previously inactive in research also indicated their interests in forming research teams with colleagues. As suggested in relevant literature (Hanover Research, 2014), support for research collaboration can be offered for these academics which helps to develop an active research culture.

The wide range of academics' needs involves cooperative endeavours by various units in the university to provide relevant support (DFID, 2010). For example, the administrative policies and procedures have to be explained to academics by different relevant units. Provision and coordination of research facilities and resources also involve collaboration of various units.

Given the limitation of resources, it is unrealistic that all the needs and issues raised by academics will be met and resolved. Among the various suggestions, several major ones can be identified as priority, such as promoting the research culture, providing training of research software tools and research skills, and facilitating research collaboration.

7 Conclusion

As an integral part of research capacity development, this needs assessment helps to ensure that the research support services would be "purposeful, appropriate, valid and relevant" (Zaščerinska and Melnikova, 2015, p. 216).

Based on the findings of the study, relevant research resources and support are being provided systematically. For example, the software tool for bibliographic management has been purchased for academics' use with relevant training provided. Regular roundtable meetings are being organised for gathering academics to generate research ideas and facilitate research collaboration. A series of seminars and workshops for quantitative data analysis are being held, which have been well-participated by academics. Their positive feedback suggests that the implementation of the research capacity development programme is on the right direction.

As the academics gradually develop their research capacity, it is expected that their needs of research support may change and new needs may emerge. Periodic needs assessment will be required to update their latest developments and adjust the provision of research support accordingly.

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Teaching practice in college physics based on the SPOC teaching model

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Abstract. MOOC has set off a worldwide education reform, which brings a strong shock to the traditional education mode, but it is not perfect , so the SPOC teaching model arises at this critical moment. It does not repalce the traditional teaching model and MOOC but rathar recombine them in a hybrid pattern. The hybrid pattern can make full use of the advantages of traditional in-person courses and MOOC to reshape the relationships between teachers and students.This paper presents the main process about the teaching practice of college physics based on SPOC teaching model in Tongji University and analyzes the practice effect acording to test scores which can indicate that the SPOC teaching model can help students promote the improving of their academic performance. A summary is made of the key factors concerning the teaching effect according to this teaching practice at the end of the paper.The main purpose of this paper is to provide references for improving the teaching.

Keywords: SPOC; hybrid pattern; teaching practice; practice effect

1 Introduction

Courses which combine online instruction with face-to-face classroom work are referred to as “hybrid” course or “hybrid”curriculum(Rogers & Ohrn,2007). The more current term for this type of pedagogy is “blended leaning”(Garrision & Vaughan,2008).In practice, blended learning combines the best elements of face to-face teaching with the best elements of online instruction to improve student engagement and learning.While there are many kinds of blended learning, one emerging model focus on the SPOC teaching model. SPOC teaching model makes full use of the advantages of traditional in-person courses and MOOC to reshape the relationships between teachers and students, more importantly, it can effectively improve the teaching quality.

In this paper, we share our experience about a fully college physics class based on SPOC teaching model with the goal to assist other faculty who may be interested in trying to use this teaching model.

2 What is SPOC

SPOC means “Small Private Online Courses” ,it is a kind of new teaching models,and the number of it is less than MOOC,it also sets the restrictive admission requirements for students. Only students meet the requirements, could they participate in the study of the course(Kang Yeqin,2014)).It switches the delivery system for course content, administration, and communication to an online system and uses the face-to-face with students in a more meaningful and productive way. It means setting aside all or most face-to-face classroom time for students to participate in learning activities(Rogers&Tingerthal,2013). It has combined MOOC with traditional teaching model,and utilized their advantages to promote teaching.

3 The teaching practice of college physics

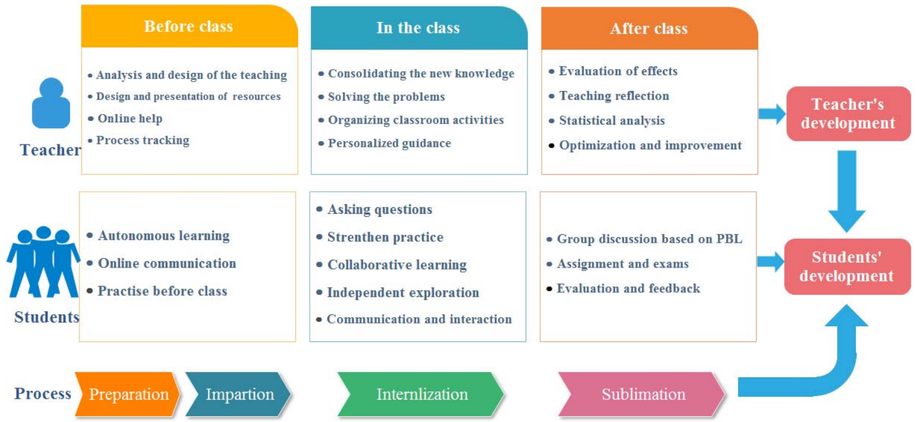

Fig.1.SPOC teaching model of physics in Tongji University(Yu Jingsong & ChenZesong,2014)

Tongji university had fully considered the characteristics of the physics course,and it had made an in-depth teaching design and selected the platform of wisdom tree as the major online learning platform for three terms. Its specific teaching model is shown in figure 1. The teaching process of this teaching model is mainly divided into four phases:

Firstly, it is a phase of knowledge preparation .In this phase,teachers need to make a comprehensive analysis and design for the teaching. They must have a clear teaching goal, understand their own students, and be familiar with the new teaching model.Only they had made a full preparation, could this kind of teaching model improve their teaching.Besides,the teachers also need to be ready for curriculum resources and then present some of them to the online learning platform for students’ online learning. The curriculum resources are divided into two parts:online learning resources and offline learning resources.Offline learning resources include: PPT for teaching, the practice questions for consolidation, chapter exercises, and researching question. Online resources mainly include: course video, course materials, chapter discussed topic, chapter test and group discussion based on PBL. Each course resource has different characteristics,for example, the course videos are divided into short pieces, and every piece just only has 8 to 18 minutes . More importantly,it is done by many teachers. It can fully embody the wisdom of the group.

Secondly, it is a phase of knowledge impartion. In this phase,students need to study according to the way they like, for example,they can study like M-leaning in anytime,anywhere and anystytle. Students can understand the basic concept,theory and methods of physics through this process,it is helpful for further study. Of course, the teachers have provided a reasonable study plan for students in the online learning platform in advance, students can have autonomous learning according it.Besides, the student must complete the online tests and assignments, which accounts for 80% of online performance. In addition to online learning, students can also communicate online with other student and their teachers, they can share their harvests or ask questions on the forum of the course. The teachers or students will give replies in time. If students are very positive in the forum, they will get extra 10 points of online performance as an encouragement. The teachers' role in this process is to urge and help the students to learn.

Thirdly, it is a phase of knowledge internalization. It is a face-to-face classroom time for students to participate in learning activities. Students will have three times to meet their teacher every two weeks, but the teacher will smoke one of the three times for the students to answer their remaining questions. In the classroom, teachers will start from consolidating the new knowledge to connect the online knowledge together , then help students solve the problems. After that, the students are divided into groups of five students to explore new problems and communicate with each other. The students can obtain the best solutions of the problems through the collaborative learning. In addition, the teacher will give each student the opportunities to show themselves on the platform. In the classroom, the teacher is just a facilitator or guider, the students are the true owners.

Finally, it is a phase of knowledge sublimation. In this phase,students will have the group discussion based on PBL online.PBL is a way of learning,which means Problem-Based Learning. This process mainly requires students in the form of group to solve the problems of complexity, actuality or authenticity.In this way,students can learn the implicit knowledge of science(Han Yangling,Zhang Yun,Zhou Ruyan,etal.2014).It also can promote the students' abilities of solving problem, autonomous learning and life-long learning.The performance of the group discussion based on PBL accounts for 20% of online performance. Besides, students will carry on the multi-dimensional evaluation at the end of the term, including the evaluation of teachers, the evaluation of other groups, assessment of group members and self-evaluation. Not only the teachers but also the students can have a deep reflection and summary for themselves through this process to promote the growth of the teaching and learning at the same time.

These four phases are closely linked together and continuously cycle for teaching, it can stand out principal status of students ,highlight the teacher's leading role in all phases, and its ultimate goal is to promote the development of students.

4 The practice effect based on SPOC teaching model

The test score is the important yardstick of measuring teaching quality.In this teaching practice,the new teaching model has obtained a good practice effect.The comparision of test scores between the SPOC class and traditional teaching class is the best evidence.Table 1 presents two classes' test scores in the spring 2014, and it's worth noting that the two classes belong to the same teacher.

Table 1. The comparison of the test scores between the SPOC class and the traditional teaching class

Them mid-term exam	100	90-99	80-89	70-79	60-69	<60	**The average score**
The SPOC class%	0	26.1	26.1	17.4	17.4	13.0	78.4
The traditional teaching class%	1.9	25.2	22.6	20.6	12.9	16.8	76.3
The final exam	100	90-99	80-89	70-79	60-69	<60	**The average score**
The SPOC class%	0	4.4	26.1	43.5	17.4	8.6	74.7
The traditional teaching class%	0	4.6	21.9	27.1	24.5	21.9	67.8

As is shown from the Table 1 above, the average score of SPOC class is higher than the traditional teaching class’s, especially in the final examination results,the average score of SPOC class is higher than the traditional teaching class’s by 6.9 points.It indicates that the SPOC teaching model can help the students improve their performance. For students, it can not only improve their ability of autonomous learning, skills of analysis and solving problems, but also develop their spirit of exploration and bring the students a new and pleasant learning experience of physics course in the process of learning . For teachers, it not only reap the friendship between students, but also enrich their teaching experience, which can provide a valuable reference for the improvement of physics teaching in next term.

5 Conclusions and Recommendations

Although using SPOC teaching model in teaching practice can effectively improve the teaching effect, it is not easy.It is different from the traditional classroom, and it is also not equal to online courses, putting it into effect smoothly needs the following factors:

(1) The unified pace between teaching plan and the rhythm of online learning for students

Only the students prepare ahead of time and have certain knowledge reserves,can the teaching in the classroom carry out smoothly, otherwise the atmosphere of discussion in the classroom will be very low, the teacher will not be able to organize the in-depth teaching activities. On the contrary ,they must teach the students the online knowledge in detail, then teaching time can't be efficiently used in the classroom, so the unified pace between teaching plan and the rhythm of online learning is very necessary.The students should keep up with the pace of the teaching plan.

(2) The teachers should switch their roles to support students' learning

The roles of teachers have changed from imparters of knowledge to integrators of learning resources,promoters and supporters of the learning process in the SPOC teaching model.They play an important role in the process of teaching. They should switch their roles reasonably according to the needs of teaching, and they should play well all roles for their students to support the learning of students rather than merely play as a imparter (Luo Jiutong,Sun Meng,Gu Xiaoqing,2014). Only in this way,can they guide and promote the students to master the knowledge of physics and benefit themselves as well as the students.

(3) The joint efforts between teachers and students

No matter what kind of teaching models ,it is in vain without the efforts of the teachers or students .For students, they need to get used to the new teaching models , strive to complete the online and offline learning tasks and pay attention to the cultivation of their ability. Especially in the classroom, they should seize the opportunity to interact with teachers or classmates and be bold to speak,brave to explore. For teachers, they need to spend more time and energy on the course of preparation and maintenance . They'd better use the wisdom of the teamwork and do the task division of labour ahead of time ,if each teacher makes a little contribution, this course will run efficiently and favourably.

(4) To build a good learning environment

Creating a good learning environment for students is very necessary, it is good for the effective learning of students. Firstly, teachers must create a personalized and collaborative learning environment in the classroom for students to give students an open, active, reliable learning environment, it will stimulate their interests in learning, inspire their thinking, then it can improve their learning effect. Secondly, teachers should build an online learning environment with simple operation, friendly interface, complete function and rich resources for the students . For example, in our third semester of SPOC teaching practice,the online learning platform had emerged 76 questions in total.It had reduced students' learning enthusiasm and learning efficiency.So building a good learning environment cannot be ignored.

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Issues and implications of involving stakeholders in budgetary planning in a self-financing university providing open and flexible education

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Abstract. Same as most of the tertiary educational institutions which are providing open and flexible education, The Open University of Hong Kong (OUHK) is a self-financing university. In order to support effective operation and student enrolment, and most important, to excel university's mission of making higher education available to all through open and flexible education, sound financial budgeting is considered as significant. Over the past 25 years, OUHK has successfully tackled the challenges of running a self-financing educational institution within limited financial resources through well-planned financial budgeting. The budgetary planning mechanism of OUHK is characterized by having multiple levels and involves multiple stakeholders. Heads of academic units are invited to identify new programmes or expansion of existing programmes and project student number for the coming academic year, and heads of administrative units are required to estimate the expected expenditure for each financial year. The budget is then subjected to approval by a number of committees at different levels, namely the Budget Committee, the Finance Committee and Executive Committee, and finally, the Council. In each level, multiple stakeholders are involved. Involving stakeholders in budgetary planning enhances the budget to be developed with input from diverse perspectives, facilitates identification of the gap between need and practice, ensures that the preferences of the ultimate recipients of resources are taken into account, and improves transparency and accountability of governance. However, the wide involvement of stakeholders may lengthen the decision making process. To evaluate the outcome, the important indicators of resource usage, including equity, efficiency, and effectiveness in achieving educational objectives are used. Despite of the difficulties, the present experience demonstrates that the involvement of stakeholders in the budgetary process facilitates the development of a realistic budget for meeting operational needs and sustaining growth of the university. Specific suggestions are given to further improve the current operation.

Keywords: budget, stakeholders, self-financing university, open and flexible education

1 Introduction

A budget is a quantified financial plan for a forthcoming specified period that helps facilitate the planning of actual operations by forcing an organization to consider in advance where the income comes from and how it will be distributed. It controls resources, communicates plans to various parties within the organization, evaluates the financial performance of the organization, and provides visibility into the performance of an organization (Glover & Levačić, 2007). Budgeting is the planned allocation of available financial resources to each unit within an organization. It ensures adequate resources are allocated to areas that generate significant income and prevent overspending in less productive areas (Glover & Levačić, 2007; McAleese, 2000). Budgeting is important to an educational institution because it provides a process which translates educational goals and programmes into financial plans (Brimley *et al.*, 2012).

Open and flexible education occurs as a response to the desire for educational opportunities from people at all levels. It offers open access and adopts a variety of teaching modalities, thereby facilitating the students to study in a flexible way (Ambe-Uva & Adegbola, 2009). Same as most of the tertiary educational institutions which are providing open and flexible education, The Open University of Hong Kong (OUHK) is a self-financing university. It is expected to use resources wisely and demonstrate value for money to its stakeholders. In order to support effective operation and student enrolment, and most important, to excel university's mission of making higher education available to all through open and flexible education, sound budgeting is indeed necessary. Over the past 25 years, OUHK has successfully tackled the challenges of running a self-financing educational institution within limited financial resources through well-planned financial budgeting. The budgetary planning mechanism of OUHK is characterized by having multiple levels and involves multiple stakeholders at each level. This essay, with reference to the situation in OUHK, examines the issues and implications of involving stakeholders in budgetary planning in a self-financing university providing open and flexible education in Hong Kong.

2 Budgetary Planning Mechanism that Involves Multiple Levels and Multiple Stakeholders

OUHK was established by the government under an ordinance, but is financially independent. The major source of income is tuition fee (96%). Revenues from investment, donation, sponsorship, and matching grant contribute to a part of the income (4%). The government offers financial support through tax exemption. As an educational institution with high degree of self-management, it has the authority to approve its own budget. To exercise this authority, formal structures are developed, which are presented in three levels.

The first level is the Budget Committee, which is responsible for overseeing the financial resources of the university and ensures that the objectives of the university are achieved. The Budget Committee develops the budgetary timetable, offers guidelines and information for the preparation of budgets, and resolves problems that may come up during the budgetary process. The Budget Committee is chaired by the President. The Director of Finance Unit acts as the secretary. Members of the committee include the Vice-President, a Dean from the academic units, a Head from the administrative units, and a Senate representative. In practice, the Budget Committee initiates the budget planning exercise around eight months before the commencement of each financial year. The committee invites the heads (budget holders) of all academic units to project student enrolments for the next three financial years. The Planning Unit and Public Affairs Unit are then involved to give their views on the rate of tuition fee from the planning and marketing perspectives, respectively. Afterwards, the Vice-President, Registrar, and Director of Finance Unit meet the head of individual academic units to review and finalize the enrolment projection, which is then forwarded to all administration units to project their level of activities. Finally, the Budget Committee reviews the entire budget and makes recommendations to the Management Board, which advises the President on the financial management and financial control of various units. Once the budget is endorsed by the Management Board, it is passed to the next level. Although no external input exists at this level, the proposal will be reviewed by external parties in the subsequent levels. During the planning of budget, issues of equity, efficiency, and effectiveness are considered. The analysis is presented in the next section of the paper.

The second level is the Finance Committee and Executive Committee, both of which are Council Committees. The Finance Committee administers financial stewardship on behalf of the Council, which is the supreme governing body of the university. It advises and provides recommendations to the Council on budgets and monitors expenditure against approved budgets. The Finance Committee is chaired by the Treasurer of the Council. The Director of Finance Unit acts as the secretary. Members of the committee include the President, a Senate representative, five members of the Council, and co-opted members of the Finance Committee. The Executive Committee is responsible for considering and providing recommendations to the Council on matters that are referred to the Council by its committees. The Executive Committee is chaired by the Chairman of the Council. The Secretary to the Council acts as the secretary. The committee members include the Deputy Chairman of the Council, Treasurer of the Council, Chairmen of other Council Committees, and President. When the budget is endorsed by these two committees, it can be passed to the next level.

The third level is the Council, which has general control over the administration of the University. The Council composition includes appointed Chair and members, who are community leaders or respected professionals, President, Vice-President, and staff representatives. The Council is responsible for the final approval of the budget that has been endorsed by the Finance Committee and Executive Committee.

From the theoretical perspective, the mechanism for formulation of budget in OUHK is theoretically sound. The consideration focuses on the three dimensions of budget, which include educational programme, cost of programme, and revenue plan (Brimley *et al.*, 2012). The educational plan is determined before the tuition fee is presented, which is then followed by the determination of required revenues. Such consideration adopts the philosophy that educational programmes should be determined by the needs of students rather than availability of funds.

From the operational perspective, the mechanism is rational. Instead of using the previous year's budget as the sole reference in developing the budget for the coming year, stakeholders are involved in every annual exercise of budgeting. It is being commented that simply adjusting each area of last year's budget by the same percentage to develop the present year's budget is not a rational approach (Brimley *et al.*, 2012). One should understand that the budget for the previous year may not be perfect and that each part of the budget in the last year may have changed in different amount. Moreover, there should be a system that ensures that the budget is evaluated regularly so that there is an opportunity to resolve the limitations. Lastly, the right and responsibility of stakeholders in continuous evaluation of the budget for improvements should be respected (Brimley *et al.*, 2012).

The existing mechanism is also stringent and realistic. It is operated in a system with multiple levels and involves multiple stakeholders both within and outside the university. The involvement of internal stakeholders is basically at the first level which involves the head of various units and a few staff representatives. The involvement of external stakeholders increases as the level escalates. Although the frontline teachers and students, who are major stakeholders of education, are not directly involved in the decision-making process, they can convey their opinions through other indirect mechanisms, such as meetings held by individual academic units, student survey, and informal sharing. It is understood that when more stakeholders are involved in the budgetary planning, more resources are required to support the stakeholders who may not be knowledgeable in financial management. Consequently, more time and effort is needed to arrive at a consensus. For a self-financing educational institution that has limited resources, such impact is particularly significant. The underlying difficulty should be taken into consideration.

3 Effect of Involving Stakeholders in Budgetary Planning on Practice and Outcomes for Teachers

The present mechanism for budgetary planning involves internal stakeholders from academic units and administrative units. Such practice facilitates identification of the gap between need and practice (Weindling, 1997). The mechanism also ensures that the preferences of the ultimate recipients of resources are taken into account (Glover & Levačić, 2007). For example, the academic unit is in a better position to understand the demand of a particular educational programme and facilitates a realistic projection of student number. The Planning Unit investigates the financial situation of the potential students and develops a reasonable proposal of the tuition fee. The other supporting units work out the expenditure for supportive items, such as human resources, infrastructure, library holding, computer, and information technology. When income and expenditure are planned carefully and the preferences of the stakeholders are considered, the budget will become practical and realistic. A reasonable amount of resources can be allocated to support various teaching-related activities. In a university that has a designated budget to support teaching in a comprehensive way, teachers are able to conduct teaching activities with better quality and to develop their potential without great concern on financial restriction.

The present mechanism for budgetary planning involves both internal and external stakeholders in the decision making. The internal stakeholders, who are staff of the university, contribute from the operational perspective. The external stakeholders, who are mainly appointed community leaders and professionals, contribute from the administrative perspective. Such combination enhances the budget to be developed with input from diverse perspectives. In a working environment that has a well-developed mechanism for budgeting and a stable financial condition, teachers are more likely to develop long-term and large-scale educational initiatives.

The involvement of stakeholders in the budgetary planning improves transparency and accountability of governance (Glover & Levačić, 2007). Such involvement facilitates budget holders to maximize the assigned budget according to their original plan. Consequently, the chance of having unused budget and the need to carry it forward to the next financial year is reduced. More importantly, the intended quality of teaching will not be compromised.

Nevertheless, the wide involvement of stakeholders may lengthen the decision making process. The impact is especially significant in situations wherein difficult decisions are needed (Glover & Levačić, 2007). If teachers are involved in the budgetary process, they should be prepared for a lengthy process, which is going to use up part of their time for teaching.

4 Equity, Efficiency, and Effectiveness

Given that education is non-profit establishment, the assessment of the financial report cannot adequately reflect the achievement of educational outcomes (Capaldi, 2011). A financial report can reveal where money is spent, but cannot fully convey the message about the important indicators of resource usage, such as equity, efficiency, and effectiveness. These indicators are highly relevant to open and flexible education which has emerged as an unavoidable and phenomenal form of education in the history (Ambe-Uva & Adegbola, 2009). The following analysis attempts to adopt these three indicators as the focus of analysis.

4.1 Equity

Equity refers to the extent to which every individual is treated fairly. Equity is different from equality, which means treating every individual the same (Brimley *et al.*, 2012). In education, equity can be interpreted in terms of equal access to education, equal educational treatment, and equal educational outcomes (Garner, 2004). However, providing access alone cannot guarantee that students receive equal educational treatment, and giving equal educational treatment does not automatically generate the expected educational outcomes. Different stakeholders have different preference toward a particular aspect of equity, and achieving complete equity is difficult because students have different abilities and needs. Moreover, provision of financial resources cannot legitimately achieve equity in education. Therefore, addressing the issue of equity in education through budgeting is difficult and is sometimes considered as a dilemma (Brimley *et al.*, 2012).

Under the equal access principle, the concept of "education for all" is adopted. Open and flexible education intends to increase access to education to those who cannot access it within the mainstream (Ambe-Uva & Adegbola, 2009). Consistently, the mission of OUHK is to make higher education, through open and flexible education, available to all who aspire to get it. Nevertheless, this mission is valueless until it is converted into dollar costs. To achieve equal access to education, OUHK has adopted a number of strategies. Being a non-profit making organization, OUHK is exemption from taxation. The tax exemption, to a certain extent, relieves the financial burden of the university and prevents charging students expensive tuition fee. The university also establishes bursaries and other forms of financial assistance from donations. Over the years, OUHK has managed to keep the tuition fee at a level that is comparable with government-funded universities, thereby offering study opportunity to students who cannot afford expensive tuition fee. Nevertheless, the demand for financial assistance remains high that the limited Student Assistance Fund has to be shared among deserving students.

Equal access is believed to be ineffective if students do not receive equal treatment (Garner, 2004). However, the provision of identical education for all students is not an appropriate approach to achieve equal treatment because some students, such as those with special needs, require more support than others to complete their study. This is particular true for open and flexible education which operates by making education delivery flexible to the students and meets their needs (Ambe-Uva & Adegbola, 2009). Therefore, additional resources must be made available to those students with special needs.

The equal treatment principle implies the provision of the essentials and does not rule out spending more money for students with more needs. An equitable educational programme should provide students with the same abilities with equal educational treatment (horizontal equity), as well as provide students with unequal needs, such as those with financial difficulty, disabilities, or limited language proficiency, with unequal educational treatment (vertical equity) (Brimley *et al.*, 2012; Garner, 2004). A budget is required to ensure an optimal learning environment among all students. In government-funded universities, a common practice is to have a certain portion of expenditures designated as bursary for students with financial difficulties and as support service for students with disabilities. For a self-financing university that mainly relies on students' tuition fee as income, however, a dilemma arises when it attempts to maintain horizontal and vertical equity simultaneously. The involvement of stakeholders in budgeting does not only ensure that the needs of special groups are drawn into attention, but it also contributes to make a balance between maintaining horizontal and vertical equity within limited resources.

On top of providing students equal access to education and ensuring that they receive equal treatment, schools are increasingly expected to ensure that students achieve a specified level of competence. Under the equal outcome principle, the finance policy in education nowadays is tied to educational quality, which is defined in terms of improvement in educational outcomes (Garner, 2004). Obviously, a considerably larger amount of money is required to enable students to attain a certain level of achievement than the money for provision of equal access or treatment. However, the infusion of money does not necessarily result in equal outcomes (Garner, 2004). Many factors such as school culture and leadership, students' intelligence and motivation, parents' expectation, and community attitudes toward a particular programme affect educational outcome as well. For example, some of the abovementioned factors can create a better working environment to attract and retain good teachers and administrators. As a result, students gain more benefits from them and show better performance (Brimley *et al.*, 2012).

Despite the involvement of stakeholders in budgeting has its advantages, different stakeholders may hold different opinions about equity. Stakeholders who advocate equal access may suggest budget to be allocated evenly to support more students. Stakeholders who espouse excellence may suggest giving extra resources to reward outstanding programmes/units, reinforce their performance, and support further improvement. As resources are limited and priority for use of resources has to be set, the university tends to emphasize the provision of quality education. The outcomes will certainly differ due a combination of confounding factors.

4.2 Efficiency

Efficiency refers to the extent to which an output is produced from the costs of input. Efficiency is achieved when a given quantity or value of output is generated from minimum cost (Levačić, 2000). Although educational efficiency can be achieved easily by increasing the tuition fee, this strategy will probably induce inequity as the poor students will be less likely to gain access to education. Therefore, educational efficiency has to be achieved through other means.

In a university, the major cost is teachers rather than programmes (Capaldi, 2011). With reference to the concept of efficiency, a university is considered more efficient when its teachers are teaching more programmes or when a university manages to introduce new programmes without adding new teachers. Over the past 25 years, the increase in academic programmes, student number, and degrees awarded in OUHK has outweighed the increase in teacher number. In terms of the number of teachers, the operation of the university can be considered efficient.

Moreover, a university is operated by its academic and administrative units rather than programmes (Capaldi, 2011). Instead of involving the head of individual programmes, the university involves the head of academic units and administrative units in budgetary planning. This approach is in congruent with the concept of efficiency, which supports operating in a collective perspective and encourages maximization when using resources.

4.3 Effectiveness

Effectiveness refers to the extent to which the intended outcomes are met regardless of cost. Effectiveness is closely related to the objectives that have been set (Levačić, 2000). One of the objectives of OUHK is to provide high-affordable and high-quality programmes across disciplines and at a variety of levels to meet the needs of lifelong learners. To achieve this objective, the university has successfully launched programmes of different disciplines. Yet, the tuition fee is set at an affordable level. Some disciplines, such as Humanities and Social Sciences, are generating more revenue. Other disciplines, such as Engineering and Sciences, are generating less revenue because of the expenses for faculty, laboratory, equipments, and small class sizes. Even though these programmes do not generate much revenue, they are offered and contribute to a main portion of the existing programmes. Another objective of OUHK is to commit itself to excellence in research and scholarship. Therefore, research-based programmes at master and doctoral levels are offered. Obviously, running research and doctoral education is expensive (Capaldi, 2011). With regard to efficiency, the aforementioned low-revenue generating programmes should not be offered. With regard to effectiveness, however, such programmes contribute to meeting the objective of the university and their existence is fully justified. The university manages to prepare a budget and makes a balance between efficiency and effectiveness.

With persistent effort in financial management and upholding of educational quality, OUHK has gained the self-accrediting status by the Hong Kong Government in 1996. Since then, the university is able to validate its own programmes and have its degrees recognized. The ability of university to maintain educational effectiveness within budget is evident.

5 The Way Ahead

Working with all stakeholders is believed to be essential in achieving desirable planning. Therefore, it is suggested that the Budget Committee of OUHK can consider including representatives of more stakeholders in the university. At present, the composition does not include representatives from frontline teachers and students. If they are included, their opinions and concerns can help the university make more responsible decisions. However, effort should be paid to operate the committee with members of diverse backgrounds. Although decision making works on a group basis, individual members may have their own interests and biases. Clarifying the goal of the committee and communicating the strategic goal of the university among members are essential, thereby facilitating a smooth operation and establishment of consensus.

Being financially literate is a quality that can maximize a staff's contribution in the budgeting process. At present, many staff working in the university do not have a background on financial management. The dearth of related knowledge and skill limits their ability to construct an effective budget. Developing training package for staff in different ranks/positions is suggested to increase their awareness of financial management and understanding of own role in budgeting. As they are better prepared, they can function in a more effective way.

The aim of having different levels of committees for approving budget is to strengthen the quality assurance mechanism. Nevertheless, overlapping of membership between committees can weaken the intended effectiveness. In OUHK, some members of the Budget Committee are also members of the Finance Committee or Council. If a staff is involved in two or more committees, then he/she is likely to be less critical in financial monitoring and control measures (Mestry & Naidoo, 2009). Such practice also weakens the ability of the university to achieve equity and ensure fairness for all budgetary headings. Therefore, overlapping of membership should be avoided as much as possible. For example, a special requirement can be stated in the terms of reference of the various committees to guide selection of members. If overlapping of membership is necessary, the role of these members should be specified clearly.

With increasing frequency, teachers in the U.S.A. are invited to request budget for an optimal programme in addition to an ordinary one (Brimley *et al*., 2012). By doing so, administrators can have an idea about how much money is needed to provide the best possible programme. It is worthwhile to adopt this practice in the local setting because it provides the university an opportunity to carefully consider available alternatives. In terms of equity, the university is moving toward achieving equal educational outcomes. In terms of efficiency, the teachers will be more willing to actualize the optimal programme because it is a programme that they desire. In terms of effectiveness, the university can identify better ways to achieve university objectives.

6 Conclusion

In an educational institution, income is used to meet operational needs and to foster educational development. To all schools, budgeting is an integral part of financial management. For a self-financing university, sound budgeting is particularly necessary to support effective operation and student enrolment. The present scenario of a self-financing university providing open and flexible education illustrates how stakeholders are involved in the budgetary process. Heads of academic units are invited to identify new development and project student number for the coming academic year, and heads of administrative units are required to estimate the expected expenditure. The budget is then subjected to approval by a number of committees at different levels. The outcome is evaluated in terms of equity, efficiency, and effectiveness in achieving educational objectives. The difficulties are revealed. Although availability of financial resources is a pre-requisite for desirable outcome, it should be accompanied with supportive policy and sound financial management. The involvement of stakeholders in the budgetary process facilitates the development of a realistic budget for meeting operational needs and sustaining growth of the university. The present experience sheds light on the management of financial resources through budgeting in self-financing universities worldwide.

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Flipped classrooms in Japan

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Abstract. Flipped teaching, developed by Bergmann and Sams (2004), is a recent teaching method requiring students to watch an online lecture before coming to class. Then during class-time, rather than having a traditional lesson conducted by the instructor, students have discussions and do assignments based on online lecture under the guidance of their instructor. The benefits of this flipped approach to teaching, which merges traditional learning with the continuously advancing world of online learning, is enormous for both students and instructors (Fulton, 2012). Although various combinations and applications of this model have been implemented, little research has been conducted concerning which models are more effective at enhancing student motivation and encouraging them to take control of their learning. This study looks at the development and evaluation of flipped classroom approaches as implemented in various Japanese educational settings, and discusses the benefits and limitations revealed thus far.

Keywords: flipped classroom, flexibility, online learning, Japanese

1 Introduction

Flipped teaching models have recently been incorporated by educational professionals as one of the most effective teaching approaches in providing students with more time to study at their own pace and prepare to participate in class activities before each class (Watanabe, 2014). Students in flipped classrooms watch video-recorded lectures as homework outside of class. They often communicate with other students and the instructor via online discussion forums (Tucker, 2011). During class-time, students have discussions with other students under the guidance of their instructor. Students then improve their understanding of, and enhance the familiarity with the lecture topic, during the class time. Flipped teaching models differ from prior techniques in many ways. For example, compared to the traditional classroom, this model gives students more time to study at their convenience and prepare questions in advance.

There are several benefits of this flipped approach to teaching, for both students and instructors (Fulton, 2012). For example, this model enables students to access different videos of lectures created by various instructors. This helps students appreciate diverse styles of teaching and increases their exposure to various academic topics. There are however some drawbacks to this model. For example, watching digital lectures in advance is only effective for self-motivated students (Butzler, 2014). For those who are less motivated, this model of teaching isn't successful. In classrooms with students with different proficiency levels, it is difficult for the instructor to make sure all are learning at a steady pace (Chen at el., 2014).

This teaching model has become popular since it was demonstrated by Khan (2011) and Bergmann and Sams (2012). However, in terms of the evaluation of flipped models of teaching, there is a lack of research regarding how to best structure and utilize this model in maximizing Japanese students' learning.

2 Purpose of the Study

The purpose of this study is to examine the development of, and students' reaction to, flipped classroom approaches as implemented in various Japanese educational settings, and to discuss the benefits and limitations revealed thus far.

2.1 Research questions

1. What are the distinctive characteristics of flipped classroom models in Japan in terms of teaching methods and materials?

2. What are students' and instructor's perceptions of this model?

3 Methodology

3.1 Overview of the research papers examined

In this study, 6 research papers were selected for evaluation. The flipped teaching methods described in these papers were recently introduced into classrooms around Japan. Most of this research was conducted in secondary schools and tertiary institutions.

3.2 Higashi Koyodai Elementary School (Sato, et al., 2015):

Students were given iPads to take home, which leased to the school by Fujitsu. They were asked to used them to watch an instructional video about 'ratios and proportionality' in mathematics, and to take notes. The video was approximately 2 to 3 minutes long. The duration of time students spent watching and making notes ranged from 30 minutes to an hour. Every student watched the video thanks to the encouragement of their parents. Afterward, during class time, the instructor checked students' notes and further assisted those who hadn't yet fully understood the examples presented in the video. Also in groups, students helped each other too. After the introduction of this flipped approach, drill exercises, which had previously been assigned as homework, were given to students as classroom exercises instead. Students grades appeared to benefit significantly from this learning approach, and students reported 'feeling of security' being able to prepare before coming to the classroom.

3.3 Secondary schools

Kinki University Secondary School (Shigeta, 2014):

Since 2013, students entering this elementary school have been required to purchase an iPad and utilize digital textbooks and materials via a learning management system. Flipped classroom models were introduced into math and English courses.

In the math courses, students studied by themselves by watching lectures from home on their iPads. In the classroom, in addition to studying independently or receiving lecture-type instruction, students also took part in cooperative learning sessions. For their English course, students did lexical and read-aloud exercises at home using digital materials. In the classroom, the instructor reviewed these exercises, and in groups students did cooperative activities utilizing what they had learned. The chief benefit owed to the flipped method was that students were able to engage with the learning material for longer periods than they would have just during class time, enabling slower students to take as much time as they need in picking up the materials. As a result, the instructor was able to spend more time with students in the classroom. Also interesting was that before the introduction of this new teaching method, the instructor had been spending a year on the prescribed textbook, but after introducing flipped teaching, the class managed to finish it in only half a year! The Kinki study concluded that with the flipped classroom approach students were able to make significant improvements compared to in their traditional lessons.

Hokusei Girls Secondary School (Konishi, 2013):

In this secondary school, the instructor uses a commercial online system, called *Surara,* as a flipped classroom resource. This system, awarded a grand prize in e-learning systems by the Minister of Education, Culture, Sports, Science and

Technology in 2012, includes Math, English and Japanese materials. In each module, cartoon characters explain what students should learn and frequently give quizzes to increase students' excitement. This system enables the instructor to monitor students' progress and remind them of their homework. In addition to lectures and drill exercises, the system includes tests that students are required to take. In the classroom, students review what they have learned from the materials and do exercise in groups of 4 or 5. During class time, students are able to ask questions they prepared at home. Creating digital materials is time consuming, but this system solves that.

3.4 Tertiary institutions

Hokkaido University (Shigeta, 2014):

In an information science course, an educational program, called *Justice with Michael Sandel* produced by Prof. Michael J. Sandel of Harvard University, was used as a digital material. This program generated a lot of discussion and has been made available to the public through "iTunes U" and through Tokyo University. The program contains 8 different topics. Several groups of 4 or 5 students select one of the topics and watch it outside of the class in advance. Then in the classroom, students have a discussion, make a report about this and submit it to the instructor. Since more than 90% of the students watch the digital materials, they discuss the program in the classroom without any problems. According to the results of the questionnaire conducted at the end of the course, students engaged in classroom discussions enthusiastically because they had enough time to do so, unlike in traditional lecture-type lessons.

Waseda University (Kogo & Ishikawa, 2014):

This study includes research conducted from 2008 to 2014. The digital materials were created by the instructor using software called Camtasia. Each module was about fifteen minutes long and in it the instructor gave a speech without any prepared script. Students accessed the materials either via a visual delivery system or a private YouTube account. After watching the video, students did quizzes and tasks included in the materials and made a short report. In the classroom, several groups of 5 or 6 students discussed the task from the material they had watched.

Medical school at Kagawa University (Nishiya, Sumitani & Okada, 2014)

In a medical management and administration course, a flipped teaching approach was introduced into a 75-minute class 87 students attended. The instructor uploaded a 15-minute digital lecture on 'Bleeding Tendencies' to an online system, called *Ub!Point* created by Fujitsu, and students were encouraged to watch it before class time. During the class time students reviewed what they saw in the video for approximately 10 minutes and interactive dialogues took place for the rest of the class between the instructor and students. The results of the questionnaire conducted at the end of the class revealed that 67% of the students watched the video and they were satisfied with its duration and its degree of difficulty. 66% thought the video was easy to understand and 69% thought this teaching approach was helpful. 9% thought all their courses should be based on flipped teaching approaches and 45% thought these approaches should be introduced into at least a half of the courses they take.

4 Findings

Shigeta (2014) points out three benefits to flipped classroom methods. Firstly, the flipped classroom enables students to increase their time to study time. In traditional classrooms visual materials are given during class time, but the flipped classroom enables students to use this time for their discussions. Secondly, flipped methods provide students with opportunities to actually apply what they learned from the digital materials they watched at home. In traditional classrooms students learned passively, but the flipped classroom promotes active learning. Thirdly, in flipped classrooms students progress faster and learn more effectively, as shown by Kinki University Secondary School example cited above. Kogo & Ishikawa (2014) claim that these methods also help students actively engage in group activities and explore new ideas as they deepen their understanding. In addition, they enable students to prepare questions to ask regarding anything they find unclear or confusing and to better participate in classroom discussion.

Flipped classrooms are also beneficial for instructors. As Nishiya, Sumitani & Okada (2014) state, this model boosts face-to-face instruction time, which ensures students fully understand topics. In addition, when students do their assignments in the classroom, instructors have new and better insights into their abilities, especially in identifying problem areas, and enables customization and improvement to courses as needed. Class time is used more effectively and students' levels of achievement increase.

On the other hand, there are some problems with implementing flipped classroom methods. Shigeta (2014) points out three. Firstly, educational institutions require high-speed broadband Internet connections for students to access the digital materials. In addition, individual students need a computer or tablet, but many cannot afford to buy one. Secondly, the instructor needs to have enough open resources or materials of sufficient quality to include in lectures. Although many different open resources are available nowadays, such as Khan Academy, Japanese language resources are still being developed. Thirdly, the instructor must consider students' total workload to determine whether or not they have enough time to watch digital materials in advance. The results from the questionnaire conducted by Shigeta (2014) indicate that the more time students spend the digital materials the higher marks they got. The instructor's role as a facilitator determining students' comprehension of what they have learned, supporting students individually and promoting cooperative learning, is important.

5 Discussion and Conclusions

The number of flipped classroom examples outlined in this study is too small to allow any generalization of the development and evaluation of flipped classroom approaches implemented in educational institutions in Japan. However, the characteristics of these approaches demonstrated in this study provide interesting insights and implications as to how they should be introduced in different educational settings. The findings suggest that flipped classrooms provide students with opportunities to better prepared to participate in class work and help them learn more effectively. The results also indicate that flipped classrooms promote active discussion between the instructor and students and therefore contribute to a productive teaching environment. Instructors need to take into consideration of the ways to create digital materials suitable for students' needs, preferences and workload.

Further research on flipped classrooms should be conducted to determine how instructors should act effectively as a facilitator in implementing flipped teaching approaches in order for students to enhance their active learning. It is also essential for instructors to provide students with a collaborative learning environment which enables them to take an initiative and become ready to be in charge of their own learning.

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The blending of student-generated videos in an operating systems course

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Abstract. Digital video is an effective instructional tool for providing learning content and illustrating concepts. Digital video storytelling turns students from media consumers into media producers, and consequentially motivates them to take control of their learning process. In this paper, a pilot study of blending in digital storytelling in an operating systems course is described. Students in an operating systems course need to overcome the difficulty of abstract and dynamic concepts. The findings show that through a highly engaging course project of producing a video for illustrating these concepts, students were able to reach even metacognitive level of understanding. The experience was a successful and satisfying one for both the students and the course instructors.

Keywords: blended learning, operating systems course, digital video, digital storytelling, student engagement, group work

1 Introduction

Computer system design is one core knowledge area in typical undergraduate computing curriculums. This knowledge area covers architectural organization of computing systems as well as logical utilization of computing resources including processors, memory, and peripheral devices. A course called Operating Systems (OS) is usually designated as the place where this knowledge area is addressed. Operating systems is a key technology responsible for management of computing resources for executing application programs. The course is laden with concepts and principles. It presents various design approaches of operating systems and compares models of computing resource utilization. One learning outcome that is challenging to achieve is the ability to analyse the trade-offs inherent in different approaches related to resource management processes. Similar to other computer algorithms, these processes are abstract and dynamic, and difficulties arise if they are not taught in the same way (Hansen et al., 2002). Providing authentic situations and real-world contexts should better engage students in analysing the processes (Lincke, 2005). It is now common for OS courses to include hands-on authentic activities such as programming a real or teaching operating system (Andrus & Nieh, 2012; Qu & Wu, 2012) or doing experiments with an algorithm simulator (Fischbach, 2013). However, students who are weak in programming could suffer more frustration with the former, and the latter could be too shallow compared to the complexity of real situations.

This paper argues that student-generated video project is an effective alternative for learning the concepts and principles in operating system design. In the video project, student teams are tasked to produce a short video footage about a particular process or issue covered in the course. Through well thought-out project instruction and assessment strategy, they are made aware of the importance of educational value, and they are given the incentive to rigorously consider how to facilitate their peers to learn. The idea of a student-generated video project is aligned with a number of good practices including authentic learning, active learning, deep learning, and project-based learning (Kearney & Schuck, 2006; Barrett, 2006).

Blending in student-generated video project in an operating system course should create a learning environment for the following two objectives:

- Encourage students to actively analysing concepts and processes of operating systems, and to take control of their learning process such as how deep should delve for a particular issue.
- Enhance student participation and motivation in a textbook based operating system course.

The aim of this paper is to present and review the design of a student-generated video project for an operating system course. The findings of a pilot study that has been carried out at the authors' institution are to be reported in the rest of this paper.

2 Background

OS is perhaps one of the less appealing courses in current computer science curriculums, compared to the more popular courses such as mobile application development and digital multimedia. The now well-established course syllabus is laden with concepts, principles, and algorithms (Billard, 2005). Building the course on a textbook, such as (Silberschatz et al., 2013), is a common approach that would take students through topics related to executing programs on a computer, and invites students to make sense of key processes such as processor scheduling and memory address binding. Studying and analysing computing processes, which are both abstract and dynamic, often causes frustration. Hansen et al. (2002) suggested one reason that the characteristics of a computing process would usually be observable in a operating context but a textbook or a lecture could not provide it. Many students would therefore resort to memorization instead of understanding, and Jong et al. (2013) pointed out this is why they would feel boring and unmotivated.

A number of research papers have reported various ways to improve the teaching and learning of an OS course. Creak & Sheehan (2000) added the element of users to the teaching model and presented a new course structure that considered operating systems as a service provider. The report included no proper findings, but the impression that the students grasped the overall structure better. Majority of other papers acknowledged the dynamic nature of operating systems' concepts and proposed learning activities based on programming an operating system. For example, Bovet & Cesati (2001) used Linux, a real popular operating system, for demonstration of how each OS component would operate. The complexity of a real operating system was found to be a hindrance and there were a number of instructional operating systems appeared. These OS, such as Nachos (Christopher et al., 1993), OS/161 (Holland et al., 2002), and BabyOS (Liu et al., 2007) are simple to understand and designed to support programming tasks for student experiments. However, this programming approach demands strength in reading and writing programs. Average students are likely to spend disproportion amount of time in programming, and perhaps even more in debugging. Programming should not be considered as a key course objective and therefore alternatives that require less or no programming have appeared. Aviv et al. (2012) proposed a simplified programming environment called PennOS, which allows students to complete the whole system within a short time period. (Mustafa, 2013) went further in removing programming work altogether and developed an operating system simulator which provides a nice graphical user interface for interactive experiments. (Jong et al., 2013) addressed the motivation problem by introducing a collaborative game-based approach in which teams challenge each other with questions about the course content. Even though they are effective to a certain extent, a major drawback of these instructional systems is heavy investment on system development.

Central to any effective teaching and learning strategy is that students are willing to engage in learning activities. A highly engaged student is willing to spend time and effort (Kuh, 2001), which consequently affects the level of understanding and knowledge construction achieved (Entwistle, 2000). Basically, students who do the work will learn, and they work persistently if they have high motivation. The existing teaching and learning strategies for a textbook-based OS courses seem only able to motivate a minority group of students. For example, the instructional OS approach attracts students with the value of real-world practical experience but causes frustration to those who cannot handle the programming work. Table 1 summaries the merits and drawbacks for the teaching and learning strategies in the aspect of motivation. The types of motivation follow the taxonomy used in the Academic Motivation Scale (Vallerand et al., 1993).

Table 1. Merits and drawbacks for the major teaching and learning strategies.

Approaches	Motivation	Disincentive
Experiments with a real operating system (Andrus & Nieh, 2012)	Able to apply the skills in professional work. (Extrinsic Motivation)	Difficulty with the size and complexity of real OS. Difficulty with debugging in programming tasks.
Experiments with an instructional operating system (Holland et al., 2002)	A right level of realism for students to experience real systems. (Intrinsic Motivation)	Difficulty with debugging in programming tasks.
Experiments with building a simple operating system (Black, 2009)	Project was fun and contributed to learning the concepts (Intrinsic Motivation)	Difficulty with debugging in programming tasks.
Interactions with operating system simulators (Mustafa, 2013)	Project was fun and contributed to learning the concepts (Intrinsic Motivation)	Generally, algorithm simulators do not allow in-depth exploration.

Games that assessed knowledge (Jong et al., 2013)	To learn more about operating system through the desire to win the game as a team (Extrinsic Motivation and Intrinsic Motivation)	Weak students stopped participation and only the capable students remained.

An engaging learning activity should be one that motivates students in multiple aspects and avoids irritating weaker students. The pleasure in knowing new things should only be the beginning. Sensation of accomplishment, opportunity to prove one's ability, and increased potential for tangible rewards are also important motivational aspects. The activity should allow teamwork and yet each member could participate in an essential role.

2.2 Student-Generated Video Projects

Student-generated video projects enable students to go through an engaging learning experience. In such projects, students, normally consumers of multimedia, become digital storytellers through developing an audio-visual artefact. Digital storytelling as an instructional tool can have a strong impact whenever it is used to provide content or illustrate a concept (Berk 2009). Barrett (2006) identified that digital storytelling facilitates multitudes of good teaching practices including student engagement, deep learning, and project-based learning. A properly designed digital video production project can promote active learning (Greene & Crespi, 2012) and group work (Kemp et al., 2012).

Kuchel et al. (2014) designed a video project in that teams of students investigated in a local environmental issue. The video content was expected to bring up an issue for laypersons and to explain the science behind the issue. The project was found to be highly engaging and achieving multiple learning outcomes. The high level of engagement was inferring from the additional study hours, places visited, number of interviews arranged, and in additional the accuracy of scientific concepts covered. Kearney & Schuck (2006) noted the value of video project lies in relevance to real-life contexts and real audiences. On the other hand, digital storytelling facilitates students in understanding abstract difficult concepts such as those in the computing discipline. Furthermore, it encourages students to consider how to present these concepts in a motivational and accurate manner. Bromberg et al. (2013) successfully blended a video project into an information system course and found out that the quality of the content, delivery, and production of digital stories were all important. Khalid (2014) remarked that a group of aerospace engineering students found digital video project useful for understanding abstract processes.

Student-generated video project work is a highly creative process and it is also a highly involved one, which includes steps like setting theme, doing research, drawing up a storyboard, recording, editing, and producing (Robin, 2008). It offers genuine roles similar to a real-life video production team. Students should enjoy these roles and handle them both independently and collaboratively (Kearney & Schuck, 2006).

Digital video capture and production is now within reach of common people. Smartphones offer sufficiently good quality capture with unprecedented convenience and mobility. Students, especially those studying computing, should encounter little technical problem, and they can channel their effort on the analytic and creative part of the project.

3 Methodology

3.1 The Course and the Video Project

A student-generated video project was piloted in the 2015 spring presentation of the course COMPS267F Operating Systems, a 13-week long course with enrolment of over 180 students. It replaced an earlier version of the project that required students to develop a weblog about a topic selected from the course. It contributed towards half of the continuous assessment score. The syllabus is a standard textbook-based one, including topics such as process management, process synchronization, memory management, file systems, and input-output management.

Details of the video project including the possible themes of the video, group formation rules, assessment criteria, and submission method were given to students at the beginning of the course. Each team of 4 students would produce and submit a digital video in a period of 10 weeks.

The student teams had the freedom to select a theme for the video, but the following guidelines were given to define the objective of the video project.

- The theme should belong to one of the following categories, in order to ensure video content cohesiveness:
    - An explanation of one topic and its related processes and issues (e.g. memory management, deadlock).
    - A comparison of algorithms or models (e.g. different CPU scheduling algorithms).
- The assessment criteria included educational value, presentation quality, and creativity. Educational value was regarded as the most important so that more time would be spent on investigating related concepts and how they should be presented.
- The use of real-life analogies to illustrate abstract concepts was recommended.

The video project used a number of incentives so that the objectives could be reinforced:

- A public screening of student videos was arranged which included a polling of favourite videos. The most popular teams would receive bonus marks.
- The course instructors would select the best videos and the teams would receive cash prizes and certificates.

The technical requirements include the following:

- The length of the video is shorter than 150 seconds.
- The size of the video file is smaller than 75 Mb.
- All team members must visually appear in the video.
- Audio is optional but sub-titles are encouraged.

The students were given instructions on how to produce a digital video both technically and content-wise. The development of a storyboard was also suggested so that the assignment work could be divided into smaller manageable parts, facilitating content development, task distribution, and the final production of the video. In addition, links to various video editing software and instructional materials for short video production were provided.

3.2 Research Questions

It was important to collect evidence on whether the student-generated video project was effective for improving operating systems courses. Here are the research questions that guided our investigation.

1. To what extent do student-generated video projects facilitate the learning of concepts in operating systems?
2. How do student-generated video projects enhance the learning experience in an operating system course?

The first research question stemmed from our initial view that video projects could provide an engaging learning activity to overcome the abstract and dynamic nature of operating system concepts. Previously studies in video projects mostly set reflections of real-life issues as their goals, such as emerging issues in bioethics (Willmott, 2014) and current affairs (Baepler & Reynolds 2014). The other studies that focused on creating educational videos unfortunately did not thoroughly review the expression of cognitive and meta-cognitive elements in the video. This question will provide insights through reviewing the video content.

The second research question will inform how to enhance teaching and learning of operating systems, especially in how to improve participation and motivation of students.

4 Results and Analysis

4.1 Mastery of Operating Systems Concepts and Meta-Cognitive Experience

The extent of students' cognitive and meta-cognitive effort is reflected by the selected topic, the video content, and probably most significantly the use of analogies. Proper use of analogies and metaphors provides evidence that students had not only learned and also considered how to stimulate learning.

Table 2 below shows the number of teams selected each of the two theme categories. More teams took up the more challenging topical theme. A *topical* themed video required not just in-depth study of a topic, and also integration of several selected issues into a coherent presentation. On the other hand, a *comparison* theme video was easier to handle.

Table 2. Number of groups selected each of the two theme categories

Categories of Video Theme	No of Teams
Comparison	18 (40%)
Topical	27 (60%)

Figure 1 and 2 shows the distribution of topics in the *comparison* and the *topical* categories respectively. The two course instructors reviewed all the submitted videos and coded the video topics (Cohen's Kappa = 0.935). Despite the obvious bias in selecting the two topics *CPU scheduling algorithms* and *Deadlock*, the video topics spread across the first part of the course curriculum. This finding coincides with our hypothesis that digital storytelling can indeed carry abstract and dynamic concepts related to operating systems and in general computing.

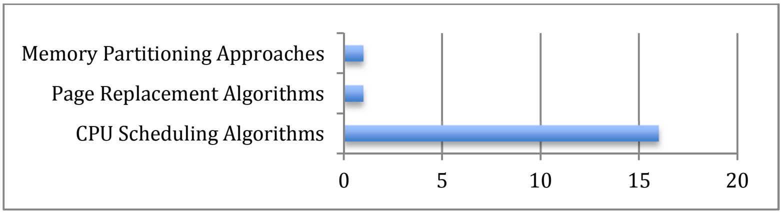

Fig. 1. Distribution of topics in the Comparison theme category

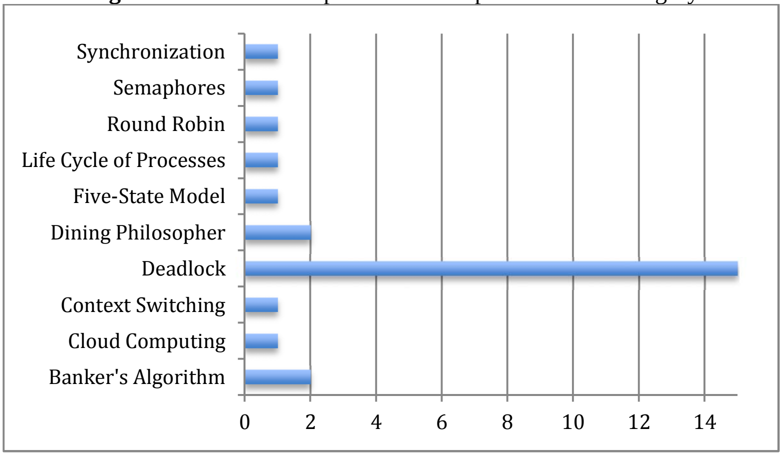

Fig. 2. Distribution of topics in the Topical theme category

To examine students' effort on meta-cognitive activities, how they selected analogies and metaphors were examined. Fortunately, the topic bias towards *CPU scheduling algorithms* and *Deadlock* provided a good amount of samples. CPU scheduling algorithms use different criteria and conditions to allocate the CPU (i.e. the resource) to different computing processes (i.e. the resource utilizer). In the real world, there is an abundance of cases where resource utilizers compete for resources.

Table 3 lists the analogies and metaphors used in the videos about *CPU scheduling algorithms*. The analogies selected by students were found to be suitable, which means that the analogies are familiar to common students and transferrable to the corresponding concepts (Patil & Tiwari, 2012). The creativity and the effort putting into identify suitable analogies were also noted. There was a wide range of real life situations captured in the videos, often in a stimulating and humorous manner. Similar findings were also discovered from the videos about *Deadlock*.

In conclusion, indicators were found that the teams demonstrated mastery of concepts in operating systems, which are supposed to be difficult to learn due to their abstract and dynamic nature. Students' selection of suitable analogies supported this view. We will continue to find more appropriate methods for gauging the depth of learning.

Table 3. The analogies selected to represent resources and resource utilizers in the videos about CPU scheduling algorithms.

Sample	Resources	Resource Utilizers	Suitable Analogies
1	Toilet	Human	Yes
2	Toilet	Human	Yes
3	Toilet	Human	Yes
4	Consultation Desk	Human	Yes
5	Library Loans Desk	Human/Book Borrowers	Yes
6	Officer (Stamp)	Human/Documents	Yes
7	Kitchen	Human/Hamburger Order	Yes
8	Fruit Stall	Human	Yes
9	Candy Stall	Human	Yes
10	Boutique Cashier Boutique Fitting Room	Human/Customers	Yes
11	Workers	Tasks	Yes
12	Reception Desk	Human/Jobs	Yes
13	Human	Homework	Yes
14	Food	Monsters	Yes
15	Auto-Teller Machine	Human	Yes
16	Café Kitchen	Human/Drink Order	Yes

4.2 Roles in Video Production Teams and Student Participation

The availability of well-defined roles in a video production process facilitates higher level of participation. The roles are meaningful and their required skills are familiar to students. Even if team members have no self-proclaimed relevant skill, they can still participate in acting. This low skill-threshold participation makes free riding less likely (Hall & Buzwell, 2013).

Table 4 (a) and (b) shows the level and role-specific participation of students in the video project. The data was based on a survey (N = 174) administered when the students submitted their videos. The results indicate a high level of student participation with many students taken up multiple roles. As expected, editing required the least number of students and acting the most.

Table 4. (a) Total no of students taken up each particular role. (b) Total number of students against the number of roles taken up.

Tasks or Roles	Freq.	Average Per Team
Research	107	2.38
Story Development	124	2.76
Recording	95	2.11
Acting	143	3.18
Editing & Production	81	1.80

No of Roles Taken Up	Freq.	%
1	25	14.2
2	40	22.7
3	34	19.3
4	42	23.9
5	35	19.9

For the students who took up only one role, further analysis indicated (see Figure 3) that just over half of them were in acting, which was perceived to be the least demanding. Perceiving single role students be the least participative as a view is not supported by the results. Nearly half of them are likely to be skilled in the role and therefore assigned accordingly by the team.

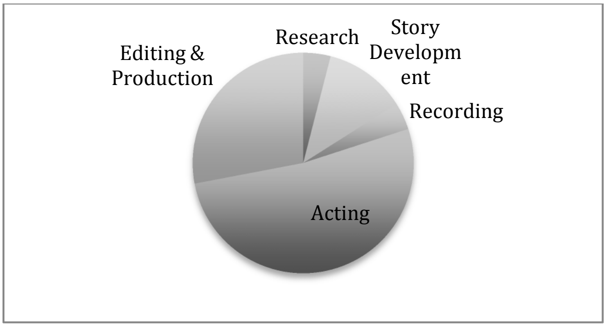

Fig. 3. Distribution of role types for those students who had taken up one role.

To better understand the relation between background skill set and the role taken up, the students were asked to report the relevant data in the same survey. Table 5 shows the correlations between self-proclaimed prior experience and actual role taken up in the video project. There is a connection, albeit weak, between prior experience and actual roles taken up. The strongest correlation is editing and production, which is in agreement with the perception of the most specialized among the roles.

Table 5. Correlation between prior experience of roles and the actual roles taken up.

		Prior Experience				
Actual Roles		Research	Story Dev.	Recording	Acting	Editing & Production
Research	Pearson Correlation	.34**	.36**	.25**	0.2	.20
	Sig (2-tailed)	.000	.000	.009	.837	.040
Story Development	Pearson Correlation	.13	.28**	.22	-.01	.08
	Sig (2-tailed)	.177	.004	.025	.947	.434
Recording	Pearson Correlation	.22	.32**	.37**	.08	.20
	Sig (2-tailed)	.024	.001	.000	.425	.038
Acting	Pearson Correlation	-.06	.00	.08	.26**	-.17
	Sig (2-tailed)	.549	.992	.387	.007	.089
Editing & Production	Pearson Correlation	.08	.10	.19	.03	.40**
	Sig (2-tailed)	.440	.321	.047	.786	.000

4.3 Students' Perception of the Video Project

Various aspects of students' perception of the video project were investigated through the same survey described in the previous section. The reliability of the quantitative items was found to be acceptable (Cronbach's alpha = .80).

Table 6 lists the results of the survey. All indicators were found to positively support the blending of the video project in the course. Over 75% of students found the project enjoyable and two-third of them believed that the project was suitable for the course and it should be continued. The teamwork was also found to be effective, which was agreed by over 85% of students. There was a weak correlation found between all pairs of the items at significant level of 0.01.

Table 6. Results of the survey

No	Item	Agreement on 5-point scale (5 being strongly agree)
1	Project was enjoyable	3.98
2	Project enhanced learning	3.84
3	Project suitable for the course	3.86
4	Motivated for the project work	3.65
5	Teamwork was effective	4.16

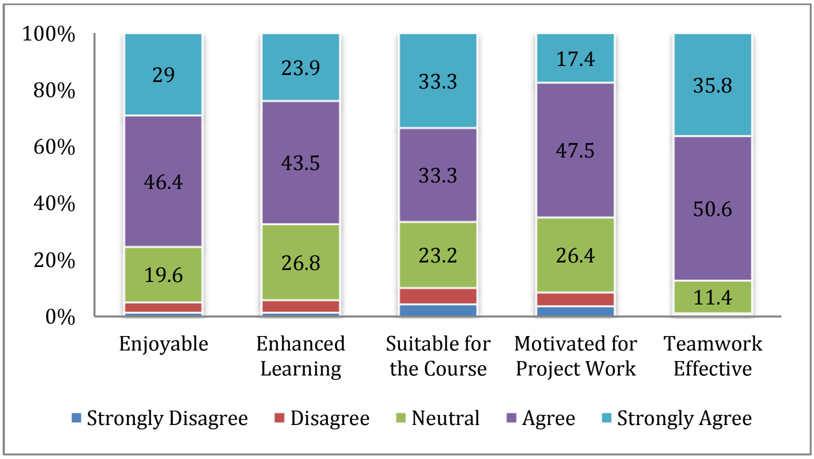

Fig. 4. Results of the survey as stacked bars indicating the strength of different responses

4.4 Project Implementation Issues

The pilot study generally went smoothly. The course instructors received no reports of technical problems concerning video recording and editing, which was expected given the experience of computing students with various gadgets. All videos were found to have included overlay graphics or sub-titles. Interestingly, two videos employed a speech synthesizer for narration.

5 Conclusion

A student-generated video project for an operating systems course was successfully designed and implemented. Evaluation shows that the project encouraged students to engage in a learning journey to overcome a difficult concept, and to enhance student participation and motivation in a group project.

The project demonstrated that digital storytelling is conducive to illustrating abstract and dynamic concept, but clearly the subject nature of operating systems was a key positive factor. Operating systems concepts mainly address computing resource utilization and management issues, which fundamentally reflect situations in the real world. The daily life of a student will encounter plenty of these situations and the familiarity makes them suitable analogies for the videos. In the evaluation, over half of the analogies used for illustrating CPU scheduling algorithms are related to the campus. The real challenge presented to the students was a meaningful one, which is to correctly attribute associations to objects or events in the metaphorical world. The students were required to have an in-depth understanding of a concept before they can identify a suitable analogy for it.

The video project, implemented as a group project, invited participation of students due to the familiar and distinctive team roles. No free-riding case was noted and the students perceived their team work as effective. This segregation of roles however has one potential problem. Only some team members were involved in research and story development, which could imply that other members did not investigate course concepts. The high average number of team members involved in research (2.38) and story development (2.76) seems to indicate the contrary. A more rigorous investigation in this aspect is suggested. Along in this line of discussion, the fact that each student could investigate only one selected topic is undesirable but inevitable due to the limited course time. Clearly watching the video work of peers is beneficial but it is not comparable to the value of going through the whole project. However, the project implementation could be refined that a *making-of* clipping should be added to explain the thinking process behind the video.

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Augmented reality campus learning: Engaging learning objects as an approach

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Research and Innovative ODL Practices: Use of ICT in Course Delivery

In this paper, Augmented Reality Campus Learning is proposed for teaching and learning using learning objects in Wawasan Open University (WOU). It provides self-directed virtual learning capabilities through an Augmented Reality (AR) approach running on mobile and table devices. The initiative focuses on learners' interactions with virtual learning objects in the teaching and learning environment. The augmentation was performed mainly on: (i) Posters (ii) 3D Model objects and (iii) Campus building and facilities. Augmented Reality Campus Learning aims to bring a new dimension to life on campus and learning for adult learners as it allows learners to enhance what they observe in images (AR books/posters/figures/charts), model objects and campus buildings using the camera in their mobile phones and tablet devices. A layer of Augmented Reality is added to what learners can see on their devices, which has embedded learning object content such as three-dimensional (3D) objects, videos, audio and animations. This extra layer can be used to exhibit student facilities, scenery, points of interest, activities and even to teach the concepts of geometry in a mediated reality learning environment. The AR Campus Learning approach proposed in this study provides potentially transformative added value in WOU campus learning environment and described the Point of Interest and AR learning objects created during the experimental study.

Keywords: Augmented reality, learning objects, mobile-learning, AR simulations

1. Introduction

In mobile augmented reality environment, an extra layer of Augmented Reality (AR) is added with embedded content such as 3D objects, videos, audios or animations to exhibit 3D structures, simulations or points of interest in mediated reality learning environment. AR has great potentials in education, and more excitingly, opens a novel realm for engaging virtual learning objects in mobile-learning environment. This paper presents the study of an Augmented Reality Campus Learning in Wawasan Open University (WOU) to foster learners' interactions using the virtual learning objects for teaching and learning environment mainly (i) Augmentation of an image, (ii) Augmentation of an object and (iii) Augmentation of the campus building and facilities. The WOU AR Application provides a fully automated approach to overlay augmented information accurately on top of the real-world augmented objects which supported by wide range of mobile devices mainly in smartphones and tablets for iOS and Android platforms.

2. Objectives

The research study presented in this paper aims to provide augmented reality in mobile-learning environment as an alternative way to accommodate the major needs of interactive learning by using ***context-aware technologies*** (e.g. mobile devices, tablets). The following objectives of the AR in mobile-learning environment are listed below:

1. To support u-learning (ubiquitous-learning)
2. To encourage interactive learning by providing WOU AR Learning App
3. To provide Augmented Reality (AR) Campus Learning
4. To combine mobile-learning with AR which fosters use of the following types of information in support of learning:
    4.1. The mobility of the learners
    4.2. The physical place where learning can occur
    4.3. Formal learning connections to informal learning

3. Literature Review

AR aims to enhance the real world by overlaying computer-generated data to be projected in AR devices. Recently, the widespread use of AR-based mobile technology can be observed in leveraging handheld devices capabilities such as GPS and camera to create "immersive" learning experiences within the physical environment, providing educators with a novel and potentially transformative tool for teaching and learning environment (Azuma et al., 2001; Dede, 2009; Johnson et al., 2011). AR provides the capabilities to merge computer-synthesized objects with learner's space in learning environment (Andrei et al., 1996). The following Table 1 summarizes the comparisons of traditional e-Learning and AR campus learning environment.

Table 1 Comparisons of Related Research in e-Learning Environment

	Traditional e-Learning Environment	**Augmented Reality Campus Learning**
Descriptions, Features	Large number of users and web sites (already true for Web 1.0)	(i) Support ubiquitous learning (ii) Stimulate learning through pursuing outdoor learning activities (iii) Immersed in learner-centered environment through 3D projections
Learning Technology Devices	(i) Workstation (ii) Notebook	(i) Context-aware techologies (ii) Mobile devices (iii) Tablets
Learning Contexts	(i) No clearly visible real-world interactions (ii) Passive online-learning	Promote widespread use of (i) virtual objects (ii) real-world environment (iii) interactive learning in real-time
Data, Knowledge Source Exchange	(i) Support web-based learning applications (ii) Support interactive learning	(i) Support data regeneration (ii) Users create or update the AR content at specific locations known as ***Mashups*** (iii) Information from different sources can be combined and create a new value-added learning content in three dimensional space.

3.1 Benefits and Potential of Augmented Reality

The contents of a virtual world are rich and diverse with the support of collaborative manipulation of 2D and 3D AR objects. AR can provide rich contextual customized learning environment and contents for mobile learners. AR brings in new aspects to educators by augmenting learner's surrounding in a variety of media formats with the combinations of visual, audio and graphic overlays to enable learning takes place in virtual education. The benefits and potential of AR as a learning tool is its ability "to enable students to see the world around them in new alternative ways and engage with realistic issues in a context with which the students are already connected" (Klopfer & Sheldon, 2010). AR also affords educators the ability to leverage physical space in mobile-learning environment as an additional layer of content for learners to observe, manipulate and analyze using their mobile devices (Squire et al., 2007; Perry et al., 2008).

AR is well aligned with constructive learning notions, as learners can control their own learning and manipulate learning objects in augmented environment to derive and acquire understanding and knowledge. According to Wang (2012), there are proven benefits from interleaving theoretical and practical learning, and there is a growing need for innovative e-Learning concepts and the associated enabling technologies, which can support such integration. From the challenges stated above, AR can bridge this gap between the theoretical and practical, and focus on how the real and virtual can be combined together to fulfill different learning objectives and outcomes.

AR applications can also make textbooks "alive," which is thus defined as AR books (Wang, 2012). Martin-Gutierrez et al. (2010) and Marcus et al. (2011) explored on how AR book assists students visualize and perform spatial engineering tasks. The mobile AR allows educators to devise and design innovative learning scenarios in real world settings. The AR books approach provides immersive book experiences or illustration of 2D static media with dynamic 3D media in learning material. In addition, the research indicated above can be used to support learning by integrating information panels, labels and video lectures in AR mobile-learning environment.

3.2 Augmented Reality Architecture (M-pedagogy)

In mobile-learning environment, AR assists in acquiring relative content presentations which enable participants to interact with digital information embedded within the physical environment that runs interactively in real-time manner.

The AR metaphor of overlaying digitized information in spatial relationships to real-world objects support virtual interactions with learning objects displayed in fixed screen positions of AR devices. Figure 1 illustrates how spatially aligned AR overlays can concisely represent virtual learning objects and maintaining the ***spatial alignment*** between virtual annotation and real objects as learners move by incorporating ***dynamic tracking*** of the ***indicative viewpoint*** relative to the objects.

Since mobile-learning approaches have grown quickly nowadays to complement the conventional e-learning system, integration of AR technology and learning objects has been a tendency to improve the creation, organization and delivery of enhanced view of new dimension on campus learning. AR platform can be used as primary sources for knowledge creation, adjunct aids to navigation processing, organization of ideas, and story-board assistance in e-Learning environment.

The AR implemented into mobile-learning combines several areas of core functionalities mainly:

- Transition of flexible learning (Learning wherever and whenever one wants to)
- Maximization of transfer of learning (Self navigation of necessary learning objects or components)
- Course interactivity (Learning environment with direct access and communication with course provider and peers in real time)
- Creating and editing virtual learning objects
- Associating learning objects with real objects and locations

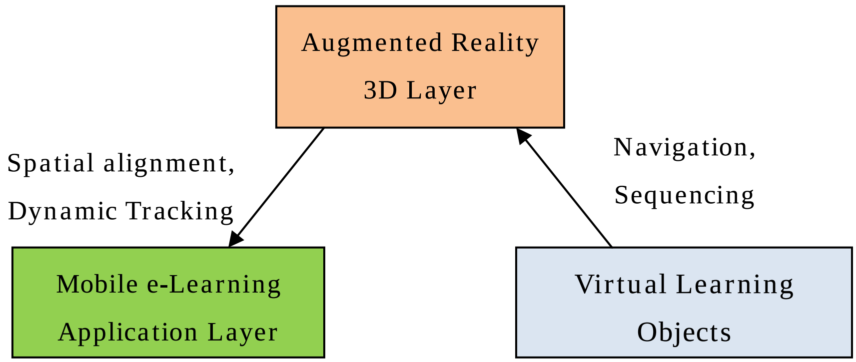


Figure 1: Augmented Reality Layer and learning objects in Mobile Architecture

4. Embedding Learning Objects in Mobile Augmented Reality Environment

The proposed architecture in Figure 2 below consist of AR and learning objects initialization that compromised the navigating system generating various types of learning objects projections using three-dimensional (3D) and two-dimensional (2D) interface layer.

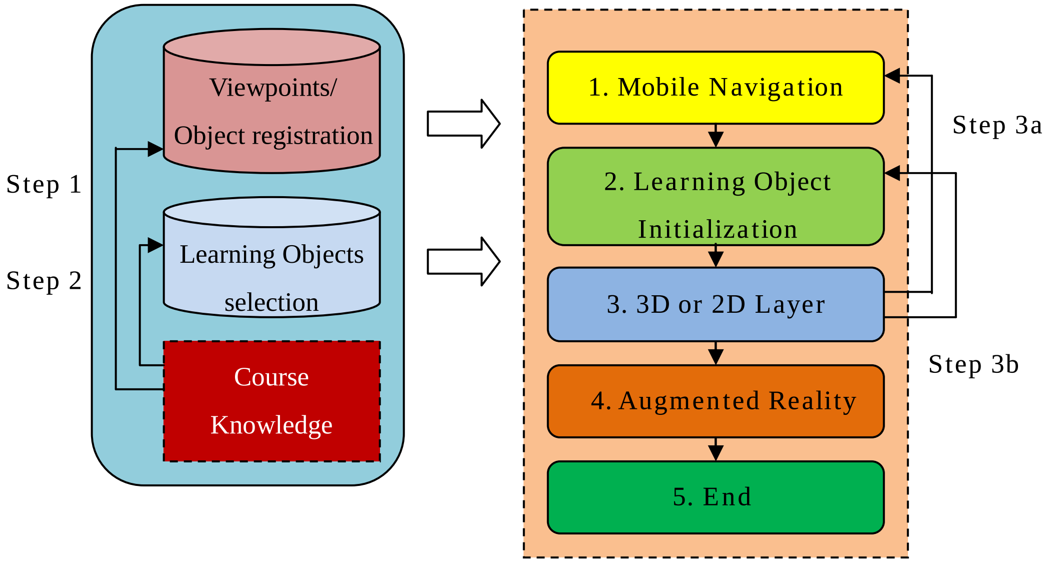


Figure 2: AR implementation via mobile-learning using learning objects

Figure 2 depicts the flowchart of the AR initialization in mobile application layer with the implementation of learning objects. The first two steps, ***step 1*** and ***step 2***, are locating and identifying the corresponding learning object(s) and position (viewpoints/object registration) of the augmented object through identification of relational schemas, concept schemas and related learning objects from Course Knowledge Databases. The AR system generates overlay information for 3D or 2D layer representations in ***step 3a*** and ***3b*** respectively. If there is no further learning objects correspond to the augmented object, the mobile navigation system goes to the "END" step. If there is any other learning object that is required for learning in the same learning spot, the system goes back to ***step 1*** "Viewpoints/Object Registration" via ***step 3a*** and, if there is any other learning object that is required for learning but locates in the other spots, the system goes to ***step 2*** "Learning Object Selection" using ***step 3b***.

5. Implementation

The following section describes the AR mobile implementation structure which consists of four point of interests (POIs) as shown in Figure 3 below. AR in ***Campus Building Facilities*** provides supplementary information at specific points on guided tours (e.g. Students can engage with interactive AR environment by accessing location-specific information on geological objects observed in the WOU campus building.) In the ***Laboratories Equipments***, the ***3D Workstations*** superimposed upon the actual laboratories equipments serves as guidelines and manual to show step-by-step instructions for students that need to be done and how to do them in laboratory sessions conducted. In ***AR books, Poster, Figures and Charts***, students who actively seek supplementary information can access contextualized diagrams, figures and charts using the AR interface and listen to voice lectures. The use of ***3D Drawings and Interactive Graphs*** in ***Mathematics Geometry*** allow students to enrich their understanding and effectively increase learning motivation and engagement. In this way, learners can take the initiative to explore learning and actively construct new knowledge in their learning paths (Azuma, 1997).

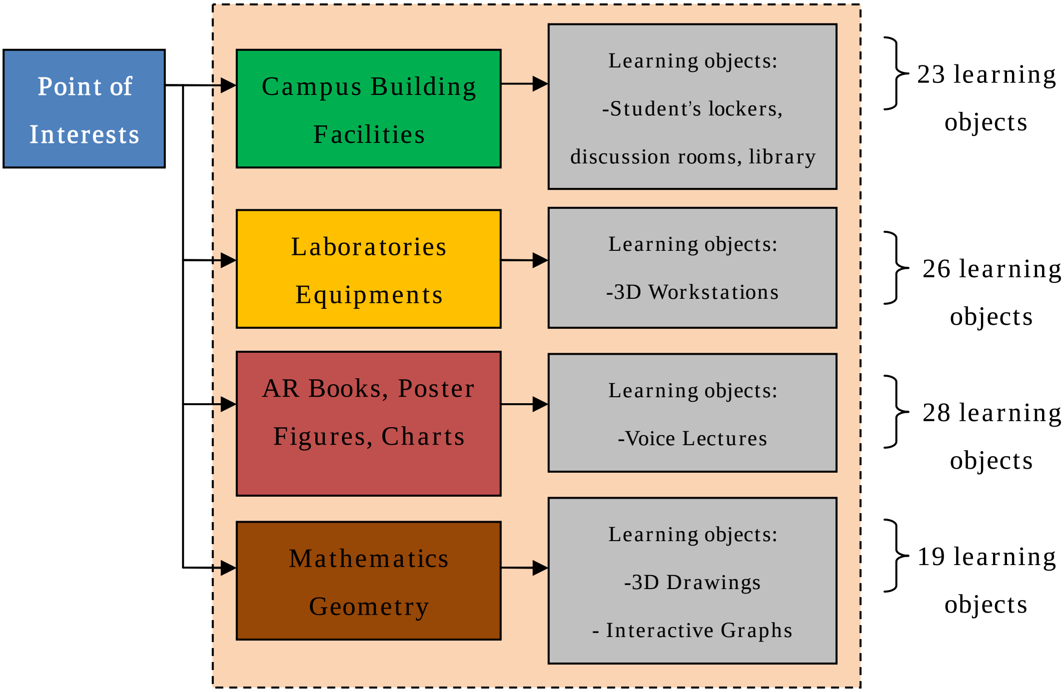
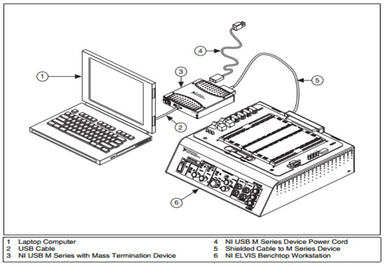
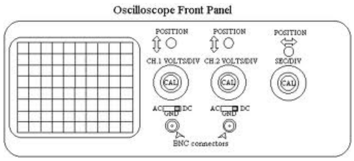
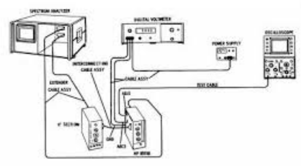


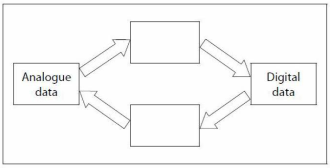
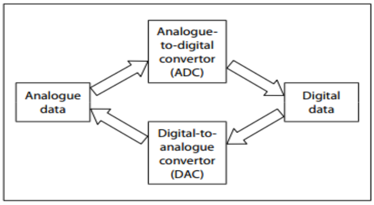
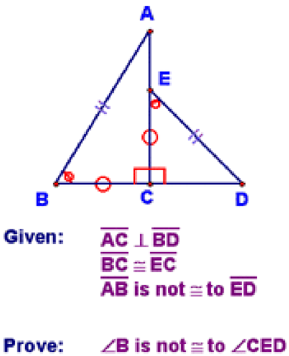
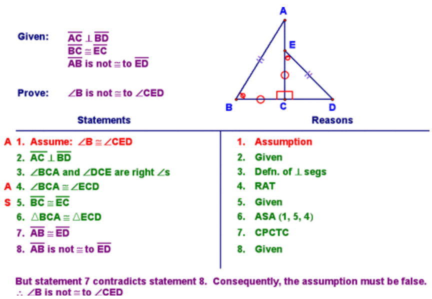
Figure 3: AR implementation with embedding learning objects

The following Table 2 presents the illustrations of the POIs in this approach. The POIs created for specific location or building can be revealed and instantly immerse on the screen of AR users, allowing a range of information panel (learning objects) to be quickly assessed and viewed on mobile and tablet devices.

Table 2: Implementation of AR Projections in Campus Learning Environment

Points of Interest	**Augmented Reality Objects**	**Projection Action**
WOU Main Building	 Augmented objects • Main entrance • Library location	Information panel 
University Library Main Entrance	 Augmented objects • Students' lockers • Discussion rooms • Library foyer	Information panel: • Projecting library's facilities such as students' lockers, discussion rooms and library foyer  

		
Laboratories Equipments	 Augmented objects: • Benchtop workstation	Information panel  Figure 2-2. Parts Locator Diagram for USB NI ELVIS Systems
	 Augmented objects: • Oscilloscope	Information panel 
	 Augmented objects: • Spectrum Analyzer	Information panel 

• AR Books • Posters • Figures • Charts	 Augmented objects: • Process Flow Diagram	 (i) Projection of interactive graphics labeling and voice lecture. (ii) Digital data is superimposed over AR figures/diagrams to provide the learner with ***just-in-time coaching*** during task-based assessment.
• Mathematics • Geometry Education	 Augmented objects: • Geometry triangle problem	 Projection of interactive graphics labeling and voice lecture

The development and rapid prototyping of AR learning objects was carried out in different undergraduate WOU courses enabling learners to use AR to triggers and call up supporting augmented materials to assist learners to interpret and contextualize the objects. The created AR learning objects aims to spark active engagement with remotely-taught ODL courses, whilst enhancing the learning experience by 'surrounding' the object with digitized learning content. The learning objects created in augmented reality environment are shown in Table 3 below:

Table 3: Learning objects constructed in Augmented Reality Environment

Augmented Reality Point of Interests (POI)	**Number of POI**	**AR Learning Objects generated**[1]
Building/Structures	12	23
Equipments/Objects	18	26
Posters/Figures/Charts	28	28
Mathematics/Geometry	18	19

6. Conclusion

This paper described how AR and Learning Objects may be implemented to enhance the learning experiences and interactive learning in the mobile-learning environment. The study explores the feasibility and practicality of using AR in augmenting different point of interests using mobile devices. AR technologies involves enhancing or augmenting the learner's perception of the real world and able to take any situation, location, environment, or experience to a whole new level of delivering meaningful and enhanced-view of learning objects and uniquely change the way users learn with mobile devices. AR in

[1] AR Learning Objects generated are associated to the Point of Interest. A single POI may contain two or three Learning Objects.

Example: University Library's POI contains three Learning Objects (Students' locker, discussion room & library foyer) mobile-learning is a new trend of e-Learning which will be essential to education organization by implementing suitable concept and learning objects architecture in wireless transmission. The approach using the combination of both AR and Learning Objects plays an important role in AR Campus Learning environment by providing an intelligent solution to facilitate participatory and learning processes such as active observation, peer coaching and reciprocal teaching. Advances to AR based mobile-learning provides the advantage of a natural human-computer interface, flexible mobility, and context-aware instruction which allows learners to develop psychomotor skills while interacting with their natural environment with augmented perceptual cues. It is hoped that AR approaches would facilitate more widespread use of learning objects in mobile-learning environment.

7. Future Work

The future work involves the deployment of competency assessments onto AR mobile-learning environment for more AR learning objects, capturing the assessment output including learners' feedbacks and synchronizing back into the student's AR based e-portfolio. This assessment was then reviewed by the course provider with feedback and mapped against competencies achieved in mobile AR environment. The AR mobile-learning initiative is also proposed to incorporate and filter according to learner's movement path and facing direction established using meta-information such as the learner's personal interests or profile. AR mobile-learning is capable to present delivery models that incorporate learning object path and transformative tool for teaching and learning in distance learning environment.

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Embedding MOOCs in academic programmes as a part of curriculum transformation: A pilot case study

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Abstract. The University of Wollongong's first locally developed and hosted Massive Open Online Course (MOOC) "The Reluctant Mathematician" was a highly scaffolded MOOC designed to support stressed and low-efficacy maths learners. It was developed to lift maths skills at our university and also in the community – where maths skills continue to be a challenge and in some cases a source of stress. Internally the MOOC provided an alternative online way to support students who struggle with mathematics at university level, and as a complement to the existing face to face services. This paper describes a successful approach to using MOOCs not only for addressing skills shortage among university students, but also to engage staff in the hybrid learning aspects of curriculum transformation. Based on a small-scale pilot, the paper describes the narrative of engagement of academics, and highlights the main elements which were conducive to their engagement in selecting and using the MOOC as a support for an assignment in their curriculum. A framework is proposed educators who are interested in using MOOCs for a similar purpose.

Keywords: MOOC, open-education, curriculum design, re-use, OER

Introduction

The 'maths skills crisis', which has been on the national education policy agenda for some time, has implications not only for students, but also for tertiary education staff. This skills crisis is characterized by a lowering of maths skills in students and the community, and the removal of maths pre-requisites for university entrance. This skills crisis is slowly impacting mathematics education through a vicious cycle (Professions Australia 2008), where fewer and fewer high-school students study advanced or intermediate mathematics, resulting in fewer students enrolling in university mathematics classes. This, in turn, leads to a reduction in the number of mathematics teaching staff in universities, and to lower numbers of enthusiastic, mathematics-qualified teachers in schools (Professions Australia 2008). In addition, universities are expected to face an increase in the number of students enrolling in university courses who are short on maths skills, and who struggle in the classroom across a wide range of disciplines including nursing, economics and finance, education and even engineering. The ultimate consequence of this vicious cycle is expected "shortage of skilled professionals in the fields requiring tertiary mathematics education, including engineering, science, finance and the actuarial profession, all of which are areas on which our society and economy depend for continued prosperity" (Professions Australia 2008).

There have been numerous staff and projects engaged in finding solutions to the 'maths skills crisis' over many years at the University of Wollongong, and the current strategic push for Curriculum Transformation provides additional motivation and mandate to do so within the framework of a review of entire course curricula.

One of the four themes of the Curriculum Transformation project is "Technology Enriched" and one of the related 5 Transformational Practices that will positively impact the student experience is "Hybrid learning@UOW". These approaches align with an extensive body of research on what best delivers engaging student experiences and relevant lasting impact (Huber and Hutchings 2004; Kuh 2008). The re-use of a MOOC as a self-paced resource and activity parallel to the classroom activities represents an early case of the "Hybrid learning" and "Technology enriched" approaches being undertaken and evaluated.

This approach draws on student-centered online instructional scaffolding, inspired by MOOCs video lesson and quiz approach. This approach does not focus on merely delivering content online, but rather scaffolds the skills that students need to acquire, and uses online tools to ensure this gradual acquisition. The result of this approach has demonstrated benefits not only to student performance, skills enhancement, self-efficacy, and anxiety issues, but also to the engagement of teaching staff across disciplines. Where the original module was developed to address the shortage in generic maths skills, staff members are now seeking similar educational programs to support discipline-specific maths applications as well as gaps in students chemistry skills.

The paper is organised as follows. First, a description of the original MOOC and its design are provided, to understand the general context of the engagement. Then, the reuse of the MOOC and the main elements conducive to the engagement of academics are summarized, based on interviews with academics. The MOOC elements which are conducive for resource re-use are summarized and discussed. Next, future directions for actions are proposed. The paper concludes by suggesting a framework for educators who are interested in using MOOCs for a similar purpose.

Original MOOC – "the reluctant mathematician"

Massive online open courses (or MOOCs) have displayed explosive growth over the last few years, with growth in the number of students, courses, platforms (such as EdX, Coursera, Udacity, FutureLearn, OpenLearning, etc.), and staff involved (Pappano, 2012). Being offered by prestige universities such as Stanford, MIT, or Berkeley, being accessible to anyone with an internet connection, and being more affordable than many other higher-education options makes them an attractive ways to learn about various topics (Delbanco, 2013). MOOCs have also been viewed by some as a threat to traditional Higher Education institutions and programs (Campbell, 2013; Delbanco, 2013; N. L., 2013).

However, disruptive technologies also have the potential to spur innovation within existing members of the sector (Conole, 2007). It may be possible for Universities to embrace the MOOC phenomenon to advance their own educational practices. The suggested benefits to universities resulting from offering MOOCs typically refer to an academic training ground for students (Campbell, 2013), a pipeline of paying students (Campbell, 2013), and / or a source of revenue resulting from online students paying for accreditation (Valentin, Nafukho, Valentin Jr, Johnson, & LeCount, 2014).

This paper, however, identifies and describes another benefit to the uptake of MOOCs by traditional universities. Following the principles of open learning, which supports reuse and repurpose of educational resources, this paper presents an example of benefits to internal students, as well as to staff engagement, as a result of re-purposing a MOOC designed for the general public. In the case described here, teaching staff became interested and inspired to reuse and re-purpose an existing MOOC originally designed to address shortage of maths skills and / or aversion to the learning and usage of maths identified in on-campus students in their own disciplines. Such expressions of interest from teaching staff in accounting, engineering, and natural sciences suggest wider potential for the re-use of MOOCs within other curricula.

MOOC design

Addressing the maths skill shortage identified in the local community, the University of Wollongong (UOW) developed and hosted a reusable Massive Open Online Course (MOOC) "The Reluctant Mathematician", which was run in the last 4 weeks of the summer holiday, prior to Autumn session in 2014.

Out of 11 maths topics included in a pre-existing pre-university summer program, 4 were selected by staff of the School of Mathematics and Applied Statistics as the ones most widely-applicable to university and community use. The four topics selected were fractions, basic algebra, factorisation, and indices. Each topic had the same learning sequence:

1. A theory refresher video lesson, including recapping terms;
2. A series of short video lessons with a mathematician solving maths problems at the whiteboard, starting with easy ones before moving on to more complex problems
3. Video-embedded quizzes – a hybrid resource/quiz where the learner needs to try their skills (described next).
4. A self-testing long assignment – a series of 50 maths problems. This task was substantial, and required 2-3 hours to complete. In the case of the novices it could take a whole day, including breaks for reviewing lessons, text-book and/or resources.
5. A final optional assignment task, asking the students to make their own video lesson, inspired by some recent advances in research in maths education (Hoban et al, 2009).

The learning sequence shows scaffolding in action, the first item is teacher demonstrates maths, the last item is student practices maths on their own, and there is a gradual reduction in support by the teacher of the course of the sequence such that the student gets used to doing aspects of the maths on their own until they can do it all on their own.

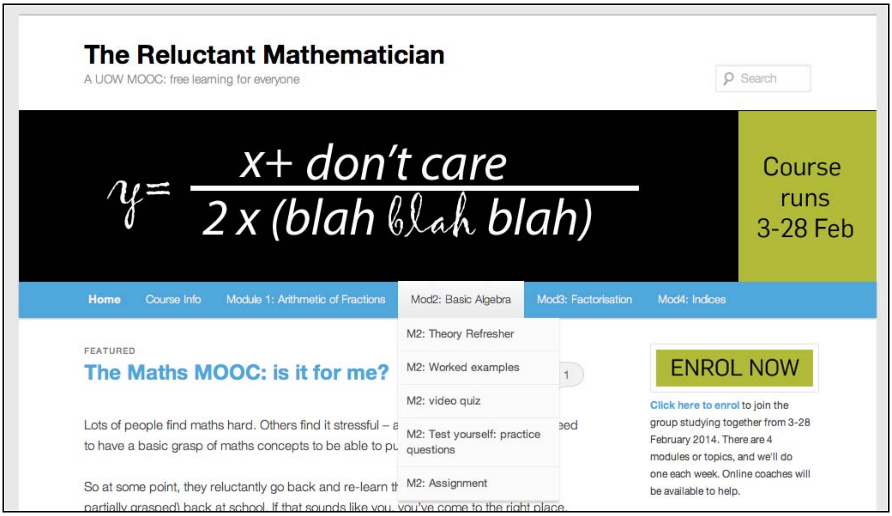

Fig. 1. Original MOOC homepage showing pull-down menu navigation to the items in the learning sequence

Video-embedded quiz

For effective outcomes, online learning experiences must engage the students (Greenagel, 2002). In order to engage students in activities based on their specific skills deficiencies, we developed a series of 3-4 video-embedded quizzes for each of the 4 maths topics. These quizzes allowed for a greater degree of scaffolding and formative feedback than a standard quiz, as follows: videos demonstrated the worked solutions to various maths problems however the demonstration would stop at 3-4 places in the solution sequence, and ask the student to answer a quiz regarding the particular step in that problem. After the submission of a quiz question, the student would receive feedback as to whether their answer was correct and then the video would continue and demonstrate the correct method of thinking and working out that step, before moving on to the next aspect of the solution item. Each video included around 3-4 quiz "stop points". This way, the student could test their understanding by completing a quiz question, before the video continued. The videos were rated highly by students in the online form used to collect feedback on students' satisfaction with the MOOC resources.

Reusing the MOOC

After successfully running the original MOOC, evident in students' responses and performance (Lambert, Forthcoming), UOW staff were contacted by a university wide email, titled: "Do your students need maths skills to succeed?", two weeks prior to start of session. All respondees were invited to a meeting to discuss the potential next steps in the evolution of the MOOC to meet stated shortfalls of skills within various classrooms of various different disciplines. Subsequent to interviewing staff, one program was selected within the Faculty of Engineering, with several subjects relying on the maths skills addressed by the MOOC. A single subject "*Workplace Health and Safety*", was selected for initial re-use within a new Masters' level subject. Based on multiple discussions with the academics involved, the following elements were highlighted as conducive for this re-use:

- The learning experience was scaffolded. Rather than a teacher-led experience, the MOOC provided a student-paced environment for individual learning and practice.
- The MOOC's content was modular, therefore allowing teaching staff to select only relevant modules. This was therefore not burdening students with irrelevant tasks.
- The content covered by students was flexible and self-determined. The modular structure of the MOOC enabled students to only engage in learning pathways relevant to them.
- The content was delivered outside of class time, and therefore did not compromise existing subject structure.
- The MOOC applied to a wide range of skill level. Thus, academic did not need to match students to resources, but rather, the MOOC enabled students to improve the skill at the level relevant to them.
- The MOOC addressed learning-related stress and anxiety by providing a private self-paced experience. Students' practice and learning are conducted privately, with no risks of being judged, shamed, or mocked.
- The MOOC's delivery was customizable: a subject-related banner and introduction video addressing the specific subject-related cohort was offered to subject coordinators (Fig. 2).

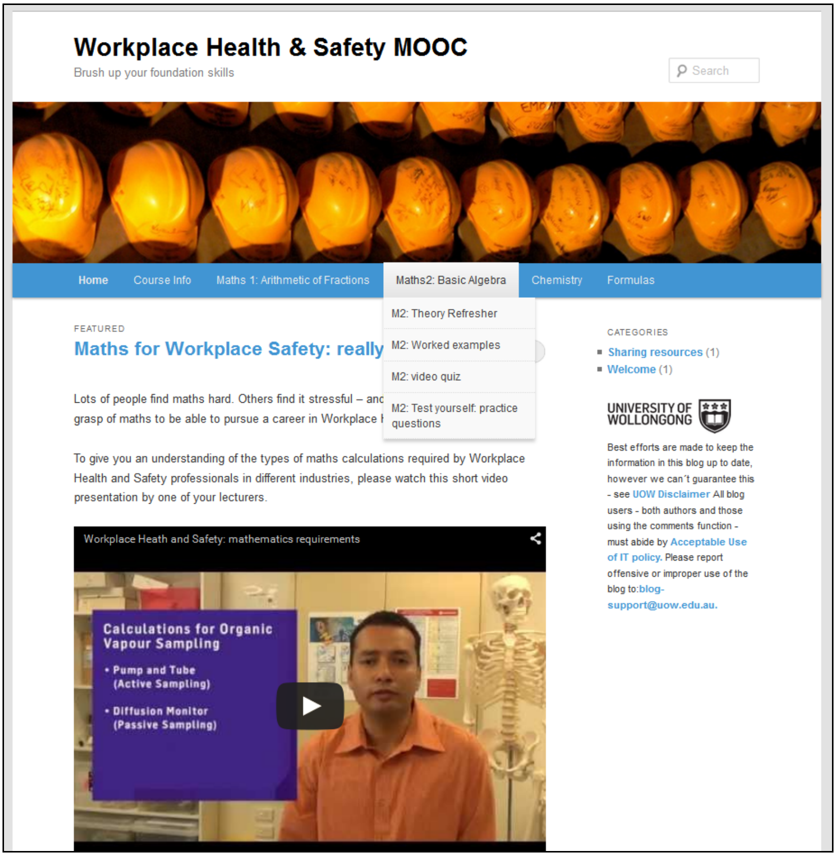

Fig. 2. Re-used MOOC homepage showing pull-down menu navigation to the items in the learning sequence, and a customized welcome video featuring the subject coordinator

In addition to the uptake in the *Workplace Health and Safety* Masters level program, there were expressions of interest in customizing this MOOC for chemistry students.

Proposed framework to guide MOOC re-use

We have summarized the themes that emerged with interviews with the academics involved in this project to develop a proposed framework to guide MOOC re-use in the curriculum, by focusing on key success elements of this reuse are applicable both to teaching staff and to students, as follows:

Teaching staff:

Addressing a pressing need – the need to improve students' maths skills was identified in a consultation process with academics closely involved in existing attempts to address this need. The School of Mathematics and Applied Statistics has been addressing this need in many other ways over the years, and their familiarity with the needs was essential to the selection of the content.

Low time demands – as most of the content was already prepared and relevant to the teaching staff's needs, teaching staff members were not required to devote a lot of time to the customization or implementation of the component. Minimal customization (banner and welcome video) was sufficient for the initial launch of the components, and future customization of questions forms, to integrate subject-related content (for example, calculating the levels of permitted gas levels as part of the fractions module) was possible and staff from the Learning, Teaching and Curriculum area were able to advise on digital resource development methods that was suitable for staff in the Faculty to do on their own. While that involved the purchase of a licence for the software Camtasia and a graphics tablet (to allow handwritten inputs) the costs were under AU$500 and the time required to create their own workplace safety based maths calculation video samples was rated as achievable by the staff, to be done a few at a time over time.

Students:

User control – the teaching staff were impressed by the degree of control and self-direction available to students. It was evident that the MOOC provides students with the option of selecting their own content areas, and skill levels to be taught and demonstrated. Indeed, web usage data shows that these features were taken advantage of by most students (Lambert, Forthcoming). Many students first attempted the concluding assignment, before undertaking the full learning sequence, and then selected the content relevant to them.

Scaffolded learning experience – the teaching staff believed that a scaffolded approach would be effective at addressing students' skills deficiencies.

Safe and tailored learning environment – the teaching staff believed that providing students with a private, as well as responsive, learning experience would address students' specific skills deficiencies in a discrete, non-intimidating and stress-reduced environment.

Future research

Examining the effectiveness of the reused modules is the next step. We intend to undertake a pre-post study, evaluating the effect and benefits of these modules on the following:

- Attitudes and perceptions (Anxiety and confidence, Expectations of future usage, and Expectations and prospects of future learning), and
- Performance in maths (quiz marks);

Controlling for the following factors:

- Online usage
- Perceptions of usefulness

In addition, the university will be engaging more academics with this and other MOOCs, as a result of its current success. This engagement will provide further confirmation and refinement for the proposed framework for re-use, as well as establishing the value of MOOCs as aspects of the Hybrid-learning and/or Technology Enhanced Learning approach to Curriculum Transformation.

Furthermore, there is interest in developing a similar MOOC for essay writing skills, as this is another pressing need identified across many teaching disciplines in the university.

Conclusion

The quality and performance of MOOCs worldwide has set a high standard for modern distance education in general and online education in particular. The case study presented here shows how meeting these standards by academic institutions when they address the wider community can produce re-usable resources for the benefit of enrolled students. The case described staff engagement with MOOcs for the purposes of solving particular local problems (maths skills) during a university-wide curriculum transformation process. Re-using MOOC elements within an existing subject served as a useful and informative pilot for the curriculum transformation process, with regard to two major aspects: hybrid learning and technology enriched learning.

In addition, the paper suggested a design framework which is conducive to re-use, and highlights both teaching staff related as well as student related aspects in the design. Teaching staff related aspects involve addressing a pressing and need across a wide range of students, modular content, and customizable delivery presentation. Student related aspects involve student control over content and pace, a scaffolded learning experience, and a learning experience which is at the same time both tailored to individual needs as well as safe, thus reducing anxiety and stress. Further examination of this framework, measuring pre- and post- MOOC usage levels of student performance, anxiety, and stress will inform the framework's generalizability.

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Factors affecting the media literacy of young students

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Abstract: The objective of this paper is to find out the current situation and differences of media literacy and explore the factors that affect the core competence of media literacy among Chinese youth students. The sample of the study included 534 young people aged between 12 to 18. Principal components analysis revealed a five-factor structure that corresponded closely with the underlying conceptual model. This scale may be valuable for the measurement of factors affecting media literacy. Based on these findings, the researchers made a number of recommendations.

Keywords: Media literacy, young students, factors

INTRODUCTION

Media surrounds us and is present in everything. This phenomenon has made learning easier and more interesting for youth students. Television, telephones, computers and the Internet are gradually entering classrooms and changing the way that students learn. In particular, computers and the Internet are quickly becoming our dominant cultural tools for searching, selecting, gathering, storing, and conveying knowledge in representational forms (Covington, 2004; Jenkins, 2006; Kuiper, Volman, & Terwel, 2009). There are both advantages and disadvantages to increasing one's knowledge of the different aspects of media. As we adopt the good components of this knowledge, we should also try to avoid the bad. The negative messages disseminating through various media technologies can be avoided by developing the skills to question, evaluate and analyze these messages. Therefore, it is vital for students to develop media literacy so that they can make the best use of the new technology and so that they are able to interpret and process all kinds of media messages (American Library Association, 1989; Enochsson, 2005; Thoman, 2003).

Contemporary youth are a particularly interesting group to consider with regard to media literacy today. On the one hand, those who have literally grown up in an environment saturated with media technologies may be highly skilled in their use of technologies to access, consume, and generate information. This view suggests that in light of their special relationship to media tools, youth are especially well positioned to navigate the complex media environment successfully. On the other hand, youth can be viewed as inhibited, in terms of their cognitive and emotional development, life experiences, and familiarity with the media apparatus. This perspective suggests that although youth are talented and comfortable users of technology, they may lack crucial tools and abilities that enable them to seek and consume information effectively.

Within this context, the purpose of this study is to describe the current situation and differences of media literacy and explore the factors that affect the core competence of media literacy among Chinese youth students.

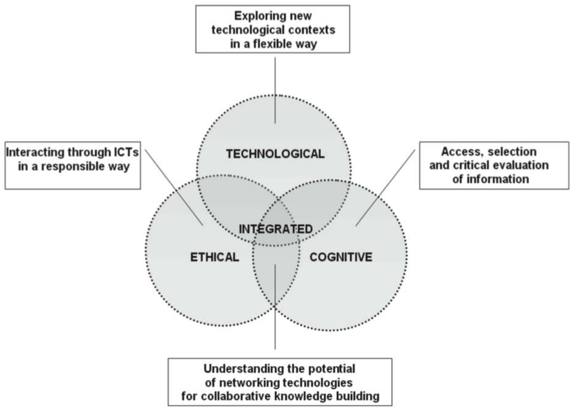
RESEARCH METHODOLOGY

A conceptual framework for media literacy

With the aim of exploring media literacy, we try to expose dimensions of the way people use media based on a detailed review of literature as above. We have tried to map these different factors and dimensions using the conceptual model in figure 1.

This definition emphasizes the co-existence of three dimensions and their integration. Technological dimension: being able to explore and face problems and new technological contexts in a flexible way; Cognitive dimension: being able to read, select, interpret and evaluate data and information taking into account their pertinence and reliability; Ethical dimension: being able to interact with other individuals constructively and with a sense of responsibility towards oneself and towards others. Integration between the three dimensions: understanding the potential offered by technologies that enable individuals to share information and collaboratively build new knowledge.

Figure 1. Media literacy framework.



Data collection

The target population for this study was middle and high school students (12-18 year-old) in the capital of China. A purposive sample of students should study in digital campus demonstration school. Future testing could be expanded to other city, ages or a more generally diverse population.

The survey consist of closed questions, multiple choice, 5-point Likert scale and open questions, which contained five parts: the demographic part (question 1 - 5), media environment (question 6 – 15), the use of media (question 16 – 32), the attitude of the media (question 33–37), media ethics of young students (question 38) and whether they have the core competencies of media literacy(question 39 – 43).

Data analysis and discussion

Background characteristics of students

Among the responded questionnaires, a number of students were incomplete, and some of them were unavailable. After excluding these data, there were 534 students participating in the study. The analysis showed that the majority of the samples were male (53%) aged between 15 and 18 (53.4%) who were studying in urban (60.5%). Most students (nearly 90%) are satisfied with their media-rich environment in home and school. Table 1 presents the core of descriptive statistics of variables.

Table 1. *The core of descriptive statistics of variables.*

	Variable	**Frequency (Percent)**		Variable	**Frequency (Percent)**
School districts	Haidian	23(4.3)	**Home hardware conditions**	Better	295(40)
	Xicheng	300(56.2)		General	295(55.2)
	Shunyi	211(39.5)		Poor	25(4.7)
Gender	Male	283(53)	**School hardware conditions**	Better	79(14.8)
	Female	251(47)		General	368(68.8)
				Poor	87(16.2)
Grade	Middle	249(46.6)	**Media usage abundance**	High	70(13.2)
	High	285(53.4)		Middle	229(42.8)
Ranking	Lead	183(34.3)		Low	235(44)
	Middle	248(46.4)	**Media usage frequency**	Often	189(35.4)
	Behind	103(19.3)		Sometimes	252(47.2)
				Seldom	93(17.4)

Factor analysis

In this research, factor analysis was primarily applied before other statistical analyses. It is used in this research to reduce the data into a smaller number of variables.

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity (BTS) are applied to the data prior to factor extraction to ensure the characteristics of the data set are suitable for exploratory factor analysis (Field, 2009). In this instrument, KMO was 0.920, above the minimum value of .5 (Kaiser, 1974), and Bartlett's Test (p = 0.000) in Table 1 demonstrate that the correlation between the items is strong enough to conduct a factor analysis. With principal component analysis in extraction and varimax in rotation chosen, the final result comes out as expected above. As designed, the three components should involved (Technological dimension, Cognitive dimension, Ethical dimension) in Table 2, which guarantees the content validity of the questionnaire and is a good complement to the existing framework.

Table 2. *KMO and Bartlett's test.*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.920
Bartlett's Test of Sphericity	Approx. Chi-Square	6327.016
	Df	276
	Sig.	.000

Media literacy education

As shown in table 3, popularity of media literacy education is not high (from 44.2% to 65.5%), some activities about media literacy already exist, but that there are still significant expansion needs. In this situation, where there is not always public attention for media literacy education, it is important to preserve and if possible to improve media literacy education activities and research and to also raise awareness for media questions which are of central importance for education.

Table 3. *The external environment.*

	Variable	**Percent**
The teacher will let us use computer to solve the practical problems	Disagree	40.3%
	Agree	59.7%
The teacher taught us how to quickly browse complex information, how to focus on key methods	Disagree	23.2%
	Agree	54.5%
The teacher gave us over the task requires us to use different digital resources to create new works	Disagree	41.4%
	Agree	44.2%
The teacher told us what website, forum can get the information we need to learn	Disagree	19.1%
	Agree	61.8%
The teacher has taught us about how others think through the role play or virtual games	Disagree	16.1%
	Agree	65.5%
The teacher told us how to analysis and evaluation of the information in the network	Disagree	19.3%
	Agree	51.9%
The teacher recommended or taught us some software to help us summary of the law, refining the model	Disagree	16.5%
	Agree	59.6%
The teacher assigned us the use of Wiki cooperation to complete the composition or project tasks in the network	Disagree	16.2%
	Agree	52.6%
The teacher taught the skills of communication and negotiation method we discussed on the Internet	Disagree	21.7%
	Agree	56.4%

In china, media literacy does not exist as separate subject, but is integrated in the syllabuses for other subjects. Youth are in favor of having media literacy included and promoted as part of the formal education process, and this is an area that requires major efforts for the formal education to be able to respond to fast-emerging societal changes.

Regression analysis

Table 4 shows that, gender, area, diversification of media use, frequency of media use and media education has obviously positive correlation with media literacy. Boys are good at technical operations while the girls of the moral sense are stronger. Not surprisingly, higher-grade students are more media literate than lower grade students on cognition dimension. Leading students' achievement in the cognitive and moral aspects is outstanding. On the contrary, home hardware conditions, school hardware conditions, which will not impact on media literacy.

More diversified results emerge in the ethical dimension. For example, on one hand, students disapprove cyber bullying; on the other hand, they do not have clear ideas about respect of privacy and personal safety. The most difficult question proved to be the one about the digital divide, which shows the scant awareness of the access problems and technical difficulties that developing countries could have in Internet communication. About half of the students state that the quality of communication depends only on the quantity of pictures, audio and video, and do not agree with the opinion that an excessive quantity of multimedia can give rise to some problems.

Table 4. *Regression result.*

Variable	**Cognitive**	**Technological**	**Ethical**	**Media literacy**
Ascription of human capital				
Gender_Female	-.031	-.239***	.463***	.166***
Home hardware conditions	.075	.087	-.129	.055
Grade_Middle School	-.162***	-.022	.046	-.015
Induced by human capital				
Area_Haidian	.557***	.069	.124	**.281*****
Area_Xicheng	.176***	-.121	-.151	-.016
Score_Lead	.210***	.031	.525***	.027
Score_Middle	-.056	.096	.363***	.033
School hardware conditions	.069	.111	.039	.074
Independent variables				
Media usage abundance	.437***	.650***	.312	.398***
Media usage frequency	.048	.144***	.069	.058***
Media education	.345***	.568***	.171***	.363***

CONCLUSION AND DISCUSSIONS

Firstly, the study found that students from various schools in the cognitive of media literacy are significantly different, which indicates the existence of various schools of the unbalanced development in literacy and media literacy-related applications. Therefore, in order to achieve balanced regional development objectives of education between schools and between regions should strengthen media literacy-related teaching resources sharing and experience sharing.

Secondly, age and gender are important factors affecting the level of media literacy of young students. The student's age and their cognitive performance is inversely proportional to the level of the younger students on the cognitive level, the better the performance. Besides, schools should strengthen the training of the technical aspects of the girls and the moral sensitive aspects of the boys.

Thirdly, the higher the frequency of the use of computers and networks of the students, the better the performance of the technical level. The use of computers and networks, frequently and plump, have a positive impact on students' cognitive abilities. If the school encourages students to increase the use of computers and networks, in and outside the school, in and outside the classroom, increase vitality ratio, strengthen the strength of information technology and subject integration, encourage computer assisted learning, which will improve the students in the cognitive level of performance to a great extent.

As regards the socio-ethical dimension, the results seem to be conflicting in some degree. In fact, though young students judge cyber bullying as objectionable, they are little aware that online behavior needs to be adequate for their own safety and respectful of privacy and they are completely ignorant about the problems connected to technological inequality and the digital divide. These aspects bring up once again the classical psychological theory of child and adolescent egocentrism (from Piaget, 1964, onwards), that is, the difficulty to understand that others could have different points of view. As it were, the Internet amplifies youth egocentrism in so far as young people seem to overlook the digital needs of the other people (James et al, 2009).

Future research and subsequent development of reliable and accurate media literacy measures will need to include construction of similar literacy questions that are applicable to newer media forms. The three areas of assessment for this measure may provide a valuable framework for these future efforts.

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A study of instruction in college physics experiments in the context of big data

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Abstract. The research of educational big data in the field of education is the positive response to the era of big data. Mining big data, which is produced by students who learn in the way like mobile learning (m-learning) and ubiquitous learning (u-learning), can promote instruction effectively. So, in the physics experiment learning process, the big data about experiment process and data should be recorded, mined and used. To study college physics experiment instruction in context of educational big data, this paper analyses the present research results about m-learning, u-learning and educational big data, and combines the characteristics of physics experiment teaching and learning. This paper includes five parts: (1) educational big data can promote personalized adaptive learning, which means that educational data mining and learning analytics can be used to help students find the best learning methods and resources for physics experiment when it is needed; (2) digitalizing college physics experiment course, which is the foundation for us to record resource usage and the experiment operation process; (3) physics experiment teaching reform, teachers are required to provide rich e-learning resources and an useful communication platform , which can be used to record the data which is produced by students in the physics experiment learning process. Teachers should through analyze the big data to adjust teaching methods and use different teaching strategies for different students; (4) physics experiment learning reform, students are required to adopt blended learning method which combines informal after-class learning and formal classroom experiment learning, and students can use the prediction function of big data to change learning method for different experiment; (5) physics experiment evaluation method reform, by analyzing the whole physics experiment learning process, students' actually level can be reflected more objectively.

Keywords: big data; college physics experiment; teaching; learning

1 Introduction

If the launching of the China education and research network as the beginning of Chinese informatization construction in colleges and universities (Zhu, 2009), the road of informatization of colleges and universities in China has gone through 21 years. And with the deepening of educational informatization, type and amount of data generated in education has far exceeded the expectations at the start of the educational informatization, our education has entered the era of big data. How to mine and use these accumulated data is an important issue we should face. General office of the ministry of education of China in February 2015 issued "Educational Informatization Priorities for 2015" , which points out that promote the application of big data in monitoring, evaluating, forecasting , early warning, providing the basis for scientific decision-making, macro management. Research and formulate measures about education data management and use, standardize the planning, acquisition, sharing and using of education data (China Department of Education, 2015). Educational big data has become an important part for educational informatization, educational big data will penetrate into all aspects of education, especially in the level of management and decision aiding. The significance of educational big data is not just for educational management and decision aiding, but more importantly, for promoting teaching and learning. The ministry of education of American in October 2012 issued "Enhancing teaching and learning through educational data mining and learning analytics: An issue brief", which points out that through educational data mining, learning analytics and visual data analysis to improve personalized adaptive learning system, realize personalized learning (U.S Department of Education, 2012).

College physics experiment, as a basic course of undergraduate students in science and engineering, is the important link in learning experiment knowledge, cultivating operation skills and improving the overall quality, the beginning of the experimental skills training and the basis of the follow-up of the experimental course (Liu, Xing, & Su, 2014; Gong, 2012). The curriculum organization of the college physics experiment has an obvious characteristic is subject-centered. At the same time, the teaching of college physics experiment still follows the traditional teaching mode, “theory study + experiment + experiment report”. The modern education theory is more advocated taking the students as the center of the curriculum to highlight the students' subjectivity and meet the students' personalized learning, which requires us change our traditional course organization and teaching mode. The educational big data has the irreplaceable superiority in the realization of personalized learning in accordance with request of modern education idea. So, the educational big data will become the important technical foundation for our modern education idea. The college physics experiment should make reform which should accord with the modern education idea and the times should start from the construction of college physics experiment educational big data.

2 The Digital Construction of College Physics Experiment Course

The digital construction of college physics experiment course should meet students' personalized adaptive learning, and provide the data for data mining and learning analysis. It should be carried out in several aspects, including the students’ basic information digitization, learning content and process digitization and experiment report digitization. Through the digital construction of the college physics experiment, the multi - data of each student can be obtained, which can be used to establish mathematical model about experiment learning; on the other hand by comparing the established mathematical model and each student’s data, student’s learning progress can be predicted and evaluated.

2.1 The Digitization of Students’ Basic Information

Students’ basic information can be used to analyze students’ characteristics, which include both intelligence and non-intelligence factors. The intelligence factor refers to the general characteristics of individual cognitive development such as knowledge level, cognitive characteristic, cognitive structure, etc. The non-intelligence factor refers to interest, motivation, emotion, attitude, anxiety, will, personality and the cultural and religious background (He, & Li, 2009). Through students’ registration on the e-learning platform, questionnaire and former test, the basic information can be obtained. The information acquisition is a prerequisite for the digital, the key of digital is to use the basic principles of the pedagogy and psychology as well as data mining tools to set up a basic model about each student. Students can use the model to get help in choosing physical experiments, predicting the knowledge and psychological difficulties.

2.2 The Digitization of Experiment Learning Content and Process

The digital construction of the students’ basic information can help us to get students’ basic situation before the experiment, but it does not fully predict what will happen in the specific learning process. Experiment learning process is generative, and students’ intelligence and non-intelligence factors are constantly changing. So, in the specific experiment learning process, the students' learning mathematical model continuously should be adjusted, according to the data generated in the learning process. To acquire these data, students' experimental learning content and process must be digitized.

The digitization of experiment content requires teacher to provide rich learning resources in e-learning platform, such as micro lecture, virtual experiment etc. These resources using in different experiment learning stages will broaden the students’ choices. At the same time, the details of the student’s learning resources, such as the length of study time, the number of mouse clicks, the content of the comments and the type of error, will be recorded by e-learning platform, while the data will be incorporated into students’ individual database. The digitization of the experiment learning process will not only record the process, but also relate to the digital construction of the experiment instruments. The digitization of experimental instrument shows digitized experimental results which are measured with the sensors to remake experiment instrument and record the process of students' operation. It has an important significance for the students to analyze their own experimental process to find the advantages and disadvantages of the process of their own experiments. At the same time, recording the complete experiment operating process is also important for teacher to analysis students comprehensively.

2.3 The Digitization of Experiment Study Report

Experiment report is an important part for college physics experiment teaching. Improving students' experiment report quality, and establishing a scientific scoring mechanism, will effectively promote the reform of physics experiment teaching in colleges and universities (Guan, 2011). Traditional experiment report have some disadvantages, such as the update speed of content and form is slow, the same experiment report requirements for different professional background students, students' experiment report plagiarism and teacher has difficult in scoring for the similar reports. The digitation of experiment report has the following advantages: (1) Teacher can push different experiment reports to different students according to the subject characteristics and ability of each student, so that the experiment report can achieve Personalization. (2) Digital experiment report can help to record the operation process and data, which can reflect the real process of the students' experiment. (3) The digital experiment report can be easily corrected by teacher, while some questions in the digital experiment report with fixed answers can be corrected directly by the system. (4) The digital experiment report can be saved and analyzed conveniently to evaluate the students objectively and establish mathematical model on the physics experiments.

3 The Reform of College Physics Experiment Teaching Based on Educational Big Data

The goal of using educational big data in college physics experiment is to digitize college physics experiment teaching, while the more important significance is to deepen the reform of the college physics experiment. Introducing big data into college physics experiment is a challenge, which requires teachers to carry out reform in the context of big data should be carried out mainly in teaching content, teaching method, teaching mode and so on.

3.1 Teaching Content

College physics experiment is usually carried out around a specific experiment. The teaching contents are mainly based on the physical experiment textbook and guidance of experiment operation. In the era of educational big data, the teaching content should be changed to adapt to students' personalization and content digitization. Firstly, provide rich digital teaching resources. Learning type can be divided into three categories, visual learner, auditory learner and tactile learner. Provide rich learning resources can satisfy different type of students who can choose suitable teaching resources according to their own needs. So, we should provide video, audio and virtual experiment on the e-learning platform, these resources can be used for students' preview and review. Secondly, provide teaching content about digital experiment instrument operation. Many traditional physical experiment instruments are not digitalized. Even through some instruments are digitalized, the degree of digital is unable to meet the requirements of big data. When the experiment instrument is digitized, the experiment operation steps may be changed. Therefore, the content of the experiment operation must not be used to follow the teaching content before, but to be redesigned with the new experiment methods and instruments. Diverse and digital teaching content have important significance in breaking discipline-center and establishing student-center.

3.2 Teaching Method

College physics experiment teaching is generally divided into two stages, theory teaching and experiment operation guidance. In theory teaching process, macro-teaching is often taken, which can improve the efficiency of knowledge propagation in physics, but can't meet the personalized requirements. In experiment operation guidance process, demonstration method and finite individual counseling method are mainly adopted. These teaching methods can help students complete the experiment operation, but it is hard for students to understand and construct the experiment knowledge. At the same time, experiment theory teaching sometimes is separated from the experiment operation, so when students do experiment, they may not remember the physics theory of the experiment.

College physics experiment teaching based on the educational big data can change these imperfect teaching methods. Firstly, teacher can arrange the experiment project according to the big data analysis, which is based on student basic information. When the teacher can push experiment teaching contents according to the characteristics of experiments and students, students can accept, completely or partially, the teaching content, which is based on the methods pushed. Secondly, experiment e-learning platform can provides rich digital teaching resources, students can learn experiment theory by using out-of-class time, while the theory learning can be repeated not limit by time and space. At the same time, if students encounter some problems during the learning process, they can directly retrieve and ask questions, these questions and answers will be recorded in the database, to facilitate other students to retrieve. Finally, through educational big data analysis, students can be divided into different groups to carry out experiment operation. In a specific experiment, students in the same group may have similar level of the knowledge, ability and problems. So teacher can more-targeted in guiding students' experiment operation and facilitating students to construct their experiment understanding.

3.3 Explore New Teaching Mode

In the era of educational big data, some fundamental changes will happen in teaching content and method. To fully exert the advantages of these changes, teacher should explore new teaching mode for each specific physics experiment. And these new teaching modes should give full play to the function of data mining and learning analytics, and do as follows. Firstly, through data mining, student's basic situation can be understood, and personalized experiment project can be pushed to students. Secondly, through learning analytics, student's learning progress and behavior can be understood, learning difficulties can be found, targeted learning intervention can be carried out. Thirdly, student can use the rich teaching resources on the e-learning platform to learn experiment theory and to understand the steps of experiment operation by themselves. Teachers organize classroom teaching according to the situation which is reflected by the e-learning platform. Finally, use educational big data to record student's learning process, make a formative evaluation for students, and help students to improve their experiment learning method. Each kind of teaching mode should be based on specific teaching background and education value pursuit. So, the effective implementation of the teaching mode is bound to be restricted by many factors, such as teaching situation and teaching target (Zhang, 2015).

4 The Reform of College Physics Experiment Study Based on Educational Big Data

In the process of college physics experiment reform, the focus is to establish a student-centered teaching mode. So, the college physics experiment reform should meet the students' personalized experiment learning need, should introduce information technology into the experiment learning process, and help students to construct the cognition of college physics experiment. The rapid development of information technology makes m-learning and u-learning become possible and makes informal learning enter our real life. College physics experiment reform should draw on these kinds of learning method.

4.1 Personalization of Physical Experiment

Personalized learning emphasizes that learning process should conform to students' personality and development potential and take appropriate means, method, content, starting point, process and evaluation methods to promote students development fully, free and harmonious (Li, & Jiang, 2005).Combining with pedagogy and psychology, educational big data can help build mathematic models about students learning situation, which can be used to analyze students' personality and development potential. At the same time, these mathematic models changing with the data will become richer. The mathematic models are the basic for personalized learning. Students also can make choices based on the mathematic models.

Personalization includes experiment projects and contents. Ordering experiment projects mainly refer to system can push appropriate experimental project to students, and students can modify the project. In this way, the instructional objectives and students' real need can be considered. Ordering experiment content mainly refers to that by using big data to analyze the experiment project, progress and cognitive characteristics. Then the experiment learning content for students can be provided based on the analysis result. When necessary, teachers can also organize students to carry on the face-to-face tutoring. Of course, Order personalized experiment content also includes predicting student achievement and potential learning difficulties.

4.2 Blending Learning of Physical Experiments

Singh & Reed proposed that blending learning is "in the 'appropriate' time, using 'appropriate' learning technology that fit 'appropriate' learning style, transferring 'appropriate' ability to 'appropriate' learners to obtain optimal learning effect " (Huang, Ma, Zheng, & Zhang, 2009). The traditional physical experiment learning is mainly based on physical experiment textbooks and classroom teaching. Learning in this way, the efficiency is relatively low, can’t meet all of the students’ needs. Blending learning of physical experiment involves many aspects. (1)Blend textbook learning and multimedia learning resource. (2) Blend formal classroom learning and informal u-learning. (3) Blend offline communication and online communication. The blend is not random and chaotic, and it should meet the five "appropriate".

The physical experiment textbook is still the main learning resources, which has complete knowledge and logic system and can help student construct the discipline. Multimedia resources have rich expression forms, which is good for students to understand the specific knowledge. The part of physics experiment theory can be finished by u-learning anytime and anywhere. In the experiment learning process includes people interact with instrument and interpersonal interaction. The online communication is the extension of real communication, which can broaden our communication time and space and can help students get help when necessary. U-learning and online communications generate a lot of data. Through mine and analyze the data can guide the next round of experiment learning, and even can arrange the time for textbook learning, classroom learning and offline communication.

5 College Physics Experiment Evaluation Method Based on Educational Big Data

Instruction evaluation is an important link in college physics experiment instruction. Summative evaluation can be used to examine students’ actual ability. Diagnostic evaluation and formative evaluation can be used to find the problems in the learning process and provide feedback to students in time. But in the actual experiment instruction, the instruction evaluation about physics experiment includes experiment preview, observing students’ experiment operation process and experiment exercise. This evaluation process is coarse-grained and the effect is very limited. Because of the educational big data can record the complete experimental learning process, we can know much more details about students. Then we can evaluate students more comprehensive.

5.1 Individualized Evaluation

Students have different knowledge background, different experiment requirements and different problems. All these factors require us to take different evaluation methods for different students. College physics experiment course is composed of many specific physical experiments. So, the same evaluation criteria can’t be used in all students' physical experiment evaluation. . Evaluation of students based on the background and the learning resources is not only to distinguish students' difference in knowledge and ability in a specific experiment, but to help them find problems and make improvement.

The background of educational big data makes it possible for us to carry out individualized evaluation. E-learning platform can be used to record each student's multiple information that includes student's background information, experiment requirements, experiment operation process and experiment learning progress. These information constitutes the educational big data that can be used as the basis for us to push different evaluation data to different student. Students can get feedback in time. The feedback is not simply a simple feedback about wrong or right, which also includes the next learning plan and recommendations for each student.

5.2 Complete Learning Process Evaluation

By collecting bits and pieces of information, using strict and detailed logical reasoning, big data can show a student's complete image objectively. In the cloud, the separate database can be connected to each other, and can be used for multi-dimensional on-line analysis. In this way, a grand educational scene will be shown, each student can be placed in the educational scene to examine and evaluate (He, 2014). The traditional evaluation for students' physical experiments is mainly according to the experiment report result and teacher's feeling about students' experimental operation. Big data records the complete physical experiment process, which can objectively reflect student's actual learning effect.

When students choose experiment, educational big data can help students make a diagnostic evaluation in choosing appropriate experiment. In the preview process, students should study the resource that is pushed by system and learning situation will also be recorded by the system. In the physics experiment operation process, the digital experiment instrument can record the process and data that is generated by students. After the experiment operation, in order to consolidate the understanding about the experiment, students are required to complete reports designed by the big data system. In the context of educational big data, the whole learning process of physics experiment is a quantified-self process for students whose results can also be used to evaluate students.

6 Summary

Big data has considerable prospects, and it is changing our way of life. Educational big data will also change our education, which requires us to make reform based on educational big data. The reform must be based on the idea of modern education. To integrate college physics experiments with educational big data, digital experiment instrument and e-learning platform with big data mining and analysis should be established. The present teaching and learning methods should be reformed to make teaching and learning around the student-center. Although the integration has irreplaceable advantage, the integration is still in the initial stage.

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The evaluation of the quality of mobile applications in Al-Quds Open University

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Abstract. The future trend of mobile applications in education pays more attention to flexibility with high quality. Palestinian students have adequate knowledge and practice of mobile usage in their daily life. Furthermore, AL-Quds Open University (QOU) has the necessary infrastructure to implement mobile services in terms of wireless networks and applications. QOU needs to provide mobile flexible education services regardless of time and place. This study aims to evaluate the quality factors of mobile application among students in the QOU. A questionnaire was utilized as an instrument to measure the quality factors. 239 students were successfully participating from different ages and faculties. The results show that all of the participants are highly agreed on Information Quality, System Quality, and Service Quality. Regarding the services that available on QOU's mobile application, respondents expressed that Exams' Timetable is the highest rank previously used followed by GPA and Passed Credit Hours. The result indicates that students are very active with the mobile application of QOU. Results show that students highly appreciate quality factors of QOU's services accessed via university mobile applications. This study provides the quality factors that should pay attention by management, developers, and educators.

Keywords: mobile learning, open education, quality factors, student satisfaction, Palestinian higher institutions.

1 Introduction

In the mobile era, everything will be mobile. Mobile Business (m-business), m-commerce, m-payment, m-banking, and m-learning will be the way that people could manage their daily life activities. Mobile applications are the first choice for people to access services which have a web-based alternative. The Palestinian higher education environment, as well as Al-Quds Open University (QOU) has the required infrastructure to utilize m-learning services (Alzaza, 2012). The study shows that the students are quite aware about mobile technology issues and they had adequate knowledge to use mobile applications.

QOU adopts a philosophy of open learning and blended learning to keep up with international advances in technology and learning. Founded in 1991, it has achieved many goals and success to promote academic standard in the Palestinian community. Since its establishment, over 56542 students have joined its scientific edifice distributed in seventeen educational branches throughout Palestine. QOU aims to deliver knowledge to all society segments as it includes six faculties(Al-Quds Open University, 2001).

QOU provide a mobile application for two platforms: iOS (iPhone) and Android. This application enables students to follow-up their academic affairs such as their personal data, classes schedules, exams schedule, current semester data such as incomplete courses, passed hours, number of registered hours and cumulative average, registered courses for the current semester and the University news (Al-Quds Open University, 2013). Fig. 1 shows some examples of screenshots of QOU mobile application. The university students can access this application by using their student number and password which will enable them to enter to their accounts at the academic portal.

Fig. 1. Screenshots of QOU mobile application (Android platform).

2 Quality Factors

Mobile learning (m-learning) is a special type of information system (IS) (Hsin-Hui Lin, Wang, & Li, 2015). Quality factors of IS can utilized to measure the quality of mobile application for open education.

2.1 Information Quality

Information is an asset, and losing it means losing competitive advantage. In addition, information quality refers to the desirable characteristics of the information system outputs. Moreover, Jennex and Olfman (2003) defined information quality as ensures that the right information with sufficient context is captured and available for the right users at the right time.

In the traditional information system (IS) success measure, Delone and Mclean (2003) used information quality as one of the technological factors necessary for system success. Several studies (Delone & Mclean, 2003; Halawi, McCarthy, & Aronson, 2007; Tongchuay & Praneetpolgrang, 2008; Wu & Wang, 2006; Şahin, 2010) suggested that Information quality is an important aspect in Information system success. In a study on the determinants of information system success, Delone and Mclean (2003) and other studies (Halawi et al., 2007; Tongchuay & Praneetpolgrang, 2008; Wu & Wang, 2006; Şahin, 2010) highlighted the importance of accuracy, completeness, currency, consistency, relevance, format, availability relevant, and security of information. Indeed, Information quality could play an important role to success the mobile application.

2.2 System Quality

Based on Delone and Mclean (2003) IS success model, Jennex and Olfman (2003) and Wu and Wang (2006) argued that system quality is an important part of IS success. Quality of IS systems includes accessibility, ease of use for retrieval as well as input, output flexibility to meet the user needs, search capability, and documentation (Kulkarni, Ravindran, & Freeze, 2006). System quality is recognized as an important technical factor in successful Information system implementation (Jennex & Olfman, 2006). According to Kulkarni et al. (2006) system quality measures the technical success of IS.

Wu and Wang (2006) found that system quality depends on the intended operational characteristics. It is concerned with whether there are errors in the system; its ease of use; response time; flexibility, or stability. System quality measures the reliability and predicts ability of the system independent of the Information it contains. In essence, the system quality is critical to success the mobile application.

2.3 Service Quality

Service quality is defined as the discrepancy between what students expect and what they get. Wu and Wang (2006) state that system quality depends on the intended operational characteristics. It is concerned with whether there are errors in the system; its ease of use; response time; flexibility, or stability. System quality measures the reliability and predicts ability of the system independent of the Information it contains. The measurement of information systems success or effectiveness is critical for understanding the measure of IS service quality. There are five dimensions to evaluate service quality which are tangibles, reliability, responsiveness, assurance, and empathy (Parasuraman, Zeithaml, & Berry, 1988). However, service quality one of the important measurement to evaluate the mobile application.

3 Methodology

A questionnaire was utilized as an instrument to measure the quality factors of mobile applications in the QOU. Questionnaire has two parts; first part collects personal and demographic data about participants. Second part consists of quality factors comprises Information Quality, System Quality, and Service Quality. The instrument was adapted from Wu and Wang (2006); Tongchuay and Praneetpolgrang (2008); Jennex and Olfman (2003); Halawi, McCarthy, and Aronson (2007); Kulkarni, Ravindran, and Freeze (2006); and ahin (2010).

The descriptive analytical approach was employed to measure the level of three quality factors among QOU students. The community of the study consisted of all students at the QOU for the second semester of study year 2014/2015. The sample of the study consisted of (239) students.

4 Findings

Demographic data of respondents presented in Table 1. It shows that the majority of respondents (239) were male (53.1). 75.3% aged between 18-23 years which reflects the undergraduate students' level. Despite Faculty of Education and Faculty of Administrative and Economic Sciences made up the largest groups of respondents 40.2% and 34.3%, respectively, Faculty of Media was only 1.7%. In terms of mobile devices that respondents have, most of them have smartphones (77%). Android mobile operating system was most popular platform for students (69.5%).

Table 1. Demographic data of respondents

Profile	Classification	N	%
Gender	male	127	53.1
	female	112	46.9
Age	18-23 years	180	75.3
	24-30 years	38	15.9
	31-39 years	17	7.1
	More than 40 years	4	1.7
Faculty	Faculty of Technology and Applied Sciences	32	13.4
	Faculty of Social and Family	25	10.5

Profile	Classification	N	%
	Development		
	Faculty of Education	96	40.2
	Faculty of Administrative and Economic Sciences	82	34.3
	Faculty of Media	4	1.7
Mobile Device	Smartphone	184	77.0
	Cellphone	55	23.0
Mobile Experience	Less than 4 months	101	42.3
	1-2 years	88	36.8
	More than 2 years	50	21.0
Mobile Platform	iOS	73	30.5
	Android	166	69.5

The internal consistency validity was employed to measure the items of instrument. The internal consistency validity indicates the correlation of the degree of each item with the total average of the test. It also indicates the correlation of the average of each scope with the total average. This validity was calculated by using Person Formula. Table 2 shows the coefficient correlation of each item within its scope is significant at levels (0.01) and (0.05). All items were significant and useful for the instrument factors.

Table 2. Correlation coefficient of information items

Items	Pearson correlation	Sig. at 0.01
The Mobile Application provides more accurate and correct information.	0.824	0.000
The Mobile Application provides complete and adequate information.	0.685	0.000
The context in contents provided by The Mobile Application is consistent.	0.698	0.000
The Mobile Application produces information in a presentable format.	0.758	0.000
The Mobile Application always provides current and up to date information.	0.548	0.002
The Mobile Application produces relevant information that meets organization's requirements.	0.813	0.000
The Mobile Application provides high available information.	0.796	0.000
Information from The Mobile Application is secure and free from threats.	0.596	0.001
The Mobile Application allows information to be readily accessible to me.	0.722	0.000
The Mobile Application is easy to learn.	0.858	0.000

Items	Pearson correlation	Sig. at 0.01
The Mobile Application is reliable.	0.805	0.000
The Mobile Application returns answers to my requests quickly and in a timely manner.	0.799	0.000
The Mobile Application is flexible enough to meet my organization's current and future needs.	0.620	0.000
When The Mobile Application promises to do something by a certain time, it does so.	0.819	0.000
The Mobile Application is always willing to help me.	0.795	0.000
The Mobile Application team has the information to do their job well.	0.664	0.000
The Mobile Application team understands the specific needs of its users.	0.763	0.000
The Mobile Application physical facilities are visually appealing.	0.736	0.000

The test is reliable when it gives the same results if it is reapplied in the same conditions. The reliability of the test was measured by Alpha Cronbach (α) and the Spilt-half techniques. Table 3 presents the Cronbach alpha (α) value for each measure. All measures have Cronbach alpha of greater than 0.7, thus, these measures satisfy the internal reliability criterion (Pallant, 2007). It shows that all of the participants are highly agreed on Information Quality, System Quality, and Service Quality. The Spilt-half technique shows that correlation between forms is (.728) via Spearman-Brown Coefficient of equal length is (.843), that is indicate the instrument was successes to applied in the study.

Table 3. Cronbach Alpha Values for All Dimensions

Factor	Number of items	Mean	Alpha
Information Quality	8	3.617	.859
System Quality	5	3.607	.832
Service Quality	5	3.578	.798

In terms of mobile application services, respondents expressed that Exams' Timetable is the highest rank previously used (91.1%) followed by GPA (88.1%) and Passed Credit Hours (81.1%). However, an incomplete course (41.5%) was intended to use in the future. The result indicates that students are very active with the mobile application of QOU, see Table 4.

Table 4. Mobile applications services used by participants

Service	Previously used (%)	Intend to use (%)
Exams' Timetable	91.139	8.861
GPA (current semester)	88.186	11.814
Passed Credit Hours	88.136	11.864
CGPA	86.134	13.866

Service	Previously used (%)	Intend to use (%)
Classes' Timetable	86.076	13.924
Registered Credit Hours	86.076	13.924
Student Profile	85.232	14.768
News & Announcements	71.008	28.992
Email & Transactions	66.387	33.613
Incomplete Courses	58.475	41.525

4 Conclusion

This study intends to investigate and evaluate the quality factors of mobile applications in QOU. Mobile application has the opportunity to be one of the keys in open education. The future trend of mobile applications in education pays more attention to flexibility with high quality. Palestinian students have adequate knowledge and practice of mobile usage in their daily life. QOU has the necessary infrastructure to implement mobile services in terms of wireless networks and applications. QOU needs to provide mobile flexible education services regardless of time and place. A questionnaire was utilized as an instrument to measure the quality factors. 239 students were successfully participating from different ages and faculties. The results show that all of the participants are highly agreed on Information Quality, System Quality, and Service Quality. The result indicates that students are very active with the mobile application of QOU. Results show that students highly appreciate quality factors of QOU's services accessed via university mobile applications. This study provides the quality factors that should be considered and followed by management, developers, and educators. This study will be of value not only to the students and system developers responsible for the implantation and utilization of mobile applications in the QOU but also to researchers interested investigating the quality factors of mobile applications.

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Creating awareness of food safety and climate change through mobile learning

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Abstract

The food safety and food security have emerged as important concerns in the era of climate change. The potential impact of climate change on food safety include increased ability of fungi to produce mycotoxins, emergence of virulent pathogens, stress induced microbial evolution, increased use of pesticides and decreased water availability driven food spoilage. The policy resolutions and studies connecting food safety and abiotic stress lay emphasis for the capacity building to mitigate the risks associated with food spoilage. There is a dire need for sensitization, training for trainers, education and applied research on food safety in relation to climate change. Open and distance learning (ODL) has huge potential for a wider and larger coverage in innovative ways. The educational content must be adequate both qualitative and quantitative. Qualitative trait reflects the features of the educational content like clarity, brevity and engaging content. Quantitative feature means the encyclopedic coverage of food safety science with Information and Communication Technology (ICT) enabled educational tools to deliver creative learning environment. The challenge of reaching the unreached at their doorsteps in a cost-effective manner can be met by technology enabled mobile learning since use of mobile phones particularly smartphones are on rise. Mobile learning involves the use of mobile technology either alone or in combination with other ICT to enable learning anytime and anywhere. It is the delivery of tailored learning contents and learning support on mobile phones, tablets, notebooks. Development of mobile applications in different mobile operating systems like android, iOS, Windows etc. can help in creating awareness as well as stimulating critical thinking. Triggering critical thinking can be done by providing contents like Scramble, crossword, brain games, puzzles, cartoons etc. Hence, by developing mobile application containing these components, the learner can not only get updated about the recent development about food safety and climate change, but can also motivate to implement the action. This paper focusses on creating the awareness about food safety and climate change through mobile learning.

Keywords: mobile learning, food safety, climate change, awareness

Introduction

Industrialization, population explosion, urbanization and chemical intensive agricultural development have led to environmental degradation which has far reaching impact on the well-being of the humanity. Over the years, the focus of both the developed and developing countries have shifted from food production to food production system, from economics to ecological economics, from production chain to supply chain, from economic development to sustainable development, from food security to food safety, etc. Food safety is gaining importance in the backdrop of globalization, global environmental change and urge of every individual to lead a quality and healthy life. The challenge of achieving food safety and food security in the era of climate change is undoubtedly arduous particularly under developed and populated countries. Unfortunately, the resource poor individuals are vulnerable to food hazards. In the past decade, Government of India has stepped up its efforts in providing safe and wholesome food for its citizens through implementation of Food Safety and Standards Act, 2006 as well as focusing on curtailing the carbon foot print. In a country like India where both the population of consumer as well as food business operators are very high, it will not be easy to implement the food safety act only through rules and regulation. Therefore, there is a need to create awareness among the stakeholders to correct wrong perceptions and promote better practices. Today, both food safety and climate change are two buzz words which is creating havoc in the day-to-day life of every individual in this world. In this world of technology, mobile is one of the tools which has reached the nook and corner of the country. A large mass of the population is using smartphones which not only helps in communication but also in sharing information. Hence, mobile technology can be one of the easiest and cost effective tool for creating awareness on food safety and climate change among the public. Some of the countries like USA, Macau have developed mobile applications for creating awareness among its public on food safety issues. This paper aims to introduce the concept of creating awareness about food safety and climate change through mobile learning.

Food Safety and Climate Change

Climate change has potential impact on food production systems and food safety. Temperature, amount and frequency of precipitation, relative humidity and other weather variables are expected to change due to climate change (IPCC, 2013). There is a growing consensus that human activities may be changing our planet’s climate. These changes in climate have a number of possible implications for human health and welfare, one of which could be the safety of food (EUFIC, 2014). The Emerging Risks Unit of the European Food Safety Authority (EFSA) has identified climate change as a driver for emerging risks in food and feed safety in the mid- or long-term (Robinson *et. al.*, 2012). Climate influence the growth, survival and transmission of pathogenic micro-organisms. Climate restricts the range of infectious diseases, whereas weather affects the timing and intensity of disease outbreaks. (Epstein, 2001). The increase in temperature increases salmonellosis and harmful algal blooms (Confalonieri *et al.,* 2007). Food-borne diseases are the product of multiple factors like consumption patterns, human behaviours, contamination sources, prevalence of pathogen in the animal reservoir, survival patterns of pathogens and vulnerability of human population. The weather variables have an effect on toxigenic molds and also on the interactions between molds and host plants. Unfavourable environmental conditions caused by climate change increases the susceptibility of host plants and under such condition, the toxigenic molds produce great amount of mycotoxins. Climate change influences the pest composition, species distribution, pest development, pest resurgence, pest outbreak and susceptibility of host plant to pests. On account of significant effect of climate change on pests, the pesticide use and environmental contamination increases leading to increased pesticide residues in crops. In effect, climate change is happening and may reduce food safety.

Mobile Technology – A Boon for ODL

Open and distance learning (ODL) has huge potential for a larger coverage in innovative ways. The educational content must be adequate both qualitative and quantitative. Qualitative trait reflects the features of the educational content like clarity, brevity and engaging content. Quantitative feature means the encyclopedic coverage of food safety science with Information and Communication Technology (ICT) enabled educational tools to deliver creative learning environment. The challenge of reaching the unreached at their doorsteps in a cost-effective manner can be met by technology enabled mobile learning since use of mobile phones particularly smartphones are on rise. Mobile learning involves the use of mobile technology either alone or in combination with other ICT to enable learning anytime and anywhere. It is the delivery of tailored learning contents and learning support on mobile phones, tablets, notebooks. Mobile communication enhances interactivity with tutors and peer group collaboration. The growing use of wireless technology and mobile devices suggests that training and education cannot ignore the use of mobile devices in the learning/training process. Mobile technologies are major innovative ways of supporting teaching and learning of students, who are by their nature, invisible (Paul *et. al.,* 2013). Mobile phones are growing at a rapid pace in India. According to Telecom Regulatory Authority of India (TRAI, 2015), there are about 952.34 million wireless telephone subscribers in India during March 2015. Due to rising population rate and high development potential, India has the fastest growing telecom network in the world. A number of educational institutions in India have started using mobile. As mobile devices are becoming increasingly ubiquitous, many individuals and institutions have incorporated the technology into their teaching and learning environments (Ally & Tsinakos, 2014). Mobile Learning is not just about the use of portable devices, but is also about learning across contexts (Walker, 2006).

Creating Awareness – The Need of the Hour

The Climate change is going to affect all the dimensions of food security and food safety and the impact shall be visible on food production, human health and livelihood assets. The scientific community is continuously developing a set of guidelines across the food chain to correct wrong perceptions and promote better practices. The objective is to have a sustainable food production system and lay the due emphasis on importance of food safety and food security. Creating awareness does not mean informing the masses. In today's context, it means explaining issues and disseminating knowledge to people so that they can make their own decisions. High public awareness occurs when a significant proportion of society agrees that the food safety and food security are of great importance. Raising consumer awareness is the most effective means to ensure greater engagement of food handlers in improving their practice in an overall strategy which is largely dependent on self-regulation as the consumers are the "proxy regulators". Information, Education and Communication strategies have an important role to play for effective outreach and impact of the proposed initiatives (Anita, 2011). The policy resolutions and studies connecting food safety and abiotic stress lay the emphasis for capacity building to mitigate the risks associated with these. There is a dire need for sensitization, training for trainers, education and applied research on food safety in relation to climate change.

Mobile – A tool for creating Awareness

Development of mobile applications in different mobile operating systems like android, iOS, Windows etc. can help not only in creating awareness but can also help in stimulating critical thinking thereby fulfilling the objective of imparting knowledge and skills in the area of interest. For triggering critical thinking which will in turn result in implementing the action can be done by providing contents like scramble, crosswords, brain games, puzzles, cartoons etc. Mobile application can help in awareness creation in the following ways:

- **Imparting Knowledge and skills:** The information regarding food safety and climate change can be imparted through mobile by the following ways:
    - ***Document:*** The information pertaining to food safety, climate and the implications of climate change on food security and safety can be presented in the form of simple document or webpage. This kind of presentation can only provide knowledge to the learners.
    - ***Powerpoint:*** This format helps the viewers to understand the concept or information in an organized and easy manner. The powerpoint can be made eye-catching by using attractive designs, incorporation of graphs, multimedia tools like audio, video etc. This format is normally visually appealing and attracts the learners towards the information or concept.
    - ***Flash:*** It is easy to develop flash based animations and video which can attract the learners. Nowadays, most of the websites use flash based animations and video which can convey the message/ information in an organized and attractive manner.
    - ***Video:*** This is one of the best multimedia tools which can be used to convey the information in a short period of time. Videos provide

a sensory experience that allows concepts and ideas to actually become an experience and come to life as learners are guided through each adventure.

  - ***Audio:*** This is one of the well-established tool used in education for imparting knowledge and has been used for decades.
  - ***Chatting:*** This tool can help the learners to interact with the experts and peer group. It is the best tool for instant flow of information, ideas and facts among the group.

- **Stimulate Critical Thinking**: Simply imparting knowledge and skill on the subject will not suffice the purpose. It is important to make a person understand the subject/concept, identify problems and make necessary efforts to solve them. Critical thinking will help a person in improving the problem solving and decision making capabilities. Some of the ways to stimulate critical thinking on food safety and climate change through mobile are as follows:
  - ***Scramble:*** This is one of the effective ways of stimulating critical thinking of a person. It can be in the form of scramble words or scramble story. For example, scramble words can be developed. Clues can be provided to the scramble in the form of sentences or pictures.
  - ***Crossword:*** Crossword can provide opportunities for mobile learners to evaluate, analyze, synthesize, and summarize information and experiment.
  - ***Brain games:*** This is gaining popularity since it aids in improving memory skills and problem-solving. For example, games can be developed asking a person to develop a green village incorporating environment friendly activities.
  - ***Puzzles:*** Puzzles are like food for brain. They arouse learner's critical thinking skills, while developing and reinforcing the knowledge and skills.
  - ***Cartoons:*** Though funny and attractive, they are thought provoking tools.

Therefore, by developing mobile application containing these components, the learner can not only get updated about the recent development about food safety and climate change, but also can motivate to implement the action.

Conclusion

Food safety and climate change are two buzz words which is creating havoc in the day-to-day life of every individual in this world. The potential impact of climate change on food safety include increased ability of fungi to produce mycotoxins, emergence of virulent pathogens, stress induced microbial evolution, increased use of pesticides and decreased water availability driven food spoilage. There is a need to generate awareness on food safety and food security for mitigating the risks and challenges associated on these aspects due to climate change. Raising consumer awareness is the most effective means to ensure greater engagement of food handlers in improving their practices. Open and distance learning has huge potential for a larger coverage in innovative ways. The challenge of reaching the unreached at their doorsteps in a cost-effective manner can be met by technology enabled mobile learning since use of mobile phones particularly smartphones are on rise. Development of mobile applications in different mobile operating systems like android, iOS, Windows etc. can help not only in creating awareness but can also help in stimulating critical thinking thereby fulfilling the objective of imparting knowledge and skills in the area of interest.

Recommendations

- Creation of Awareness on food safety and climate change among the general public is key to achieve a healthy and quality life.
- In order to reach the larger spectrum of population, mobile technology can be used effectively to impart knowledge and skill on food safety and climate change issues.
- Tailor-made mobile applications incorporating knowledge imparting tools like flash, audio, video etc. and critical thinking stimulating tools like puzzles, brain games, crosswords etc. should be developed.
- Mobile learning should be the most preferred and cost-effective mode of delivery in the domain of ODL.

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Mobile learning in nursing education: Preference and readiness of nursing students

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Abstract. Nursing education stresses the importance of theoretical and practical integration. Teaching and learning activities occur both in classroom and clinical venue. Owing to these characteristics, nursing education has to be delivered in a flexible way and mobile learning appears to be a desirable means. In order to achieve effective learning outcome from mobile learning, one of the essential issues is to deliver mobile learning that meet the preferences and readiness of nursing students.

This paper presents a survey which aimed to investigate the preference of nursing students for engaging in mobile learning and their readiness to adopt this learning mode. A convenience sample of 158 full-time undergraduate nursing students in The Open University of Hong Kong was recruited. Data were collected by a questionnaire. The survey results revealed that nursing students would like to access their learning materials anytime and anywhere. The nursing students considered 'ease of reading' and 'ease of note-taking and highlighting' as the most important factors that determined their use of electronic learning materials. They further considered 'level of comfort in reading', 'portability', and 'input and output capabilities' as the three most important factors in using a mobile device for learning. Among the different study topics, they highly preferred to have body systems and diseases as well as medical terminology to be provided in multimedia materials in the mobile device. Based on these findings, the challenges and opportunities of mobile learning in nursing education are discussed. Unique features of mobile learning for nursing education are suggested.

Keywords: mobile learning, nursing education, m-learning readiness

1 Introduction

Mobile learning has been regarded as one of the promising means of education delivery. It allows learning to take place across different settings beyond geographical barriers and time constraints. As a young but rapidly growing field playing an increasingly important role in education (UNESCO, 2012), mobile learning may benefit learners in multiple ways. For example, it allows learners to vary the location of their study and to learn "on the move" (Evans, 2008). Learners may learn within a specific context, which provides authentic cultural and environmental cues for understanding the utilisation of information, and thus enhances the retention, retrieval and transfer of the information for practical use (Koole, 2009). In addition to individual learning, mobile learning also facilitates social interaction among learners and teachers, through applications such as text messaging or voice communication (Uzunboylu & Ozdamli, 2011).

With the growing popularity of mobile devices, the development of mobile learning has been gaining momentum. Nursing education emphasizes acquisition of both conceptual knowledge and practical skills in classrooms and clinical venues. The different learning environments of nursing education provide a suitable platform for mobile technology to take effect. The use of mobile devices enables provision of up-to-date and accurate content, and supports situated, experiential and contextualized learning in the context of nursing education (Kukulska-Hulme & Traxler, 2005).

Success in provision of mobile learning requires purposeful and thoughtful planning. Baker, Dede and Evans (2014) summarises a wide range of areas that have to be taken into account in the planning of mobile learning, such as the learning goals to be accomplished, prior knowledge and skills of learners and teachers, instructional and curricular materials to be developed, and their ways of delivery via mobile devices. Prior to implementation, studies are thus needed for an institution to assess how well its students and staff are ready for mobile learning.

This paper presents a survey on the preferences of nursing students for mobile learning and their readiness to adopt this learning mode. The findings show the relevant support required, which facilitate course designers and teachers to plan and deliver mobile learning in a way addressing students' specific needs. This study also reveals how mobile learning may be integrated into a traditional classroom setting so as to achieve a high level of learning and teaching effectiveness.

2 Mobile Learning for Nursing Students

This study focused on the practice of mobile learning in nursing education at the Open University of Hong Kong (OUHK). OUHK has been leveraging mobile technologies for clinical education support as far back as 2004. Mobile and wireless technologies were applied to remove the physical barriers associated with classroom learning (Lee & Tsang, 2006). The nursing programmes at OUHK have in recent years been making use of iPod Touch in their clinical practicum, in order to facilitate teaching and support learning. Equipped with the mobile devices, nursing students can access the learning materials anywhere anytime and feasibly complete their clinical assessment.

Based on this successful experience, the university is planning to extend the provision of mobile learning to the classroom setting of nursing courses. An iPad mini will be given to each nursing student for learning purpose in the 5-year curriculum. Specific features are planned to be built into the mobile learning environment of the nursing courses, such as electronic database of nursing information, assessment/ performance record, video clips, classroom attendance, ePortfolio, real-time quizzes, news announcements and reminders. These features are designed to enhance students' learning and interaction and to relieve teaching staff of their administrative burden.

A survey was conducted to collect nursing students' preferences and their readiness for mobile learning, so as to understand the mobile contents and ways of delivery suitable for them. It assessed the extent to which the nursing students are ready for adopting mobile learning, their preferences of mobile contents, and their preferred ways of mobile learning. Such understandings are crucial to the planning, development and implementation of mobile learning in nursing education.

3 Related Studies

There are a broad range of dimensions suggested in literature regarding students' readiness for mobile learning. For example, Parasuraman (2010) raised the notion of technology readiness, defined as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (p. 308). Cheon, Sangno, Crooks and Song (2012) explained students' intention to adopt mobile learning based on the theory of planned behaviour (Ajzen, 1991), with constructs of perceived behavioural control, attitude and subjective norm. Kenny, Van Neste-Kenny, Burton, Park and Qayyum (2012) used mobile self-efficacy as an indicator to measure students' readiness to engage in mobile learning. They observed a tendency to mobile learning engagement that would emerge as a result of one using more frequently mobile devices, i.e. the more one uses the devices, the more self-efficacy one would be, and in turn more usage of the devices is encouraged.

Hussin, Manap, Amir and Krish (2012) categorised mobile learning readiness into five types, namely basic readiness, skills readiness, psychological readiness, budget readiness and institutional readiness.

Basic readiness is related to students' ownership of devices, as well as features of the devices such as storage capacity and networking functions. It also includes device capability of running mobile apps for tasks such as reading PDF or PowerPoint files. Kenny et al. (2009) also noted that "access to and usability of mobile learning devices is critical to supporting the context of learning and learning interactions" (p. 94).

Skills readiness refers to familiarity of students to perform various tasks using the mobile devices, such as sending and receiving e-mails or files, accessing social networking sites and reading online news. Hamat et al. (2012) found that skills readiness is positively correlated with students' prospect of engaging in mobile learning. So (2008) also reported that acceptance of mobile phones for teaching and learning has a direct relationship with students' daily uses of mobile phones.

Psychological readiness examines students' understanding and perception of mobile learning. In this dimension, Cheon et al. (2012) commented that inclusion of contents or materials mostly desired by students might be helpful to achieve a high level of perceived usefulness of mobile learning. For example, they found students ranked course information (e.g. schedulers and exam results) as the most desired function. Abas et al. (2009) found that students of the Open University Malaysia preferred to have reminders of important events and study tips, as well as learning materials such as online tutorials and quizzes.

Institutional readiness concerns students' perceptions of whether the university and teachers are ready to offer mobile learning. Hamat et al. (2012) identified three most important factors for successful implementation of mobile learning, including integration of mobile contents with the existing e-learning platform of the university, complementary role to traditional teaching, and well-designed interface of mobile devices for convenient access of materials.

Budget readiness regards willingness of students to bear extra cost for mobile learning. Hussin et al. (2012) showed that students are mindful of additional financial costs that might have incurred in the practice of mobile learning. Abas et al. (2009) revealed that students are cost-aware and not willing to spend extra money on mobile learning. Kenny et al. (2012) also noted that a major barrier to implement mobile learning is the party responsible for the associated cost of purchasing mobile devices and connecting to mobile network.

These dimensions suggest the wide range of areas to be taken into account in the planning and development stages, which are addressed in this survey studying the preferences and readiness of nursing students for mobile learning.

4 Research Method

This study aimed to investigate the preference and readiness of nursing students for mobile learning. Using a convenience sampling, the students participated in the study were year-2 undergraduate nursing students from a course Health Assessment, who did not practice mobile learning yet. Two focus group interviews had been carried out in advance to collect 20 students' views and experience on their study of nursing courses and mobile learning. The focus group findings were used for developing a questionnaire for the survey.

The survey was conducted in December 2014. A total of 158 responses were collected, with 80.4 percent of female respondents and 19.6 percent of males. Students were asked to indicate their preference for a wide number of areas related to mobile learning, such as mobile device, electronic material, and means of communication.

5 Findings

The findings of the survey are presented with reference to the dimensions of mobile learning readiness from Hussin et al. (2012) relevant to our context, i.e. skills readiness and psychological readiness.

5.1 Skills Readiness

Table 1 shows the familiarity of students with mobile devices using iOS, i.e. the operation system of mobile device to be given to students (using a 7-point Likert scale from 1: strongly disagree to 7: strongly agree). Despite the fact that they may own different types of mobile devices, the students generally indicated a moderate familiarity with devices running iOS. The students are expected to possess the skills for tasks such as using e-mails services, accessing Wi-Fi network, uploading and downloading files, and reading online materials.

The results show that the students are in general more familiar with iPad/iPad mini than iPod touch and iPhone. As the students will be given iPad mini for mobile learning, this implies that they would not have great difficulty in adapting the device for learning purpose.

Table 1. Familiarity of mobile devices using iOS

I am familiar with the following mobile devices using iOS.	Mean	SD
iPad/ iPad mini	5.070	1.820
iPod touch	4.665	1.891
iPhone	4.898	1.812

Table 2 reports the version of textbook owned by the students which is used in the nursing course. Most of the students (61.2% in total) owned either the electronic version or both electronic and printed versions. According to Hamat et al. (2012), students' familiarity with electronic materials would result in a favourable attitude to mobile learning.

Table 2. Ownership of textbook version

Which version of textbook do you have?	Frequency	Percentage
Printed (i.e. paper) version	32	20.6%
Electronic version	63	40.6%
Both of the above	32	20.6%
None of the above	28	18.1%

Table 3 and 4 show the students' preference in means of communication with teachers and classmates on academic matters respectively. A ranking scale is used from 1 (most preferred) to 9 (least preferred). The results show that most students favour face-to-face interaction with both teachers and fellow classmates. Other than this, the students appear to have little barrier to use mobile devices for communication, especially instant messaging which ranks the second or third for both student-to-teacher and student-to-student interaction. It is worth noting that, among email, telephone call and social networking site (e.g. Facebook), the students prefer to reach the teachers using emails, while they prefer telephone calls and Facebook when communicating with classmates. However, the discussion board on the Online Learning Environment, the web-based learning management system currently in use for the nursing courses, ranks the lowest for communication with both teachers and classmates.

Table 3. Pattern of communication – Preferred means to communicate with teachers

Means of communication	Rank (frequency of students) 1	2	3	4	5	6	7	8	9	Median rank
Face-to-face interaction	85	10	11	3	2	0	0	2	5	1
Mobile instant messaging (e.g. WhatsApp, Line)	13	30	25	10	16	6	12	2	3	3
E-mail – using computer	8	16	27	17	23	10	8	5	4	4
E-mail – using mobile device	4	15	19	37	12	15	8	6	2	4
Telephone call	2	31	16	10	13	3	14	5	22	4.5
Facebook – using mobile device	2	5	5	14	14	24	15	24	15	6
Facebook – using computer	0	3	9	11	15	16	22	21	20	7
Discussion board on Online Learning Environment – using mobile device	3	3	2	7	10	29	16	33	15	7
Discussion board on Online Learning Environment – using computer	1	5	4	8	14	14	23	18	30	7

Valid responses = 118

Table 4. Pattern of Communication – Preferred means to communicate with classmates on academic matters

Means of communication	Rank (frequency of students) 1	2	3	4	5	6	7	8	9	Median rank
Face-to-face interaction	81	17	5	6	4	1	0	0	1	1
Mobile instant messaging (e.g. WhatsApp, Line)	27	46	31	1	2	1	4	2	3	2
Telephone call	3	32	35	4	18	5	7	1	10	3
Facebook – using mobile device	3	7	20	37	15	9	8	14	4	4
Facebook – using computer	1	4	9	31	32	11	10	7	12	5
E-mail – using mobile device	0	2	4	19	14	41	25	9	3	6
E-mail – using computer	0	2	5	9	18	28	44	5	6	6
Discussion board on Online Learning Environment – using mobile device	0	2	4	2	11	13	9	55	21	8
Discussion board on Online Learning Environment – using computer	0	3	4	8	3	8	11	24	56	8

Valid responses = 117

5.2 Psychological Readiness

Fig 1 shows the students' preference of mobile device for study. A majority of the students (65%) indicated their preference for iPad mini over iPod touch and other mobile devices (e.g. android devices and notebook computers). This suggests a favourable response to mobile learning using iPad mini.

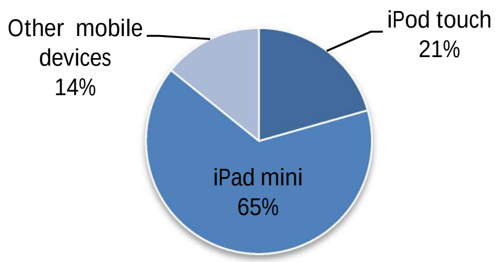

Fig. 1. Preference of mobile device for study

Table 5 reports the students' rating of learning materials to access anytime and anywhere (using a 7-point Likert scale from 1: strongly disagree to 7: strongly agree). Lecture PowerPoint slides and handouts are the two most preferred materials to be accessed in a mobile environment, followed by the textbook. This suggests that the students wish to study the lecture contents in mobile environments other than the classroom.

Table 5. Learning materials students would like to access anytime and anywhere

Learning materials	Mean	SD
Lecture PowerPoint slides	5.766	1.095
Lecture handouts	5.763	1.187
Textbook	5.101	1.442
Videos from external sources (e.g. YouTube)	4.950	1.281
Supplementary learning materials (e.g. on-line articles)	4.918	1.321
Nursing videos from OUHK	4.911	1.299

Table 6 presents the students' preferences of functions/materials to be provided in the mobile device (using a ranking scale from 1: most preferred to 7: least preferred). The students tend to favour the nursing learning materials. It is notable that communication function for class interaction ranks the lowest. The students may not have a strong need for online class interaction or such need has been largely satisfied by mobile apps in use.

Table 6. Students' preferences of functions/ materials to be provided in the mobile device

	Rank (frequency of students)							Median
Functions/materials	1	2	3	4	5	6	7	rank
Multimedia materials of body systems and diseases	37	24	21	18	14	4	5	3
Medical terminology	24	31	16	11	19	15	7	3
Audio examples of auscultation (e.g. heart sounds and breath sounds)	15	19	23	30	24	10	2	4
Procedures of health assessment	28	12	19	18	14	31	1	4
Image examples of ECG patterns	11	20	22	30	32	7	1	4
Audio version of reference articles	8	12	22	12	15	40	14	5
Communication function for class interaction (e.g. discussion board)	0	4	1	5	7	15	89	7

Valid responses = 123

Table 7 presents the students' preferred locations to access electronic materials. Most students prefer to use electronic materials at home (54.8%) or places with Wi-Fi network (50.3%). Some of them also wish to assess the materials in classrooms (43.3%) or libraries (34.4%). This result supports the need of the students for mobile learning to access learning materials in different environments.

Table 7. Students' preferred location to use electronic learning materials

Locations	Frequency	Percentage
Home	86	54.8%
Other places with Wi-Fi network (e.g. restaurant)	79	50.3%
Lecture halls / classrooms	68	43.3%
University's libraries	54	34.4%
Other (Self-study room, Computer room, Street, Vehicle)	13	8.3%

Note: Students may choose more than one option.

Table 8 shows the students' perceived importance of factors determining their use of electronic materials (using a ranking scale from 1: most preferred to 9: least preferred). Ease of reading and ease of note-taking and highlighting are the two most important factors, followed by ease of searching information, portability, ease of storage and look and feel. It is noted that look and feel has extreme ranks, in which a high proportion of the students perceived it as an important factor while another substantial proportion regarded it as unimportant. Multimedia content, cost and ease of sharing were deemed less important for the use of electronic materials.

Table 8. Students' perceived importance of factors determining their use of electronic learning materials

	Rank (frequency of students)									Median
Factors	1	2	3	4	5	6	7	8	9	rank
Ease of reading	33	30	26	13	10	4	2	1	0	2
Ease of note-taking and highlighting	34	31	18	19	7	4	2	4	0	2
Ease of searching information	5	12	21	14	18	21	16	8	4	5
Portability	10	11	8	19	18	18	14	18	3	5
Ease of storage	2	10	17	18	20	21	13	10	8	5
Look and feel	23	11	7	14	9	7	4	17	26	5
Multimedia content	0	9	8	9	15	13	19	26	20	7
Cost	8	6	8	6	9	12	17	10	41	7
Ease of sharing	2	2	3	7	15	19	30	24	16	7

Table 9 shows the students' perceived importance of factors determining their use of mobile devices for learning (using a ranking scale from 1: most important to 6: least important). Level of comfort in reading is the most important factor, followed by portability and input and output capabilities. The students paid less attention for the processor speed and 3G/4G networking function of the devices. For the factors that may be contradictory, such as level of comfort in reading (which may refer to a device with a larger screen size) and portability (which implies smaller size and weight of the device), the students prefer the device to be more suitable for reading.

Table 9. Students' perceived importance of factors determining the use of mobile devices for learning

Factors	Rank (frequency of students) 1	2	3	4	5	6	Median rank
Level of comfort in reading (e.g. screen size)	59	18	19	7	6	11	2
Portability (e.g. size and weight)	32	33	18	17	11	12	3
Input and output capabilities (e.g. efficiency of typing)	16	26	24	18	26	11	3.5
Storage capacity (e.g. memory)	5	18	26	39	16	18	4
Processor speed	4	13	22	19	46	17	5
3G/4G networking	6	12	12	22	17	52	5

6 Discussion

This survey has shown the preferences of nursing students in mobile learning. It has also revealed how the students are ready to engage in mobile learning.

The students generally possess the knowledge and skills required for mobile learning. They are familiar with the mobile devices and electronic materials of the nursing courses. This implies that most of them can adapt to mobile learning without much effort, when the contents and ways of delivery suit their needs.

For the mobile learning materials, the students indicated their preference to have those summarising the major contents of the nursing courses, i.e. lecture handouts and PowerPoint slides. They also preferred supplementary materials such as multimedia materials of body systems and diseases and medical terminology. On the other hand, the students expressed a diverse range of preferred locations to access the materials, e.g. home, libraries and other places with Wi-Fi network. This suggests their need of mobile learning in terms of accessing the materials anytime anywhere to facilitate their study of the nursing courses.

The students appear to view mobile means of communication as a less-preferred alternative. Most of them would choose to have face-to-face interaction, if applicable, both for communication with teachers and classmates on academic matters. This is also reflected in their preference of functions/materials to be provided in mobile device — communication function for class interaction is ranked the lowest. This result deviates from the hypothesis of some mobile learning theories. For example, in Koole's (2009) FRAME model, social interaction is one of the core aspects in mobile learning. Further investigation is needed for finding out the reasons of such students' preference.

In general, the choice of iPad mini to be used for mobile learning in nursing education will suit the students' preference, both in terms of their familiarity with the device and their need to have a high level of comfort in reading. Among the different features of the mobile device, mobile networking (3G/4G) was ranked the lowest. This suggests that the students may not have a strong need to access the Internet anytime, or they deemed it acceptable to access the Internet only in locations with Wi-Fi network.

7 Conclusion

This study contributes to uncover the preferences and readiness of nursing students for mobile learning. The students expressed their desired ways of studying the nursing courses which can be largely satisfied by the features of mobile device and mobile learning materials planned to be provided.

For implementing mobile learning in the nursing courses, the present findings show that the students may only value the learning materials provided and the opportunity to access the materials anywhere. While they did not indicate a strong preference of mobile communication with teachers and classmates, further support may be necessary if part of learning activities are planned to deliver through mobile interaction. This may involve provision of training and technical support for the communication functions of the mobile device, or having the learning activities as a compulsory part of the courses. As mentioned in Kenny et al. (2012), increasing students' familiarity and experience in using mobile devices would facilitate their engagement in mobile learning. It is expected that their self-efficacy will be increased if more exposure is provided to the students, which would contribute to raise their attitude to mobile learning.

Looking ahead, students' preference may change after mobile learning has been implemented. Further adjustment in mobile learning provision may be required. We are also waiting to see the extent of effectiveness when mobile learning has been planned in a way taking into account the students' preference that this study has shown.

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Mobile learning support to distance learners: A study on the usage pattern

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Abstract. WhatsApp Messenger is a popular mobile application commonly used by people in Malaysia. Since it is pervasively used by Open University Malaysia (OUM) learners, this paper examines how the university forays into using this recent mobile technology trend as a tool for supporting learning. The pilot project was implemented on the new group of about 3,000 first semester learners. The mobile learning messages were in the form of image, audio and video in addition to the text format. There were four areas of mobile learning support namely, (1) important announcements, (2) learning tips, (3) guide on myVLE (OUM's learning management system) and (4) information on helpdesk support available in OUM. A preliminary survey was conducted using the Google Drive survey instrument and it was communicated to the learners via WhatsApp. This paper outlines the OUM's efforts and processes in the implementation of the WhatsApp as a tool for mobile learning support and distance learners' experience and usage patternfor the mobile learning messages.

Keywords:mobile learning, WhatsApp Messenger, instant messaging

1 Introduction

As more and more learning institutions are offering distance learning, there is an increasing need for supporting learning. Information and communication technology as well as new media technologies are capitalised on for the purpose of learner support. Appropriate use of technology can take the distance out of the learning (Watts , Lewis & Green, 2003). The emergence of mobile learning offers opportunities to make new inroads into open and distance learning (ODL) especially since it provides mobility and the means to individualise learning (Kim, Mims and Holmes, 2006).

One popular mobile learning tool is WhatsApp Messenger, a cross-platform mobile messaging app which sends real-time messages to individuals and groups of people with no extra cost other than that incurred by theInternet connection. WhatsApp is widely used by mobile phone users to communicate and share information in the form of text, images, audios, videos and also location information. According to Statista (2015), Whatspp ranked top for the most popular global mobile messenger app as of March 2015, with 700 million active users per month. As of the fourth quarter of 2014, South Africa ranked first with 78% mobile internet users usage penetration and followed by Malaysia with 75%.

Instant messaging technologies hasshown positive impact on youth preference over voice call (Lenhart & Ling, 2010). Learners in Malaysia reported their preference to integrate mobile learning in their studies (Harvinder, 2012 & Veeramuthu, Hui, Siew & Sharmala, 2014). Given the fact that Malaysia has such a high adoption rate and little is known of the impact of WhatsApp on learning, it is important to find out how WhatsApp can be used as a tool to revolutionise learning.

In view of this, this study seeks to highlight the distance learners' experience and usage pattern of mobile learning messages received.

2 Methodology

In this section, processes involved for broadcasting the mobile learning support messages via WhatsApp Messenger and data collection methods will be described.

2.1 Research Site

The study was conducted at Open University Malaysia (OUM), the pioneer and leading ODLinstitution in Malaysia. OUM practices a blended learning approach which comprises face-to-face tutorials and online learning via the University'slearning management system called myVLE.

2.2 Sample

Mobile learning support was given to 2,934first semester learners taking OUM's undergraduate programmes. A total of 12 groups of learners were formed, with each group comprising a maximum of 250 learners. These learners were located across the country in 34 learning centres. However, only 150 participants responded to the online survey questionnaire via their mobile phone. As shown in Table 1, the majority of the respondents (61.3%) were female. About 50% of the respondents were from the age group 21 to 29 years, followed by 29.3% in the age group 30 to 39. Most of the respondents (84.7%) had Internet data plan on their mobile phones.

Table 1: *Demographic details of the respondents of the survey*

Demographic		**Number**	**Percent (%)**
Gender	Male	58	38.7
	Female	92	61.3
Age	Below 21 years	8	5.3
	21 – 29 years	75	50
	30 – 39 years	44	29.3
	40 – 49 years	20	13.3
	Above 50 years	3	2
Internet data plan	Yes	127	84.7
	No	23	15.3
Total		150	

2.3 Types of Messages

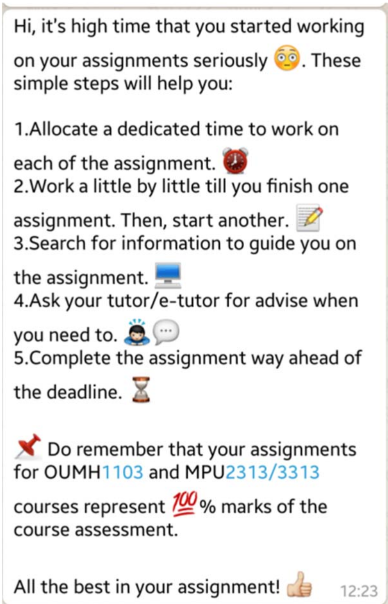
There were four areas of mobile learning support namely, (1) important announcements, (2) learning tips, (3) guide on myVLE (OUM's learning management system) and (4) information on helpdesk support available in OUM. The messages were in various format such as text, graphic, audio and video. Hence, the messages were designed accordingly to fit for the purpose. A total of 23 messages were delivered to the learners. Table 2 shows the number of messages by category and by format.

Table 2: *Number of messages by category and by format*

Format / **Category**	Text	Text + Image	Audio	Text + Video	Total
Important announcements	5	2	1	2	10
Learning tips	3	1		5	9
Guide on myVLE	1			3	4
Information on helpdesk support		2			2
Total	9	5	1	10	25

The messages that contained image and video were accompanied by text. This means the number count of the messages in Table 2 is based on the content or topic of concern for the message and not number of messages that were broadcasted for each topic. Figure 1 shows some examples of the mobile learning messages.

The text messages included meaningful emoji from the list of available emoticons in WhatsApp Messenger. Messages filled with emoji helps learners to process the messages more effectively as images are more representative than words. Messages with emoji are like pictographic script that helps to convey emotion and expression and lighten the communication, thus leading to an enrichment of the messages.

Category	**Examples**
Text	 Hi, it's high time that you started working on your assignments seriously 😳. These simple steps will help you: 1.Allocate a dedicated time to work on each of the assignment. ⏰ 2.Work a little by little till you finish one assignment. Then, start another. 📝 3.Search for information to guide you on the assignment. 💻 4.Ask your tutor/e-tutor for advise when you need to. 🙋💬 5.Complete the assignment way ahead of the deadline. ⌛ 📌 Do remember that your assignments for OUMH1103 and MPU2313/3313 courses represent 💯% marks of the course assessment. All the best in your assignment! 👍 12:23
Image	[4/2, 4:58 PM] OUM Mobile Learning: Dear Learners, As part of OUM’s commitment in providing quality tutoring, we value your feedback on tutors. Please respond to the short survey “Learner Evaluation on Tutors”. It will only take 2 minutes or less. The Tutor Rating System link can be found by clicking the Feedback icon at the right side of myVLE. Then, continue by clicking the Tutor Rating System icon. Kindly view the steps in the image to access the survey form.

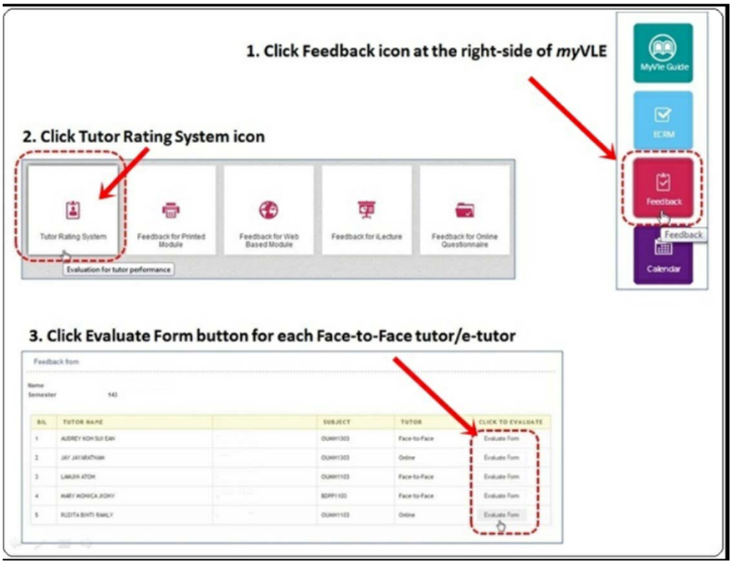
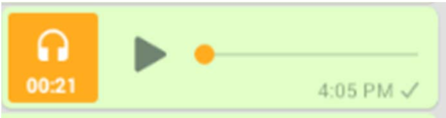
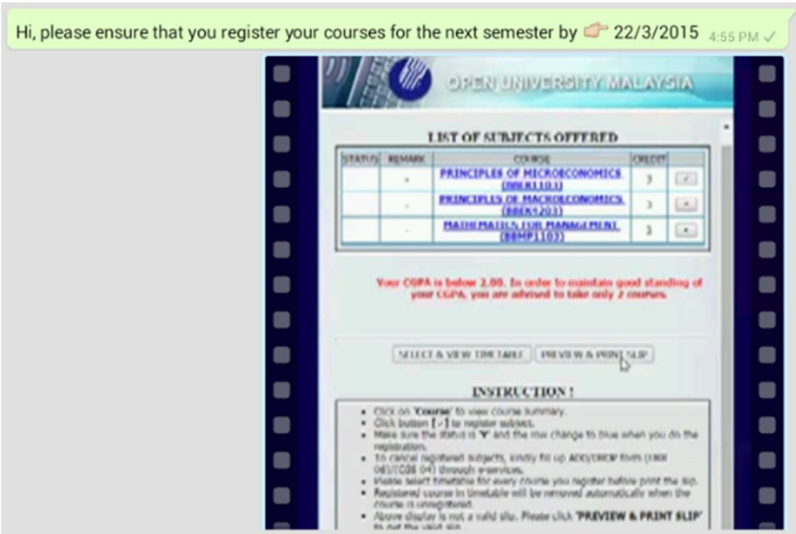
	Thank you for your contribution in evaluating OUM tutors 😊 
Audio	
Video	

Figure 1: Screen shots of WhatsApp messages

2.4 Software and Hardware Tools

At the start, a BlueStacks App Player was downloaded to host the WhatsApp Messenger on the laptop. This software enabled broadcasting of WhatsApp messages to unlimited number of groups with a maximum of 250 recipients per group instead of only limiting to100 recipients per group using the mobile phone device. A local pre-paid phone SIM card number was keyed in the software system which then allowed the laptop to function as a phone device. The audio and video recordings of the messages were done using the smart mobile phone and Snagit 12 Editor software. Some of the video messages were sourced from the YouTube. In addition, the images in the messages were captured and edited using PhotoScape software.

2.5 Procedure

The methods and the procedures of the study involved the following phases:

Phase 1: Development ofMobile Learning Messages

- Identifying the learning support required by first semester undergraduate learners
- Formulating the mobile learning messages using pedagogically sound strategies

Phase 2: Implementation

- Scheduling the mobile learning messages appropriately into the semester calendar
- Delivering / broadcasting the mobile learning messages to the learners. Learners were not allowed to communicate among themselves - this is to avoid the overwhelming number of messages that will likely occur in the group if this option is enabled.

Phase 3: Evaluation

- Collecting feedback through online survey
- Analysing the feedback

2.6 Data Collection Instrument

To collect data, an online survey instrument was created using Google Drive. The online survey link was sent to the learners in the sample group through a WhatsApp message. The questionnaire had 6 question items under the demographic section and 26 questions items were on the mobile learning experience. The next section of this paper highlights the usage pattern of mobile learning support through WhatsApp Messenger messages.

3 Findings

This section analyses the responses collected from the learners via Google Drive online survey instrument. The analyses and interpretation of the findings are presented as follows.

3.1 The Purpose of Using WhatsApp Messenger

Table 3 confirms that WhatsApp Messenger is mostly used for chatting with friends (44%), followed by discussion on job related matters (22.7%). Interestingly, only 8.7 per cent indicated that WhatsApp was mostly used for learning purposes. A total of 14% reported that they do all the activities. This suggests that the WhatsApp Messenger tool is used as a communication tool among OUM learners, allowing them to connect with each other on a variety of matters. It is not just confined to learning but also brings the learners together socially by allowing them to chat and discuss job-related and family matters. The implication seems to be that WhatsApp may help learners by “taking the lonely out of distance learning” (Gilding, Helm and McClements, 1998).

Table 3: *Purpose of using WhatsApp Messenger*

Purpose	**Number**	**Per cent (%)**
Chatting with friends	66	44
Job related	34	22.7
Family matters	16	10.7
Study	13	8.7
All the above purposes	21	14
Total	150	

3.2 Time Spent on WhatsApp Messenger

Figure 2 shows that 28% of the respondents reported they spent an estimated of 1 to 2 hours per day on WhatsApp Messenger. This was , followed by respondents who spent an estimated less than 1 hour (24%). Third place went to respondents who spent more than 6 hours a day (21.3%). This suggests that there is no generalised pattern in terms of time spent on WhatsApp Messenger per day by the respondents, possibly because most distance learners are working adults juggling family with work commitments and thus, it is natural for them to use the WhatsApp according to their individual preference and time available.

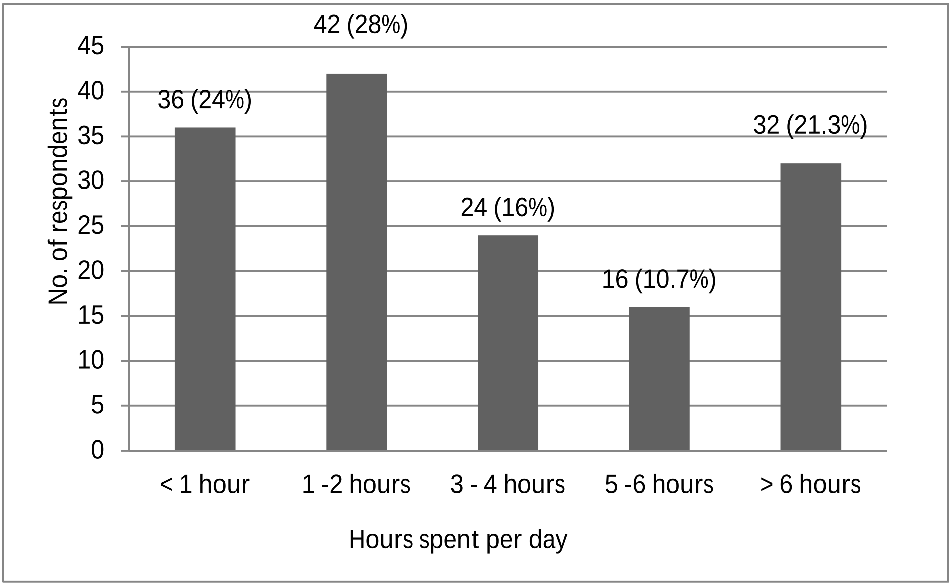


Figure 2: Estimated time spent on WhatsApp Messenger per day

3.3Reaction to Mobile Learning Support Messages via WhatsApp Messenger

The respondents were keen to read or view the mobile learning message sent to them via WhatsApp Messenger as shown in Table 4. A total of 69.3%of the respondents read or viewed the message immediately, followed by 29.3% of the respondents who read or viewed the messages when they were able to do so. Only2 (1.3%) of the respondents never read or viewed the messages sent to them. None of the respondents deleted the message.

Table 4: *Reaction tothe Mobile Learning Support Messages*

Whenever I receive a WhatsApp message from OUM Mobile Learning, I usually will	**Number of Respondents**	**Per cent (%)**
read /view it immediately	104	69.3
read / view it when I am free	44	29.3
delete it immediately	0	0
not read / view it at all	2	1.3
Total	150	

Table 5 also shows that 75.3% of the learners read or viewed the mobile learning messages twice or more. These findings suggest that most learners considered the messages deserving of their time.

Table 5: *Frequency of Reading the Mobile Learning Support Messages*

For each OUM Mobile Learning WhatsApp message received, I normally read /view	**Number of Respondents**	**Per cent (%)**
once only	37	24.7
twice only	55	36.7
more than twice	58	38.7
Total	150	

As shown in Figure 3, a large number which represents 50% of the respondents preferred text type WhatsApp messages, followed by image type WhatsApp messages (32.7%) and subsequently by video type WhatsApp messages (13.3%).

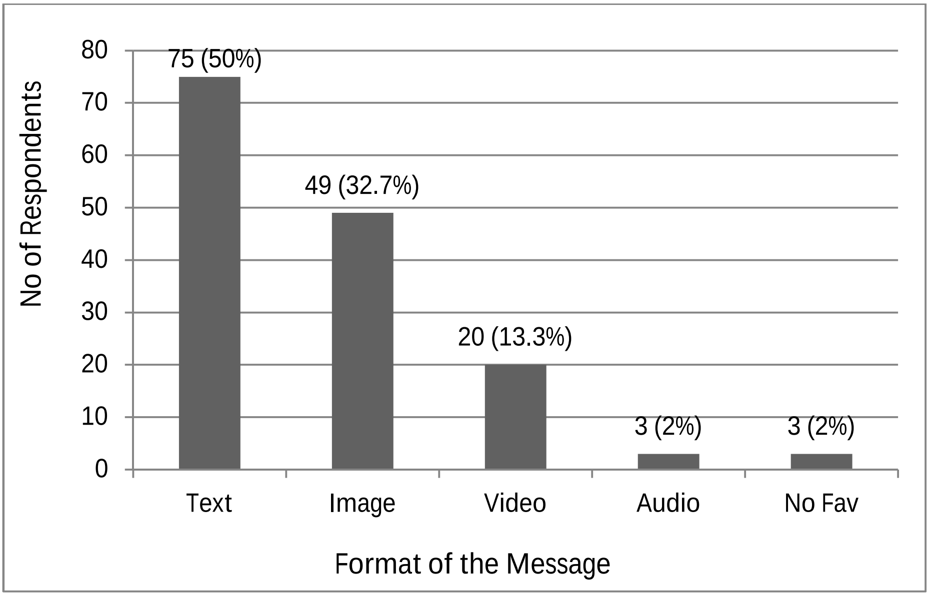


Figure 3: Preferred message format

Figure 4 shows that more than half of the respondents (51.3%) preferred to receive announcements / reminders type of messages followed by respondents who preferred learning tips (36%) and 10% of the respondents reported to like the guide on myVLE.

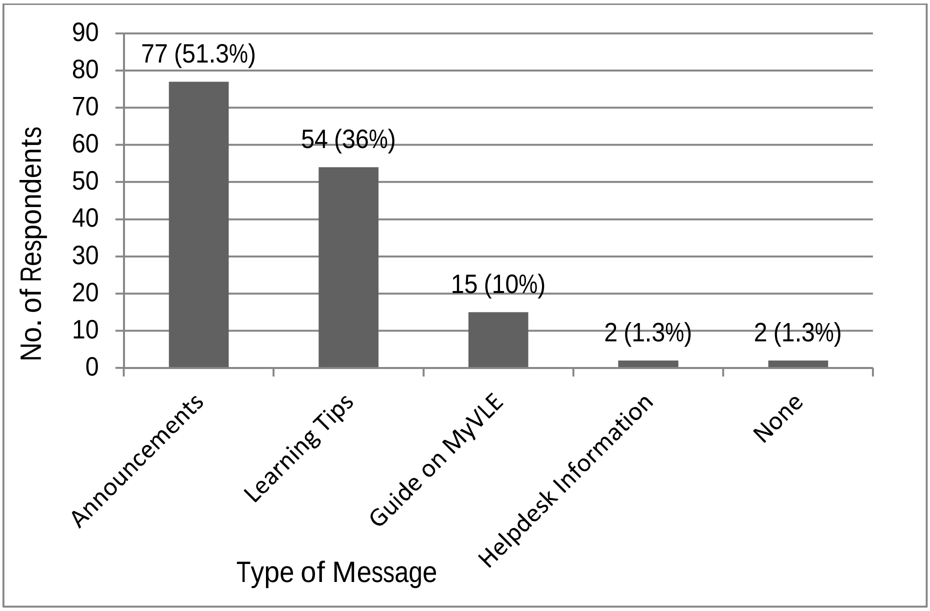


Figure 4: Preferred message type

Interestingly, this depicts that respondents tend to prefer text messages over rich video format type of messages because it is most effective format for receiving reminders easily and quickly. Heavy video and /or audio files can be very slow and need time for downloading but text messages can be instantly received and easily convey the required information. Even though many of the videos were no longer than one minute in duration, some learners found it difficult to access due to slow downloading.

Overall the mean for the satisfaction rating given by the respondents was 4.37 (from 1 being "least satisfied" to 7 being "most satisfied"). The rating is above average and that is because many of the respondents felt that the mobile learning messages were beneficial and useful to them as indicated in their comments as follows:

"The daily reminder was interesting and helped to motivate the learner" (Learner ID5).

"Quick, fast, and easy understanding." (Learner ID20).

"Easily understood …. I don't access myVLE often as I've work responsibility. I depend on WhatsApp to remind me" (Learner ID21).

"Its help me alot when I do my assignments" (Learner ID32).

"I give a rating of 4 because I have gained a lot from the messages received especially tips on doing assignments and reminder for the assignments deadline (Learner ID83).

However, 26.7% of the respondents rated 3 and below on their satisfaction for the mobile learning support messages.Some of the reasons for the poor satisfaction rating areas follows:

(i) Lack of sufficient information	*"The information given is too general and at times does not provide any great impact" (Learner ID43)* *"Give more information on myVLE at the appropriate moment. More about assignment and library information" Learner ID110)* *"Still lacking of latest information as in myVLE…for an example, information on registration" (Learner ID129)*
(ii) Lack of understanding of the message	*"Sometimes the messages are not in dual languages and therefore need to refer to other learners for understanding it" (Learner ID53)* *"Lack of understanding" (Learner ID86)* *"Because I'm new to learning, I don't understand much about it" (Learner ID111)* *"Sometimes I don't understand"(Learner ID112)*
(iii) Uninteresting content	*"Content is less interesting" (Learner ID36)* *"Bored with texts" (Learner ID38)*
(iv) Downloading time	*"Sometimes it is difficult to access due to slow downloading" (Learner ID76)*

4 Implications and Conclusion

WhatsApp Messenger is primarily used for chatting with friends andacceptedas a media for social networking; however it has great potential to be used as a tool for facilitatinglearning or provide the support for learning. The mobile learning support messages were meant to enhance awareness of the University's learning environment to new undergraduate learners and also to reduce the feeling of isolation among ODL learners. Broadcasting one to three messages per week regularly in the semester helped to create a connection between the learners and OUM.

The findings of this study revealed that the mobile learning support via WhatsApp Messenger had successfully helped majority of the learners and they considered the messages useful and worthy of their time and attention. However, the mobile learning support need to be enhanced further based on the feedback received. In future, the mobile learning support messages will include more important reminders and will be delivered in both the English and the Malay language toensure undergraduate learners understand the messages.

Future work will focus on how the postgraduate learners perceive the mobile learning support and the use of WhatsApp to support learners in high failure rate courses.

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The possibilities of using mobile and flexible technologies to enhance workplace learning in vocational education and training (VET)

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Abstract. This paper discusses the possibilities of using mobile and flexible technologies to enhance workplace learning in Vocational Education and Training (VET). This paper also proposes a number of innovative pedagogical practices enabled by technologies to facilitate better learning and teaching experiences for VET's students and mentors in workplaces. Reforms in Hong Kong's VET programmes give rise in the value of using workplace as an authentic learning environment. This includes the change of delivery modes such as The New Earn and Learn Pilot Scheme, The Dual-track System, The Workplace Learning and Industrial Attachment, that have become more work-driven than content-driven and intend to train students with competencies sought by the industry. Different from traditional education, VET focuses on deliver workplace competencies in situated workplaces more than contemplation of academic theories in school. Students receive theoretical knowledge and practice in simulated work environments in school, whilst the learning and practices of 'authentic' trade-specific happen in their work engagements in real-life workplaces. Although a number of studies showed promising results using mobile and flexible technologies to enhance learning and teaching in higher educational institutions, their adaptability on VET are still in question. While mobile and flexible technologies emphasise self-paced online and virtual learning experiences but conversely, VET stresses on mastery of hands-on skills and practices in authentic workplaces; how would these two learning paradigms complement each other and benefit workplace learning? Findings of this study showed that despite the need of innovative pedagogical practices, the increase in effectiveness of mobile and flexible technologies relies on the instructional design of the trade-specific learning and teaching materials as well as the readiness of students, teachers and workplace mentors.

Keywords: mobile and flexible technologies, pedagogical practices, workplace learning, Vocational Education and Training (VET)

1 Introduction

Half a century ago, McLuhan (1964) advocated “medium is the message” and asserted that any new invention of technology is an extension of ourselves and contributes to the changes in human interactions. To McLuhan, changes are multi-dimensional, addressing technological, societal and cultural aspects. Following this vein, the rapid advancement of information communication technology and the popularity of mobile devices (smartphones, iPads and tablets etc.) and flexible technologies (WiFi, online and web-based networking) ease the accessibility to information. The advancement sparks a phenomenon of technology hype and massive information exchanges. Robertson (2007) contended that there is a “convergence of technologies into the single units and a shift from fixed to wireless and mobile systems” (p.11). Rather than using station and laptop computers, there are increasing preferences on retrieving information using mobile devices. Nowadays, mobility and flexibility are the priorities for technology consumers, especially for the young generation. The impact of the above not just rests on technology and entertainment consumption, but also implies that students may prefer using mobile and flexible technologies for learning. In response to this issue, it is not surprised that higher educational institutions have been experimenting mobile and flexible technologies to enable students’ self-paced online learning for academic subjects. Although promising results were found in a number of studies (Klopfer, Squire, Jenkins and Tan, 2003; Lee, Lam, Liu et al., 2014; Tang, Pang, Wong et al., 2014; Tsang, Yuen & Cheung, 2014), interestingly, while mobile and flexible technologies emphasise self-paced online and virtual learning experiences, Vocational Education and Training (VET) stresses on mastery of hands-on skills and practices in authentic workplaces. Now, the question remains, how would these two learning paradigms complement each other and benefit VET?

For a better understanding of the above, this paper discusses how possible mobile and flexible technologies can be applied to VET and how would they benefit and enhance workplace learning. Through extensive review of literature and policy documents, this paper addresses the current VET’s position and practices then proposes a number of innovative pedagogical practices using mobile and flexible technologies to facilitate better learning and teaching experiences for VET’s students and mentors in the workplace.

2 Current Issues in Vocational Education and Training (VET)

2.1 A Global Perspective

The global VET sector has undergone rapid changes in the past decade. Findings from the report “Global Trends in Vocational Education and Training” (Dandolopartners, 2011) revealed that one of the global trends is that students are coming into vocational education at an earlier age and later in life. The report found that in the United Kingdom, the total number of vocational qualifications awarded increased 11% in 2009, driven largely by students undertaking vocational courses at school (BBC News, 2009). The number of school students aged 15 to 19 participated in Australian vocational education and training also increased nearly 30% from 167,100 in 2006 to 216,700 in 2009 (NCVER, 2010). In Asia, Singapore, for instance, quadrupled its annual capacity in continuing education and training from 22,000 workers in 2007 to 80,000 workers in 2010 (Ministry of Manpower Singapore Government, 2010). Likewise, China has introduced a ‘dual certification’ system that provides students with a diploma and vocational permit upon graduation from secondary vocational education schools to enhance the work-readiness of its young people (Australian Education International, 2010). Indeed VET aims to give people skills – skills like lift maintenance, automobile repair, culinary, design, and so on – that would help engage them in useful endeavours and at the same time address the operational needs of the society. VET is also to recognise that people are of different talents – some geared more towards academic study, and others towards hands-on dexterities – and offer them education that suits their attributes. In sum, the above signifies a growing anticipation on the possible aid of VET towards a number of societal and economic issues – the higher unemployment rate of the youth, the large number of traditional schooling’s down-and-outers generated every year who are frustrated with where to go in employment or education, the shortage of suitably skilled manpower in the various service and industry sectors of the society etc. To better cater for the increasing demand and diversification of trade-specific subjects in VET, governments and VET institutions in different countries has begun to make significant efforts to enhance VET’s positioning, curriculum design and delivery, learning and teaching strategies as well as industrial and community collaborations.

2.2 The Hong Kong Experience

VET has received more attention in Hong Kong in recent years. There are a few significant factors contributing to the betterment of VET. Firstly, VET is reckoned as an alternative study pathway beneficial for the less academically achieved students. Secondly, there is a growing demand of skilled labour in some of the industries, especially for those manufacturing and production lines returned from China. Thirdly, there is an urge of the Hong Kong Government to produce graduates with knowledge and skills matching labour qualities demanded by various industries. There are signs that Hong Kong Government has started to step up her emphasis on VET. The Government had set up a Task Force on Vocational Education to map out a strategy to promote vocational education in the community as well as to enhance the image and quality of vocational education. 2014 is a particularly important year for VET in Hong Kong. An evidence is that a substantial portion of the 2014 Policy Address of the Chief Executive of Hong Kong was spent just on VET. The Chief Executive in the 2014 Policy Address highlighted that “mainstream education is not a straightjacket that fits all young people as everyone has his or her own interests and abilities. The Government should re-establish the positioning of vocational education in our education system and guide the younger generation in choosing their career" (Hong Kong SAR Policy Address 2014, p.102). He went on to announce a series of measures to strengthen VET and support its development alongside academic education. In particular, a pilot training and support scheme 'The New Earn and Learn Pilot Scheme' achieved by "integrating structured apprenticeship training programmes with clear career progression pathways" was proposed to attract and retain talent for industries with a keen demand for labour (Hong Kong SAR Policy Address 2014, p.106). The new Earn and Learn Pilot Scheme integrates structured vocational education and on-the-job training with clear progression pathways to attract talent for industries and trades. The Government and participating industries will provide the participants with an allowance and a guaranteed salary, such that young people can earn a steady income while equipping themselves with knowledge and skills to pursue a promising career. The modes of training will be specially designed to cater for the needs and operation of specific trades and industries. Participants will study training programmes of VET and receive on-the-job training at employing companies. Graduates of the schemes can also pursue further studies to acquire higher academic qualifications for career development. The New Earn and Learn Pilot Scheme was subsequently endorsed by the Legislative Council. During their study in the Scheme, students receive theoretical knowledge and practice in simulated work environments in school, whilst the learning and practices of 'authentic' trade-specific and generic competences such as communication, team-work, problem solving, transferability and work ethics happen in their work engagements in real-life workplaces (Deissinger, 1997; Merrienboer, 2001; Tremblay and Le Bot, 2003). For the above reasons, VET in Hong Kong has developed to have heavy emphasis of workshop learning and industrial attachment. The salient issue is then the development of appropriate pedagogical approaches that enable the workplaces, in the settings of Hong Kong, to be used as authentic learning environments.

2.3 The Distinctive Nature of VET

VET emphasises mastery of hands-on skills, and pursues that students acquire more generic and higher level knowledge together with work professionalism (i.e. work ethics and work attitudes) (Mohamad, Heong et al., 2012). There are over 60,000 full-time VET students studying in different trade-specific disciplines in Hong Kong's VET institutions. Most of the programmes aim to equip students with 'authentic' trade-specific and generic competences, and work integrated learning has been a basic requirement in the related curricula. Jiang (2014) asserted that applying theories to practices through competency-based training (CBT) and task-oriented learning approach in an authentic work environment is extremely important in VET. Naturally, for effective delivery of VET, the education pedagogy has to go beyond the use of lectures, literature review, tutorials etc. which heavily emphasised in traditional schooling. Competency in tackling tasks and solving professional problems with sound understanding of the fundamental concept behind each process constituent is the target outcome of learning. Hands-on exposure to skills in workshops, in simulated work environments, and in real workplaces must be is a key feature in VET to be well utilised. However, the fundamental questions remain on how school-based learning and workplace learning can be designed, delivered and assessed coherently so that they reinforce or complement each other.

3 Workplace Learning and Situated Learning

Rauner and Maclean asserted that "vocational education and training is characterised by the crucial importance of learning in the work process as a dimension of intentional and informal competence development" (Rauner and Maclean, 2008, p.15). Workplace learning is an important characteristic of VET as it provides "a fertile opportunity for learners to appropriate knowledge that connects theory to practice in a realistic and efficient way" (Billett, 1996 c.f. in Smith, 2003, p.53). Workplace learning is a manifestation of Lave and Wenger's (1991) view of learning as "situated activity" (p. 29). In these authors' view, learning is a social process in which learners participate in the lived-in world and understand the world as they experience it. During workplace learning, students experience the real, factual consequences of their doing and the ultimate aim is 'learning transfer': students internalise the theories and skills and then export to the field of enterprises and connect their learning experiences so that an earlier learning process can enhance a later process in a positive way (Bank, 2013). Research revealed that most VET learners prefer to learn in groups and from mentors in workplaces rather than learning on their own. Collegial context for learning is the essence of workplace learning where learners learn in social environment assisted by peers and instructors (Sangster, Maclaran and Marshall, 2000; Smith, 2006). Apparently, it is asserted that applying theories into practices through a competency-based training (CBT) approach in authentic work environment is exceptionally important in VET. However, given that many of the workplace mentors are trade specialists and do not have formal academic training, students' learning of subject theories in the workplace may not be provided. Instead of training, it is very often that students spend most of their time doing practical and production work without a solid knowledge and theoretical background, hence, learning outcomes may not be archived and students may not benefit from the workplace learning as much as desired (Evans, 2001, Smith, 2003, 2006; Stehlik, 2003). Furthermore, as there are increasing changes in VET's programmes and delivery modes in Hong Kong, i.e. The New Earn and Learn Pilot Scheme, The Dual System, The Workplace Learning, Industrial Attachment and the extended scope of new VET disciplines, i.e. design, information communication and technology, nursing and health care, just to name a few, it is necessary to review and propose innovative pedagogical strategies for VET in order to cope with the needs of students, mentors, institutions and industries in the workplaces.

4 Apply Mobile and Flexible Technologies to Enhance Workplace Learning in VET

In addition to learning management platforms (Moodle, Blackboard etc.), technology enhanced learning such as 'MOOC', 'Flipped Classroom' and 'Lecture Capture', in particularly enabled by mobile and flexible technologies (smartphones, iPads, handheld devices and WiFi, online, web-based networking) have become common means to facilitate learning and teaching in the education sectors. These kind of technologies provide "just-in-time contemporary learning and can be accessed from any site" (Choy, 2006, p.2). Other than supplementary activities, technology enhanced learning when combined with flexible delivery and situated, workplace learning would able to promote students' cognitive and transferable skills, i.e. problem solving, analysis, reflection, learning to learn, self-management, collaboration as well as nurturing of life-long leaning attitude. Studies have found mobile and flexible learning best connects theories and practices to enrich workplace learning experiences in VET (Smith, 2003, 2006; Stehlik, 2003; Hiller, 2009; Liu, Han and Li, 2010). As early as 2000, Mitchell (2000) observed the emerging of a network-based model of workplace training and realised that there is an increasing use of flexible learning methods involving technology-mediated forms of delivery. Liu, Han and Li, (2010) pointed out that "mobile learning is increasingly used in workplaces, museums, schools, enabling a wide spectrum of possibilities" (p.210). For instance, if students are to spend much of their time in the workplaces, having a certain number of learning sessions that do not require the students to go back to school but allow them to be in different workplaces to co-learn together at the same time-slot becomes desirable. In workplaces, students apply academic theories into practices and collaborate with peers and mentors for a better understanding of tasks. To make the above possible, Billett (1996) suggested develop learning strategies based on students' everyday practice and human interactions in connection with mentoring, direct instruction, observation and listening, other workers and the work environment" and subsequently found that "everyday practice and engagement with authentic activities were consistently viewed as more effective than print-based instructional materials (Billett, 1996 c.f. in Smith, 2003, p.53). For that to be possible, effective means of pedagogies that take advantage of the mobile and flexible technologies need to be introduced to facilitate better quality workplace learning.

Taking this opportunity to better facilitate learning of different trade disciplines (i.e. nursing, catering, language) in diverse workplaces, a number of studies on the effectiveness of using mobile technologies (Tsang, Yuen and Cheung, 2014), social media and instant messaging (Ng and Leung, 2014), and real time augmented reality (Lee, Lam, Liu et al., 2014; Tang, Pang, Wong, et al., 2014) have been conducted by Hong Kong's academics to enhance students' motivation, learning interest, collaborative learning as well as their cognitive, psychomotor and communication skills with promising results. Such kinds of flexible, mobile, web-based and blended-learning tools would allow VET students to review recorded lectures or participate in live-broadcasting learning sessions (i.e. lectures and seminars in schools or conferences) and share their views collaboratively in their own workplaces. In view of the above, it is assumed that appropriate technology enhanced pedagogical approaches ultilising mobile and flexible technologies would promote learning and teaching in workplaces and generate mutual benefits between workplace mentors and students for better learning and teaching experiences in the workplaces. Interestingly, Liu, Han and Li (2010) found that although students are enthusiastic in mobile devices, flexible technologies and all sort of online activities, they regarded themselves as technologies users and consumers rather than learners. Similarly, Robertson (2007) also found students prefer using mobile devices and flexible technologies for entertainment, to acquire information and communicating with others but they seldom use them for educational purposes. Given mobile and flexible learning provides learners with a large degree of leaning autonomy; it requires learners to have a higher degree of self-directness, self-management, persistence and independency. On the other hand, teachers also expressed their views that they are more likely to use technologies in teaching practices if they are user friendly and compatible with their existing practices and teaching needs (Errington, 2001, 2004; John, 2002, 2005 and Robertson, 2005a, 2005b c.f. in Robertson, 2007). Furthermore, while mobile and flexible technologies are well adapted for higher educational institutions' academic subjects and theory classes, their applicability on VET's trade-specific subjects are still in question because generally teachers and mentors regarded that there is no substitutions for practical and hands-on lessons such as mechanical engineering and printing. Therefore, the consideration of what to be taught in schools and workplaces and what should be covered by mobile and flexible technologies is crucial. It is assumed that mixed modes or blended-learning delivery with appropriate instructional design enabled by mobile and flexible technologies could be the solution. In sum, application of technology enhanced learning in VET is a dichotomy with a number of problematical issues yet to be resolved.

To enable the workplaces, in the settings of the Hong Kong, to be used as authentic learning environments for VET, The Vocational Training Council (VTC) in her strategic plan for learning and teaching has salient the importance of technology enhanced learning for the benefit of VTC's students, teachers and workplace mentors. The initiatives including a study on using mobile and flexible technologies to facilitate learning in workplaces, a study on flipped classroom and social media, a study on wearable technology, the adoption of video capture system in lecture theatres and classrooms and, a pilot scheme of mini-MOOC and a project on Augmented Reality/ Virtual Reality (AR/VR). The authors of this paper work in the Centre for Learning and Teaching in the VTC, with their major duties in supporting learning and teaching initiatives the VTC, they have been providing instructional design for teachers and mentors on the pilot tests and projects on the applications of technology enhanced learning in workplaces. Examples of proposed and piloted strategies are illustrated in the following section.

5 Proposed Strategies of Technology Enhanced Learning

With an aim to better support students to obtain trade-specific skills and provide them with record of performance and timely feedback in workplaces, technology enhanced learning in different forms are being adopted as supplementary and complementary learning activities. Learning and teaching resources in the forms of video (lecture capture, live broadcasting, wearable technologies, mini-MOOC), Augmented Reality/ Virtual Reality (AR/VR) and instant messaging (social media, group chat) were developed for students and teachers' ease of access. The major direction in developing the learning and teaching resources is on the resources' mobility and flexibility.

5.1 Video Capture System, MOOC and Wearable Technology

To cope with VET's increasing flexible delivery mode, video capture system provides opportunities for students to review lectures in workplaces or after work at their own pace. Employing the concept of 'Bring your Own Device' (BYOD), it is recommended that students bring in their own mobile and handheld devices such as smartphones, iPads to access the learning materials. An example to illustrate mobile learning in workplace would be: since there are more than 100 basic recipes in culinary study, students may have difficulties to memorise the exact ingredients for particular dishes. In such case, with the use of mobile devices, they can retrieve the recipes or short video clips of demonstrations for immediate references without flipping through cook books or print-based materials that are not convenient to carry around in the kitchen or learning area. Merits of mobile learning in workplaces are not limited to the suggested and are subjected to well planning of curriculum, instructional design together with teachers and mentors' facilitation skills. For instance, students who engage learning in workplaces such as kitchens, flight cabins or work locations that normally are not equipped with computer facilities can use their own mobile devices to retrieve recorded lectures or watch live broadcasting of pre-scheduled lectures and seminars simultaneously in different work locations without the restriction of viewing them in classroom settings. Together with the group chat and instant messaging functions, students can conduct real time questions and answers with teachers and peers. Taking the advantages of these mobile technologies and apps, teachers can further generate discussions on particular issues raised from the lectures followed by group or individual tutorials. A typical blended-learning lesson enabled by mobile and flexible technologies in workplaces would be: students attached in different workplaces will first practice skills and solve particular problems in workplaces assigned by workplace mentors followed by watching a pre-scheduled lecture (recorded or live broadcast) specially designed and related to the assigned practices and problems on their mobile devices. Secondly, students learn the theories or solutions from the recorded or live broadcasted lecture, then conduct online peer discussions and tutorials with the lecturer through instant messaging. Afterwards, students can try out the learnt theories and skills in their workplaces. Last but not least, mentors can conduct on-the-spot assessments using the apps on their mobile devices and send the marks and comments to their students instantly. These kinds of mobile enabled blended-learning activity, if well designed would generate multi-groups sharing as well as to promote learning transfer to enrich learning experiences.

Similar learning and teaching activities can be applied on MOOC to facilitate workplace learning. As MOOC is well studied by academics and researchers, it is not necessary to generate additional discussions in this paper. Nonetheless, the key issues of MOOC rest on the contents, instructional design and online assessment. Despite well-developed learning and teaching resources, the readiness of VET students is another issue because VET stressed on trade-specific skills and currently most of the MOOCs' topics are on theories and humanities. In addition, the attention span and self-learning skills of VET students are much shorter than students studying academic subjects. The above raised another thought on how to incorporate MOOCs with workplace learning To accommodate the above, mini-MOOCs with a 30-minute video each are developed and pilot tested to cater for VET students' learning preferences and the teachers and mentors' acceptance. The result showed that mini-MOOCs are best aligned with the concept of 'flipped classroom' to enable pre-class theory study. Similarly, wearable technologies such as Google Glass and Go-Pro Camera enable workplace mentors to record or conduct live broadcasting of their demonstrations of specific trade skills for students' instant viewing or playback. For example, with strapped-on wearable recording devices, mentors in hair salon can video record the procedures, processes and skills during hair washing, cutting, or perming on his/her hair models or even real clients from the hairdresser's viewing angle. Despite the different locations of students, they can watch the mentor's demonstration projected on a screen together or on their mobile devices. It is also helpful for the students to review the demonstrations step-by-step from the recorded video for a better understanding of the procedures at their available time. The demonstrations from real-life work tasks also apply to other trade-specific disciplines (mechanical engineering, printing, hospitality and servicing industries etc.).

5.2 Augmented Reality/ Virtual Reality (AR/VR)

Augmented Reality and Virtual Reality (AR/VR) learning would arouse students' interests according to their learning preferences. AR provides learning experiences in immersive environments for a live direct or indirect view to generate physical, real-world experiences augmented by sound, videos, graphics or animation etc., while VR uses virtual or simulated environments generated by computers to enable students' presence in the virtual environments. In VR environments, students can feel the sensory experiences that may involve taste, sight, smell sound and touch etc. and interact with equipment to practice tasks. AR/VR is cost effective in terms of flexibilities. It is much easier to change the virtual environments than having different physical set ups of venues and scenarios and enable student for a faster knowledge transfer because AR/VR allows repeat practice for a large number of students simultaneously in a virtual environment before practice in real life locations. Examples of using AR/VR in VET context including the AR/VR retail laboratory on one of VTC campuses. The retail laboratory is equipped with a changeable non-immersive VR environment (projected to one side of wall) to cater different contexts and scenarios for students' practices on the operation of a supermarket or a retail store. AR technologies are also applied on the real goods and commodities on the display shelves, using mobile devices, students can learn the origins, history, characteristics, ingredients and details etc. of the goods and commodities in forms of three-dimensional (3D) animation and graphics. Another AR/VR training facilities for practical training in electrical and mechanical services provides students with immersive simulated VR environments (projected to the whole room from wall to wall and floor to ceiling) that simulate real life locations. The facility is now equipped with a simulated 3D engine plant room with the scenario of safety enhancement as context tailored for the training on safety procedures. Further training using the facility can be designed as supplementary or complementary activities to facilitate learning between schools and workplaces. For instance, a scene with the scenario of routine maintenance checking to be conducted on a roof top of a skyscraper can be simulated into VR environment for students' practice of diagnostic and observation skills, so as to identify risks and problems in the simulated environment that need to be addressed. Students can work on the checklist on their mobile devices and report their diagnostic assessments of the roof top to teachers for comments. The same learning and teaching activity can be applied to environments of other contexts, i.e. flight cabins; construction sites, restaurants or hospitals. The activities do not stop here; further follow-ups include working on real machines and tools in the real workplaces or workshops to tackle the problems identified in the VR environment. Riding on the experience of the pilot tests, it is planned to further develop a series of learning resources on arboriculture, aircraft and lift maintenance, and engineering and automotive engineering to enrich students' learning experiences. In sum, the flexibilities of AR/VR technologies enable ease of adaptation, recycling and timely update of learning materials. AR/VR facilities once installed can be employed to deliver different learning contents; it also well suits the purposes for learning and practicing trade-specific methodical skills in safe simulated virtual workplace environments.

In a nutshell, the pilot tests suggested that for content development of mobile and flexible learning, it requires three types of specialists, a programmer, an instructional designer and a trade-specific expert. Furthermore, to implement mobile blended-learning or AR/VR learning in workplaces effectively, the collaborations between lecturers and workplace mentors are also essential. There is a need for them to negotiate the distribution of teaching and mentoring workload and plan thoroughly on who, when, how and what to do to facilitate lessons in workplaces.

6 Implications and Conclusion

Like all kinds of new innovations, learning and teaching with new technologies raised a number of issues and implications that need to be looked into. The first issue rests on the investment. The investment on hardware and software is high with most of the expenses are being spent on the upgrading and maintenance of equipment and on the renewal of newer versions of software. The first generation iPad is regarded as a dinosaur when compared to the latest iPad mini or iPad Air and the smartphones are getting smarter and smarter with advanced technologies. Secondly, with the rapid changes in trade skills, contents of VET learning resources have to be constantly updated to meet the industry standards. Thirdly, it is realised that there is a shortage of professionals for content development (programmers, instructional designers and animators etc.) without mentioning teachers and mentors in specific subjects and trades. Fourthly, the acceptance, willingness, readiness and mindset change of teachers, workplace mentors and students are the hurdles on using mobile and flexible technologies for learning. Teachers and workplace mentors may find the new technologies not applicable to VET training because of VET's heavy emphasis on hands-on skills. To cite an example, a teacher once asked the authors that how could students practice a simple task like tightening and loosing nuts and bolts on a simulator? In real life, you need to use certain degree of strength to tighten and loosen nuts and bolts but in today's technologies, it may not able to achieve it unless you invest a fortune to develop the hardware and software. Another teacher said that people only live once; you will not hurt in simulated environments if you make mistakes but will surely injure in real life. Fifthly, to implement mobile and flexible learning, teachers and mentors need a closer work relationship and better instructional design but in reality, the collaborations between the two players are sparse. Very often, workplace mentors learnt from their jobs and not likely had received formal trainings in mentoring skills, learning and teaching pedagogies as well as principles of assessment. A noteworthy point derived from the students' perspectives suggested that although students are followers of technologies, they may not prefer using their mobile devices for learning as most of them are technology users and consumers rather than learners. Moreover, as indicated by earlier studies, VET students prefer working in groups rather than self-learning. They need a lot of guidance and supervision from workplace mentors. Therefore, the distribution of blended-learning activities between schools and workplaces is another issue to be examined. Hereby, the authors suggested that applicability of mobile and flexible learning in workplaces should not be substitutions of real-life practices. On the contrary, it should be regarded as supplementary or complementary activities. Last but not least, effective mobile and flexible learning largely depends on the instructional design of the learning materials and learning supports from workplace mentors to raise motivation, sustain engagement so as to enrich learning experiences.

Implications of this paper provided views for further study on the effectiveness of using mobile and flexible technologies to enhance learning in VET. Future studies may focus on the motivation, acceptance and readiness of the key players: teachers, workplace mentors and students. The proposed strategies on the development of innovative pedagogies to facilitate mobile and flexible learning in workspaces are yet to be explored and refined. Given the varieties of trade-specific modules, it is suggested to develop core and foundation modules' learning resources for the most popular trades that can be easily adapted for enrichment, for example, engineering disciplines, culinary and catering services or hospitality and retailing industries. To conclude, this paper addressed the increasing needs of mobile and flexible learning technologies to accommodate the fast changing VET sector. This paper also discussed the importance of applying new technologies to enhance students' learning experiences in workplaces. With examples of innovative learning and teaching pedagogies, this paper further proposed using mobile and flexible technologies as complements and supplements learning and teaching strategies to enable self-paced learning and practices of hands-on skills in authentic workplaces.

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Can classroom response systems improve the learning performance of Hong Kong undergraduate students?

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Abstract. Clicker is one of the most popular wireless classroom response systems. Numerous studies reported that clickers could effectively engage students in class. However, most of them were not talking about Hong Kong and their finding seldom reported student perceptions on using this mobile technology in learning. Hence, the study is to fill in the gap to collect students' perception on using clickers and to investigate the impacts of clickers on academic performance of Hong Kong undergraduate students in finance classes. The data about student perception using clickers was collected by the survey and the academic performance of students was measured in term of their final examination results. In the study, most of students agreed that using clickers was fun and believe that using clickers could improve their learning competency. The results found a statistically significant difference in the examination results between clicker users and non-clicker users. On average, student using clickers performed better than those not using clickers. Overall, the study found that clickers could improve learning efficacy, raise student involvement in class and most of Hong Kong students were positively towards using clickers.

Keywords: Classroom response system, Clickers, Hong Kong

1 Introduction

Over last decades, most of universities encourage instructors to us innovative teaching methods to raise the teaching qualities and students' leaning efficacy. According to Han and Finkelstein (2013), classroom response systems such as clickers are interactive and effective teaching technologies for tertiary education. The clicker is a wireless classroom response system and it can effectively allow students to answer questions and let instructors make timely feedback to students in class. The questions and the results summarizing student responses can be shown to students simultaneously. Both formative assessment and real-time feedback to students to improve their learning and engagement in class are the main purposes for adopting the "clicker" (Han and Finkelstein, 2013). One of the main function of "clicker" is to help the instructors adjust the flow and focus of their lecture materials based on students' feedback, which is regarded as positive outcome of "clicker" by a number of studies (e.g., Dufresne et al., 1996; Cue, 1998; Draper et al., 2002; Elliott, 2003).

Numerous studies have presented that adapting appropriate teaching instruments, like clickers, can promote student engagement and learning performance (Fies and Marshall 2006, Hoekstra 2008; Kaleta and Joosten 2007 and Rice and Bunz 2006;). As Bruff (2009) showed that teaching along with classroom response systems such as clickers could increase student attendance and interest. Judson and Sawada (2002) also confirmed that using clickers in teaching improved student engagement and involvement in class. A number of scholars also supported that the immediate feedback using clickers was indeed effective in improving examination results of students. (Draper et al., 2002; Lantz, 2010; Lantz and Stawiski, 2014; O'Donoghue and O'Steen, 2007; Ghatala, 1981; Glisky & Rabinowitz, 1985; Hirshman & Bjork, 1988 and Taconnat et al., 2008).

Some prior studies have found that clicker could decrease the response reticence especially in large classes (Cue 1998; Draper et al., 2001 and Elliott, 2003). Mayer et al., (2009) also showed that by adopting the "clicker" in class, students were supposed to get more involved in cognitive activities in the following three aspects: 1) students could be more attentive to the learning material beforehand; 2) students would have more incentive to organize and integrate the learning material, when they were answering the questions; and 3) after receiving immediate feedback, students intended to develop metacognitive skills for gauging how well they understood the lecture materials. Hence, it is believed that using clicker in teaching could change students' involvement in learning from passive bystander to active learner. Thus, it is reasonable for us to assume that the "clicker" can improve students' learning efficiency and raise their engagement in class.

There are two purposes of the current study. The first one is to collect student perception using clickers in class, i.e. whether students enjoy using clicker in class and whether using clicker is useful to them to improve their learning competency. The second is to investigate whether using clickers can improve student learning efficacy, which is measured in term of their final examination results

The remainder of the paper is organized as follows. Section 2 provides the background of the study in which a set of research questions will be developed based on significant and relevant literature. In Section 3, we will provide methodological details including data collection and instruments. Result analysis is provided in Section 4. Finally, we will conclude the findings of the study in Section 5.

2 Background

A number of studies have shown that using appropriate teaching instruments, like clickers, can increase student engagement in class. (Fies and Marshall 2007, Hoekstra 2008; Kaleta and Joosten 2007; Rice and Bunz 2006; Lantz and Stawiski, 2014; Shon & Smith, 2011). As Bruff (2009) showed that teaching along with classroom response systems e.g. clickers can increase student attendance and learning interest. Han and Finkelstein (2013) found that adopting the clicker could provide instructor with a tool to provide real-time feedback to students to improve their learning and engagement in class. Judson and Sawada (2002) also found that use of clickers in teaching improved student engagement in class. Using "clicker" in teaching and learning activities make students more actively engage in class activities. Some studies also pointed out that using clicker in teaching could change the students' involvement in learning from passive bystander to active learner (Cue 1998; Draper et al., 2001; Jones et al., 2001; Elliott, 2003). Hence, we believe that using clickers would promote students' engagement and involvement in class. The first research question of the study is:
1st RQ: To what extent does the use of clickers effectively increase Hong Kong undergraduate students' involvement and engagement in class?

Apart from that, clicker is an effective means of formative assessment as it can provide the instructors with a way to adjust the flow and teaching materials based on students' feedback, which is seen as positive outcome of adapting clicker in class activities by a number of studies (e.g., Dufresne et al., 1996; Cue, 1998; Draper et al., 2001; Elliott, 2003). Draper and Brown (2004) also found that clicker was an effective tool to improve the communication between students and instructors and make instructors understand better about their students. Wit (2003) and Flavell (1979) also found that adapting clicker in class activities could quickly spot student misunderstandings by their responses. Hence, based on above-mentioned studies, we believe that using clickers would improve students' understanding of the topics. The second research question is:
2nd RQ: Will Hong Kong undergraduate students in Finance course perceive that clickers increase their "understanding of the topic"?

Regarding student perception of fun in a clicker-based classroom, many studies provide evidence to support that find that "using clickers in classroom could keep students interested and attentive in a class (Beatty et al. 2006; Fies & Marshall, 2006; Wolf, 1978). Some studies also shows that students find clicker-based classes to be more fun than non-clicker based classes (Burnstein & Lederman, 2001; Dufresne, Gerace, Leonard, Mestre, & Wenk, 1996; Fies, 2005). Poirier and Feldman (2007) reported that students using clickers could earn better final examination results and

reported positive attitudes toward utilizing clickers in class. Based on these results, we hypothesize that students using clicker would perceive using clickers as fun. Thus, the third research question is:
3rd RQ: Will Hong Kong undergraduate students in Finance course perceive that the use of clickers to respond to questions is “fun”?

In addition, prior studies provide evidence to support that using clicker can improve student academic performance in term of their examination results. They find that clicker users can accomplish better examination results than “non-clicker” users. (Mayer et al, 2009; Flynn, 2012; Freeman et al., 2007; Lantz and Stawiski, 2014; Morling et al., 2008; Poirier and Feldman, 2007; Ribbens, 2007; Shaffer and Collura, 2009 and Crossgrove and Curran, 2008). However, a few studies like Karaman (2011) mentioned that the impact of clicker on student learning performance is limited. A few of studies such as Tregonning et al. (2012) which find that there was no difference in examination results between clicker users and non-clicker users. Based on these studies, we assume that the final examination results of clicker users will be better than non-users and so the forth research question of the study is:
4th RO: Will the final examination results of clicker users be better than non-users in international finance course?

3 Methodology

3.1 Sample size

Students who participated in this study were enrolled in the business faculty of Hong Kong Polytechnic University in year-3 International Finance classes. Participation for this study totaled 170 students across four separate sessions and students were assigned into control and treatment groups. Of the 170 participating students, 50 students from one session who did not receive clickers, were classified in the control group. The treatment group received clickers and consisted of 120 participants from three other sessions.

Two Different instructors taught four of the sections sampled for this study. One taught the treatment group and another one taught the control group. Participant information including their responses of the survey and their examination results was coded to maintain anonymity in a secure location by the principal investigator.

3.2 Instrument

Student academic performance was measured by their final examination results. Data on student perception on using clickers in class was collected using a questionnaire from Chan’s survey in 2013 which consists of 100 questions based on items from

Terrion's (2012) and Morling's (2008) previous works about student mobile device ownership and application technology acceptance towards using mobile devices for learning, and student engagement.

At the completion of the course, the students who used the clicker completed a questionnaire. The questionnaire is comprised of 86 items with responses on a 5-point Likert scale.

3.3 Data collection

In the study, academic performance of students was measured in term of their final examination results and was compared across two groups of students: one group using clickers and another group that did not use clickers. Two different doctoral level instructors with 5 years of experience taught four classes, participating in this study met over the course of a semester. In the course, course content including lecture notes was delivered via PowerPoint and the course was taught in a face-to-face setting. For the course with embedded MC questions, the average percentage of question to content slides was 20%, and the instructor of the clicker using sessions employed clickers throughout the delivery of the lecture. Upon response to question, results were immediately showed on a bar graph. If the result showed 10% or more of incorrect student responses, the instructor will re-teach the topic by providing additional explanations to questions. If more than 90% of students chose the correct answers, the instructor would presume the correct response, giving a brief explanation and then moving on.

4 Result analysis

Participants in the finance classes totaled 170 students. Of the total student participation, 50 students were in the control group and 120 participants were in the treatment group in which 98 students completed the questionnaires. Thus, survey data was analyzed using 82% of the 120 total students (N=98). Inferential statistical analysis was performed for the forth research question comparing the final examination results of students between treatment and control groups. Descriptive statistics on the perception of clicker technology usage were collected on the treatment group for research questions one through three.

Based on the survey results, we found that over 90% of student in the treatment group owned at least one smart device and over 60% of them are IOS and Android smartphones **(Figure 1)**. The main response devices for in-class clicker activities were IOS smartphones, followed by Android smartphones, IOS tablets and Android tablets, respectively **(Figure 2).**

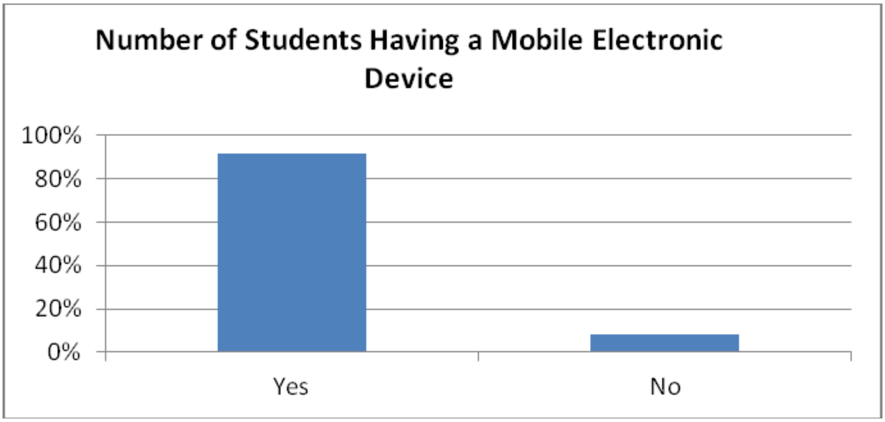

Fig.1. Number of Students Having a Mobile Electronic Device

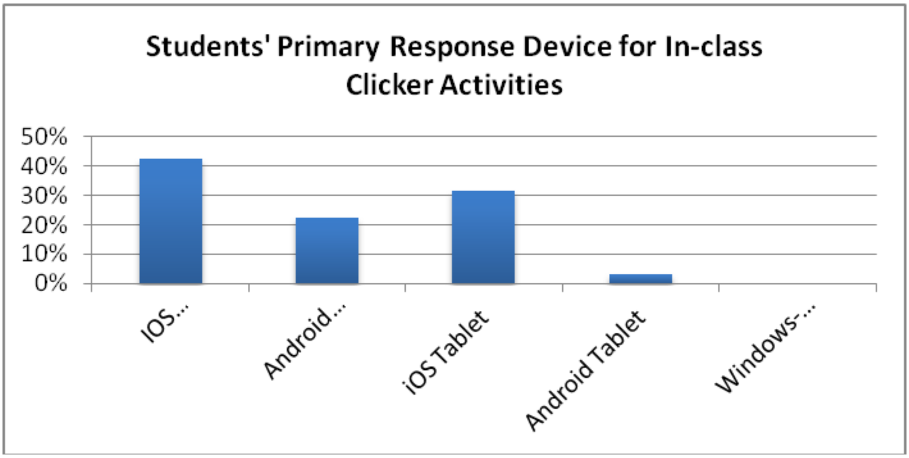

Fig. 2. Students' Primary Response Device for In-class Clicker Activities

Regarding the first research question: *"To what extent does the use of clickers effectively increase Hong Kong undergraduate students' involvement and engagement in class?", we* found that using clickers effectively increase students' involvement and engagement in class. In the survey, over 70% of them agreed that Clickers contributed significantly to their interest in the course (Figure 3) and most of them also expressed that using the Clickers made them feel more engaged and involved in class discussions (Figure 4). Most of students found clickers very useful in their learning (Figure 5). As a result, we can confirm that the use of clickers effectively can increase student involvement and engagement in class.

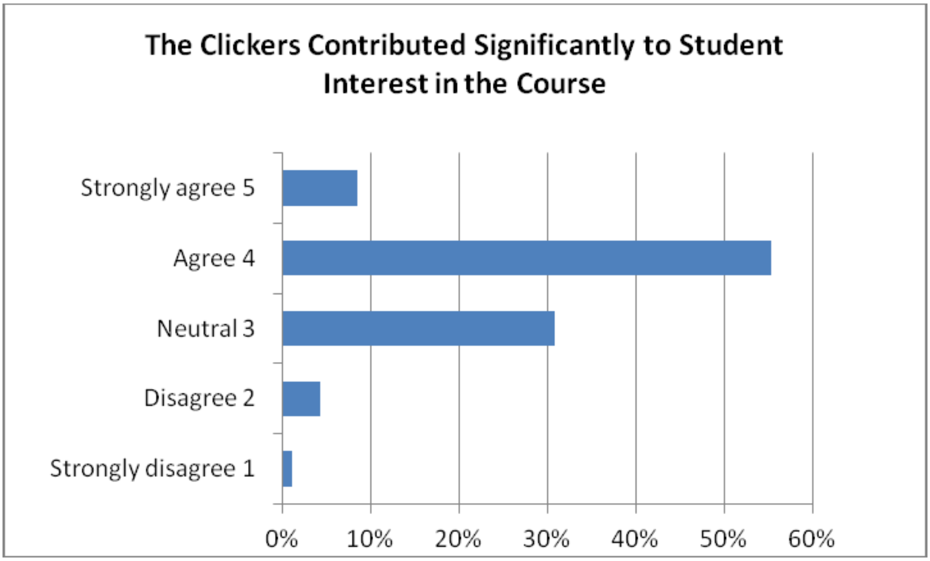

Fig.3. The Clickers Contributed Significantly to Student Interest in the Course

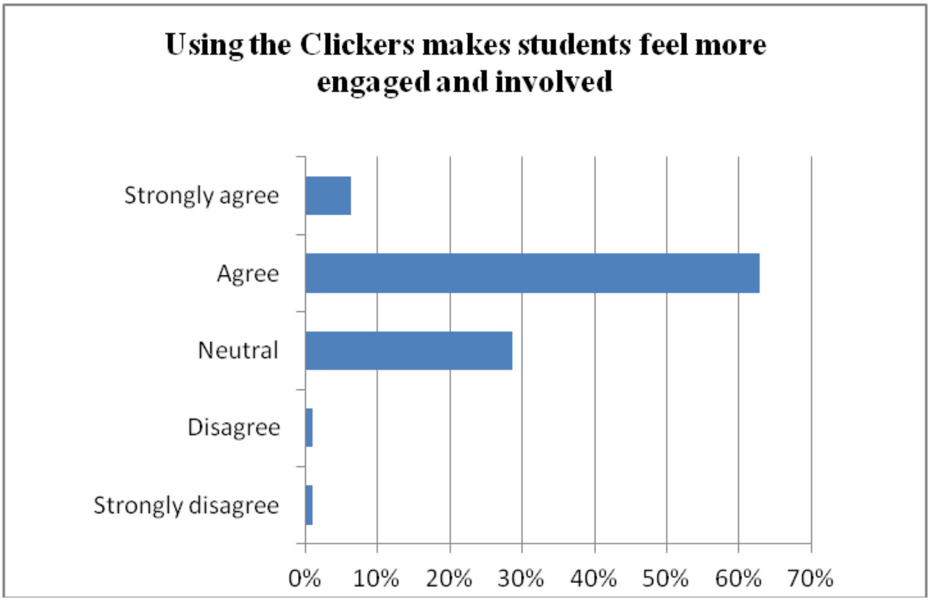

Fig. 4 Using the Clickers makes students feel more engaged and involved

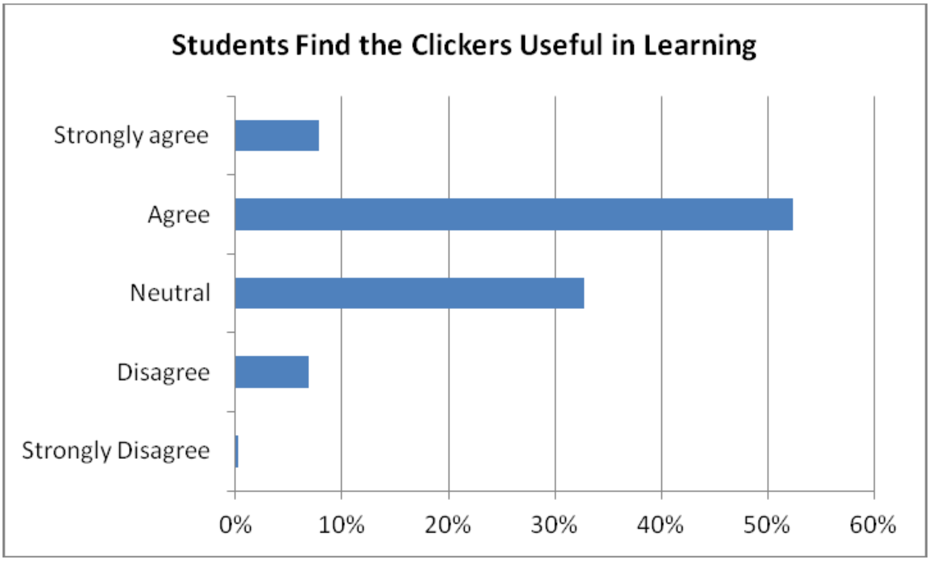

Fig. 5 Students Find the Clickers Useful in Learning

For the 2nd research question about *whether Hong Kong undergraduate students in Finance course perceive that clickers increase their "understanding of the topic"?*, the survey results provided evidence to support the hypothesis. The result reported that over 60% of students found that using clickers enabled instructors to provide them with timely responses (Figure 6) and to clarify concepts that make them confused (Figure 7). About 50% of students agreed that benefits from using clickers could overweigh any disadvantages and a few of them reported negatively towards the use of clickers (Figure 8). Over 60% of students agreed that a continuous usage of clickers was good for their learning (Figure 9).

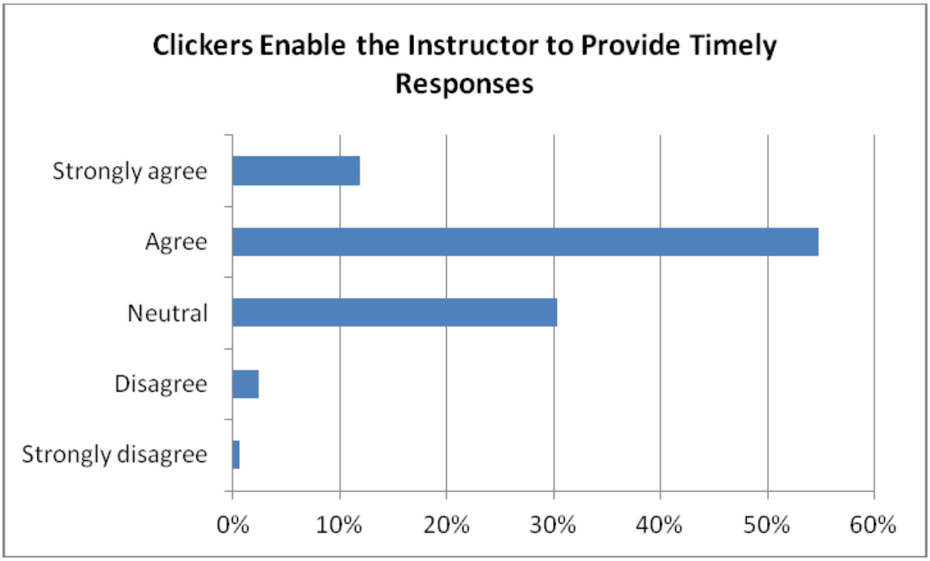

Fig. 6 Clickers Enable the Instructor to Provide Timely Responses

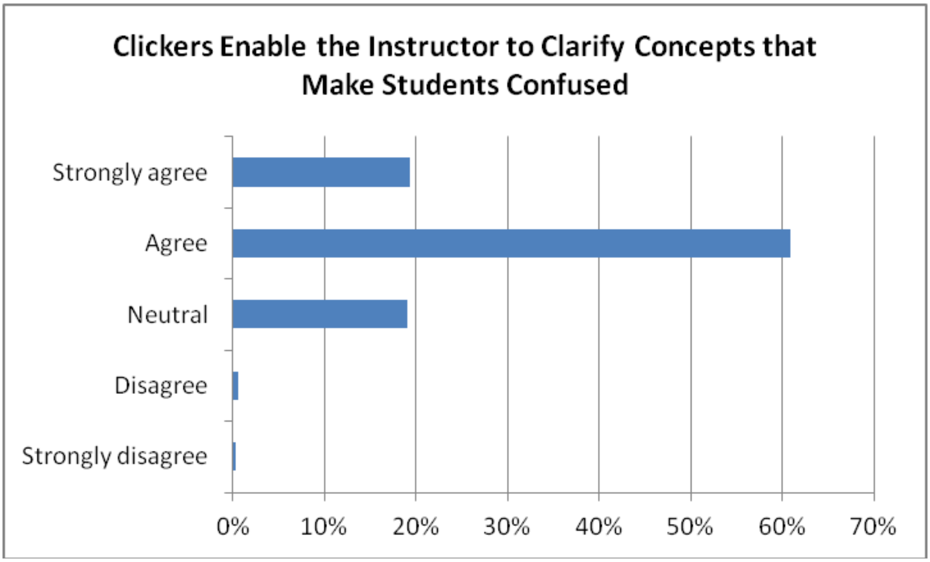

Fig. 7 Clickers Enable the Instructor to Clarify Concepts that Make Students Confused

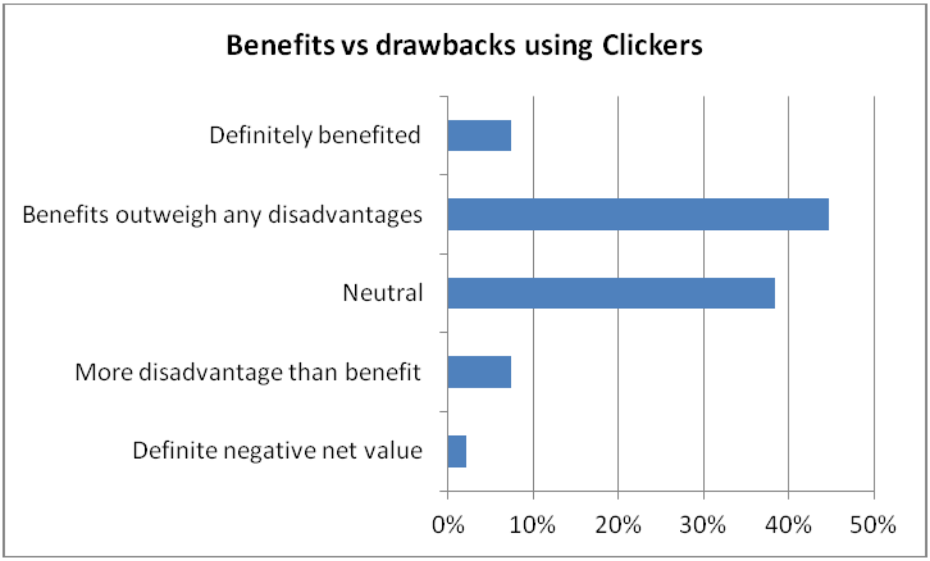

Fig. 8. Benefits vs drawbacks using Clickers

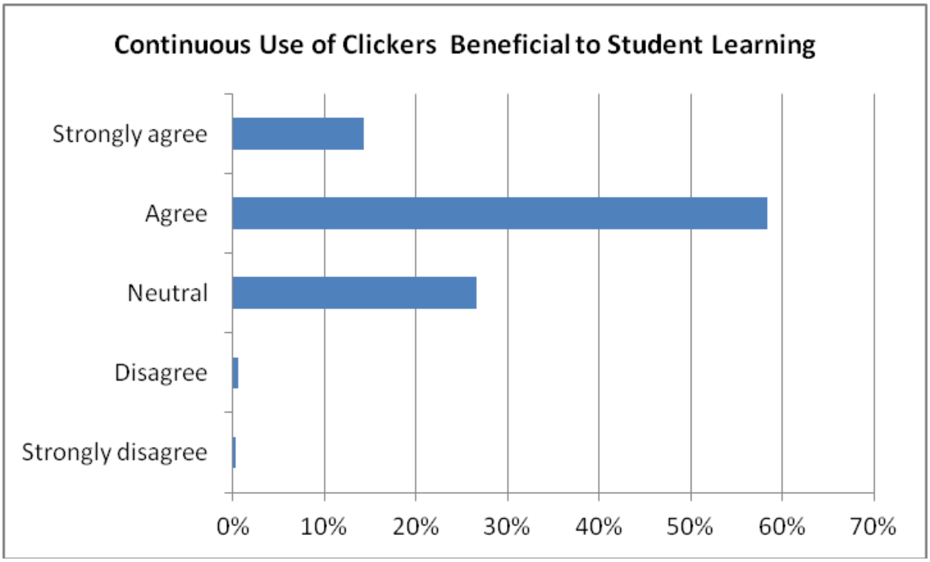

Fig.9. Continuous Use of Clickers Beneficial to Student Learning

With regard to the third research question about whether *Hong Kong undergraduate students in Finance course perceive that the use of clickers to respond to questions is "fun"?,* the result also supported the hypothesis. The result showed that 71% of students agreed that they had fund using clickers in learning and only a few of students (below 10%) had reservation about the clickers (Figure 10). The result also found that over 60% of students were positive towards clickers with the average rating of 3.3 of above for various questions to study their acceptance of the classroom response system (Table 1).

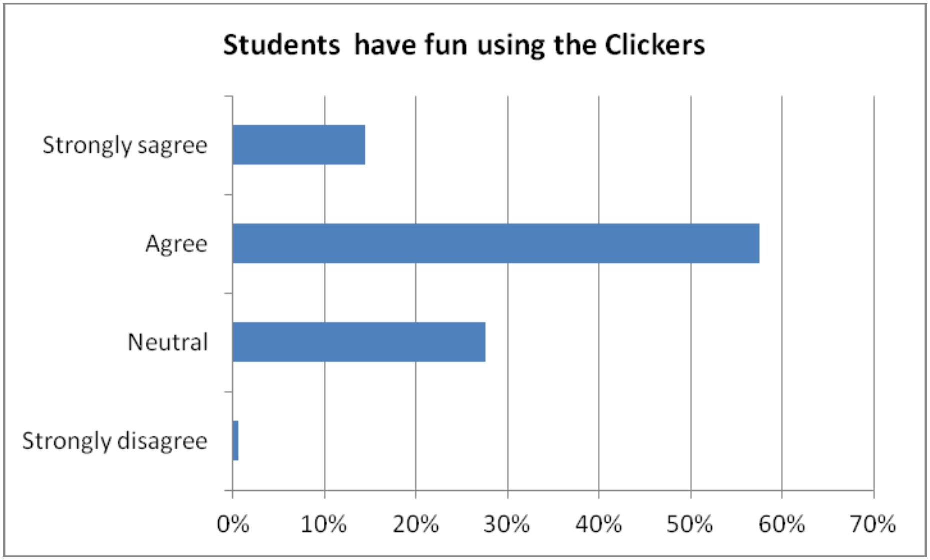

Fig. 10. Students have fun using the Clickers

Table 1: Student perception towards using clickers

Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Average rating
I find using the Clickers to be enjoyable.	2%	22%	35%	35%	5%	3.2
The actual process of using the Clickers is pleasant.	3%	20%	35%	36%	5%	3.2
I have fun using the Clickers.	2%	34%	53%	11%	0%	3.7
I would find the Clickers useful in my learning.	1%	12%	37%	45%	5%	3.4
Using the Clickers enables me	5%	37%	27%	23%	7%	2.9

to accomplish learning tasks more quickly.						
Using the Clickers increases my learning productivity.	3%	22%	38%	30%	6%	3.1
If I use the Clickers, I will increase my chances of getting more competence.	1%	6%	41%	45%	6%	3.5

From the survey, it is found that over 80% of students would like to pay attention and stay engaged in class (Figure 11) and they also thought that regular attendance was important (Figure 4).

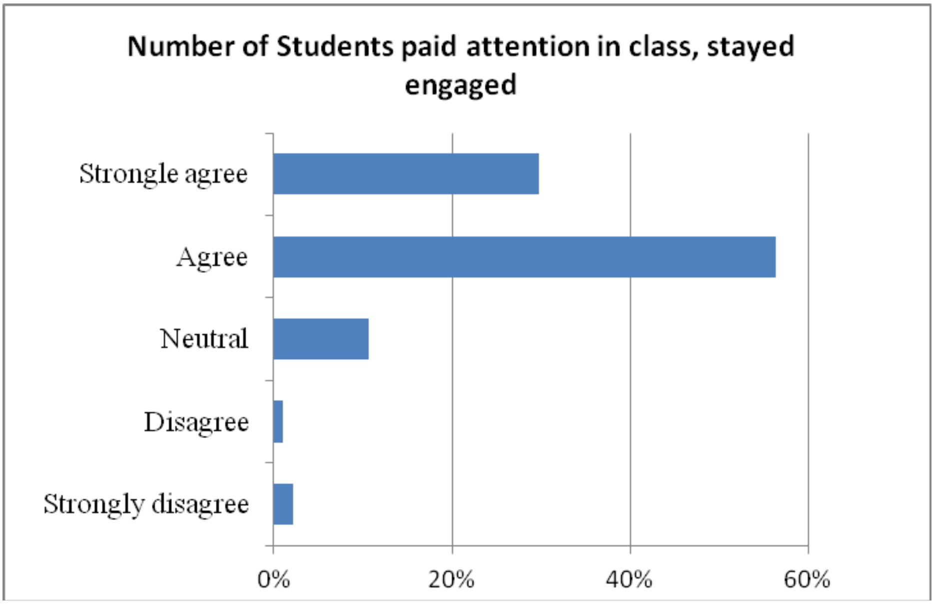

Fig. 11. Number of Students paid attention in class, stayed engaged

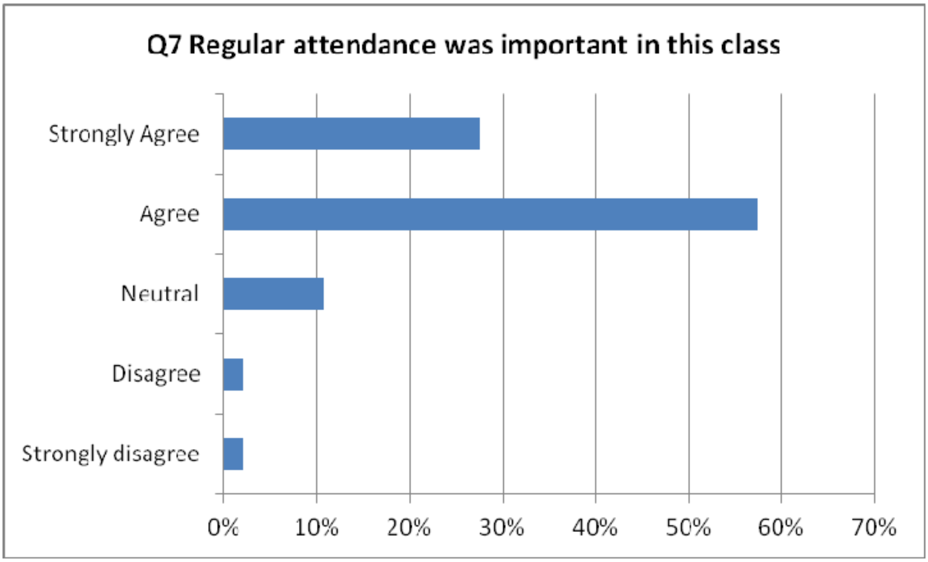

Fig. 12. Regular attendance was important in this class

For the forth research question about whether *the final examination results of clicker users be better than non-users in international finance course*, we conducted an independent ***t*** test to determine if there is a significant deterrence ($p < 0.05$) in mean score of final examination results between clicker users and non-clicker users. The test was statistically significant, $t\ (170) = 7.326$, $p < 0.05$. Students using clickers *(mean = 76.8, SD = 12.5)* scored higher than students not using clickers *(mean = 71.3, SD = 13.4)*. The degree of the clicker impact was calculated by eta squared[1] and found to be 0.043 showing that about 4% of the variance in the final examination results was accounted for the difference of clicker users and non-clicker users. Hence, the results confirmed that students using clickers would perform better than students not using clickers in term of their final examination results.

5 Conclusion

In line with prior studies, the study provided evidence to support importance of clicker in learning and teaching. Using clickers positively affect students' conceptual understanding (DiBattista et al, 2004), classroom engagement and discussion (Draper & Brown, 2004; Masikunas, Panayiotidis, & Burke, 2007), student motivation (Boyle & Nicol, 2003), final examination results (Mayer et al, 2009 & Ribbens, 2007), and

[1] Eta-squared is a measure of effect size for use in ANOVA analysis and it is analogous to R-square in the multiple linear regressions.

their enjoyment of lectures (Elliott, 2003; Masikunas, Panayiotidis, & Burke, 2007). The result also confirmed that the clickers could provide a device for collecting information about students' understanding (Elliott (2003). Most of students agreed that using clickers in class was fund. Overall, the results of the study found that using clickers in learning and teaching could improve learning efficacy of undergraduate students in Hong Kong.

However, there are a few limitations in the study. For example, the result of the study cannot be generalized to other instructional settings because the study was conducted with international finance classes only and potential measurement errors may exist for research questions. We will look at the issues in future and make an improvement. In spite of these limitations, we believe that the study makes contributions to the ongoing research about the impacts of clickers and other classroom response systems on the student learning performance.

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Revisiting flexible learning: Definitions, implementation and potential

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Abstract. For decades, flexibility has been a focus of attention and efforts the field of education. Flexibility in learning, which emphasizes student choice, has been considered one key to enhancing education quality and satisfying highly diverse student needs. It is often associated with the terms 'open learning', 'distance learning', and 'e-learning'. With the increasing application of information and communication technologies in the field of education, flexible learning has been especially closely associated with e-learning, and sometimes is considered to be the essence of the term. Since the ambiguity of the term could be counterproductive in discussions of flexible learning, a systematic review of relevant literature is badly needed to put the meaning of the term in perspective. This paper provides a critical review of literature relevant to flexible learning. The development of the use of 'flexible learning' and the implementation of the term are summarized. In this paper, the term 'flexible learning' is redefined with clarification of its relationship with relevant terms and a proposed system of its dimensions. Suggestions for future research are also provided.

Keywords: flexible learning, flexible education, open learning, distance learning, e-learning

1 Development of the Use of Flexible Learning

In early 1970s, when Britain and other advanced economies went into a post-Fordist era, the economic paradigm was often referred to as 'flexible production'. It was then when the education systems were required to become more flexible responding to the new economic paradigm (Chalkley, 1997). The term 'flexible learning' originated in the United States during the 1970s and started being used in Britain during the early 1980s (Bell, Bowden, & Trott, 1997). In the late 20th century, the word 'flexible' became highly frequently used (Nunan, 1999). The 21st century witnesses a more rapid increase in the interest in flexible learning. This is reflected in the number of papers on the topic. From a search done in June 2015 on the topic of 'flexible learning' in Web of Science, results show that there were 431 papers on flexible learning in 1980–2000. During the next five years, there were another 409 papers. The number of papers in 2006–2010 increased to 1301, and then 1943 in 2011–2015.

The growing use of 'flexible learning' has raised such questions as "What does 'flexible learning' mean" (Roebuck, 1987), and "what does flexible learning look like in practice" (e.g., Hudson, Maslin-Prothero, & Oates, 1997; Lindberg & Olofsson, 2006; Sadler-smith & Smith, 2004; Wade, Hodgkinson, Smith, & Arfield, 1994). During the decades of use of the term 'flexible learning', learners are often put in the centre (Collis & Moonen, 2002; Li, 2014; Moran & Myringer, 1999). Flexible learning is defined as a teaching and learning approach which are learner-centred' (Moran & Myringer, 1999) or approach revolving around provision of learning options based on students' specific needs and preferences (Demetriadis & Pombortsis, 2007).

Since its conception, flexible learning was used as a term which was closely associated with 'open learning' and 'distance learning'. It was also associated with information technology with its boom at the end of the 20th century. As Ellington (1997) noted, flexible learning was interpreted very loosely at that time, and it was suggested that the term should not be defined and should be left to practitioners to interpret. After decades of use, defining flexible learning is still a highly perplexing task. There is no universally accepted definition for the term (Casey & Wilson, 2005; Tucker & Morris, 2011) . Besides open learning and distance learning, it is now also closely associated with e-learning or technology mediated learning.

Despite its haziness and indistinctness in meaning, flexible learning has been pursued by many educators and researchers. As Collis and Mooner (2002) point out, 'Flexible learning is becoming somewhat a buzzword: everyone is for it, but often people have not thought further about it' (p. 218). However, the ambiguity of the term has been counterproductive in discussions of flexible learning and led to confusion of teaching staff (Kirkpatrick, 1997). Thus, there is a need for a clear definition of flexible learning and an anatomy of its semantic dimensions.

2 Meaning and Semantic Dimensions

2.1 Flexible Learning and Open Learning

One way to clarify the meaning of flexible learning is to distinguish it from the terms that it is often associated, and open learning is a term sometimes used interchangeably with it. Although both open learning and flexible learning try to minimize constraints of access, time and place, pace, methods of study (Kember, 2007; Khan, 2005), open learning targets democratization of access to education and training by not requiring entry qualifications (Olakulehin & Singh, 2013) while flexible learning targets learning flexibility to satisfy diverse student needs. In Demetriadis and Pombortsis (2007), flexible learning refers to the learning where 'learners are offered a variety of options for personalizing the learning experience based on their specific needs and preferences' (p. 148).

Learning equity or having equal opportunities to receive education, is the core of open learning (Perraton, 2007), while for flexible learning, learner choice is crux (Collis & Moonen, 2002). As Collis and Moonen (2001) suggested, to increase flexibility, students should be allowed to choose what is best for them as the key dimensions of learning. Entry requirements could be one aspect of flexibility (Collis & Moonen, 2002; Li, 2014; Tucker & Morris, 2011), but flexible learning should cover many more aspects in the learning process (Collis & van der Wende, 2002).

2.2 Flexible Learning and Distance Learning

Besides ‘open learning’, ‘distance learning’ is often associated with flexible learning. In these cases, flexible learning ‘has replaced distance education as a means of servicing the needs of geographically distant or remote students’ (Kirkpatrick, 1997, p. 160). However, flexibility does not necessarily refer to distance and there is a lot more than distance that flexible learning refers to. As Collis and Moonen (2002) note:

> There are many ways to make education more flexible that can benefit students who are in full-time residence on a campus and even benefit those who are in the same room together. Flexibility can involve options in course resources, in types of learning activities, in media to support learning, and many other possibilities. There is more than distance that can vary. (p. 218)

Although many efforts in flexible learning focused on allowing and facilitating to learn at a place which is at a distance from the teacher or teaching institution (e.g., Cartier, 2014; Casey & Wilson, 2005; Drennan, Pisarski, & Kennedy, 2005; Lindberg & Olofsson, 2006), flexibility also covers students’ learning on campus or in classrooms, by making flexible learning time, learning contents, and instructional approach (e.g., Casey & Wilson, 2005; de Boer & Collis, 2005).

2.3 Flexible Learning and Technology Mediated Learning

Sometimes, technology mediated learning is used synonymously with flexible learning (Irvine & Cossham, 2011) and there is a widespread feeling that flexible learning means the use of technology (Cybinski & Selvanathan, 2005; Kirkpatrick, 1997), or technology is at least a main component in the provision of flexible learning (Collis & Moonen, 2002; Khan, 2005; Sadler-smith & Smith, 2004). With the development of information and communication technologies in the field of education, flexibility is associated specifically with e-learning (Khan, 2005). It is not only the understanding of researchers, the teaching academics also see flexible learning as ‘learning that was carried by information technologies’ (Kirkpatrick, 1997, p. 170). However, concerns have been addressed about the appropriateness of overweighting the role of technology in flexible learning (Casey & Wilson, 2005). Casey and Wilson (2005) argue:

> It is much better to regard technology as a set of generic ‘services’ or tools that may be called on to support flexibility, and instead concentrate our efforts on the far more profound issues of designing for flexible learning. (p. 3)

It should be inappropriate to take flexible learning as the use of technology in learning. Though technology is an important enabling factor of flexible learning (Casey & Wilson, 2005; Kirkpatrick, 1997), as it is the case with distance learning and open learning, flexible learning is more than the use of technology.

2.4 Dimensions of Flexible Learning

Identifying dimensions or components of a term is an effective way to comprehend and operationalize a concept with broad connotation. Table 1 summarizes, with reorganization, the components proposed in previous work and present them in a hierarchical system.

Table 1 Components of flexible learning

- Time
  - *Time and date to start or finish the course/module* (Collis & Moonen, 2002; Goodyear, 2008; Hart, 2000; Li, 2014; Race, 1988; Tucker & Morris, 2011)
  - *Pace of learning in a course* (Collis & Moonen, 2002; Goodyear, 2008; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011)
- Content
  - *Level of difficulty of module content* (Hart, 2000; Race, 1988; Tucker & Morris, 2011)
  - *Sequence in which topics are covered* (Chen, 2003; Collis & Moonen, 2002; Li, 2014; Tucker & Morris, 2011)
  - *Topic to learn* (Collis & Moonen, 2002; Hart, 2000)
- Entry requirement
  - *Prerequisites for module/course participation* (Collis & Moonen, 2002; Goodyear, 2008; Hart, 2000; Li, 2014; Tucker & Morris, 2011)
- Delivery
  - *Channels for course information* (Collis & Moonen, 2002; Li, 2014; Tucker & Morris, 2011)
  - *Place for learning* (Chen, 2003; Collis & Moonen, 2002; Goodyear, 2008; Hart, 2000; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011)
- Instructional approach
  - *Amount of learning activities* (Goodyear, 2008; Li, 2014; Tucker & Morris, 2011)
  - *Instructional language* (Collis & Moonen, 2002; Li, 2014; Tucker & Morris, 2011)
  - *Modes and structures of presentation* (Sadler-smith & Smith, 2004)
  - *Social organization of learning* (group or individual) (Collis & Moonen, 2002; Goodyear, 2008; Hart, 2000; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011)
  - *Time and duration of learning activities* (Chen, 2003; Collis & Moonen, 2002; Goodyear, 2008)
  - *Type of learning activities* (Collis & Moonen, 2002; Goodyear, 2008; Hart, 2000)
- Assessment
  - *Assessment mode* (Chen, 2003; Hart, 2000; Ling et al., 2001)
  - *Assessment standard* (Collis & Moonen, 2002; Tucker & Morris, 2011)
  - *Assignment requirement* (de Boer & Collis, 2005)
  - *Weighting of assignments and examination in the course result* (Li, 2014)
  - *Examination dates and assignment deadline* (Collis & Moonen, 2002; Tucker & Morris, 2011)
- Resource and support
  - *Amount of learning materials, tools and support* (Race, 1988)
  - *Method of obtaining learning materials, tools and support* (Collis & Moonen, 2002; Tucker & Morris, 2011)
  - *Place where learning materials, tools and support are available* (Li, 2014; Tucker & Morris, 2011)
  - *Time available for support* (Hart, 2000; Li, 2014; Tucker & Morris, 2011)
  - *Type of learning materials, tools and support* (Chen, 2003; Collis & Moonen, 2002; Goodyear, 2008; Hart, 2000; Li, 2014; Tucker & Morris, 2011)
- Orientation or goal

- *Orientation of the course* (theoretical, practical) (Collis & Moonen, 2002)
- *Goal of learning the course* (Goodyear, 2008)

Attempts have been made to clarify the term ‘flexible learning’ by identifying or anatomizing its dimensions (e.g., Collis & Moonen, 2002; Goodyear, 2008; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011). Yet they tend to focus on some dimensions rather than having a holistic view of the term, which is necessary for understanding its potential. Caution should also be taken that the components under one dimension proposed by a scholar could be identified by another under another dimension or as an independent dimension.

3 Implementation of Flexible learning

It is not realistic to expect that all the dimensions/components should be involved when flexible learning is carried out in practice. The proposed dimensions are only options for institutions to choose from. As Chen (2003) argued, flexibility should not be always presumed good and ‘flexibility is but one way to approach learning’ (p. 27). Collis and Mooner (2002) suggest when carrying out flexible learning in practice, an institution needs to decide which dimensions and what range of options within these dimensions it will focus on. As it is done in some studies (Li, 2014; Tucker & Morris, 2011), the selection of the dimensions to be focused on could also take into consideration the perceptions of practitioners and learners. Great efforts have been made to discuss the implementation of flexible learning (e.g., Cavus & Al-Momani, 2011; de Boer & Collis, 2005; Demetriadis & Pombortsis, 2007; Dorrian & Wache, 2009; Sadler-smith & Smith, 2004; Wilkinson, Forbes, Bloomfield, & Gee, 2004). An example practice of implementing flexibility with respect to language is allowing international students to do assignments in their own mother languages (de Boer & Collis, 2005). Examples of implementing flexibility regarding channels for module/course information are providing a wide range of alternative delivery mechanism (Sadler-smith & Smith, 2004), creating online learning environment (Ash, 2012; de Boer & Collis, 2005), and reducing physical meetings (Olakulehin & Singh, 2013), etc. Twenty papers have been found discussing the implementation of flexible learning. The numbers of cases described in these papers, which discuss the implementation of specific dimensions, are presented in Table 2.

Table 2 indicates that among the dimensions proposed in Table 1, ‘delivery’, ‘assessment’, ‘resource and support’ are the ones that are implemented by most of the studies reviewed. As regards components, ‘place for learning’, ‘channels for course information’, and ‘type of learning materials, tools and support’ are implemented the most often according to the studies reviewed. No study is found to implement flexibility regarding the dimension of ‘entry requirement’. Flexibility of some components is not implemented in the studies either, which includes ‘amount of learning activities’, ‘time and duration of learning activities’, ‘level of difficulty of module content’, ‘sequence in which topics are covered’, and ‘prerequisites for module/course participation’.

Table 2 Number of cases of implementation of flexible dimensions and components

Dimension	Component	N
Delivery	Place for learning (Ash, 2012; Casey & Wilson, 2005; Cybinski & Selvanathan, 2005; Herat, 2000; Lutteroth & Luxton-Reilly, 2008; Phillips, 2004; Wilkinson et al., 2004)	7
	Channels for module/course information (Ash, 2012; de Boer & Collis, 2005; Dowling, Godfrey, & Gyles, 2003; Gutl, Chang, & Freudenthaler, 2010; Lindberg & Olofsson, 2006; Nisselle, Hanns, Green, & Jones, 2012; Richardson, 2009; Sadler-smith & Smith, 2004)	8
	Total	**15**
Assessment	Examination dates and assignment deadline (de Boer & Collis, 2005; Dorrian & Wache, 2009; Lindberg & Olofsson, 2006)	3
	Assessment mode (Barron & Whitford, 2004; Cybinski & Selvanathan, 2005; Lutteroth & Luxton-Reilly, 2008; Wilkinson et al., 2004)	4
	Assessment standard (de Boer & Collis, 2005; Lutteroth & Luxton-Reilly, 2008)	2
	Assignment requirement (de Boer & Collis, 2005)	1
	Way of submitting assignment (Phillips, 2004)	1
	Weighting of assignments and examination in the course result (Barron & Whitford, 2004; Cybinski & Selvanathan, 2005)	2
	Total	**13**
Resource and support	Type of learning materials, tools and support (Collis & Moonen, 2002b; Cornelius, Gordon, & Ackland, 2011; Cybinski & Selvanathan, 2005; de Boer & Collis, 2005; Lutteroth & Luxton-Reilly, 2008; Richardson, 2009; Sadler-smith & Smith, 2004; Wilkinson et al., 2004)	8
	Amount of learning materials, tools and support (Harper, Oliver, & Agostinho, 2001)	1
	Method of obtaining learning materials, tools and support (Phillips, 2004; Wilkinson et al., 2004)	2
	Time available for support (Ash, 2012)	1
	Place where learning materials, tools and support are available (Ash, 2012; Cornelius et al., 2011; Dorrian & Wache, 2009; Herat, 2000)	4
	Total	**16**
Content	Topic to learn (Barron & Whitford, 2004; Casey & Wilson, 2005; Sadler-smith & Smith, 2004)	4
	Total	**4**
Instructional approach	Social organization of learning (Barron & Whitford, 2004; Cornelius et al., 2011; de Boer & Collis, 2005; Sadler-smith & Smith, 2004)	4
	Type of learning activities (Herat, 2000; Sadler-smith & Smith, 2004)	2
	Modes and structures of presentation (Sadler-smith & Smith, 2004)	1
	Language (de Boer & Collis, 2005)	1
	Total	**8**
Time	Time and date to start or finish the course/module (Ash, 2012; Casey & Wilson, 2005; Richardson, 2009)	4
	Pace of learning in a course (Ash, 2012; Casey & Wilson, 2005)	3
	Total	**7**
Orientation or goal	Orientation of the course (de Boer & Collis, 2005)	1
	Goal of learning the course (Herat, 2000)	1
	Total	**2**

Note: N=number of cases

4 Conclusion and suggestion

The past three decades has witnessed an increasing growth of research on flexible learning. Efforts to pursue flexible learning have been made by not only researchers but also practitioners. However, the term is often used in an unclear way. As assumed in most relevant literature, ‘flexible learning’ is closely associated with ‘open learning’, ‘distance learning’, and ‘e-learning’. However, the connotation of ‘flexible learning’ should contain more than the associated terms.

Based on the relevant literature, the current paper proposes a hierarchical system of flexible learning. The dimensions of flexible learning include time (time and date to start or finish the course/module; and pace of learning in a course), content (level of difficulty of module content; sequence in which topics are covered; and topic to learn), entry requirement (prerequisites for module/course participation), delivery (channels for course information; and place for learning), instructional approach (amount of learning activities; instructional language; modes and structures of presentation; social organization of learning; time and duration of learning activities; and type of learning activities), assessment (assessment mode; assessment standard; assignment requirement; weighting of assignments and examination in the course result; and examination dates and assignment deadline), resource and support (amount of learning materials, tools and support; method of obtaining learning materials, tools and support; place where learning materials, tools and support are available; time available for support; and type of learning materials, tools and support), and orientation or goal of the course.

Among the dimensions and components, some have been the focus of most researchers when discussing the implementation of flexible learning, but some have not attracted much interest. Future studies on flexible learning could be devoted to the dimensions and components which have attracted less attention.

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