Motivating Pre-Service Teachers with Augmented Reality to Developing Instructional Materials through Project-Based Learning Approach

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***Abstract*—Pre-service teachers play a crucial role in educational system as they are required to be well-prepared for their future teaching to students. Hence, they should be able to construct their own teaching materials effectively. Presently, Augmented Reality has widely been adopted to make learning and teaching environments more engaging and interesting. Therefore, this study employs the advantages of AR technology to motivate the pre-service teachers in constructing the teaching materials. Project-based learning approach has been used in this proposal by requiring the pre-service teachers developing their materials in a structural manner with higher-order thinking process. By analyzing the motivation questionnaires, it has found that the proposed approach has motivated them both males and females to construct their teaching materials. This novel approach could help enhance the preparation of educational system.**

Keywords—pre-service teacher; augmented reality; learning motivation; project-based learning; instructional material

I. INTRODUCTION

Preparing pre-service teachers to be able to develop instructional materials by integrating technology into learning tools is truly important in education. Thus, before going to teach in practical teaching course in schools, pre-service teachers must learn to develop instructional materials. However, many previous research studies showed that pre-service teachers had less motivation to develop instructional materials.

Nowadays, pre-service teachers learn based on imitation learning with applied their understanding but do not use critical thinking for learning. Additionally, pre-service teachers had limitations in integrating technology into their instructional materials construction process [1]. For our teaching experience, we also found that pre-service teachers rarely concerned about applying advanced creative ability of technology to design and develop new innovations on instructional materials. Therefore, increasing motivation for integrating technology on developing instructional materials or innovations of pre-service teachers should be concerned to let them having higher motivation on learning and developing instructional materials. Thus, many research studies conducted researches on integrating technology into courses for pre-service teachers in universities [2-4]. These researches indicated that some great things immersed after the intervention; for examples, increasing of engagement, having positive perception, and getting great experience on developing instructional materials.

Recently, a new technology has been widely developed, namely Augmented Reality (AR). It is a technology which interweaves a real world with a virtual world presenting graphic, video, 3D, animation through mobile devices. In addition, there are high satisfaction on motivation when users experiencing on it. AR is portable and affordable learning materials which users can access models from any device at any time; especially, it is fun and can foster intellectual curiosity in learning.

In education, one of teaching and learning approaches recognized as an effective teaching approach on developing students' ability to construct their own knowledge and skills is Project-Based Learning (PBL). PBL is an approach that gives opportunity for students to find their own way to acquire knowledge by working on a project [5].

Consequently, in this study, we employed the Augmented Reality (AR) on Project-Based Learning (PBL) to motivate pre-service teachers in order to develop instructional materials. In this regard, an attempt was made to answer a research question: Do the pre-service teachers who learn with AR based

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on project-based learning have increased in learning motivations?

II. Related Studies

A. Augmented Reality (AR)

Augmented Reality (AR) is a technology that allows users to combine real-life sensory experience environment in real time and a variation of virtual environments that allows the user to see the real world, with virtual objects superimposed upon or composited with the real world [6]. Presently, AR has been considered one of the most platforms to deliver any educational process that can be used a wide range of educational subject areas such as science, engineering, business, and education. In education, AR platform has widely been applied for teaching and learning more and more [7-10]. Since the AR are mostly used in mobile devices, it lets users access and participate any device at any time with fun. Moreover, AR can foster curiosity to seek new experiences which come up on the screen when scanning.

With the advantages of technology, AR has been used to enhance learning in many fields, and it can support students to have more meaningful learning by interacting with multimedia via mobile devices. For example, a research study presented augmented reality (AR) in a graphic book to explore children's learning performances on their learning about the bacteria. The results presented that students could recognize the content they read and had high satisfaction on this teaching materials, since they had physical interactions with an AR graphic book that could enhance learning in practical and hands-on way for children [11]. In a research study, the AR was used to support this inquiry-based learning activities with mobile devices and it was able to improve the students' learning achievements [12]. Addition, the augmented reality technology was used in learning and the researchers showed that it could get students' motivation and attention while learning and the students also had positive satisfaction with AR learning environment. Moreover, a previous studied indicated that students who learn with AR had higher motivation than those who obtained a slides-based learning environment [13]. Some research studies showed that users were engaged and had higher motivation to learn. Furthermore, students who experienced with AR had better understanding and had higher retention on contents [14].

With the advantages of AR on learning motivation, it could foster students to learn when the instructional materials were AR. Especially, pre-service teachers would also be impassioned to develop their instructional materials. Therefore, motivating pre-service teachers to develop instructional tools by using the augmented-reality (AR) through the Project-based learning was conducted in this research study.

B. Project-Based Learning Approach (PBL)

Project based learning is a learning model based on the constructivist finding that students gain a deeper understanding of material when they actively construct students' understanding by working with and using ideas [15]. Project based learning is a teaching model that uses student's learning approach to the problem of an authenticity. The authentic problems can be interpreted as a problem that is often found in daily life the day and making a project as the result of study. Project Based Learning has been defined in many ways [16].

In the literature, previous study applied project-based learning approach in an Academic Engineering Course in order to examine the perceptions and attitudes of students carry out mini-projects [17]. Furthermore, the project-based learning (PBL) was applied strategy for increasing the attractiveness of the electronics engineer curriculum [18] and PBL for an optional subject taught on the last course of Industrial Electronic Engineering degree, entitled "Circuits and electronic systems [19]. In addition, some researcher found that the majority of teachers using project-based learning (PBL) in their classrooms in order to promoted active participation by students, motivated them to learn and helped them to acquire various curricular skills [20].

The overall concept of project based learning to engage the student exploring questions through a process of investigation and collaboration: ask questions, make predictions, design investigations, collect and analyze data, use technology, make products, and share ideas [21]. Therefore, our research, we summarized the process of learning five steps consisting of: (1) Student start with ask questions (2) student make predictions via planning (3) student research the information for design investigations (4) student use technology for constructing products and (5) student share ideas via presentation process.

The Project-Based Learning (PBL) is a teaching and learning approach which considered as both cooperative/collaborative learning under the constructive learning theory. With project-based learning, learners become active learners to construct their own knowledge via seeking knowledge for their projects [22]. Lots of previous research studies applied the PBL approach in many contents to foster student to initiatively focus on their real world by explore, create, and construct new knowledge [23, 24]. Many research studies showed that PBL could truly support students to be more active in learning and become constructors their own knowledge. The students who learned with PBL could perfectly perform on their projects with their higher thinking skills as well via their exploration under teachers' facilitation.

Consequently, in this study, we selected the project-based learning approach for enhancing students' motivation in order to construct the learning material with AR technology.

III. Methods

A. Participants

The participants of this experiment were pre-service teachers who enrolled in Instructional Material course in a university of Thailand. A total of 136 pre-service teachers (male = 59, female = 77) were included in this study, ranging age between 19 and 21 years old. All of the pre-service teachers are in the field of computer education program.

B. Instruments

We adopted a questionnaire which measures students' motivation on science learning of Tuana and colleagues [25].

The questionnaire is a five-point Likert's scales questionnaire which measures pre-service teachers' motivation on three aspects; Self-efficacy on the Instructional Material course (SEF), Instructional Material course with AR Value (ARV), and Achievement Goal on the Instructional Material course (ACG). The description of each item is shown in Appendix.

C. Experimental Design

The study was conducted in the Instructional Material course. This course is totally 15 hours and the participants learned three hours in five weeks. During the study, the participants were assigned to do the project individually followed PBL procedures while the teacher is counselling.

IV. Experimental Learning Process

Under a PBL approach, we conducted the learning activities in five steps of learning processes; questioning, planning, researching, creating, and presenting (Fig. 1).

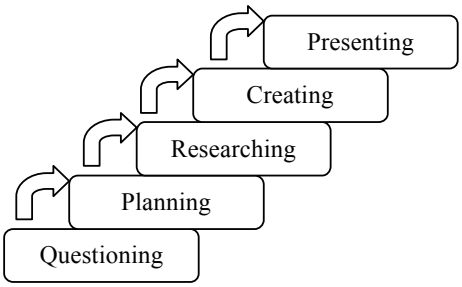

Fig. 1. Learning process on Project-based Learning approach

- *Questioning:* The teacher started the class by showing an AR technology to the participants. The participants were faced with an 3D animation cartoon, with a question in text and sound on their devices which asked "If you would like to create an instructional material to use in your classroom, what topic do you want to develop and why?". The pre-service teachers were engaged and to seek a content in order to design their own instructional materials, and they were interested to develop AR for their instructional materials.
- *Planning:* The pre-service teachers or participants got their topic contents to develop the materials. In this step, they planned the activities into the instructional materials, and presented to the class. All pre-service teachers concerned about their content and storytelling in AR. After presenting, they had some advices from the teacher and friends to develop the AR instructional materials.
- *Researching:* The pre-service teachers searched the core content of the topic they selected and studied the information for design materials.
- *Creating:* The teacher introduced Aurasma Studio software for developing AR instructional materials for the pre-service teachers. First, they registered Aurasma account and log in. After that, they created an instruction material and download Aurasma application from App Store or Google Play. Then, they tested their instruction materials via mobile phones or tablets. For an example, a pre-service teacher developed his/her material in topic of technology in my life topic to teach students about the importance of technology. In his/her material, he/she designed that when scanning the multimedia about technology in my life was showed and asked students to interact with his/her AR instructional material. After experiencing with this instructional material, students will learn about the importance of technology.
- *Presenting*: Finally, the pre-service teachers presented the developed AR instructional materials to the class and showed the summary of the project process and results. In this step, the pre-service teachers presented their answers from the Questioning Step to the class and showed how their AR material solved that problem while the teacher gave suggestions to let students completely understanding how good instructional material should be, and other pre-service teachers also learned with this step together in the same time.

Fig. 2. Pre-service teachers' learning activity

V. Results

As shown in Table I, the results obtained show the pre-service teachers' motivation towards the leaning process of AR during the Instructional Material course of their job, given that the scores are above 4 (scale range between 0 and 5) on nine items.

TABLE I. Pre-service teachers' motivation

Item	Male (N = 59)		Female (N =77)		*t*	*p*
	M	*SD*	*M*	*SD*		
SEF	4.059	0.574	3.974	0.714	0.747	0.456
SEF001	4.068	0.612	3.948	0.857	0.911	0.363
SEF002	4.051	0.539	4.000	0.538	0.547	0.585
ARV	4.373	0.610	4.368	0.551	0.050	0.960
ARV001	4.322	0.600	4.403	0.544	0.822	0.412
ARV002	4.305	0.701	4.273	0.553	0.297	0.766

ARV003	4.492	0.504	4.429	0.548	0.687	0.492
ACG	4.195	0.542	4.117	0.499	0.870	0.385
ACG001	4.288	0.589	4.143	0.555	1.470	0.143
ACG002	4.186	0.473	4.260	0.523	0.852	0.395
ACG003	4.034	0.556	4.104	0.347	0.900	0.369
ACG004	4.271	0.520	4.273	0.529	0.022	0.982

df = 134

In addition to that, pre-service teachers' motivation has been analyzed by comparing them on gender differences between male and female. Data has been checked with Shapiro-Wilk and found normality; therefore, a parametric method can be performed. Independent sample t test has been employed to analyze their differences. It was found that there were no significant difference on male and female motivations on any items. This implies that the proposed approach can motivate their instructional material construction.

VI. Conclusion And Discussion

In this study, the AR technology was applied to motivate pre-service teachers so they constructed their own knowledge and learned by themselves throughout project-based learning process and integrated technology for creating instruction material. The findings reveal that the pre-service teacher have been highly motivated with the proposed approach. Consequently, pre-service teachers may use the AR technology for enhancing the teaching and learning.

This research can be extended on several dimensions. First, it could be possible to apply on different fields of instructions. Second, students may work collaboratively in group to promote collaborative learning. Lastly, the delicate AR application might be employed to monitor their construction progress.

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APPENDIX

Item	Description
Self-efficacy on the Instructional Material course (SEF)	
SEF001	Whether the Instructional Material content is difficult or easy, I am sure that I can understand it.
SEF002	I am sure that I can do well on Instructional Material tests.
Instructional Material course with AR Value (ARV)	
ARV001	I think that using AR for developing instructional material is important because I can apply it for teaching.
ARV002	In AR learning, I think it is important to participate in project based learning.
ARV003	It is important to have the opportunity to satisfy my own curiosity when learning AR.
Achievement Goal on the Instructional Material course (ACG)	
ACG001	I feel most fulfilled when I attain a good score in course.
ACG002	I feel most fulfilled when I feel confident about the course.
ACG003	I feel most fulfilled when I am able to develop the instructional material.
ACG004	I feel most fulfilled when the teacher and other students accepts my ideas.