DEVELOPMENT OF AUGMENTED REALITY TECHNOLOGY IN VOCATIONAL SCHOOL: A SOCIO-TECHNICAL CURRICULUM FRAMEWORK

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Abstract

The socio-technical curriculum framework, particularly within the context of vocational education, requires the use of technology which also entails social aspects. This study aims to develop AR Batik Katineung, an AR-utilized application in learning Batik in a vocational high school in Indonesia based on a socio-technical curriculum. The developed application was made compatible within multi platforms to promote user-friendliness to the students. The results showed that AR Batik Katineung is an alternative of promoting local wisdom through a current technological innovation which is in accordance with the demands of industry 4.0. It is also implied that students would not face any difficulties in operating the application and most of the have got used to using gadgets with such operating systems as iOS, Android, and so on.

Keywords: Augmented Reality, Digital learning, Industry 4.0, Socio-technical curriculum, Vocational education.
1. Introduction

Socio-technical system is a future vision in which there is a close relation between social order and technological development. Additionally, it is related to integration of a variety of aspects in human life comprising infrastructure, technology, policy, regulation, culture, and social meanings [1]. A triple relationship among technological, physical, and economic aspects is actually the special characteristics of social-technical system [2-4]. Simply, social-technical system is related to human technology interaction [5] consisting of social values [6, 7].

Socio-technical perspective is also about technology transformation closely related to innovation. Such technological innovation is a change considerably influential towards the society in a form of technological adoption [8]. Within socio-technical context, innovation is viewed as a combination of social practices, norms, and value system as a social model adopting innovation of technology, or the so-called socio-technical innovation (STI) model). The model refers to two major components namely social and technical structure [9]. The influence of technological innovation reaches out almost of aspects of human life, including education as it currently refers to the development of technology in accordance with industry 4.0.

Industry 4.0 plays an important role in socio-technical system as it is a system combining both social system (human-related) and technical system (non-human related). The system is a response to new technologies affecting the complexity and dynamics of the society. In the framework of socio-technical system, industry 4.0 is considered an integration of vertical design model, horizontal design model, and end-to-end technology within the context of industrial management [10]. In addition, digitalization is another signature of industry 4.0 so that within the field of education, the industry is believed to be able to enhance the quality and efficiency of education [11].

Digitalization in education is applicable through tool or media development utilizing the most recent technological development; one of which is augmented reality (AR). It is proved that there has been very limited implementation of AR in education [12] when in fact it is able to promote attractive and fun learning [13]. It is also found that AR implemented in teaching and learning is effective to increase students’ efforts [14] as well as their self-independence as the process of teaching and learning is student-centred [15]. Such an effort to obtain educational purposes focusing on independent learning needs special strategies well integrated in terms of such important aspects of infrastructure, resources, and policies [16] in order to be effectively implemented in the curriculum [15].

Curriculum development within socio-technical framework has not been widely investigated, particularly in vocational education. Thus, this study focuses on investigating the implementation of socio-technical curriculum through learning digitalization using AR technology. The digital learning in vocational education is expected to give a significant impact to students, either in terms of technical aspects which turned out to be the mere focus of vocational education, or in terms of social aspects in their participation and collaboration in learning.

2. Material and Development Methods

AR is a technology revealing virtual objects into the real world then projecting the objects in real time [17-20]. This study aimed to create an AR application on
learning batik in a vocational high school. The application is named “AR Batik Katineung” in order to give the students deeply meaningful learning as Katineung is a Sundanese word which means deep. Therefore, it is hoped that the students will be able to catch the philosophical meanings of Batik patterns they learn.

The approach of AR Batik development in this study used socio-technical curriculum where the learning content does not only focus on technical aspects, but also social aspects, particularly ones related to the local wisdom of the Batik patterns being studied. Another social perspective - related aspect of this application is that it considers its user candidates’ conditions [21, 22]. The AR developed in this study is designed for students, making social aspect an important factor. In the meantime, in terms of the type of tools used, the application employs an open source one [23] and the type of AR built in markerless as this method does not use a frame marker as a detectable object [24, 25]. In this application, the tracking process uses picture texture saved in its database as the reference source and compares the texture shot by the camera with that on the marker database. AR Batik Katineung uses the real batik fabric as its marker to give users a real experience [26-28], unlike the commonly used AR which usually uses its markers in forms of pictures, location, and QR codes [29, 30].

The content of AR Batik Katineung consist of videos, 3D objects, and 2D objects. The videos contain philosophical description of Batik Katineung, while 2D and 3D objects are the spatial visualization of the philosophy. The videos are made using Adobe After Effect and Adobe Premier. In the meantime, the 3D objects are created using Blender as it is considered one of the most comprehensible 3D suites software available opensource with such advantages as multi-platform, up to date, complete, and light. The tool is actually quite simple, yet it comprehends all the things necessary for 3D modelling [19, 20, 31].

The tools used for the development of AR Batik Katineung were Unity Version 2020.1.3f1 and Vuforia Software Development Kit (SDK) Version 9.3.3. Unity is one of the most widely used game engines as it provides various features in multi platforms including Unity Web, Windows, Mac, Android, iOS, XBox, PlayStation 3 and Wii. In addition, Unity also has features needed in this study such as Integrated Development Environment (IDE) and the application resulted from it is compatible with a lot of platforms [18, 25, 32].

On the other hand, Vuforia SDK developed by Qualcomm enables a developer to create AR-based applications, or as they were previously known as QCAR (Qualcomm Company Augmented reality). In this study, the feature was added by computer vision technology to recognize target image and simple 3D objects in real-time. The Vuforia platform is compatible in all types of smartphones as it supports various operating systems such as iOS, Android, and Unity3D [18, 32-34].

The design of AR Batik Katineung development (Fig. 1) consists of main page, login page, register page, information page, 2D and 3D object projector, and video player.
Fig. 1. Design of AR Batik Katineung.

3. Results and Discussion

The development of AR Katineung is based on its design presented in Fig. 1. After all the 2D and 3D objects are created, the next process is integrated those to the AR application. The integration process and database configuration of Vuforia are performed by inserting the App license key to Unity (Fig. 2). The App license key was acquired from https://developer.vuforia.com by logging in, selecting license manager, and selecting get development key. The process is presented in Fig. 3.
Fig. 2. Vuforia configuration of AR Batik Katineung.

Fig. 3. License key of AR Batik Katineung.

User interface is created by implementing socio-technical design which is considered user-friendly [21, 22]. After all the “develop” process was carried out, “build” took place by converting the files into *.apk. Figure 4 shows the display of user interface of AR Batik Katineung which contains (a) main page/ main menu and (b) login page. The portrait orientation was chosen for the users’ comfort. Meanwhile, when on scanning, playing 3D objects, and playing videos, the screen was automatically switched into landscape. The display of scanning marker and playing 3D objects and video player is presented in Fig. 5.
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Fig. 4. Portrait user interface of AR Batik Katineung.

(a) Main page/Main menu
(b) Login page

Fig. 5. Landscape user interface of AR Batik Katineung.

(a) Scanning marker
(b) Playing 3D objects
(c) Video player
The development of AR Batik Katineung is a part of digital learning platform which is in accordance with socio-technical curriculum approach focusing on integration of students’ skills in terms of technical aspects, pedagogical experiences, and online learning environment. Digital learning is believed to be one of the reflections of socio-technical system as both teachers and students play an active role in learning, particularly in building knowledge and skills. This approach is also known as action learning in which it belongs to one of the characteristics of socio-technical system. This model of learning, within the social system context, refers to research-based and collaborative learning. On the other hand, within the technical system, it is related to the aspects of technology utilization and critical reflection [35].

Socio-Technical Curriculum (STC) gives clear description that the core of technology is innovation. The transformational process of the innovation in curriculum development in vocational education is influenced by three main components namely teachers as agents of change, learning delivery system related to innovation change, and students’ acceptance towards the change [8]. STC also aims to give students as many opportunities as possible to access learning [36] as well as to integrate both humanity and technicality aspects [37].

One of the impacts of industry 4.0 to vocational education is job polarization and students’ competences in the future. To this relation, the interconnection between powerful knowledge and really useful knowledge needs serious attention [38] as a response to the demand of industry 4.0 within the context of vocational education, which is to develop work-process oriented approach by ensuring the link and match with the industrial needs. Some of the competences to be developed in the curriculum comprise software orientation and technical networks. To complete such technical competences, there are several social competences needed such as communication, collaboration, and responsibility [39].

4. Conclusions

The implementation of STC concept in vocational education is a primary need, particularly in relation to industry 4.0. One of the attempts to cope with it is the development of AR-based digital media as the form of adoption of the most recent technological developments considering two important components namely social and technical aspects. STC is not only able to respond to the competence needs in accordance with the industry, but also to increase student participation, teacher empowerment, and social inclusion through the technological development. In the future, STC in vocational education will require more specific competences and interconnection between technical and social competences.

References


