Evaluating the Effectiveness and Usability of AR-based OSH Application: HazHunt

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***Abstract*—This study investigates the effectiveness and usability level of an augmented reality (AR) application called HazHunt to improve occupational safety and health (OSH) training. Previous research shows that AR has been growing in popularity as an innovative tool to enhance hazard identification courses. HazHunt, a marker-based AR app, was first developed using Vuforia software with OSH experts' guidance. Then, two online sessions of hazard identification course were conducted, where the experimental group's (EG) training was enhanced with the implementation of HazHunt. Analysis shows that the EG scores better (mean = 13.82, s = 3.38, n = 22) than the CG (mean = 13.41, s = 2.15, n = 22) in the post-quiz, but this difference is statistically non-significant, with t (21) = 0.48 and one-tail p = 0.32. Reduced Instructional Motivation Survey (RIMMS) shows that EG participants obtained higher confidence levels among the Attention, relevance, confidence, satisfaction (ARCS) factors in learning motivation. The System Usability Scale (SUS) score of HazHunt recorded the maximum count of 'Good' rating (mean = 78.41, n = 8). It is concluded that HazHunt has positive impacts on enhancing OSH training in terms of effectiveness and motivational impact. HazHunt also scored a high SUS score among the EG.**

Keywords*—*OSH training; computer-aided training; online learning; marker-based AR; AR-based application; SUS score

I. Introduction

Augmented reality (AR) has been proven to play a vital role among the nine pillars of Industrial Revolution 4.0 (IR4) in enhancing occupational safety and health (OSH) activities [1]. Among the activities include rehabilitation [2] and the innovation of serious games for safety training [3]. Particularly, OSH training has evolved tremendously over the years, but most organizations still rely upon traditional way to impart the knowledge. Today, complex working infrastructure present more hazardous environment for the safety and well-being of workers. Thus, AR is a relevant tool that has the capacity to enhance conventional training, suitable for current trend.

The effectiveness of using AR in improving academic performances has been proven for many teaching-learning process [4]. AR have been one of the many popular technologies, used by various institutions as the attractive and interactive elements provide positive effects towards learning performances. However, the overall effectiveness of AR-based technology intervention for professional training was reported to have a small effect on the outcome [5]. Interestingly, AR improved the overall effectiveness of vocational training for a large size effect [6]. This indicates the potential of deploying applications built with AR technology for OSH related training may produce better effects in achieving training outcomes as the first issue highlighted in this study.

Motivational impact is the second issue addressed when training is conducted conventionally [7]. Conventional training has seen a worse decline in providing sufficient motivational impact, especially in this pandemic era [8]. To overcome this, other IR4 technology such as virtual reality has been implemented for the sole purpose of boosting the motivation among learners [9]. In this study, the technological tool of interest, chosen to enhance motivation is AR [10], as AR is proven to be able to increase motivational impact as opposed to the conventional training delivery methodology [11].

Consequently, today's era perceived many information and communications technology (ICT) tools developed to be used in teaching-learning for various benefits, which requires the usability level of such tools to be properly examined [12], as the third issue for this study. In easy terms, usability level refers to the indicator on a specific user in a specific context, the ability to utilize the tool in achieving a goal effectively, efficiently, and satisfactorily. Simply developing a mobile app is insufficient to conclude its contribution towards the users in said fields, which is the reason to evaluate the usability level.

Therefore, based on the three issues elaborated, the following research questions are established:

1) What is the effect of implementing AR technology tool towards academic performances in OSH training?

2) What is the motivational impact of deploying the AR tool as a part of the OSH training?

3) What is the usability level of the developed AR tool?

II. Background Study

Based on the research questions stated, there is a necessity to study several important areas. These important areas include the importance of conducting OSH training among organizational members in the organization, the effect as well as motivational impact of conducting training conventionally, and the relevant usage of AR as an innovative tool that had been reported to improvise the content delivery of OSH training in recent times.

A. Importance of OSH Training

In general, training is important because it is a precondition to ensure employees can perform their job effectively and