

The Enhancement of OSH Training with an Augmented Reality-Based App

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Abstract—Recent advances in training approaches and technology have identified the need to improve training in the field of occupational safety and health (OSH). While many researchers have examined the use of augmented reality (AR) and technology-based classrooms to enhance conventional training practices, quantitative evidence for their effectiveness and motivational impact remains scarce. To contribute to filling this research gap, an AR-based application was developed to enhance OSH training. The enhanced training session was conducted in a closed, safe environment with ten participants with no background in OSH. Pre-test, post-test, and instructional material motivation surveys (IMMS) using a five-point Likert scale were deployed to measure the effectiveness and motivational impact in accordance with the respective ARCS factors. The empirical results obtained show that participants performed significantly better in the post-tests than in the pre-tests (mean = 14.60, s = 1.71, $t(9) = -12.11$ with p-value < 0.001). The IMMS results show that the perceived motivation arising from the AR-based application resulted in the highest mean score for the satisfaction factor (4.80) followed by the relevance (4.65), confidence (4.60), and attention (4.55) factors. The results of the evaluation suggest that the AR-based application boosted participants' active learning behavior, engagement, and interest during the enhanced training session and produced a better learning outcome and experience.

Keywords—safety management, mobile application, personnel training, e-learning, augmented reality, hazard identification, mobile augmented reality

1 Introduction

Occupational accidents are unpredictable and unintentional events that may cause harm to the equipment, and injury or death to employees. Training is one method used to minimize the number of occupational accidents [1]. Safety training is highly important as part of creating a climate of safety. For example, in Malaysia, organizations require workers to attend safety training, especially those in high-risk and hazardous occupations [2]. With the outbreak of the global pandemic, occupational safety issues have been further challenged [3]. This further magnifies the significance of an efficient,

timely, and affordable occupational safety and health (OSH) training program. Thus, the central problem to be highlighted is the inefficiency of current OSH training practices, though the subject matter is highly relevant to all members of an institution [2]. Although the maintenance of safety and health is the utmost priority, employees and operatives in the actual working environment are still not well-prepared by the traditional training delivery method [4]. Hence there is a pressing need to try a different approach to seeking improvements to the current training system and methodology to establish a safer and healthier workplace environment [5]. Based on this need, the problem can be further elaborated into two sub-problems. Firstly, the conventional training delivery method used in current practices is ineffective [6]. It has been reported that the number of OSH training sessions conducted is insufficient [7]. Given the situation, the lack of training and its ineffectiveness will have future negative impacts. Intervention and support for the improvement of the training methodology are imperative to overcome this issue. Secondly, the lack of interest among institutional members toward OSH contributes to the motivational issues they face when required to attend related training [8]. As OSH training is regarded as dull and stagnant despite its importance [9], there is a need for this training to be better implemented [10], which would increase workers' and employees' motivation to learn. Hence, under these circumstances, the following research questions were established:

1. How can OSH training be improved with technology?
2. What are the effects of enhanced OSH training on trainees' performances?
3. What are the impacts of enhanced OSH training on trainees' motivation?

Thus, this paper reports the research work based on the hypothesis that the enhancement of OSH training using AR technology has significant effects and impacts on trainees' academic performances and motivation. Thus, the following research objectives were established:

1. Enhance OSH training using an AR-based application.
2. Investigate the effects of the enhanced OSH training program on trainees' performances.
3. Measure the impacts of the enhanced OSH training program on trainees' motivation.

2 Background study

2.1 OSH training in organizations

Training intervention is considered a method of risk control designed to improve workers' knowledge, skills, and attitude concerning workplace hazards and safe, healthy working practices. Under the hierarchy of risk control, training intervention is categorized as a form of 'administrative control' used to supplement other more reliable risk control methods, listed as elimination, substitution, and engineering control [11]. Training intervention is commonly deemed less effective because it relies on the individual's capability and willingness to retain, maintain, and practice what they have