FINDING HOUSING DEFECTS IN VR - AN IMMERSIVE ENVIRONMENT FOR GENERAL EDUCATION CLASSES (ABU) IN SWITZERLAND

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Abstract

Immersive technologies like virtual reality can enhance learning outcomes by improving engagement, motivation, creativity, critical thinking, attention, information retention, satisfaction, self-efficacy, and problem-solving ability.

This contribution focuses on exploring the use of virtual reality (VR) environments for assessing learning content. The aim is to determine whether a 360-degree pictures-based tour of a vacant apartment in a desktop version is suitable for assessing previously acquired knowledge about apartment defects or damage than a fully immersive VR environment with a head-mounted display.

In September 2023, a study was conducted at a Vocational Education and Training (VET) school in the Swiss-German region. Around 80 logistics apprentices were involved in the study, which spanned a duration of two weeks. The primary objectives were to assess the accuracy and quality of the apprentices' responses, examine the interplay of motivational, affective, and cognitive factors, and investigate how immersive technology, both in a desktop and a fully immersive version, influences the practical application of acquired knowledge.

With the present abstract, we aim to highlight the potential of VR for learning purposes in VET schools and provide insights on immersive technology for assessment in education.

Keywords: Immersive technologies, virtual reality (VR), Vocational Education and Training (VET).

1 INTRODUCTION

Immersive technologies have been shown to be effective and enhance learning outcomes [1], improving factors such as engagement, motivation, creativity, critical thinking, attention, and information retention [2-4] and can also increase satisfaction and self-efficacy [3]. The sense of presence created by immersive technology can simulate real-life situations, enhance positive conditions conducive to learning and consequently fostering better learning outcomes [5] as well as problem-solving ability and increasing acceptance of further use. These technologies, such as virtual reality (VR), are particularly appropriate for situations where careful observation is necessary to transfer knowledge into practice, such as in a schooling context [6].

Although VR can enhance learning and thus promises great potential for educational purposes, it is mostly used to support learning content, but very little is known about how it can affect assessment. Therefore, in this paper we focus on the use of VR environments to explore assessment for learning content. At a Vocational Education and Training (VET) school in the German-speaking part of Switzerland, we conducted an experiment with apprentice logistics to determine whether a 360-degree pictures-based tour of a vacant apartment is better suited as a desktop version (DV) or as a fully immersive VR environment with a head-mounted display (HMD) to assess previously acquired knowledge about housing defects in General Education Classes (ABU[1]).

The aim of the investigation is to evaluate (1) which assessment (DV or HMD) is more appropriate in terms of accuracy and quality of apprentices' responses for assessing acquired knowledge in ABU classes; (2) to what extent do motivational, affective, and cognitive factors interact with the different assessment conditions; and (3) to what extent does the use of immersive technology support or hinder apprentices in applying previously acquired knowledge about housing defects.

[1] *ABU is the German acronym for "Allgemeinbildender Unterricht"*

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2 STUDY DESIGN AND METHODS

The study was scheduled for September 2023 and was conducted as part of the "Housing" teaching module in the ABU classes at the Swiss-German vocational school. Approximately 80 logistics apprentices participated in the study, which run for two consecutive weeks. The aim of the "Housing" module is to provide apprentices the practical knowledge related to housing search, budget planning, rental contracts, rental deposits, and the process of apartment inspection. Specifically, a three-part didactic scenario was developed that focuses on the preparation of an apartment inspection protocol, which involves documenting any damage or defects in the apartment before moving in.

During the first week, all participating apprentices attended a training session (1) conducted by the VET teachers as part of the didactic scenario in the ABU classes. They learned about common damages and defects found in rented apartments and why it is important to include them in a list of defects for the apartment inspection report. Additionally, they learned about specific issues, such as mold on walls (including the causes, incidence and responsibilities of tenants and landlords in dealing with mold issues). Following the training session, the apprentices reviewed the content of the ABU lesson independently (2) during a period of one to two hours, physically present at the school. The content was accessible to the students through the school's Learning Management System (LMS). Finally, the acquired knowledge was reinforced (3) through an interactive quiz (e.g., Kahoot) during the ABU classes.

The assessment and data collection phase took place in the second week. The apprentices were randomly divided into two groups. The first group experienced a 360-degree image-based assessment using a desktop computer (DV), while the second group experienced a fully immersive VR environment using a head-mounted display (HMD) for the assessment. In the two-story vacant apartment that was virtually inspected as part of the experiment, a total of 16 different apartment defects or damages could be identified. Ten of these were rather easy to find (e.g., missing shower head, broken window, severe mold growth on the living room wall), whereas six were fairly difficult to detect (e.g., one of three apartment keys is missing, crooked cable outlet cover, missing toothbrush glass in the bathroom). Study participants in both research groups were asked to find and report as many of these housing defects as possible.

The collection of the data was carried out in three steps. First, the participating apprentices were asked to think aloud during the assessment, regardless of condition. This method follows the approach developed by Ericsson and Simon [7, 8]. Secondly, the young learners were asked three open-ended questions about how they felt about the assessment and how much they thought it benefited their daily lives or futures. Finally, the trainees completed an online survey to capture their perceptions of cognitive, affective, and motivational aspects of the assessment as well as their familiarity with technology. The researchers accompanied and recorded the apprentices' thought processes. The online survey was based on the Cognitive Load scale [9, 10], the SOPI scale [11], the ARCS-RIMMS scale [12], the AWWWARE scale [13], and the Digital technology adoption scale [14].

After data collection, the audio files have been systematically analyzed according to Chi's guide for quantifying qualitative analyses of verbal data [15], followed by a quantitative data analysis to determine whether there are differences in the number of correct answers given by the trainees between the two study groups. In addition, it was analyzed whether there are differences in the cognitive, affective, and motivational aspects that influence the response behavior or the application of the previously acquired knowledge by using the Cognitive Load scale (CL), the SOPI scale (SOPI), and the ARCS-RIMMS scale (RIMMS).

3 RESULTS

The total sample included 81 logistician apprentices. Of these, three were young women (3.7%) and 78 were young men (96.3%). The students were 17-24 years of age (M = 18.56, SD = 1.60). Although the young people reported being generally well versed in computer games, they had a medium level of experience with virtual reality and a rather low level of experience with virtual reality games.

3.1 Number of correct answers

After successfully verifying the prerequisites for parametric tests (normal distribution within the study groups and homogeneity of variance between the two study groups), we conducted an independent samples t-test. It showed that the HMD study group (M = 6.56, SD = 2.46, n = 43) found significantly more housing defects or damage in the assessment than the DV study group (M = 4.95, SD = 1.89, n = 38) $t(79)$ = 3.271, p = .002. The effect size according to Cohen is d = .73, corresponding to a medium effect [16].

3.2 Cognitive, affective, and motivational aspects

To determine whether the technology used in the assessment resulted in differences between the study groups in cognitive, affective, and motivational aspects, a one-way multivariate analysis of variance (one-way MANOVA) was conducted. The one-way MANOVA found no statistically significant differences between the study groups on the combined dependent variables (CL, SOPI, RIMMS), $F(1, 75) = 0.42$, $p = .736$, partial $\eta^2 = .02$, Wilk's $\Lambda = .983$.

4 DISCUSSION AND CONCLUSION

Immersive technologies have been shown a promising potential in an educational context [1-6]. However, knowledge about the impact on the evaluation process remains very limited.

The current study shows that immersive technology can be an alternative possibility for assessments in VET school, especially in a multi-faceted subject such as ABU. The data indicate that when conducting assessments that require learners to use their prior knowledge to accurately identify specific elements in a 3D environment (such as housing defects), it is appropriate to use technology that can provide a fully immersive experience. Although participants in the study group who experienced full immersion using a head-mounted display (HMD) had statistically significant higher assessment scores compared to those using the desktop version (DV), it is worth noting that the magnitude of these differences is relatively modest.

Furthermore, no statistically significant differences were observed between the two study groups in terms of cognitive load, sense of presence, and the various aspects of learner motivation, including attention, relevance, confidence, and satisfaction. While discrepancies in cognitive load and aspects of learner motivation were not necessarily anticipated, the absence of a discernible group difference in the sense of presence is rather unexpected.

However, data analysis is not yet complete. Further analysis, such as structural equation modeling, will be needed to gain more accurate insights into the effectiveness of immersive technologies for assessment purposes. In addition, the audiographic data can still be transcribed, coded, and systematically analyzed using qualitative content analysis. Moreover, the virtual assessment tool can be further optimized and more closely linked to the previous didactic scenario.

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