Information Sciences Research Methodology PG (6797)

Assignment 1: Review and Critique of Research Paper & Methodology

Ajul Thomas (u3253992@uni.canberra.edu.au)

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Article: Evaluating virtual reality and augmented reality training for industrial maintenance and assembly tasks

Authors: Nirit Gavish, Teresa Gutiérrez, Sabine Webel, Jorge Rodríguez, Matteo Peveri, Uli Bockholt & Franco Tecchia

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My Research Topic

Augmented reality and virtual reality in Industrial Training

Research questions

1. What is the potential of augmented reality and virtual reality in industrial training?

2. What are the challenges and barriers faced in the wider adoption of augmented reality and virtual reality technologies in Industrial training ?

3. How does the design of AR/VR user interfaces affect the learning experience and performance of workers in industrial training programs?

4. What are the impacts of augmented reality and virtual reality assisted training on the learning outcome of workers?

Research Objectives

1. To explore the potential applications of AR/VR technologies in industral training.

2. To examine the challenges associated with the use of AR/VR technologies in Industrial Training.

3. To assess the effectiveness of augmented reality and virtual reality in industrial training and identify opportunities for future research and development.

Keywords

augmented reality, virtual reality, industrial, training, maintenance, assembly, learning

Why did I choose this paper ?

The research paper[1] provides comprehensive evaluation of virtual reality and augmented reality platforms developed for industrial training with a special focus on maintenance and assembly tasks. It provides valuable insights into the practical effectiveness in adoption of these technologies for industrial training. This closely aligns with my research objectives and is a critical source for understanding the applications and limitations of AR/VR technologies in real-world industrial settings.

How did I choose this paper?

I used keywords such as 'augmented reality', 'virtual reality', 'industry' and 'training' in consensus (AI search engine for research) to find this paper.

Title or Abstract of the paper

The title of the paper[1] effectively communicates the scope and focus of the research, which is evaluating the effectiveness of AR/VR training in industrial tasks such as maintenance and assembly. It is appropriate, concise and is directly related to the topics discussed in the paper.

The abstract of the paper[1] provides a comprehensive overview of the research problem, objectives, methods, key findings, and conclusions drawn, in an appropriate and concise manner. Additionally, it could have briefly mentioned the subjective evaluations of the learning platforms, which are discussed in the paper, but not reflected in the abstract.

Research Problem

As the complexity of industrial tasks increases rapidly, traditional training methods turns out to be costly and time-consuming. In this context, the research aims to empirically assess the potential of AR/VR training platforms for industrial training, with a focus on maintenance and assembly tasks. The intended impact of the research is to provide evidence supporting the use of AR and VR training platforms for industrial training.

Theories or Framework

The study is an empirical research focused on evaluating the efficiency and effectiveness of augmented reality and virtual reality training platforms compared to traditional training methods.

The research primarily applies theories of learning and skill acquisition, particularly focusing on the concept of procedural learning and the learning-by-doing approach. The training platform applies the enactive approach of 'learning by doing' by means of an active multi-modal interaction.

Methodology and Methods

The research paper[1] employs a mixed method research. The research uses quantitative methods to assess task performance, error rates, and training time, as well as qualitative

methods to measure user satisfaction and usability through subjective questionnaires completed by users after the training.

The primary research method employed in this study is a post-training performance test, which quantitatively measures the technicians' ability to assemble an electronic actuator after undergoing different training interventions. The performance was evaluated based on the mean performance time, the number of unsolved errors, and the use of instructional aids during the task.

The study involved fourty expert technicians, who were randomly assigned to one of four training groups in an electronic actuator assembly task: VR, Control-VR, AR, and Control-AR. Each group undergoes a different set of training, and their performance is tested in the a real actuator assembly task(which they were trained on). This random assignment is crucial as it helps to eliminate bias and ensures that the groups are comparable in terms of their prior knowledge and expertise.

Following the test, data regarding the transfer of learning (How well participants believe the training improved their skills) and usability of the training platforms(The ease of use and overall experience with the VR/AR platforms) were collected using subjective questionnaires.

The study's design helps in identification of notable differences in the performance of various training methods and promotes the use of augmented reality and virtual reality technologies in industrial training. The researchers also acknowledges that the research involves latest technologies, which may require additional time for users to adapt.

The researchers have clearly explained their selected design and methods in the study. They have emphasised the need for empirical evaluation of efficiency and effectiveness of AR and VR learning platforms compared to traditional ones, which provides objective data that can be analysed statistically. The qualitative assessments offers crucial insights into viability of these platforms in real-world applications.

However, there are certain notable areas of improvement particularly regarding the sample size and task complexity. The study uses relatively small sample size, which limits the wider applicability and generalization of the findings. Additionally, the participants were expert technicians with significant experience in the field, causing ceiling effect. The high skill level of participants may limit the study's ability to detect differences that might be more apparent in less experienced trainees.

A larger and more diverse sample consisting of novice technicians along with longer and more complex tasks, would improve the generalisation of the findings. Despite these drawbacks the study makes valuable contributions in understanding the effectiveness and efficiency of AR and VR technologies in industrial training.

Research Contributions

The research[1] contributes to both theory and practice into the field of industrial training. It provides empirical evidence that shows the effectiveness of augmented reality systems in complex and highly demanding industrial maintanence and assembly (IMA) training tasks.

It demonstrates the potential advantages of Augmented reality training platforms over traditional methods, particularly in reducing unsolved errors. This adds more data supporting previous research[1] findings that, AR technology can improve the cognitive element of training.

Furthermore, the study highlights the needs for more research with respect to virtual reality assisted trainings tasks, as it didnot show any significant improvements over traditional training methods in this research. This promotes more researchers to explore the potential of virtual reality technologies.

Research Quality

The research has a well-structured experimental design, which adds to the validity and reliability of the research outcome. However the narrow and homogenous participant group and the qualitative assessemnets could affect generalisation of the research findings and the repatability of the overall research.

The research is repeatable as the authors have provided clear and unambigous description of the experimental procedures and training tasks involved. On the other hand, hardware and software improvements in the field of augmented reality and virtual reality could affect the repeatability of the experiment.

The research article was published in the Interactive Learning Environments journal, which is a reputable academic journal with a focus on technology-enhanced learning environments. As per the data from journal article webpage [1], this peer-reviewed article has 378 cross reference citations.

Ethical Issues

The paper does not explicitly mention a detailed framework for addressing ethical issues. However, the research paper [1] should have explicitly mentioned the ethical approval obtained from a relevant body. It should have detailed the informed consent process, where the participants are explained about the research objectives, nature of their involvement and their right to withdraw at any time, without repercussions [2].

Deficiencies

The researchers [1] itself have mentioned some of the limitations of the present study, such as choice of expert technicians, novelty of the augmented reality and virtual reality platforms, lack of complexity and short duration of the chosen task and the significant differences between the augmented reality and virtual reality platforms used.

Inorder to address these gaps or deficiencies in this research [1], future research initiatives should include a larger and more diverse sample of participants. Furthermore, authors[1] have suggested inclusion of participants who are familiar with augmented reality and virtual reality platforms and use of lengthier and complex tasks, which requires high level problem solving and strategic planning. A more comprehensive understanding can be derived from future research endeavors by incorporating these improvements.

REFERENCES

[1] N. Gavish et al., "Evaluating virtual reality and augmented reality training for industrial maintenance and assembly tasks," *Interactive Learning Environments*, vol. 23, no. 6, pp. 778–798, Jul.2013, doi: https://doi.org/10.1080/10494820.2013.815221.

[2] ChatGPT, information from request 'ethical concerns or process to be followed for a research article', 11:30am, Aug, 30, 2024.