Using Augmented and Virtual Reality to Improve the Students´ Technical Skills

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Abstract
Augmented and virtual reality represents unique instructional media, affording educators opportunities to create, customize and scale authentic, student-centered and interactive learning experiences. The aim of our study was to gain insights into v-learning from the perspective of teachers and students. Our paper sets out discursive issues surrounding student performance in welding skills and opinions of participants - students and teachers - regarding pros and cons of AR. Our study confirmed AR had the ability to engage pre-service teachers to train welding skills as AR learning environment tended to provide an effective supporter of traditional education. It was more likely to lead to certain benefits such as increased motivation of learners.

Keywords: AR, VR, Students, Learning, Teaching

1. Introduction

In recent years, the integration of augmented and virtual reality technology into educational settings has gained significant attention as a promising approach to enhancing teaching and learning experiences. Augmented and virtual reality, technologies that immerse users in computer-generated environments, offer unique possibilities for transforming traditional pedagogical methods across various disciplines. One particularly promising area of application lies in the realm of technical skill development among university students. As industries continue to demand graduates equipped with practical expertise, educators are exploring innovative tools to bridge the gap between theoretical knowledge and real-world proficiency. Augmented and virtual reality stand out as potent tools that have the potential to revolutionize the way technical skills are taught and acquired.

2. Potential and Challenges Suggested by Recent Research

- Traditional education methods often struggle to fully engage students in acquiring technical skills due to limited opportunities for hands-on experiences, especially in fields that require tangible practice. Augmented and virtual reality break through these limitations by offering an immersive, interactive, and safe environment where students can actively engage with complex scenarios. By simulating real-world situations, AR and VR allows students to apply theoretical concepts in realistic contexts, thereby facilitating a deeper understanding of the subject matter.

- Engagement and motivation are crucial factors in effective learning, particularly when it comes to acquiring technical skills. Augmented and virtual reality's ability to provide a dynamic and visually compelling environment can capture students' attention and sustain their interest throughout the learning process. According to Slater and Wilbur (1997), A/VR's immersive nature can trigger a heightened sense of presence, making learners feel as if they are physically present in the simulated environment. This heightened presence can lead to increased engagement, motivation, and retention of learned material.

- Virtual reality also offers the potential for personalized and adaptive learning experiences. Through AR and VR simulations, educators can tailor scenarios to match the students' skill levels and learning pace, providing a customized journey for each student. As noted by Johnson et al. (2016), adaptive learning environments have the advantage of addressing the diverse needs of students, ensuring that both fast learners and those who require more time receive appropriate challenges and support.

- Resource constraints, such as access to specialized equipment and physical spaces, often hinder educational institutions' ability to provide practical training for technical skills. Augmented and virtual reality offers a solution to these limitations by enabling students to practice in virtual laboratories, workshops, or environments that closely mimic real-world settings. This accessibility can democratize technical skill education and create equitable learning opportunities for all students.

- While the potential of virtual reality in enhancing technical skill acquisition is promising, challenges such as the high initial costs of AR/VR setup, technological barriers, and the need for high-quality content development must be addressed. Moreover, empirical research is essential to validate the effectiveness of AR/VR-

based interventions in comparison to traditional methods. As AR/VR technology evolves and becomes more accessible, further research should focus on optimizing instructional design and exploring the long-term impact of VR-enhanced technical education.

3. Research Characteristics

3.1 Research Objective

The aim of our study was to gain insights into to a/v-learning from the perspective of teachers and students. Our paper sets out discursive issues surrounding student performance in welding level training and opinions of participants - students and teachers - regarding pros and cons of AR/VR.

3.2 Research Methodology

Our research followed a mixed method strategy combining qualitative approaches to data collection and the ensuing discussions.

We used following methods:

- Student essay analysis (opinions on achievements in level of welding training measured by AR program)
- Self-reporting of participants on welding training
- Semi-structured interviews with teachers/trainers of AR program

3.3 Research Sample

Our research was attended by 20 students at a partner secondary technical school aged 17-19 who enrolled in the course *Welding*. For the first month of the 3-month course, students were presented with traditional lectures on welding methods, theory, including traditional video training for successful mastery of welding. They were then divided into 4 groups of 5 students and trained in the AR program in a 6 of sessions.

After each session, the results in 21 categories and welding quality parameters were measured using the AR program. At the end of the course, students were asked to write a 1-page essay about their experiences with the AR program and assess its effectiveness in all 21 categories. At the beginning of the semester, students also reported their level of initial theoretical and practical knowledge of welding methods on a scale of 1-10 (10 is the highest level of knowledge skills) and were asked to compare it after their AR training. At the end of the course, we also conducted semi-structured interviews with 4 teachers – supervisors of the training.

Fig. 1: Students train their welding skills with the help of AR

4. Research Results and Discussion

Based on the objectives of our research these findings emerged from the collected data:

4.1 Students Essays – Experience With VR Program

Students reflected on their experience with the AR program as highly motivating and fun, but also tiring. Improvement and confidence were mentioned in all 21 aspects of welding quality (see Table 1), but the results appear to be different. Speed and fluency of welding improved in almost all reports, and students found that checking number of correct welding parameters was easier after training Some specific parameters of welding quality seemed more difficult to students and will require more practice. Although students' enthusiasm for AR-learn has been expressed in all the essays, this should not replace traditional teaching and learning practices, but reinforce them. Still, students believed that learning AR had a purpose by making the training meaningful. Some of their comments: "... People can forget what they write, they can also forget what they listen to, but they don't easily forget what they live and enjoy…," "... AR can help to think positively and not give up, push a trainee outside of his comfort zone…," there should be the need to work through challenging situations…, "it is nice that we can practice in a simulated situation before being with real materials…." Some limitations were expressed by some students though as they were concerned about a saturation effect: "…I don't think that it will work... people might also get bored if they use it all the time…."

When to summarize the pros and cons expressed in most essays, they would be as follows:

- feeling like being in a real welding process and with real materials, enjoyment, new experience, emotions, enthusiasm, fun, loss of fear,
- fatigue and discomfort working with AR glasses, loss of concentration after certain time.

Aspect (21)	No change	Slight change	Moderate change	Considerable change
1) Distance from material	0	2	8	10
2) Speed of welding	0	3	5	12
3) Angle 1	0	9	8	3
4) Angle 2	0	4	12	4
5) Angle 3	0	6	11	3
6) Angle 4	0	7	9	4
7) Fluency	0	1	6	13
8) weld penetration	2	10	8	0

Table 1: Crucial parameters

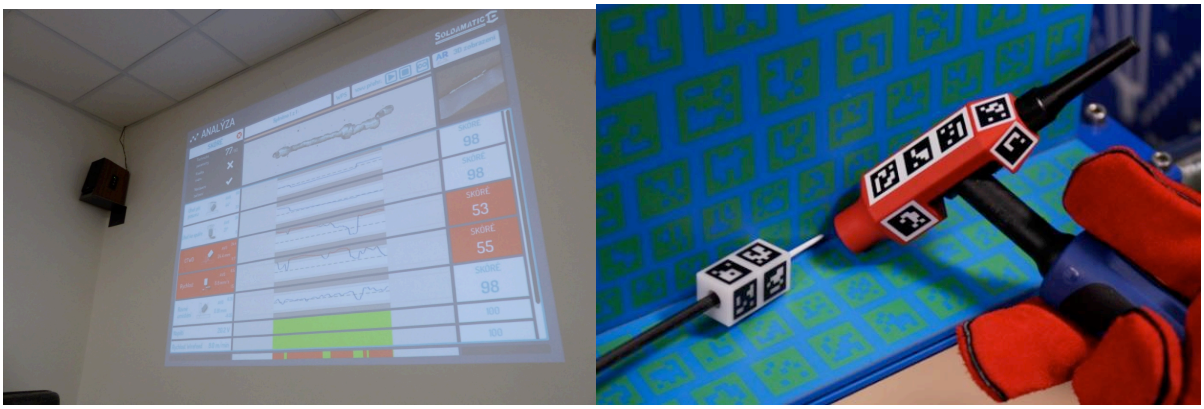

Fig. 2: Parameters of welding

4.2 Fear of Real Welding

At the start of the semester, 12 students of 20 scored 7-10 on the scale which was interpreted as high level fear of real welding, Nine of them described their fear as a huge problem. At the end of the course, most students reported mild or no fear, see Table 2.

Level of fear (1-10)	Student self-report at the start of the semester	Student self-report at the end of the semester
1-2	1	10
3-4	1	4
5-6	4	3
7-8	9	3
9-10	5	0
Students - total	20	20

Table 2: Level of fear: student self-report at the start and at the end of the semester

Fig. 3: Welding training

4.3 Semi-structured Interviews With Teachers/Trainers

According to the opinions of teachers who taught both theory and AR in the course, students significantly improved their practical welding skills during the course. The student's performance showed that AR helped students learning better. The results revealed that there was a significant positive impact of VR environment on the development of students' welding skills.

> "... The use of AR tools allowed students to practice welding as in real welding. "
>
> "Welding skills have greatly improved with the use of AR tools in the laboratory..."

When asked to summarize the pros and cons of VR-learn these were prevalent opinions as expressed by teachers:

Plus: High motivation, visible progress, more confidence, better performance of students

Minus: Cost of equipment, need to divide the students into small groups, need of technical support

5. Conclusions

Our study confirmed that AR is able to engage future welders before starting service to train their welding skills, as the AR learning environment tended to provide effective support to traditional education. It certainly led to some benefits, such as increased student motivation. Educators need to have a clear understanding of how these platforms add, but critically replace, traditional teaching and learning practices, rather than reinforce them. Thus, there are

factors to consider both with this platform and with the students themselves when incorporating this technology for welders before entering the service.

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