

# The Use of Virtual Reality Solutions to Improve Educational Experience for IT Students

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**Abstract.** The paper is focused on the research on virtual reality solutions which could be used to improve educational experience focusing on IT students. Current state of the art in the field of VR use for educational purposes was analysed. Pros and cons for VR implementation in education were considered. As the solution to enhance educational experience was proposed to integrate VR environment with learning management system in order to automate assessment for mass-learning courses. An example of such integration, a system based on Unity engine for VR laboratory environment development, and Moodle for learning management system, was presented. Experimental results obtained during testing of developed system proved possibility of proposed integration approach and possible benefits from its practical implementation for mass learning courses.

**Keywords:** *augmented reality, education, learning management system, virtual reality.*

## I. INTRODUCTION

Virtual reality (VR) has revolutionized the way we learn, creating an immersive learning experience for students across all levels of education. As technology advances and more applications become available to educators, virtual reality solutions have emerged as a powerful tool for improving the educational experience of IT students. This paper will discuss how VR can be used to enhance IT student learning by providing them with interactive and engaging activities that help build their technical knowledge and skills. It will also explore the potential issues associated with using VR in education,

such as cost, safety concerns, and accessibility challenges. Finally, this paper will provide recommendations on how institutions can best implement VR solutions in order to maximize their effectiveness in teaching IT students.

## II. MATERIALS AND METHODS

The study on the use of VR for education lasts over two decades. Thus, in [1] it was explored the concept of transformed social interaction in collaborative virtual environments, and how it can be used to decouple representation from behavior and form. The authors provide a thorough review of existing literature on the subject, as well as an analysis of their own experiments conducted with different types of users. They conclude that transformed social interaction has potential for creating more meaningful interactions in virtual environments, although further research is needed to determine its full impact.

A number of researches are devoted to study the possibility of using VR to improve teaching experience in specific areas. So, in [2] it was provided an in-depth review of the literature on virtual reality as a tool for teaching anatomy over decade, from 2005 to 2015. The authors analyze the various studies conducted and summarize their findings with regards to effectiveness of VR technologies for medical education. They also discuss implications of their findings, including potential limitations and areas needing further exploration. Overall, this paper provides an informative overview on how VR technology can be used to effectively teach anatomy in medical education settings. Paper [3] provides an insightful look into the potential of

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immersive interfaces for learning and engagement in education research and development. The authors discuss how these technologies offer a new way to engage students and provide them with opportunities for critical thinking, problem-solving, creativity, collaboration, and other higher order skills that are essential for success in today's world. They also describe the implications of using such technologies on student motivation as well as teacher effectiveness. The paper provides a comprehensive overview of the current state of immersive interface technology and its potential applications in educational settings. It is an important read for anyone interested in exploring this emerging field. Research presented in [4] provides a comprehensive and systematic review of the current literature on augmented reality/virtual reality technologies in higher education. The authors conducted a rigorous search to identify relevant studies, analyzing them according to their design, purpose, results and implications for educational practice. Their findings suggest that AR/VR can be beneficial for teaching and learning in higher education contexts, with potential applications ranging from problem-solving activities to virtual field trips. In [5] it was presented an extensive and comprehensive systematic literature review of Virtual Reality (VR) in education. The authors analyze the current state of VR in educational settings, and identify a variety of potential applications for this technology. They also discuss several challenges associated with its implementation, including cost, technical complexity, and lack of research evidence to support its effectiveness. Overall, the paper provides a valuable overview of the development and use of VR in educational contexts, as well as suggestions for future research directions. Another research on a topic provides a thorough review of the use of virtual reality in educational contexts from 2005 to 2015 [6]. The authors present an extensive analysis and discussion on various aspects such as the types of technologies used, advantages and disadvantages, applications, research methods employed etc. They also provide several suggestions for future research directions. Paper [7] focuses on conducted a meta-analysis on existing studies in order to determine whether or not VR was more effective than traditional methods for instruction, as well as its relative impact on student engagement, motivation, and achievement. The results show that there is strong evidence indicating that VR can be beneficial for teaching in certain contexts; however, it should be noted that further research is needed to better understand how best to use this technology in educational settings. Paper [8] presents a systematic review of the use of virtual reality in medical education. The authors conducted a comprehensive search to identify relevant studies, which were then assessed for quality and synthesized according to the type of educational intervention used. Results show that virtual reality interventions can be effective in improving student performance in medical education, with improvements seen across all aspects studied including knowledge, skills and attitudes. This review is an important contribution to our understanding of how virtual reality can be used effectively in medical education, providing evidence-based guidance on best practices for educators looking to incorporate this technology into their teaching. Also [9]

provides an in-depth review of the use of Augmented Reality (AR) and Virtual Reality (VR) for teaching and learning, which is becoming increasingly popular due to advances in technology. The authors discuss various applications of AR/VR technologies across different disciplines, such as medical education, language learning, mathematics instruction, engineering training etc., and analyze the potentials and challenges associated with their implementation. They also provide a comprehensive list of evaluation criteria that should be taken into consideration when designing these systems.

So, VR can be used to improve the educational experience for IT students in a variety of ways. VR can help students visualize complex concepts, allowing them to better understand and interact with the material. For example, VR could be used to create immersive 3D simulations of networks or computer systems that allow students to explore how they work and practice troubleshooting techniques in a safe environment. Additionally, VR can be used for remote collaboration between students and teachers, facilitating real-time learning activities such as coding projects or debugging sessions. Furthermore, virtual field trips and other experiential activities using VR could provide an engaging way for IT students to gain knowledge about different technologies from experts around the world without having to leave their classrooms.

The use of virtual reality (VR) in education has been gaining traction in recent years, with many schools and universities exploring ways to incorporate the technology into their curriculums. VR can be used to enhance learning experiences by providing students with a more immersive and engaging way to explore new topics. It can also provide instructors with a platform for creating interactive lessons that allow learners to interact with 3D objects or environments. Additionally, VR can be used as an assessment tool, allowing teachers to gauge student understanding of concepts through interactions within virtual simulations.

Basing on provided review, it was analysed benefits and potential issues of VR use for educational purposes, presented below.

#### *A. Benefits of Virtual Reality Solutions for Education*

The use of virtual reality solutions in education provides numerous benefits to IT students. First and foremost, it allows learners to interact directly with objects or scenarios they are studying without having to physically visit a location or handle any materials themselves – making it easier than ever before for instructors to facilitate hands-on learning experiences remotely. Additionally, the ability to “walk through” complex concepts via 3D simulations helps one to improve comprehension by allowing learners to better visualize abstract ideas; this is especially useful when dealing with difficult topics like programming languages or coding algorithms which may otherwise be hard for some learners to grasp conceptually without visual examples in virtual environment being present. Furthermore, because most virtual reality applications come preloaded with built-in analytics tools

that track user performance data over time – including completion rate times average score per lesson – instructors gain valuable insights into how their lessons are resonating among different groups of students; thus enabling them make improvements where needed while keeping an eye on overall progress made within class cohorts at large scale level too. Finally, since many VR platforms offer multiplayer capabilities, they allow multiple users collaborate together in real time from wherever they might be located – something which could prove invaluable during group projects often assigned throughout college curriculums.

### *B. Potential Issues Associated with Implementing Virtual Reality Solutions*

While there are numerous advantages associated with implementing virtual reality solutions into educational settings, these must be weighed against potential drawbacks if institutions are serious about maximizing its usage amongst their student body. The first issue is cost: since setting up a full-scale virtual environment requires investment not only in hardware but in software licenses also, investing money upfront can limit access for those who cannot afford it; furthermore maintenance fees may need be paid regularly to keep systems running optimally well after initial setup phase complete. Additionally, there health safety considerations which should be taken into account when deploying devices such as headsets due possibility of long-term strain caused by prolonged wearing. Lastly, some disabled individuals unable utilize certain features offered by current generation devices further limiting access for those already less privileged under circumstances to start off begin with.

Basing on analyzed pros and cons for the use of VR for educational purposes, it is possible to formulate recommendation on the VR implementation for educational purposes. In order to ensure successful implementation of virtual reality solutions into educational settings, several steps should be taken beforehand to minimize risk factors outlined above, whilst optimizing effectiveness of an end product, delivered staff members; students, etc.:

- firstly, budgeting for project needs to be done realistically taking both short term and long-term costs into account and avoid unnecessary financial burden later down line
- secondly, an appropriate training should be provided for personnel involved, so everyone should know what to expect them at each step of the process;
- thirdly, necessary safeguards should be put in place to protect users from any possible harm arising out of the usage of inappropriate content;
- lastly, regular reviews carried out in order to assess impact program had to be implemented upon outcomes desired versus actual results achieved and evaluate whether changes required to maintain optimal standards of operation moving forward.

Furthermore, VR solutions could be integrated into learning management systems such as Moodle which became quite popular during previous years of quarantine restrictions. Thus, a lot of educators are already familiar to work with them. Such integration allows teachers to create more engaging lessons for their students, while users allowed to access virtual classrooms, view 3D objects, create interactive simulations, and take part in collaborative activities with other learners. Additionally, educators can use tools like 360° video streaming or augmented reality (AR) within the Moodle LMS platform for even richer learning experiences. Also, results obtained during problem tasks completion in VR environment could be automatically passed to Moodle LMS simplifying assessment process for teachers.

In the following chapter an example on such integration proposed by authors is discussed.

### III. RESULTS AND DISCUSSION

Basing on the results gained during provided analysis, it was developed custom solutions for VR laboratory and Moodle LMS integration on the base of Turiba University ITN department. VR laboratory was implemented using Unity game engine. VR laboratory includes virtual environment used for teaching IT-related courses and includes HP reverb G2 Virtual Reality Headset to provide the best learning experience for students. In order to automate assessment process, it was developed approach to pass the grades obtained on the problem task completion to the database, and the use of this data to fill appropriate grades in the Moodle LMS.

The integrated environment operates in the following way. Course instructor should define objectives in the Moodle system, which are saved in the database and reflected for student in Moodle environment. Students start execute problem sets solution in Unity virtual environment, where all objectives are reflected for the user (fig. 1).



Fig. 1. VR environment in Unity showing all objectives completed.

Upon objectives completion, the number of achieved goals updated in the database and reflected for the user. Finally, upon all objectives completion or time limit event, virtual simulation program completes, and final data are saved to the database, as well as final result reflected in the Moodle LMS (fig. 2).

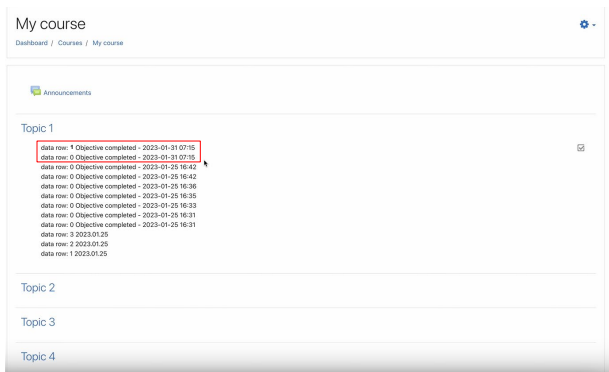


Fig. 2. Moodle environment showing progress on objectives completion.

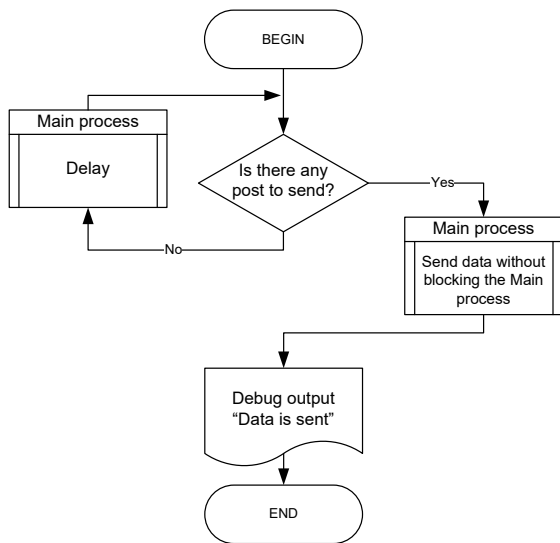


Fig. 3. Flowchart of data exchange process between VR environment and the database.

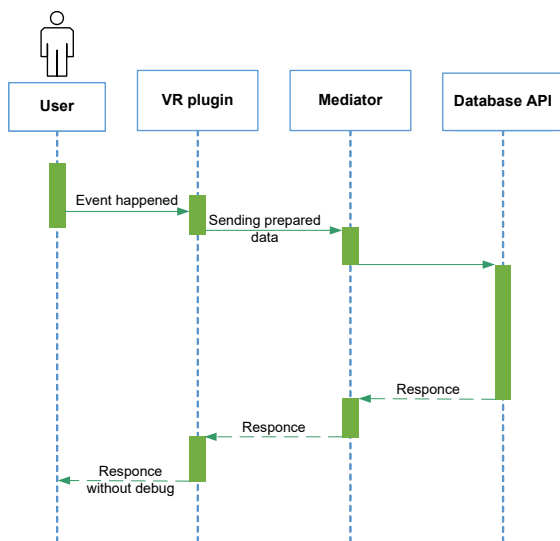


Fig. 4. Sequence diagram showing data exchange between VR environment and the database.

The flowchart showing the process of data exchange between VR environment and the database is presented in fig. 3. The process was implemented to achieve normal flow of the main simulation process in VR environment without interrupts and presented in sequence diagram (fig. 4).

Database contains three main tables containing information about students (Users), set of actions which could be implemented in the system (ActionGroups) and list of action performed by each user (Actions), which is used to reflect completion data in the Moodle system (fig. 5).

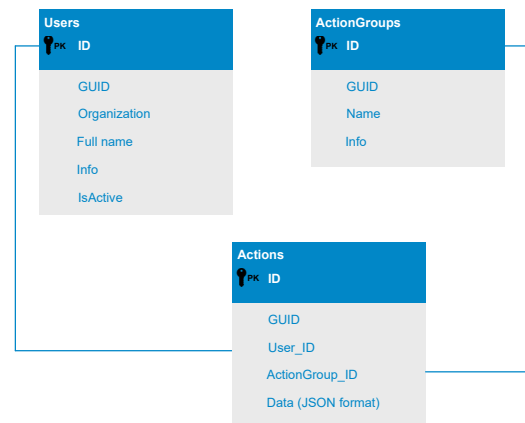


Fig. 5. Database tables.

Experimental verification of the system provided with involvement of Turiba University ITN department students showed increase in student involvement into learning process, along with better grades obtained compared to previous years students. However, there is no enough data to analyse systematic dependencies on the influence of VR solution implementation on students' grades improvement in general. Thus, further researches will be provided on the base of developed solutions.

#### IV. CONCLUSIONS

Overall incorporating virtual realities programs into learning environments offers great potential to improve quality of instructions given to IT students. However, careful planning preparation must go into undertaking to ensure maximum benefit derived minimal risks. The paper proposes one of the possible solutions to improve VR solutions experience by means of VR integration with Moodle LMS. Such approach is promising, especially in modern age of mass-learning courses, when it is quite important to automate as much processes as possible in teaching instruction execution and students' results assessment. Further researches will be related to proposed approach effectiveness comparison with traditional approaches, providing tests involving tested student groups.

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