How to train teachers in designing educational virtual reality games: a perspective from the organizers

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Abstract

The rise of technologies being applied to classrooms, mainly serious educational games, has created a need for proper training and qualification of teachers in using those resources. The teachers' lack of experience and knowledge often leads to the technologies not being used to its fullest potential, and in some cases, it leads to them not being used at all. This way, it's critical for researchers to try to address this problem, using their expertise in the subject to create and apply projects and activities geared towards training teachers to use and, sometimes, even develop their own educational digital resources. With this in mind, we created a workshop that aimed to train teachers to design their own educational serious games for Virtual Reality, with 5 participants qualified and 4 game projects. In this work, we present our perspective of this workshop, discussing the issues we noticed, the lessons learned, and future actions.

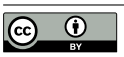
Keywords

Serious Games, Workshop, Virtual Reality, Teachers Training

How to cite this paper:
Laura Coura, Reinaldo Fortes, and Saul Delabrida. 2025. How to train teachers in designing educational virtual reality games: a perspective from the organizers. In *Proceedings of ACM IMX Workshops, June 3 - 6, 2025*. SBC, Porto Alegre/RS, Brazil, 4 pages. https://doi.org/10.5753/imxw.2025.8060

1 Introduction

The use of technologies in schools is often done through digital games, especially computer games, which are capable of engaging students in virtual worlds where they can apply content knowledge, practice skills, and enhance thinking in a fail-safe environment [5]. In other words, they allow students to interact with ideas, concepts, and experiments using digital objects and environments. However, over the years, new ways of virtual interaction have been developed and popularized, such as Virtual Reality (VR). Encompassing programs that can be viewed on a flat screen (like a desktop monitor or tablet device) and those that require the use of "goggles" and other Head-Mounted Displays (HMDs) [2], VR is defined by systems and applications that focus on immersing the user in a virtual world, often by taking the user's senses (mainly sight and hearing) away from the real world and into the virtual.



ACM IMX Workshops, June 3 - 6, 2025

https://doi.org/10.5753/imxw.2025.8060

Among the advantages that VR can bring to the classroom, we highlight the development of users' motor skills and experimenting with various postures/movements without jeopardizing their health [4], alongside the higher degrees of interaction that are possible with VR technologies that use HDMs. For example, VR can allow for more fine motor actions, like moving the arms and hands into specific positions, which is impossible in other digital games.

On the other hand, VR also faces obstacles in educational contexts. Kavanagh et al. (2017) [3] point out in their systematic review that the main issues for VR in education are related to training, cost, and usability, with minor issues such as ineffectiveness and lack of engagement from students. Considering the problems of training and ineffectiveness, it's interesting for researchers to provide teachers with forms of instruction for the use of VR.

Bearing in mind that the creation of educational VR systems and educational games must combine entertainment and learning in a way that the players/learners do not experience the learning part as something external to the game too [1], the participation of teachers in the development process is something fundamental to result in valuable digital activities for education.

Thus, we developed and applied our workshop to teach educators how to design their own digital games for VR. Although successful in its goal, resulting in 4 projects, the workshop faced a few obstacles alongside its operation, and in this work, we aim to highlight those issues and possible solutions for them. We believe that the exposure of our perspective of the workshop can provide insights to other researchers who wish to do similar projects, guiding them to avoid the same mistakes we made.

This work is divided into the following sections: Section 2 introduces the workshop applied, Section 3 presents the results and observations made during and after the workshop, Section 4 describes the subsequent actions we plan to execute in future workshop's applications, and, lastly, Section 5 presents the conclusions.

2 Workshop

The workshop created aimed to train teachers in how to design their own educational immersive game projects. We taught concepts like Computer Thinking, Game Design, and Active Methodologies and guided the participants through their projects, which were developed during the workshop. The projects were ideas of games related to the subject(s) they taught in their schools, and the participants didn't have to code the games in any step. Thus, our vision is that teachers can apply their knowledge in the design of digital games for VR that can be used in their classrooms, while the development of the games is to be done later by specialized people, those who will be chosen in the future.

The workshop lasted **8 weeks**, with synchronous and asynchronous activities. The asynchronous activities were online classes available in the teaching content management system that had to be watched and weekly practical activities related to the classes that helped the participant with their project's progress. Meanwhile, the synchronous activities were: two in-person meetings in a VR laboratory at a federal university (thus allowing the participants to try out the equipment) and weekly online meetings lasting approximately 2 hours for students to present the results obtained by doing the asynchronous activities.

We divided the classes and activities through **seven modules**, focusing on filling an Educational Game Design Canvas (EGDC) through the Workshop Notebook, a Google Drive file where the participants add the game project information, updating it weekly. This information is presented to the participants in the **practical activities** of each module, describing specific tasks that they should complete every week. A Teaching Plan, a slide presentation and video classes were also developed for each module.

The EGDC, described in past works, presents the participants with the most important data related to a game project. Thus, it is separate ito the following sections: *Problem*, *Player/Student*, *Summary*, *Game objective(s)*, *Inspirations*, *Pedagogical Content*, *Learning Objectives*, *Missions*, *Feedback (for Teacher and Student)*, *Interactions with the Space*, and *Game world*. After the workshop, some sections were changed: *Game objective(s)* became *Final mission*, *Missions* became *Specific tasks*, and *Feedback (for Teacher and Student)* became *Feedback and tips*.

Next, we describe the modules and their practical activities:

- **Workshop introduction:** presents the workshop structure, the platform for making the materials available, and the Workshop Notebook. It has details of the program's organization and how participants are to complete the practical activities. It also includes one of the in-person sessions, providing most attendees with their first opportunity to interact with and explore VR equipment, and it has no practical activity.
- **Games, teaching, and gamification:** presents basic concepts of games, serious games, and gamification, games' main genres, and the major notions of accessibility in digital games. *Practical activity:* participants must identify a problem related to the teaching or learning process of a discipline they taught and how this problem could be solved or diminished through a game.
- **Computational Thinking:** presents the basic theories of Computational Thinking, showing some applications through game-related activities. *Practical activity:* fill in the *Missions* and *Feedback* sections in the Workshop Notebook.
- **Extended Reality:** presents the basic concepts of Virtual Reality, Augmented Reality, Mixed Reality, and Extended Reality, while also displaying examples, mainly ones connected to education. *Practical activity:* complete the sections *Interaction with Space* and *Game world*.
- **Active methodologies:** introduces concepts about active methodologies and presents information and objectives of the *Problem-Based Learning* (PBL) and *Project Based Learning* (PjBL) methodologies. *Practical activity:* edit the specific tasks, feedback, and tips previously defined, using one of the two active methodologies explained in this module.
- **Workshop conclusion:** each participant presents their project to instructors and colleagues. *Practical activity:* finish and review the game project designed through the workshop execution.

The workshop evaluation was carried out using two forms, one at the beginning of the workshop and another at the end. The forms were divided into questions about the participants' knowledge and confidence levels about game design, the topics discussed in the classes and the synchronous meetings, and the tools and materials used in the workshop (with focus on the EGDC). The forms also have an open-ended question for participants to add their criticism, comments, and suggestions.

***Ethical Issues*:** the workshop project was sent to the Ethics Committee of [omitted for anonymous evaluation], having been approved by it and being identified through the Certificate of Presentation of Ethical Appreciation (CAAE) [omitted for anonymous evaluation]. Furthermore, on the first day of the workshop, the selected students received and signed an Informed Consent Form.

3 Discussions and Results

The workshop had 5 participants, 3 female and 2 male, mostly due to availability issues. In general, they had a high level of knowledge about basic internet tools, such as e-mails and search engines, and, while some had prior contact with digital games, the majority didn't have previous experiences with VR.

3.1 Participants' projects

At the end of the workshop, the participants created a total of 4 educational immersive games. Noteworthy, 2 participants developed a project together (Project 2), while the others worked individually. This provides an interesting analysis of the possibilities of applying this course - and its material - in a more group-oriented dynamic, which, as we will discuss later, can help when dealing with larger quantities of participants. It's also important to point out that those two participants worked in the same school, which probably led to them having more opportunities to discuss ideas for their project. If they didn't work at the same place, it could've been more challenging to find time to meet up, even if online, considering how their workload could be an obstacle to it. For example, in one of the workshop's synchronous meetings, one of the participants of this duo couldn't join us because they had an in-person meeting at the school.

3.1.1 Project 1. This game idea combines the areas of *Arts, Biology, and Physics* through the themes of the human visual system, optical principles and image formation, and elements of visual composition. The player's goal is to build a model of the visual system that forms the corresponding virtual image, and they must search the virtual environment for the proper objects considering their shapes and textures.

This game was envisioned by an Arts teacher, which can be seen by the number of details added to the project. Here, we highlight the author describing "cutscenes", sequences in a game where the player's actions are restricted and are often used to push the game's

story and narrative forward, which weren't explained in the workshop. One example is the description of an initial "cutscene" where the player is introduced to the game by a comic book.

In our vision, it seems natural that a participant with a background related to Art would have an easier time coming up with more dynamic ideas. On the other hand, though, this also shows us that it's compelling to introduce more game concepts, like the mentioned "cutscenes". Most participants didn't have much experience with games, which is a trend likely to be seen in future workshop applications, which highlights the importance of introducing them to the general ideas and possibilities of games.

3.1.2 Project 2. This game idea connects to the *Portuguese* language subject, focusing on grapheme-phoneme correspondence and identifying letters and their sounds. The player's goal is to catch fish in the virtual environment and, upon hearing the sound of a letter emitted when it is taken out of the water, recognize which aquarium contains the spelling of the letter corresponding to this sound.

3.1.3 Project 3. This game idea is about *Geography*, precisely location and spatial orientation (involving the use of compass, map, and GPS). The player's goal is to use the compass and GPS to find parts of a treasure map and, when it is complete, use it to find the hidden treasure.

3.1.4 Project 4. This game idea is in the *Mathematics* area, focusing on integers, operations with integers, and numerical expressions. The player's goal is to answer a mathematical expression presented in the game by selecting a basketball, among 4 available alternatives, and throwing it toward the basket. If the player's answer is correct, he will score a point, and if he is not, the ball will not fall into the basket.

In general, every project presented interesting players' actions, making sure to use the VR interaction capabilities to a high degree. This demonstrates that the participants understood the technology well, and didn't limit themselves to interactions that are more common in computer games. As an example, most projects defined interactions that focused on the use of the player's "hands" (in this case, the controller): Project 2 has the player utilizing a fishing rod as one would in real life and Project 4 points out that the player should be able to bounce the ball and throw it as usual.

3.2 Identified challenges

The first challenge we noticed in the workshop was the lack of participants. At the start, the workshop gathered much attention and interest from the public (with a total of 38 inscriptions). Eventually, only 5 people took part in it. While we sent a form questioning the people who signed up, only 2 answered, with one saying their workload didn't allow them time to participate and the times defined for the synchronous meetings weren't viable, and with the other saying they couldn't join because of an ill relative.

The participants also pointed out their own difficulties with balancing their workload with the workshop. One participant couldn't join a synchronous meeting once because they had to be present at a meeting in their school, while some participants had moments where they were late to the workshop's meetings either because they were arriving home from work or because they had work to finish.

As we were aware of the difficulty in fitting a workshop into teachers' schedules, we tried to mitigate the problem by having the workshop be online, with most of the classes asynchronous (so teachers could take their time to watch the videos), but it wasn't enough. Thus, we believe that a few possible solutions for this could be: (1) apply the workshop for teachers in training (pre-service), using the time slot of an existing subject in their curriculum for that; (2) apply the workshop in partner schools, especially private and/or state schools (in our Brazilian context), defining the workshop schedules according to the available times within the schools.

It's also significant to question whether this barrier exists only in our context (Brazil and the state of Minas Gerais) or if it is a general problem when it comes to workshops and courses for teachers. Although we can't answer this at the moment, it's something to keep in mind for future work and discussions.

We also highlight that despite the low number of people in the workshop, the synchronous meetings still lasted the total limit of 2 hours. Although this is a positive outcome, showing how involved the participants were could lead to time issues in future applications of the workshop that have more participants. So, in this situation, we recommend either having more synchronous meetings throughout the week, dividing the total number of participants into smaller groups (but with them still working individually), or separating the participants into teams, each working together to develop a project.

Regarding the technologies used during the workshop, we noted that participants had some trouble with the platforms Google Meet and Moodle. However, those difficulties were quickly dealt with during the first synchronous meeting. Still, we suggest that the creation of tutorials on how to use them is necessary, focusing on how to do presentations in Google Meet and how to send the activities in Moodle. Thus, if any tool or technology is used in a workshop, especially one that focuses on people who may not have a lot of experience, it's important to provide the participants with tutorials on how to use them.

All participants also had difficulties connecting the modules *Computational Thinking* and *Active Methodologies* to their practical activities, which involved filling in the sections related to missions, feedback, and tips. By explaining in more details the relation between them, we realized the need to update the Canvas itself alongside the modules. Thus, we changed the sections in the Canvas and decided that both modules needed: (1) more examples that directly relate to the Canvas; (2) initially present the subject closer to the participants' reality, gradually applying this content within games; and (3) update the activity's description, hoping to make it easier to understand. For the *Computational Thinking* module, it's interesting to address the doubts with the concept of "Decomposition" through examples related to the context of the participants and applicable to games.

Considering the problem mentioned before, addressing the questions related to the "Feedback and Tips" section in the Canvas is also necessary. We believe that introducing concepts related to this section in the *Teaching, games, and gamification* may be relevant.

In the beginning, the participants showed a lot of enthusiasm for the workshop, with most hoping that they could learn more and, especially, apply this new knowledge in their classroom. Although

some participants were also anxious about when they would be able to complete the workshop, they were still excited by the opportunity. At the end of the workshop, all the participants affirmed that they liked it, with 2 even pointing out that the workshop exceeded their expectations.

3.3 Lessons learned

The observations done through the workshop, mainly of its issues, have allowed us to recognize the current weak spots in our proposal. First, the current subjects covered by the workshop need to be reformulated, including more examples related to the participants' experiences, and need to further the connection between the theory discussed in the workshop's classes and the practical activities. This is more clear in the *Computational Thinking* and *Active methodologies* modules, which point out that they need more attention than all the modules.

It's also necessary to take into consideration the number of participants and how to enhance this quantity in future applications of the workshop. The amount of workload a teacher has is a common issue that makes it difficult for them to join those activities, and reducing the amount of time they will spend in the workshop may be one way of dealing with this.

Lastly, it's important to acknowledge that some teachers may have difficulties using the technologies applied in the workshop. Thus, extra material (tutorials) that help mitigate those difficulties is needed and valuable.

4 Future actions

The subsequent actions that we aspire to develop are the ones that will try to solve, or at least mitigate, the issues pointed out in Section 3, and that will take into consideration the lessons learned discussed in Section 3.3. With this in mind, we intend to try 2 different approaches, both focusing on reducing the workshop's time and being only in person: one proposal features a one-day approach with a coffee break, and the other features a two-day approach, splitting the planned activities in the middle.

In these new applications of the workshop, we will focus even more on the process of designing immersive serious games, letting the participants spend more time working on their projects with us as supporting figures during it. Thus, we will cut the time spent on theory, alongside removing some subjects that aren't as needed anymore, such as *Active methodologies*.

We will also start the workshop with a brainstorming dynamic, where the participants share ideas and themes they find interesting. Eventually, those will be organized into different groups that will work on developing them over the duration of the workshop. Thus, we hope to establish a workshop focusing on learning through examples and practical activities, which may result in a better understanding from the teachers.

5 Conclusions

The workshop discussed in this paper successfully achieved its goal of coaching teachers into designing their own immersive serious games, resulting in 4 game projects and tools and materials that can be reused in more workshops or even individually. The problems observed through the workshop can be solved in future applications, especially the questions and doubts related to the subjects taught. The main problem, retention of participants, that is, the act of managing to keep the participants engaged and committed until the end of the workshop, will also be addressed in future actions through the changes in the workshop format presented in Section 4.

We hope that our perspective, discussed in this work, can help other researchers develop more successful experiences in teacher training. Developing experiences and activities that aim to help teachers obtain knowledge about technological tools is important, and its necessity is likely to continue growing in the next years.

Acknowledgments

This study was financed in part by the Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq) - Finance code 306101/2021-1 and by Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) - Finance code APQ-03665-22. The authors would also like to thank UFOP and CAPES.

References

[1] Johannes Breuer and Gary Bente. 2010. Why so serious? On the relation of serious games and learning. *Journal for computer game culture* 4 (2010), 7–24.

[2] Christian Pierce Fabris, Joseph Alexander Rathner, Angelina Yin Fong, and Charles Philip Sevigny. 2019. Virtual reality in higher education. *International Journal of Innovation in Science and Mathematics Education* 27, 8 (2019).

[3] Sam Kavanagh, Andrew Luxton-Reilly, Burkhard Wuensche, and Beryl Plimmer. 2017. A systematic review of virtual reality in education. *Themes in science and technology education* 10, 2 (2017), 85–119.

[4] Valentin Kuleto, Milena Ilić P, Monica Stanescu, Marko Ranković, Nevenka Popović Šević, Dan Păun, and Silvia Teodorescu. 2021. Extended reality in higher education, a responsible innovation approach for generation y and generation z. *Sustainability* 13, 21 (2021), 11814.

[5] Dana Ruggiero. 2013. Video games in the classroom: The teacher point of view. In *Games for learning workshop of the foundations of digital games conference, chania, Greece.*