Simulation Tools for the Design of Virtual Training Environments

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Virtual Reality (VR) for Education is spreading around and more and more training centers want to provide digital training, especially using VR technologies. The VR market is in full growth and many companies, startups and research teams are working on developing VR for Education on a large scale. Many domains are concerned by this learning digitalization, like science (Oliveira et al., 2019), military (Taupiac, 2018) and so on. The benefits of VR for education are numerous (Mano, 2019) and deeply investigated since the beginning of VR. There are many approaches in the process of training with VR, particularly since the commercialization of new VR headsets like HTC Vive™ and Oculus Rift™. Those headsets allow room scale tracking and are shipped with 3D space tracked controllers, granting a better user experience and a higher diversity in virtual training situations. New headsets are also affordable and so not only reserved for industrials, research or military, leading to new use of VR.

In the VR industry, we have noticed some approaches used for the design of scenario. One classic approach is "serious game" that mainly consists in cloning classical educational games to VR, like point and clicks, 360° videos (Rupp et al., 2016) or dialog tree situations. The main interest of this category relies on existing projects and previous experiences with "standard serious games". The drawback is about the freshness of VR: it may not be suitable for those existing projects that were working nicely on a 2D screen. This kind of transposition could lead to atrocious user experiences and the underuse of the potential of VR. For educational purposes, other developers have followed another path: replicate reality. The main purpose is to provide situations that mimic real life situations. With this, training users with a high degree of realism eases skills transfer from VR to real situations. Realism can be achieved in many ways: visual quality, behavior credibility for avatars (Lanquepin et al., 2013; Zipp and Craig, 2019), tasks relevancy. The drawback of this approach is the limitations of VR and technology. For machine driving or construction-site scenarios, users mainly interact with equipment, but in situations involving human interactions or summoning creativity, simulating the reality become more complex, resulting in bad implementation and weak training impact over users. Finally, another common approach in today's development of VR that is worth speaking about, is what we can call the "marketing" approach. It relies on taking advantage of the VR novelty and of emotional reactions of new users. This category stands for improved visual quality and innovative interaction techniques at the expense of substantive content such as didactic, tools for teachers or targeted work situation knowledge. These aspects of the "marketing approach" tend to seduce people unrelated to VR and rely on first impression feelings to convince. Such applications are easy to setup from a didactic content standpoint, as it is not the main purpose, but require a lot of efforts on the visual and interaction parts. At the end, this can be an appealing solution, but it will not fulfill teachers' needs.

PROPOSED APPROACH

We aim to provide a new design method to build efficient learning environments by using the full potential of VR without simulating the reality. We have developed a set of virtual tools that will ease the learning process and keep the user focused on the training tasks. The pedagogical and didactic interest is our main concern when designing a new VR training scenario. We will focus on explaining and detailing some design approaches and methodologies that we have used in our developments of learning situations for the French vocational training system. Since the beginning of our VR projects, we have worked with teachers and professionals on emblematic training cases. VR cannot implement all work situations, because not all conditions are relevant for digitalization. Instead, we are looking for training situations that are difficult to setup in real life or conditions that are relevant for both teachers and students from a qualitative/quantitative point of view. To know if a training situation is a good candidate for the VR digitalization, developers need to work closely with teachers and field professionals from the taught jobs in training centers, otherwise, bad decisions may happen. Every stakeholder (developers, teachers and professionals) involved in the design process must undertake an important work of vulgarization, in order to build efficient training situations. Vulgarization is required to setup a common communication channel between all people working on the virtual scenario. For example a developer will need to explain in an understandable way why a functionality is not feasible. For a teacher, it can be to explain how the evaluation process is made in real situations. Without this process, misunderstandings may emerge causing flaws to the virtual scenario. Contribution To provide efficient and relevant training cases, we have investigated and implemented tools that can ease the learning and evaluation process in VR environment. There are many constraints using VR in real situations. We can divide those limitations in two categories. The first one relies on students, and the second one relies on how teachers will use VR in classrooms. Students, especially teenagers, are more informed about VR, thanks to low cost mediums such as VR cardboard systems. We have observed that they tend to master the controllers and interactions quickly. This ease to use leads to a new problem for the educational usage of VR: Students need to consider VR situations as training and not as gaming. Enjoyment may be in the VR application, but it is not the main purpose, trainees are using VR to practice and acquire/reinforce knowledge, not to play. That is why we have decided with teachers to design special interactions and restrict actions in order to reduce the risk of falling into gaming postures instead of training (Figure2: Interactions like object displacement is restrained. The lamp is only allowed on the shelf). Another concern addresses the time allowed to VR sessions. With a realistic approach, the student will spend most of his/her time doing pedagogical irrelevant

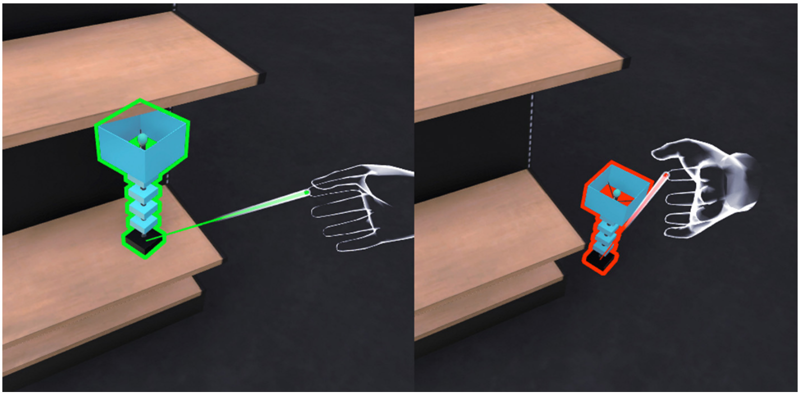

FIGURE 1: Interactions like object displacement is restrained. The lamp is only allowed on the shelf.

FIGURE 2: Example of Didactic Variables on edition screen.

tasks like navigating or mimicking real gesture. That is why we have focused some of our proposals on time saving and autonomy like tools proposed by Freitag and Weyers (2018).

The other controversy of using VR for training comes from teachers. They often do not know how to take advantage of VR with learners. In fact, this point remains poorly surveyed with real training situations with complete classes. A typical vocational training classroom is made of around 20-35 students. With VR, only one student is inside the virtual world (one user per headset). The simplistic solution to this problem would be to setup one VR device per student for the entire class. However, from a logistic and financial point of view, this is inconceivable. For this reason, a rethought of VR training scenarios design and usage is required for a use in real conditions. We have investigated this with teachers and we propose in this paper several approaches that allow teachers to use VR with entire classes. Usually, VR for training offers fixed/frozen scenarios, meaning that teachers cannot customize training conditions easily. This is a major limitation to the use of VR in this field. Because of the specificities of every trainees, teachers want to be able to adapt the training scenario to optimize learning and keep student motivation high. Teachers will not feel comfortable about VR, resulting in putting aside this new way of learning. We are concerned about integration of VR with classic training, that is why we have implemented a set of tools about that. For instance we propose "didactic variables" (Figure3: Example of didactic variables on edition screen) that allow teachers to easily customize training situations. We have also introduced links with official training documents and the virtual scenarios.

CONCLUSION AND PERSPECTIVES

Integrating VR in a training center is a hard task and developers need to think about the “outside of VR” part. In our work, we consider VR as a new training location. Classic locations of vocational training are schools and companies (for internships). VR is a link between these two classic locations. For example, a teacher needs to be able to prepare students to their internship or needs to show students as many hazardous situations that are hard to reproduce in workshops. At the end of a VR scenario, we are able to gather objective data. However, we do not want the simulation to generate a degree, because this is not the purpose of VR. Instead, we propose an approach by generating performance indicators used afterwards by teachers to debrief with students about the VR session (Figure3: Generated data used for the debriefing session). In every of our approaches, we have considered the teacher as the pilot of the VR simulation as in Vermeulen et al. (2017). In this paper, we will explain our approaches and methodologies used to achieve a correct integration of VR inside a classic learning process, by considering field specificities of the learning system.

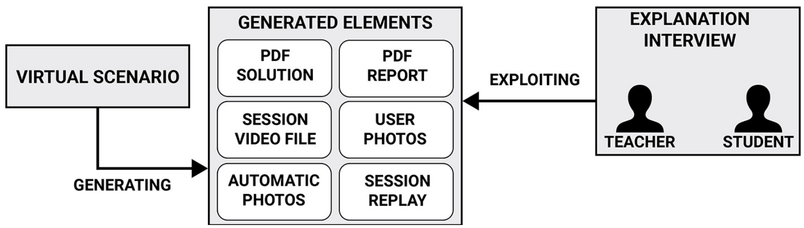

FIGURE 3: Generated data used for the debriefing session.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Keywords: virtual reality, Interaction techniques, simulation tools, Didactic, Evaluation

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