Towards an editor for VR-oriented educational scenarios

Oussema Mahdi, Lahcen Oubahssi, Claudine Piau-Toffolon, Sébastien Iksal

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Oussema Mahdi[1] [0000-0003-2185-3160] Lahcen Oubahssi[1] [0000-0002-2933-8780], Claudine Piau-Toffolon[1] [0000-0002-8911-6995] and Sebastien Iksal[1] [0000-0002-3439-5667]

[1] LIUM Laboratory, EA 4023, UBL, Le Mans University, 72085, Le Mans, France
{oussema.mahdi, lahcen.oubahssi, claudine.piau-toffolon, sebastien.iksal}@univ-lemans.fr

Abstract. VRLE (Virtual Reality Learning Environment) has long been used as an education tool. Our research work aims to propose solutions for assisting teachers to design, reuse and deploy their pedagogical scenarios in VRLE. In this demonstration paper, we present a VR-oriented pedagogical scenario editor that embeds our model allowing teachers to design and adapt their situations (in scenario form) and generate their own VRLE.

Keywords: VRLE, TEL, pedagogical activity, pedagogical scenario.

1 Introduction

For many years, teachers have been customizing their own virtual environments to promote learning. This is known as VRLE (Virtual Reality Learning Environment). However, the design and integration of VRLE into training is a complex and costly process. The production of a VRLE is an activity that involves new technical difficulties, which are caused by the interdisciplinary intrinsic to VR or cognitive, inherited from the TEL [1, 2]. We aim to offer technical and methodological solutions for assisting teachers to produce VRLE adapted to their needs. As reflection in teachers' design practice occurred before, during, and after pedagogical situation implementation [4], we propose an iterative and participatory teacher-centered design approach.

A study of the literature on VRLE design and development models, learning scenario models, functional and technical architecture [3] permit us to identify some limits in the propositions but give us some strong basis for our proposal. Main limitations are related to 1) the difficulty of implementing design models, the inadequacy of defining adaptable and reusable models by non-computer-scientists teachers in different contexts 2) the lack of solutions for assisting the teachers in their design process 3) the model of scenario that must be defined since the design of the environment without all the pedagogical situations being necessarily known 4) the functional and technical architectures for producing a VRLE that have been developed for specific domains. In particular, the problems of design (adaptation or reuse) and operationalization of scenario models directly by teachers according to their pedagogical situations are not sufficiently addressed.

These findings revealed the following research question: how do to help teachers and design, reuse and deploy their virtual reality oriented pedagogical scenarios?

2 Theoretical proposal

In order to help teachers in producing VRLE, we propose a methodological solution based on a design process that includes several steps from the definition of the learning situation to its operationalization (see the design process in detail in [3]). As part of this research work, we propose a VR-oriented pedagogical scenario model. That model has been designed from the theoretical analysis of the different existing scenario models (in TEL and VRLE) and the design of three examples of different pedagogical situations in different fields (chemistry, physics and biology). Our approach aims at creating a model that links the description of the pedagogical activity to the learner's activity in the virtual environment. Each activity can be divided into a sequence of actions to ensure the learner's interaction. These actions can be divided into some basic behaviors named “Virtual Behavioral Primitive” (VBP) [5] grouped into four categories: 1) Observe the virtual world; 2) Move around in the virtual world; 3) Interact in the virtual world; 4) Communicate with others or with the application. In order to carry out these activities, we notice the importance of a VR-oriented pedagogical object. We define a VR-oriented pedagogical object as a raw object (3D object) with educational and technical properties. Properties are used to store values associated with these objects. Some technical properties are common to all objects (such as those that govern the position, shape or color of objects), while others are specific to the object or the learning domain. For example, a cube (raw object) should have the technical properties "weight" as well as "position" and if it is released, it will fall and become deformed. It can be associated with educational properties related to gravitation to be used in a pedagogical context such as a physics course.

3 Technical proposal

To provide the necessary elements for modeling such pedagogical situation, a prototype of a VR-oriented scenario editor has been developed (using Unity[1]). This editor is the concretization of our theoretical proposals. It is intended for any teacher looking to design a pedagogical content and it allows the editing and visual modeling of scenarios. To illustrate, we define a pedagogical situation in biology field. This use case shows how the editor can support teachers to design, reuse and deploy their virtual reality oriented pedagogical scenarios. The demo scenario is a learner who must first anesthetize the animal (rat or frog) intraperitoneally injected after fixing it in dorsal decubitus on a plate. Then, he intervenes on the animal by cutting, opening the skin, opening the flesh and lifting the trachea (Table 1). Finally, he places the catheter in a canal (tracheotomy).

Table 1. The pedagogical activity example (intervening on an anesthetized animal)

VR pedagogical situation	Placing a catheter in a canal in an anesthetized animal
Virtual Environment	Virtual biology laboratory

[1] https://unity.com

VR Activity	Intervening on an anesthetized animal
VR Actions (VBP)	Cut
	Open the skin
	Open the flesh
	Lift trachea with a rope

The Fig. 1 illustrates how the teacher can script this activity via the proposed editor and presents its interfaces. First, once the teacher is logged in (Fig1.1), he may create a new scenario or modify an existing one (Fig1.2). Then, he chooses a virtual environment adapted to his pedagogical situation (Fig1.2A). In the following steps, objects are selected from the inventory and placed in the chosen environment (Fig1.4). Each pedagogical object has a list of properties; the teacher then defines the expected values. We note that the adaptation of virtual environments and VR-oriented pedagogical objects will be realized on a virtual pedagogical object's platform. This environment includes rules that describe the dynamic behavior of raw objects and their educational properties. The objective of this platform of VR-oriented pedagogical objects is to ensure their reuse in various situations regardless of the learning context. It is related to a *VR data loader module*. It embeds a VR environment loader, which defines virtual environments, and a VR objects loader which defines the graphic elements as well as their behavior and translates them into objects interpretable by the editor.

Thereafter, the step dedicated to the definition of the scenario begins. In this step the teacher identifies the pedagogical activities related to the pedagogical objectives (Fig1.3 and Fig1.3A). For each activity, a description of the expected actions is done using the bar containing the list of possible actions (Fig 1.3, Fig 1.3B and Fig 1.3C). Actions represent all the operations done by the learner (for example: moving, pouring, cutting, etc.). To adapt the learning content, the prototype allows the teacher to control and orchestrate the pedagogical activities (as well as all VR actions). This ensures that the learner always solves the current activity.

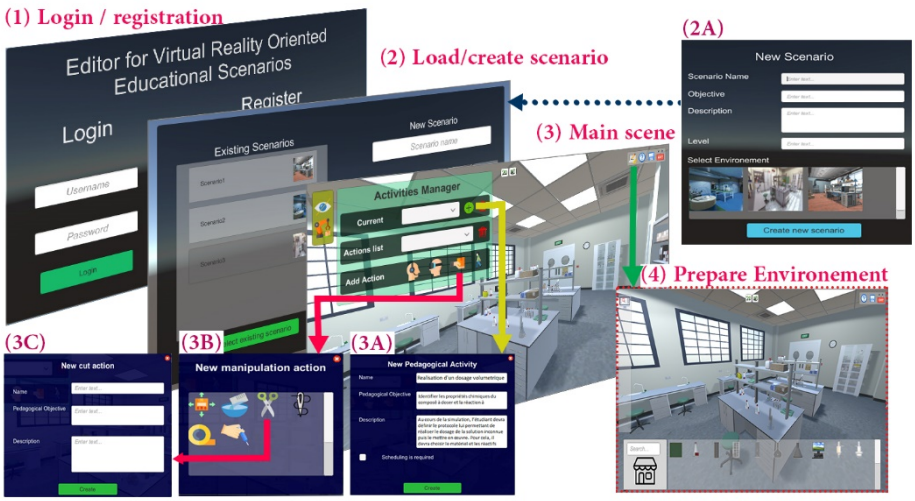

Fig. 1. Definition of VR actions to be realized in the pedagogical activity.

The editor mainly consists of a *scenario manager* which allows teachers to manage their own scenarios (creation, reuse and modification). More particularly, it allows them to define their pedagogical activities and lead the sequencing of these activities in the scenario through a *pedagogical activity manager*. The actions of each pedagogical activity are also defined through an *action manager*. The editor uses a *data context module* which provides a concise way to translate the elements of our scenario-model in data and exchange with the *scenario database*. The following link illustrates the global architecture of the editor by presenting its modules and their interactions: *https://umbox.univ-lemans.fr/index.php/apps/gallery/s/0pDf0Yg40gvnlV3*.

4 Evaluation and conclusion

Our approach aims at proposing both technical and methodological solutions to assist teachers in describing, adapting or reusing their pedagogical scenarios. In this paper we are interested in the first part of our design process, dedicated to the design of VR-oriented pedagogical situations. We first sought to provide solutions to structure pedagogical situations in the form of reusable scenario models. In that way, we developed a VR-oriented pedagogical scenario editor. We explain the experimental objectives and discuss the different characteristics of our editor. We studied the impact of our editor on teacher-designers via an evaluation phase. The teachers were led to freely manipulate the tool in order to test its functionalities. They could propose the activities that seemed most appropriate to their pedagogical situation. The results revealed overall positive and constructive feedback on the usability and usefulness of the editor. However, the tool in its current version has some gaps therefore we aim to develop additional functionalities for our editor in order to further facilitate the design task of teachers and allow them to reuse and adapt existing situations.

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