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## CREATING EDUCATIONAL DIGITAL ARTIFCATS COLLABORATIVELY IN A VIRTUAL REALITY ENVIRONMENT

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### Abstract

This paper discusses the use of virtual reality (VR) technologies in education and the collaborative creation of educational digital artifacts in a virtual reality environment. The paper presents a case study of students who collaborated creating digital artifacts in a VR environment. The artifacts were designed with the purpose of presenting the history of a local community. The study analyzed the interactions between learners, the effectiveness of the VR environment in facilitating collaboration, and the impact of the VR environment on learning outcomes. The study concludes that creating educational digital artifacts collaboratively in a virtual reality environment can lead to improved student engagement, motivation, and learning outcomes.

### Keywords:

collaborative learning, digital skills, digital artifacts, virtual reality, open education.

### Introduction

Virtual reality (VR) technologies are being used in education to create engaging and memorable learning experiences for students.

The collaborative creation of educational digital artifacts in a virtual reality environment has become a popular research topic in recent years. Researchers and teachers have explored the potential benefits of using virtual reality environments for collaborative learning and creation of digital artifacts. For instance, one study (H. Huang et al., 2021) investigated the effectiveness of using a virtual reality platform for creating a new model of learner's design collaboration. They found that students who participated in the virtual reality-based collaborative project had a higher level of engagement, motivation, and creativity compared to those who used traditional methods.

The use of virtual reality has been explored in multiple higher university settings, such as a collaboration between Queensland University of Technology Library and ProQuest in an attempt to provide high quality VR content and resources to the staff and students (Howard et al., 2018) or a research project between the departments of Law and Computer Science of Westminster University which developed a new framework in which law students can explore real case scenarios in a criminal law course using VR technology (Mentzelopoulos et al., 2016).

Virtual reality, which can be used on any type of computer, has followed this trend. In its broad bibliography, which includes papers and publications and dates from 1991 to 2009, Pantelidis (1991-2009) identifies about 800 written resources about virtual reality in education and training (Pantelidis, 2010).

In 2014, a meta-analysis study provided evidence that Virtual Reality can enhance learning outcomes (Merchant et al., 2014). The paper analyses studies in virtual reality-based instruction, in K-12 or higher education settings, on games, simulations and virtual worlds, until 2011. Games showed higher learning gains than the other two categories, a fact which is not surprising. From a constructivist point of view, a Virtual Reality educational environment can provide the students with an active role in their learning; can provide experiential and case based learning, but also social interaction (H.-M. Huang et al., 2010).

CoSpaces is a virtual reality platform that has gained increasing attention in recent years due to its potential for use in education. As educators seek to incorporate more technology into their teaching, the ability to create immersive, interactive experiences through CoSpaces has become an attractive option for many.

Since 2017, the TalkTech international project matches students at universities in the United States and Romania, to work as members of international teams as a virtual mobility, mainly to develop Virtual Reality applications using CoSpacesEdu software (Frydenberg & Andone, 2019). The project, initiated in 2008, indicates that the use of VR, but in a context that encourages enquiries in a project based learning setting have improved their digital competences, communication skills, their motivation to STEM education and also it sparks students' interest in possible future business applications of VR (Whewell et al., 2022).

Overall, the literature suggests that creating educational digital artifacts collaboratively in a virtual reality environment can lead to improved student engagement, motivation, and learning outcomes. Virtual reality environments offer a unique and immersive experience that can facilitate collaborative learning and creation of digital artifacts. These findings have important implications for educators and researchers interested in leveraging technology to enhance student learning experiences.

## Assignment

In the 2021-2022 academic year, we proposed to the students the following activity part of their exam – to create an OER as a digital educational artifact collaboratively in the CoSpaces virtual reality environment.

They had to make teams of 3-4 students in order to carry out an OER activity, as per the description offered in the Moodle LCMS platform of our university. The students had a "choice" option from where to choose the OER topic that suited them the most. Each OER subject was limited to a maximum of 3-4 students, depending on the quantity of information. All topics were related to our university's project *Patrimoniul sub reflectoare/Spotlight Heritage*<sup>1</sup>, part of Timișoara 2023 European Capital of Culture.

Spotlight Heritage Timisoara is a digital cultural initiative of the Politehnica University of Timisoara, through the eLearning Centre and the Multimedia Center, realized in partnership with the National Museum of Banat, part of the Timisoara European Capital of Culture program. Spotlight Heritage Timisoara reveals, by digital storytelling, the city of Timisoara through stories of cultural and historical heritage, technical development, communities, and neighborhoods, interwoven with the personal stories of the inhabitants of yesterday and today.

The OER product was to be made in English or Romanian and was supposed to contain an original digital artifact that presents the station differently than what is found on the website, more specifically a story or experience of the students related to one of the "stations" of the project. If they didn't have a memory/story they were supposed to go and create one until the exam. All stations must have been presented through one or more scenes, like a virtual tour, with information, images, pictures, video, link to additional information from the website, etc. For each station the students had access to several 360 photos which they could include in their scenes.

The OER artifact should have been CC licensed and the students were told that the best OERs will be integrated into courses of the university, or in the Spotlight Heritage application, keeping the authors' information. The students were supposed also to answer an online questionnaire.

## Results

There were 48 students who participated in the Web 2.0 Technologies course, 4<sup>th</sup> year of the Bachelor program in Electronics, Telecommunications and Information Technology of the Politehnica University of Timisoara. 30 were male and 18 were female, most of them around 22-23 years old. 16 projects were elected in total, each of them being comprised of 2-8 "stations" from the Spotlight Heritage Timisoara project. A "station" in this context refers to a point of interest, namely a point of historic relevance from Timisoara. Most of the students received good grades, with a 9.4 average out of a maximum of 10, and from the point of view of the teachers who evaluated, created good digital artefacts.

In Figure 1 and 2 you can see as an example one of the projects created by students. Each project was created with a script in mind, and contained multimedia elements integrated in the scene, characters created and dialogues for the visitors to read, everything with an educational and instructive component in mind.

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<sup>1</sup> <https://spotlight-timisoara.eu/>

The students were supposed to complete an anonymous questionnaire after they finished the projects. We are going to present the results of some of the questions, which the authors have considered to be most relevant for this paper.



Figure 1. The „Corneliu Mikloși” Public Transport Museum artifact created by students in CoSpaces – outdoor.



Figure 2. The „Corneliu Mikloși” Public Transport Museum artifact created by students in CoSpaces – indoor.

We asked the students to rate from 1 (very poor) to 10 (very good) the experience and way of working in Co-spaces, from the point of view of the Co-Spaces application. The results are presented in Table 1 and show that 49% of students rated the experience extremely high (9-10) and other 34% rated it as high (7-8), which brings the positive result to a total of 83%.

Table 1: Results of rating of the Co-Spaces application

Rate level – 1 (very poor) to 10 (very good)	Percentage of responses
3	2%
4	2%
5	8%
7	16%
8	18%
9	14%
10	35%

Next, we asked the students to rate how the following aspects of working in Co-Spaces have enabled them to be creative? (strongly disagree -1, strongly agree - 5): information on the Spotlight Heritage website, the 360 image on the Spotlight Heritage website, the background adaptation for Co-Spaces, creating animations in Co-Spaces, and discussing with colleagues about the model for creating the virtual tour in Co-Spaces. The results are presented in Figure 3. What this shows is that all the options provided were considered by respondents as creative enablers. However, the most positive effect was given by the collaboration with colleagues and the creation of animations.

### Rate how the following aspects of working in Co-Spaces have enabled you to be creative?

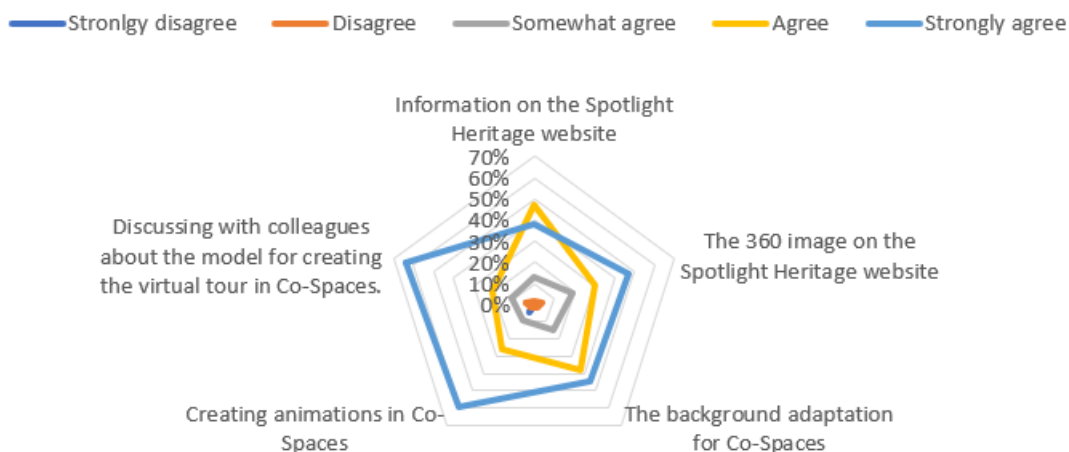


Figure 3. Results of the question “rate how the following aspects of working in Co-Spaces have enabled you to be creative”.

The following question was for the students to write two of the most important things they learned in creating the virtual tour in Co-Spaces, in terms of the VR technology used, without offering a list of words to choose from. The most used words were Programming/modelling (8), Images (7 times), Animations (7), Vision (6), Imagination (6), Orientation/Placement (6), Creativity (4), Information (3), Interactivity (3), Design (2), VR (2), Usefulness (2), Punctuality, Easy, Action, Sound, Innovation, Future, Possibilities, Videos, Collaboration, Integration, Experience,



Figure 4. Word cloud generated from reports of students describing the experience of taking a virtual tour in Co-Spaces from the perspective of using cultural and heritage information in a VR application.

The word cloud was tailored for the purpose of this research. The text was cleaned and pre-processed, removing any irrelevant or redundant information. Plurals and variations of the same word were considered as one word, for emphasis. Analysing the word cloud, we can see a total of 393 words. The words appearing the most are, in order, information (32 times), experience (28), learn (27), co-spaces (25), create (25), Timisoara (25), project (23), heritage (22), things (21), use (21), virtual (20), interesting (19), made (19) and new (19).

Here are a couple of examples of responses from the students:

“It was an interesting experience, which made me realize the heritage we have that we are not aware of. Many cultural information that I learned and that will be useful to me another time were part of the process. Thus, through VR we can learn new things about anything in a very short time and from anywhere.”

“It was a new experience. I think it's a good method to present the main ideas of a project, in a more friendly way, that takes you into a story that doesn't bore you and that keeps you attentive throughout the presentation, by creating a scene with a lot of action, dynamism, images and videos that keep you constantly focused. From my point of view, it is suitable for any type of audience, regardless of the weight of the topic discussed.”

## Conclusions

After conducting this activity with the students and analysing the results we can conclude that collaboratively creating educational digital artifacts in virtual reality environments can be an effective way to enhance student engagement, motivation, and learning outcomes.

The use of virtual reality technology can create an immersive and interactive learning experience that is more engaging than traditional classroom settings. This can lead to increased motivation and interest in the subject matter.

The Co-Spaces platform provides a user-friendly and accessible platform for creating educational digital artifacts collaboratively. The platform allows for real-time collaboration, which can facilitate group work and promote peer learning. This has encouraged students to express freely their creativity and to ‘play’ by creating memorable stories.

The OER activity proposed to the students was a successful way to incorporate virtual reality technology into the curriculum and to encourage collaborative learning and creation of digital artifacts, helping the students to learn about local history and heritage. As some of the students have shared openly their artifacts, will encourage future generations in looking into creating VR artifacts.

The collaborative creation process also promotes the development of important skills such as teamwork, communication, and problem-solving. These skills are transferable and can be applied to various real-world scenarios.

We also acknowledge the conclusions of one of our previous studies, where we found that students confirmed that the education process could be improved if the VR technologies would be used more in the practical sessions of classes. The immersiveness that VR technologies add to a virtual world cannot be achieved in a simple 3D application/simulation, this being the main reason students prefer a VR application over a classic one (Tataru et al., 2022).

While the use of virtual reality technology is still relatively new in education, the results of this study suggest that it has great potential for improving learning outcomes. Further research is needed to fully explore the possibilities of virtual reality technology in education and to identify best practices for its implementation.

Overall, the results of this study suggest that incorporating virtual reality technology and collaborative digital artifact creation into the curriculum can be an effective way to enhance student learning outcomes and engagement. The use of platforms like CoSpaces can provide a unique and immersive experience for students,

and the creation of OERs can contribute to the open educational resources available to educators and learners worldwide, but also to encourage students to share openly their work, to gain a sense of fulfilment through the public display of their work, and to encourage future students' generations to experiment with digital creation.

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