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The recent Covid-19 pandemic has presented teachers with new challenges, highlighting the need for innovation, renovation, and increased digitisation across all areas of education, including foreign language learning. At the same time, the increasing advances in Extended Reality (XR) together with the availability of authoring tools have created new opportunities to support the teaching/learning process. However, research suggests that many educators are still reluctant to integrate such technologies into their teaching syllabus. In this context and with the idea of encouraging especially language teachers at A1/A2 level to explore the possibilities of creating novel learning environments using technologies such as Virtual Reality (VR), in the current study we will share our experience regarding the use of authoring tools and the design and implementation of a VR language learning app created with CoSpaces. The latter is a freely available authoring tool which allows teachers with no specific programming skills to easily create VR environments in line with their teaching needs. The study consists of two main parts: the first focuses on describing CoSpaces as an authoring tool and our experience as developers of a VR app. The second shows the tool's functioning and offers those unfamiliar with it a short introduction. It concludes with evaluating the app's implementation and analysing teachers' and students' feedback.

1. Introduction

The current article aims to encourage and support language teachers with the creation of Virtual Reality (VR)-based learning resources in line with their teaching needs. Despite the increasing availability of VR apps on commercial platforms such as Google Play Store and App Store, such apps are usually closed products hence do not allow teachers or other stakeholders to modify and adapt their content to their personal teaching needs (Berns & Reyes-Sánchez, 2021). This fact, together with the steady rise of the development of authoring tools for stakeholders with no specific programming knowledge[1], encouraged us to explore the potential of some of the available authoring tools to create VR teaching-learning resources according to our students' needs. This article will focus on a specific authoring tool, CoSpaces, describing its main functionalities and usability

[1] For more information on authoring tools see: Vert & Andone, 2019; Tzima et al. 2019; Romano et al. 2020; Berns & Ruiz-Rube, 2022; Coelho et al. 2022; Chamusca et al. 2023.

to create VR learning environments. The intention is not to produce a manual for the tool but to enable readers, and thereby language teachers, to become more familiar with an example of an authoring tool, explaining its handling and applicability very briefly and in a very practical way. For this, we will share a concrete design example with the reader based on our experience as foreign language teachers and novel users of CoSpaces.

Consequently, the current work will be divided into two main parts. The first one will focus on the description of CoSpaces as an authoring tool and our experience with it when developing a VR app created within the context of our German language classes (sections 2 and 3). The second one will show the tool's functioning to provide those unfamiliar with it with a step-by-step guide on using CoSpaces to create their teaching-learning resources (section 4). The article will conclude with an evaluation regarding the app's implementation, analysing teachers' and students' feedback (section 5).

2. Description of *CoSpaces* as an authoring tool

CoSpaces Edu (https://cospaces.io/edu/) is a mixed reality web-based application and authoring tool developed for teachers and students with no experience in coding (Mouzakis et al. 2021; Berns & Ruiz-Rube, 2022). It allows to create VR scenes based on different multimedia elements and virtual objects (e.g., videos, 360º images, audios, quizzes, text panels, information points) with which the user can interact, hence making the learning process more dynamic, interactive and engaging than conventional materials might allow. VR scenes can be predesigned or created from scratch and shared with other stakeholders (e.g., students and teachers). CoSpaces offers end-users the option to choose the format in which they would like to visualise the VR scenes created. They can visualise them either through their smart devices with or without VR glasses (Mouzakis et al. 2021). The fact that users can choose their preferences makes CoSpaces an attractive option for those interested in highly immersive environments and also those who might suffer from seasickness and thus do not feel comfortable using VR glasses.

3. Our experience as developers. Creating a VR app with CoSpaces

In the following we will describe the VR app we have created for the current project and illustrate the development process to allow other teachers to follow our steps and create their own VR apps.

From a pedagogical point of view, embedding new language input within familiar and meaningful contexts helps make it comprehensible for the learner, facilitating its acquisition (Krashen, 2003; Valero-Franco et al. 2024). In this sense, considering that the target students of the *360º Sightseeing tour* app were students from the University of Cádiz, we have chosen the Andalusian city of Cádiz to contextualize the language content targeted in each VR scene.

3.1 Description of the *360º Sightseeing tour* app

The VR app we have created is called *360º Sightseeing tour* and invites students to explore Cádiz by navigating through a total of 22 scenes, divided into two mini-apps (*360º Sightseeing tour. Part 1* and *360º Sightseeing tour. Part 2*). All scenes are built on 360º panoramic views to allow for a semi-immersive learning experience. In addition, all scenes are introduced by means of short text and audio files to provide learners with the most relevant information regarding each place (i.e. things to see and do at each place). The VR scenes were chosen in line with the students course syllabus and curriculum requirements, embracing some of the key topics and vocabulary items established by the Common European Framework of Reference for Languages (CEFRL) for A1 level learners (e.g., vocabulary related to the place of living, to everyday time and to leisure time activities). The VR sightseeing tour invites students to explore the different places and to interact with several information points created within the VR environment (see red points in Figure 1). Interaction takes place either via mouse click (laptop) or fingertip (using devices with touch screen or Google Cardboard) (Valero-Franco & Berns, 2024).

Figure 1. Example of one of the VR-scenes illustrating several information points.

3.2 Development process

As for developing our *360º Sightseeing tour* app, we started from scratch, creating all the resources necessary to support our students' learning process, with a special focus on vocabulary learning. The resources we created for this purpose were 360º images, which were later used to build the different VR scenes and respective text and audio files to provide students with relevant information regarding each scene. We used a GoPro MAX camera to take 360º images (see Subsection 4.2.3).

In order to create each of the 22 scenes of the *360º Sightseeing tour* app, 360º pictures at different characteristic places of the city of Cádiz were taken, uploaded and edited as environment images (Figure 2). The reader will find more details on this process in section 4, providing a short introduction to CoSpaces for those who want to learn more about using this authoring tool.

Once the background images and audio-files were uploaded and added to each scene, several information points and text panels were added. During their sightseeing tour, learners are guided thanks to information points and text panels which indicate names and other relevant information about interesting places around the city in the learners' target language (in this case, German).

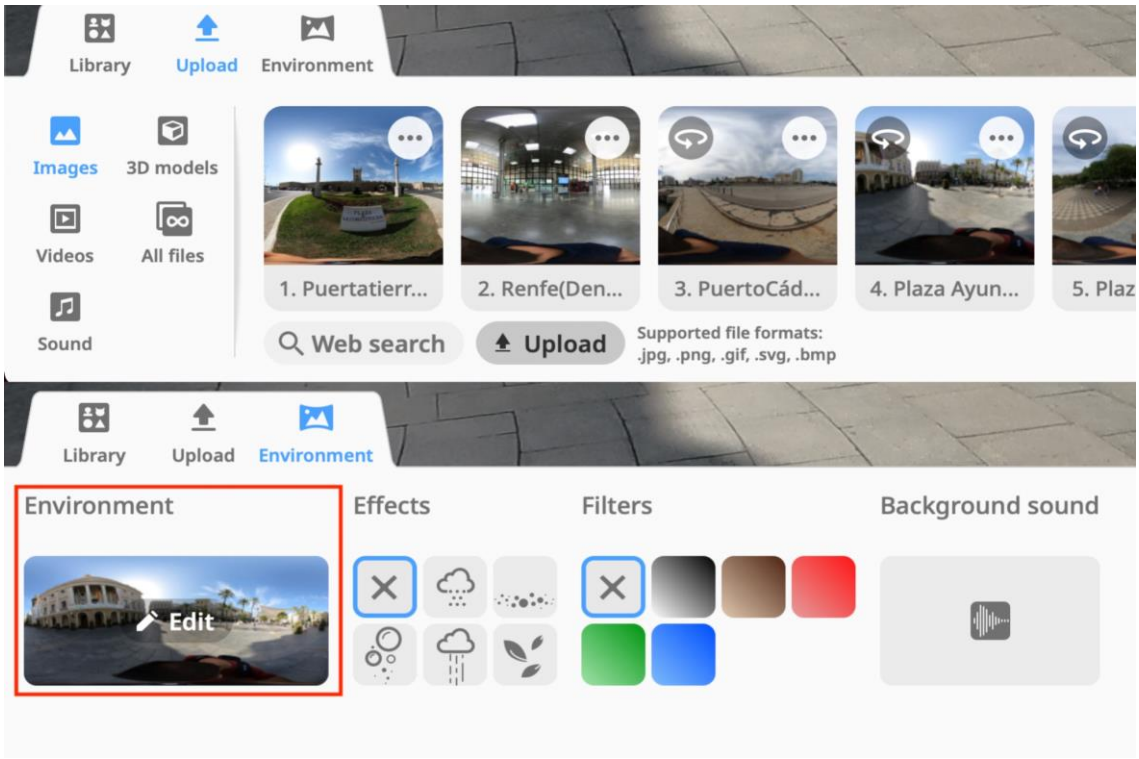

Figure 2. Screenshot to illustrate the uploading and editing process.

To create an information point, we added a red figure in circular shape to connect the point with the German vocabulary we wanted to deliver in the *360º Sightseeing tour* app. Figure 3 shows an example of the VR scenes displaying a text panel (in the middle) and information at one of the information points (top right).

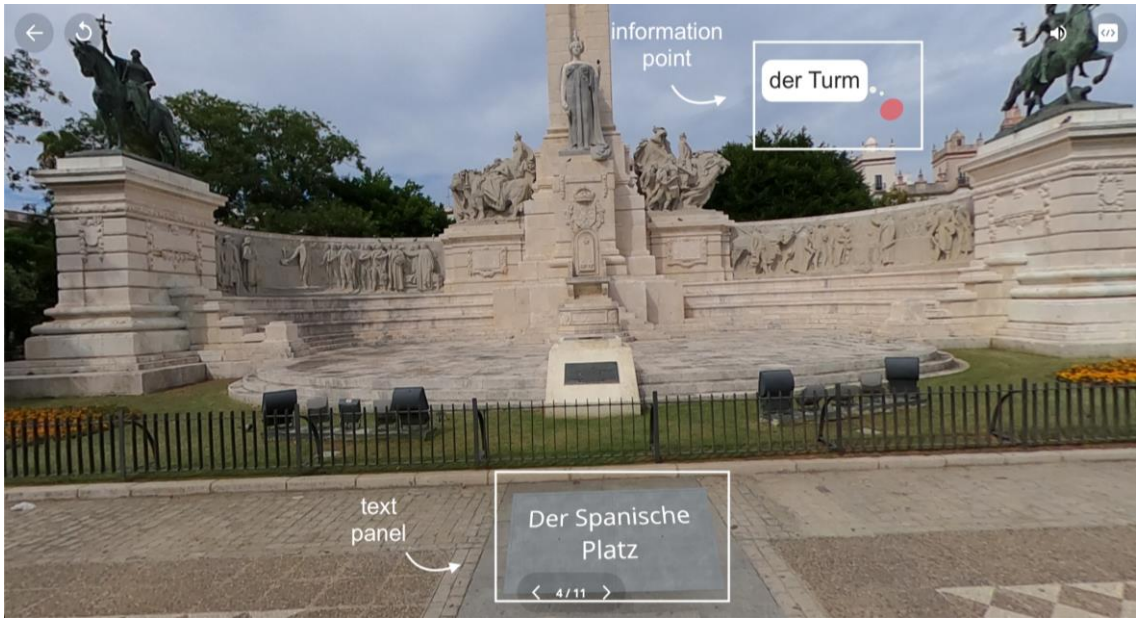

Figure 3. Screenshot from an example scene.

Finally, we added four blocks using CoBlocks (Cospaces Edu, 2020) for each information point, two of which are activated when the mouse (using a laptop or desktop computer) or finger (using a touchscreen device or Google glasses) passes over it and another two when clicking on a concrete information point. Later, we defined the content we intended to show at the different points (i.e. the name and vocabulary related to the targeted objects at each scene) (Figure 4).

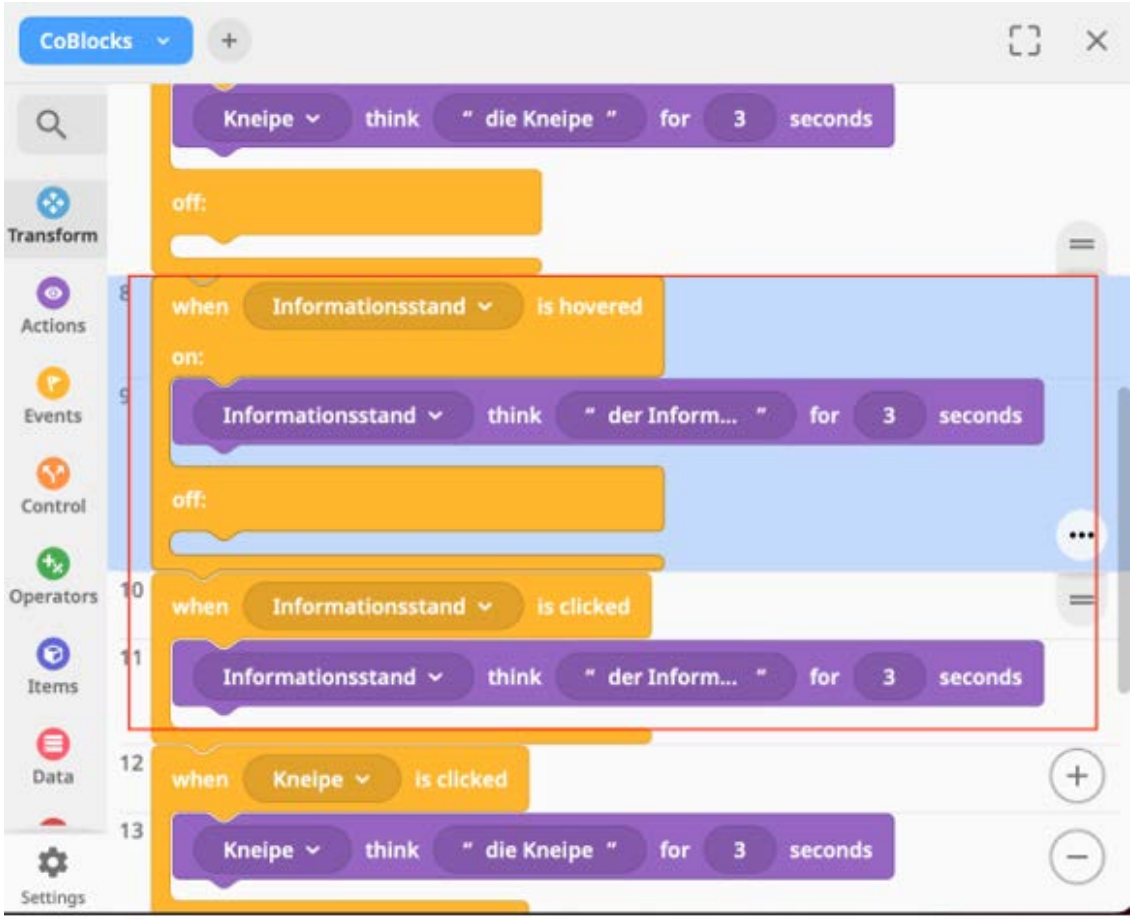

Figure 4. Coding the information points.

We tried to keep the number of information points embedded in each scene low so as not to overload learners with too much information. There are audio-recordings at the beginning of each new scene introducing the place students are about to explore, and there are information points inviting learners to investigate each scene in more detail. Our intention is to focus learners' attention on the relevant vocabulary and information targeted by the app.

Each VR scene was created with the basic free version of CoSpaces. However, for combining the 22 scenes used for our VR app we needed to use the pro version.

4. An introduction to CoSpaces for beginner users

Those unfamiliar with CoSpaces as an authoring tool will find a small guide on creating a VR app from scratch in this section.

4.1 First step: Creating a user account

In order to create VR scenes users must first download the authoring tool from the Google Play or App Store and then create a user account. When accessing the tool for the first time, users must register by creating a user account on the CoSpaces platform by selecting between registering as a teacher or a student. When registering as a teacher, users can create 3D scenes, classes and related tasks and assign and share them later with their students by means of a "class code". The latter is generated by the CoSpaces platform once a project has been created. When accessing CoSpaces from the teachers' account, a dashboard with the main screen is shown, divided into four sections (*Gallery, Classes, CoSpaces* and *Archive*) which make up the structure of the platform (Figure 5).

Note that CoSpaces offers users two options when registering: a free basic plan with some limitations for editing scenes and a pro plan which requires a subscription fee allowing the user to unlock a greater variety of features to edit more diversified scenes. Unlike the basic plan the pro plan permits the combination of more than two scenes with more than ten folders (image- and audio-files), giving access to a very extensive library. Although the pro plan version offers plenty of functionalities and without any restrictions in terms of user visualization, the free version offers the necessary resources to create an app for our teaching context which does not require more than 1000 visualisations.

4.2 Platform structure: CoSpaces' sections

4.2.1 Gallery section

The first section, called *Gallery,* is organised into four knowledge groups: Social Sciences, Languages & Literature, Makerspaces & Arts and STEM & Coding. It allows teachers to access VR scenes created by other educators from different areas of teaching hence offering especially novel users of the tool an insight into previous VR-projects developed with CoSpaces (Figure 5).

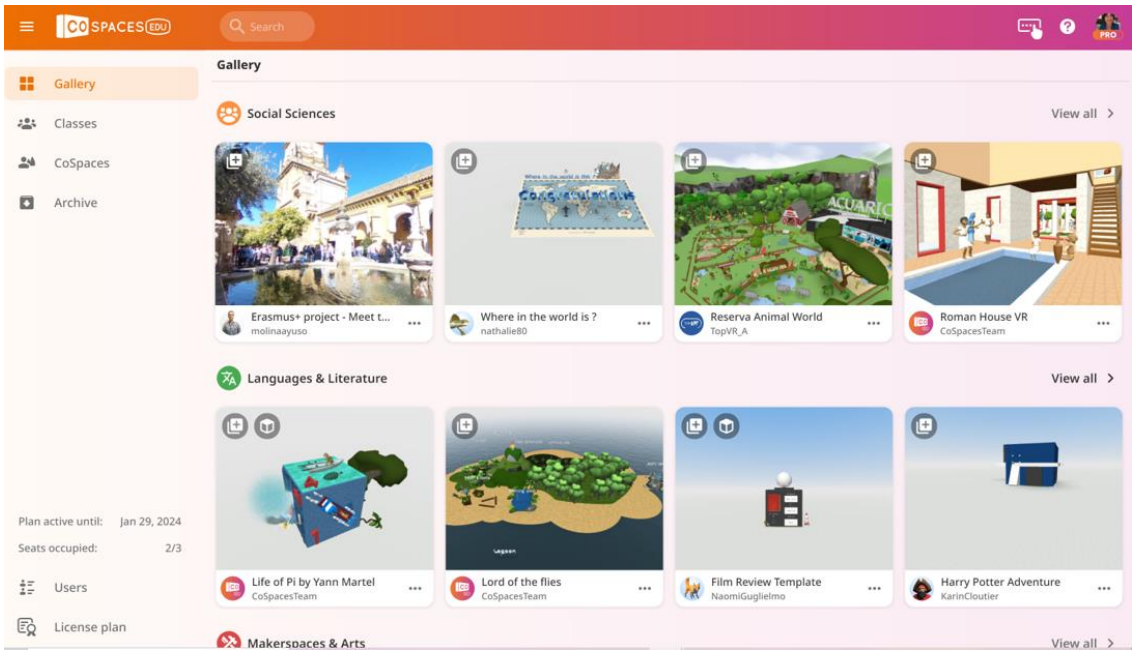

Figure 5. Dashboard of CoSpaces illustrating some examples from the *Gallery* section.

4.2.2 Classes section

The second section, called *Classes,* allows teachers to create different learning tasks to be performed later by their students. Either individually or jointly with other peers, students are invited to solve the given learning tasks by creating some VR learning scenes and applying their previously acquired knowledge in their subject. The *Classes* section is especially valuable if teachers want to employ the CoSpaces tool not only as a teaching but also learning tool, providing students with the opportunity to become actively involved in their learning process by creating their own VR learning resources based on the course content. An interesting example for such use can be found in a study carried out by Yi-ling et al. (2020).

Once a teacher has created a *Class* and learning task they can assign them to an individual student or group of students. Tasks can be assigned either by sending a class code, generated for each project or by adding students manually to the respective project (Figure 7).

4.2.3 CoSpaces section

The third section, named *CoSpaces* (named after the platform itself) permits teachers to create and edit VR teaching scenes aligned with their teaching needs. Once inside the

CoSpaces section, teachers can add and create different scenes with several virtual elements and objects inside them.

When accessing the *CoSpaces* section, two computer tabs are activated: *Create Folder* and *+Create CoSpaces*. The first option, named *Create Folder*, allows users to organize and store different virtual scenes they intend to create within the same Folder. This option might interest those who want to create various scenes related to the same topic, belonging to the same project.

By clicking on *+Create CoSpaces,* the user chooses the template they want to use to create a virtual scene. To this end, users can select amongst the templates offered in the *CoSpaces* section or take a 360º image. Such 360º images can be taken employing a GoPro MAX, a 360º action camera specifically designed to capture 360º photos thanks to its two lenses or mobile applications such as DMD Panorama, Panorama 360, and Photaf Panorama.

When clicking on *+Create CoSpaces*, a window with the created scene is activated. This window is divided into four main parts the *main menu bar, left-side menu, the bottom menu* and the *right-side menu* (side menus that are displayed by clicking the corresponding icons) (Figure 6).

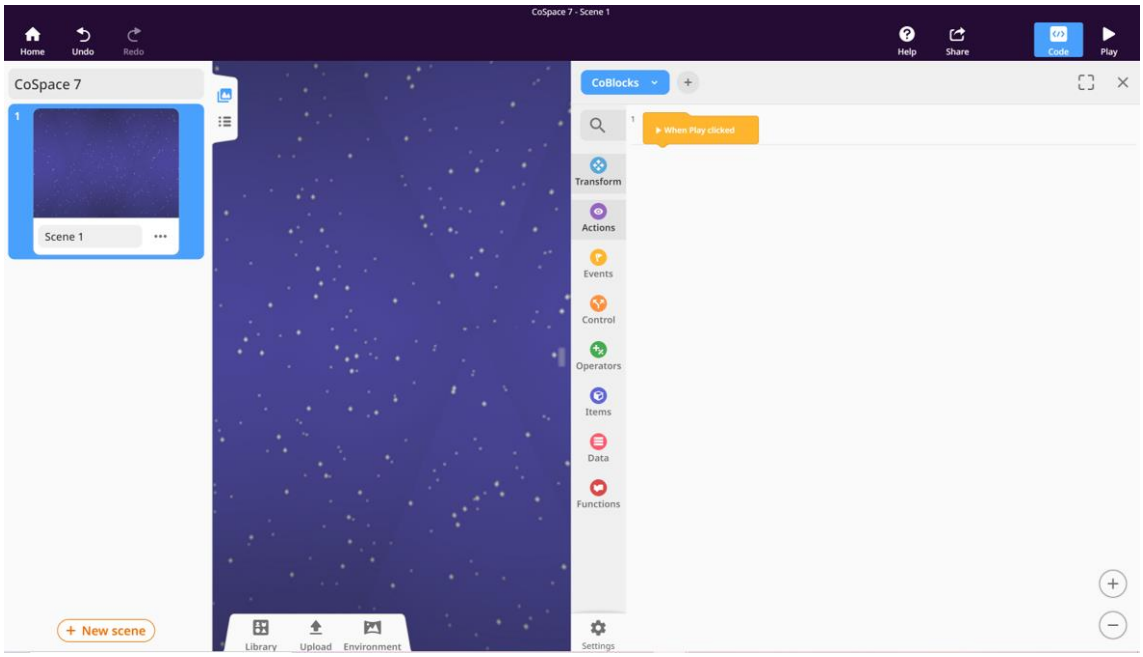

Figure 6. Screenshot of one scene +Create CoSpaces.

In the following we will describe each part.

Part 1. ***Main menu bar***

The *main menu bar* allows users to activate and display the side menus on which they find different toolkits to work with when creating VR scenes.

Part 2. ***Left side menu***

In part 2, users can visualise the different scenes, interactive elements and objects they have previously added.

Part 3. ***Bottom menu***

Unlike part 2, part 3 is divided into three subsections: *Library, Upload and Environment*. To build a scene, the *Library* subsection offers numerous 3D models that can be added based on the drag-and-drop system, which means users only have to drag the respective elements to the edited scene and then drop them into the scene (Andone et al. 2018). Such 3D models can be *Characters, Animals, Housing, Nature,* amongst others (Figure 7). Furthermore, characters and animals can be animated by means of body movements and mini-dialogues (Vert & Andone, 2019).

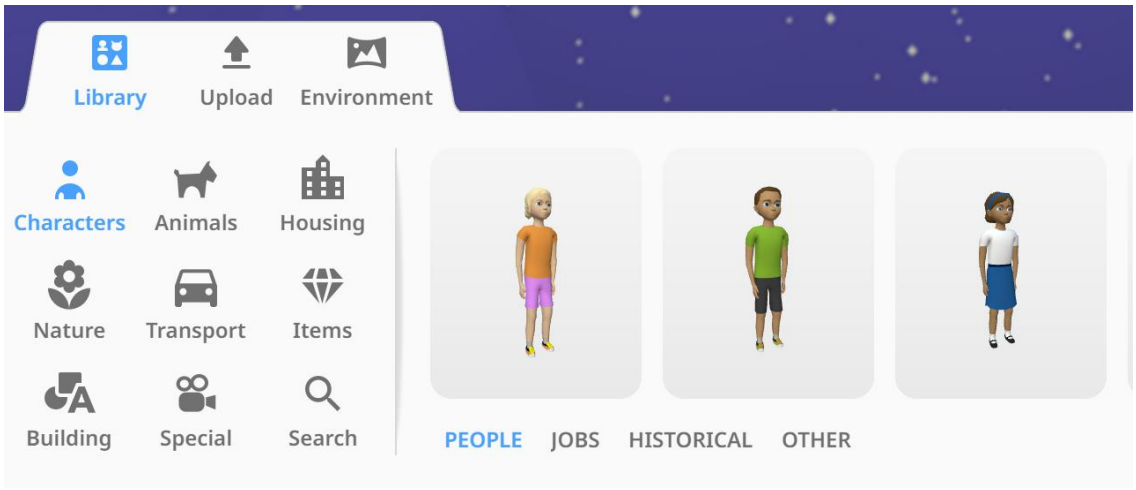

Figure 7. Screenshot of the *Characters* option within the *Library* subsection.

Apart from the 3D models mentioned above, the *Library* offers another option, named *Building,* to add different virtual elements such as text panels and shapes. Such elements allow app developers to include relevant information or instructions regarding a scene or activity.

In addition, if the objective is to create a VR app based on one's own resources, the tool offers in the *bottom menu* another two subsections, called *Upload* and *Environment*. The first one, *Upload*, provides the option to upload 3D models, 2D or 360º images, 2D videos and sounds from any external archive and device. The second one, *Environment*, allows app developers to add background sounds, images to a scene and preset filters (e.g., night filter, cloudy filter).

Once an image or audio file is uploaded, it must be edited in the *Environment* section and set as the environment image/sound. Important in this process is that images and audio files are selected all individually when setting them as background image/ sound. Regarding the edition of audio files, *CoSpaces* offers two options: one by uploading audio files from an external device and another by recording audio files directly from the platform itself (Figure 8).

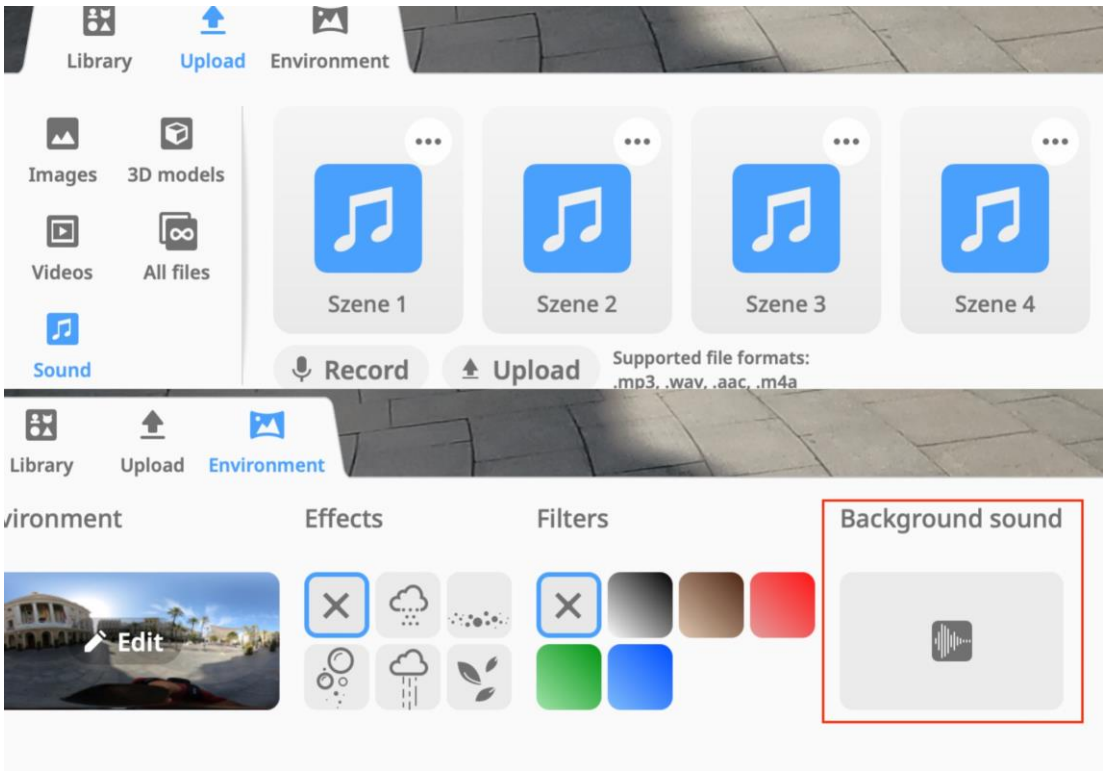

Figure 8. Screenshot of the *Upload* and *Environment* subsections.

Part 4. *Right side menu*

Another very interesting feature of the *CoSpaces* section is *CoBlocks*, a coding function which is provided on its *right side menu* (see above Figure 8). *CoBlocks* permits the creation of information points to allow end-users to interact directly with the VR environment.

In order to create information points and show specific information through a text, developers need to write the text, place it in the desired position of the scene and connect it with an image, icon or geometric form. The *Building subsection* within the *Library* section (Figure 9) offers different geometric forms that can be used.

Figure 9. Screenshot of the Building subsection.

Once they have done this, developers can change the dummy text based on the information they want to show/deliver. The dummy text can be modified by right-clicking on the panel showing different editing options regarding texture, colour or text size.

The coding of the information points in CoBlocks allows users to add action and interaction. To this end, CoSpaces offers a large variety of blocks. Amongst the most basic ones are event and action blocks (Filf, 2018). The first one corresponds to the way in which an information point will be activated (e.g., via mouse click or fingertip), whereas the second one is the consequence of the first action (e.g., showing a text) (Figure 10).

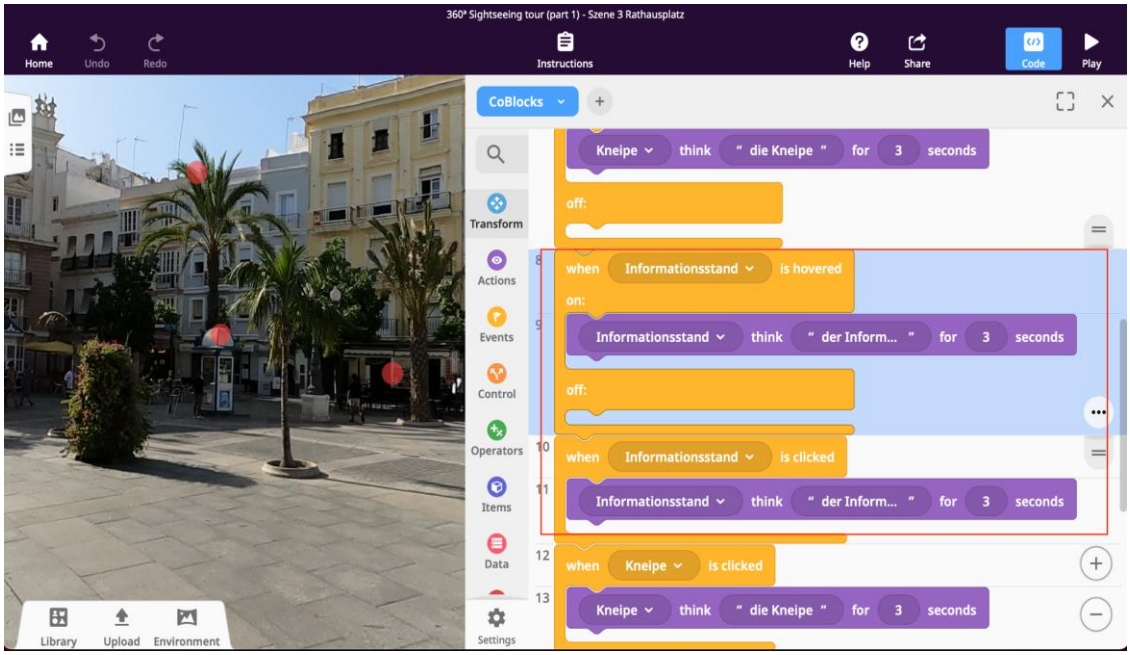

Figure 10. Screenshot of the coding information points in CoBlocks.

Once the VR project is created, app developers can visualise, revise and publish their scenes. While basic plan users can publish their scenes and share them with other stakeholders by means of a specific code, link or a QR code provided by the *CoSpaces* platform (Figure 11), those with an upgraded pro version will be able to both publish and share their scenes with other users as well as store them in the *Gallery* section.

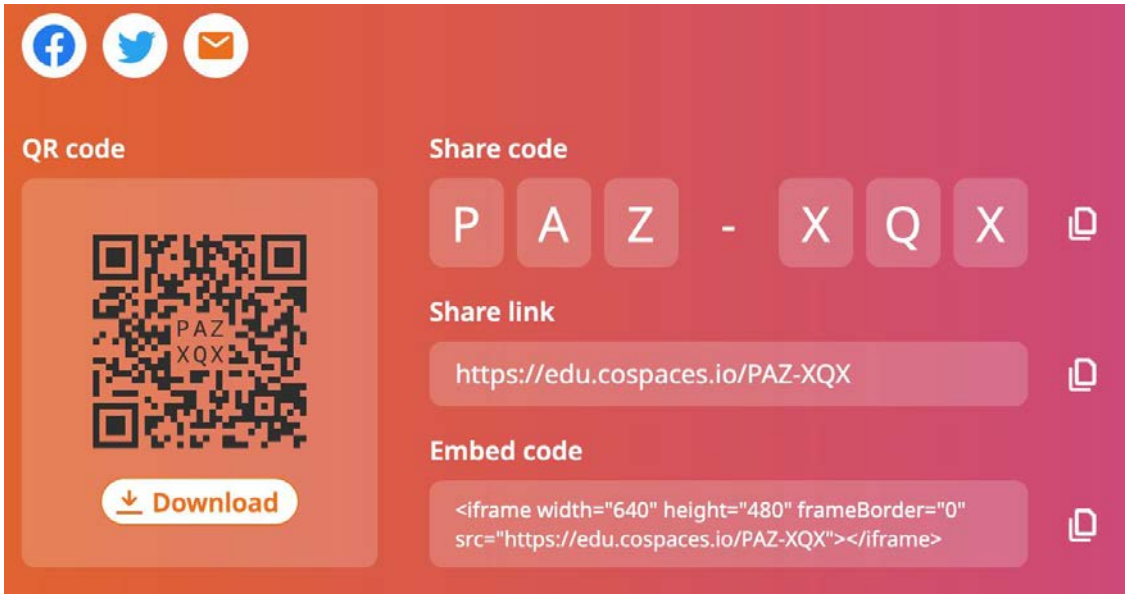

Figure 11. Screenshot with multiple options to share the VR project created.

4.2.4 *Archive* section

Finally, the fourth section, *Archive*, allows teachers to archive both the projects and scenes created together with all the classes selected, thus keeping the dashboard more organised (Figure 14). This option can be of interest for those teachers who would like to employ *CoSpaces* on a regular basis to create different VR scenes and classes.

5. Critical evaluation of the experience: Student and teacher-developer feedback

5.1 Students' perceptions regarding the *360º Sightseeing tour* app as a learning tool

The *360º Sightseeing tour* app was tested in our German as Foreign Language course with 72 students from the A1 level (CEFRL).

Student participants were from five different degrees offering German for beginners at the Faculty of Humanities at the University of Cádiz. The app aimed to provide students with a virtual learning tool to complement face-to-face teaching and support them in

their autonomous learning process. Students were given access to the app during the second semester of the academic year 2021-2022 once they had successfully passed the A1.1 level in the first semester. To ensure that learners would benefit from the app for their language learning, they needed to have some basic knowledge of German, both in terms of vocabulary and grammar. As part of the learning activity, students first received an introduction to the app and a short training session on how to use it. Hereafter students were given access to eleven scenes on which they worked for 40 minutes. The rest of the scenes were activated along the semester in line with the course syllabus and students' learning needs. Before completing the semester, students were invited to provide feedback on their learning experience and to suggest possible improvements for the design of future applications. Feedback was given in Spanish and anonymously with the idea of not inhibiting students' answers, thus contributing more efficiently to the app's improvement. The feedback given by 65 students (out of 72 participants) was summarized by the authors based on the most frequently given answers which are pointed out as follows:

- The app makes learning fun and is a very good tool to complement the other learning resources in our German class. Nonetheless, more text in the app would help with vocabulary learning.
- The app motivates and makes vocabulary learning easy and fun.
- I liked the virtual environment and the vocabulary presented in a "real-life context".
- The VR app was very visual, didactic and interactive, and I liked it very much.
- The app provides a very interactive and dynamic learning environment, but I needed to catch up on more text. I sometimes struggled with understanding the audio files and missed accessing their transcription.
- I liked the app but missed the possibility of zooming objects to visualise and explore them better. It could facilitate the learning of new vocabulary even more.
- I enjoyed navigating through the app and exploring the city of Cádiz. However, to focus more on the difficult vocabulary, it would be good to be allowed to freely navigate through the app instead of always following the established order.
- I personally need more written input. Including more text within the app would be great because I liked it as a learning tool. In general, the app makes vocabulary learning very easy since the vocabulary is related to photos.
- Although I enjoyed learning with the app and liked its content, some of the visual materials (quality of some photos) could be improved. I am thinking of some of the grey photos since they were taken on a cloudy day.
- Using the app without wifi or a data connection would be great.

In the following table we present the main aspects in terms of positive and negative students' feedback (Table 1).

Positive aspects of the app	**Negative aspects and suggestions to improve the app**
• enjoyable • dynamic, interactive and very visual • facilitates and motivates learning • exciting and engaging • real-life environments • perfect to complement vocabulary learning	• requires internet connection • zoom to better visualize and explore the VR environment not available • more flexible access to different VR scenes is needed • more written input is needed to support the input provided by the audio-files • picture and audio quality could be improved

Table 1. Students' feedback and evaluation of the *360º Sightseeing app*.

5.2 Teacher and developer feedback regarding *CoSpaces* as an authoring tool for designing VR teaching-learning resources

From a teacher and developer point of view, there is no doubt that CoSpaces provides valuable opportunities for the enrichment of the teaching and learning process. One of such opportunities lies in its potential to easily create immersive, semi-immersive and explorative learning environments; all said to benefit the learning process in general and the language learning process in particular (Alfadil, 2020; Berns et al. 2021; Huang et al. 2021). As novel users of *CoSpaces*, we appreciated first of all the very user-friendly and intuitive character of the platform and authoring tool, allowing us to create our first VR app aligned with our teaching needs. For the creation process itself, it was particularly helpful that the platform offers not only access to a *Library* with numerous features to create VR environments and resources (i.e. 3D objects, background images and sounds, text panels) but also a *Gallery* that allows users to access already existing VR apps. Through this, the platform permits especially novel users and developers to get an insight into several pedagogical examples and applications before creating their own VR app. What makes *CoSpaces* particularly attractive as an authoring tool is its flexible use; that is, app developers can either employ their materials (i.e. videos, photos, audio files, texts) when creating their VR app or those offered in the platform's *Library*. When finally evaluating students' feedback as end-users of the *360º Sightseeing app*, we found especially valuable those comments that refer to the app's usefulness for facilitating the

student's learning process. While students generally appreciated and highly evaluated the app's dynamic, interactive and engaging nature, some asked for improvement of a few features to increase the app's usefulness for learning. Such features were primarily the need to zoom into the different VR scenes and objects and to navigate freely through them to explore and focus better on the targeted learning contents. Although *CoSpaces* does not offer these features and hence did not allow us to implement them in our app design, students' demands are very valuable feedback for developing future apps and the need to look into other similar authoring tools to make future apps even more user-friendly and effective in terms of learning.

6. Conclusions

Our experience as language teachers and developers of a VR app (*360º Sightseeing tour*) shared in this article proves that *CoSpaces* allows teachers with no knowledge and experience in programming to create VR learning resources aligned with their course and teaching requirements. Considering the difficulty of facing this type of authoring tool for the first time, the current paper aims to provide some basic guidelines for novel users who wish to design VR teaching/learning resources themselves while at the same time exploring the added value of VR for language learning.

Acknowledgements

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Biographical Information

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Keywords

virtual reality, authoring tools, CoSpaces, foreign language learning, beginner learners