TRANSPAVET: INNOVATING IN VETERINARY LEARNING USING AUGMENTED AND VIRTUAL REALITY

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Abstract

The ability to communicate scientific information effectively is crucial for veterinary professionals. Consequently, veterinary students require consistent and proactive training in communication. In parallel, digital transformation has undoubtedly impacted educational institutions. To address these priorities, the TranspaVET project aimed to design an immersive educational experience through advanced and innovative technology. This article aims to share our experience involving first-year veterinary students in producing scientific posters and how augmented reality (AR) and virtual reality (VR) impact their scientific outreach. The project, developed in the academic year 2022-23, involved 35 students and eight mentor professors and resulted in nine scientific posters. The posters were digitized allowing their access through links or Quick Response (QR) codes. Firstly, they could be visualised in 3D Web preview and in AR, as images overlayed into reality through mobile devices. Secondly, they could be viewed in an immersive VR educational metaverse. Visitors could access the metaverse via their personal electronic devices and via VR headsets. Users can view, download, and share the posters and talk together inside the virtual environment. By January 7th, 2024, the posters were digitally viewed 1,795 times, and 207 unique users entered the TranspaVET metaverse from different Spanish regions (Valencian Community, Castile and Leon, Andalusia, Madrid, Catalonia, Asturias, and Galicia), as well as from Argentina and Costa Rica. The TranspaVET project represents a creative connection between educational innovation and scientific research dissemination. It sets an example for the future of immersive, technology-driven learning through a platform that combines AR and VR.

Keywords: virtual and augmented reality, science communication, veterinary medicine.

1 INTRODUCTION

Advances in technology have paved the way for new tools in education. Augmented reality (AR) and virtual reality (VR) are two approaches of extending the reality with new possibilities: AR adds information into reality and VR builds 3D online spaces where users can interact through avatars. Both technologies provide immersive and interactive environments that simulate real-world scenarios and are currently used in education to enhance the learning experience of students in various fields [1-5]. For example, AR and VR can help students to train for clinical cases and surgical procedures, study animal anatomy and physiological mechanisms, assess their performance, and increase their motivation [6-10]. Another area where AR and VR can be valuable is the dissemination of student works [11-13]. Indeed, scientific posters are an effective way to present scientific content and can help veterinary students to develop their communication skills. However, two major drawbacks of conventional paper posters are that they can only reach the people who are on site, and they are available only during the presentation. Interestingly, the integration of AR and VR can broaden the dissemination of student posters and allow them to showcase their work in a more interactive way, to a wider audience, and in an eco-friendly manner as this technology avoid paper print drawbacks.

As public is demanding greater transparency, veterinarians are frequently being called upon to provide expert opinions and defend their position on animal welfare. This topic is a crucial part of the veterinary medicine curriculum, as veterinarians prioritize the interest of animals. This curriculum aims to prepare individuals for a challenging profession that involves significant responsibilities and ethical obligations. An essential aspect of their education is the capacity to evaluate scientific literature accurately and communicate information effectively. A specific goal of their training is to instil an awareness and respect for good scientific practices and animal welfare [14].

While traditional didactic instruction is effective in delivering fundamental information, more interactive approaches supported by advanced and innovative technology have been developed and provide an immersive educational experience [15]. This article reports the methodology and outcome of an innovative educational project using AR and VR to disseminate veterinary student works, specifically

scientific posters about animal experimentation, welfare, alternatives methods and discuss the benefits and challenges of using AR and VR in this context.

2 METHODOLOGY

2.1 Animal welfare and animal experimentation in the veterinary curriculum

In the faculty of veterinary medicine of the University CEU Cardenal Herrera (CEU UCH), various modules deal with animal welfare and animal experimentation. Among them, the “Introduction to Veterinary Medicine” module is taught in the first year and covers animal welfare, scientific data collection and analysis, communication skills and critical thinking. Students are required to understand that animal experimentation should only occur when ethically justified, and they should be familiar with the main principles of reduction, reuse, and refinement (3Rs).

2.2 Participants and procedure

After approval of the Vice-Chancellorship for Academic Organization and Teaching Staff of the UCH-CEU (Ref: PI39C-VV-22), participation in this project called TranspaVET was offered on a voluntary basis to first-year students enrolled in the "Introduction to Veterinary Medicine" module in 2022-2023. The students worked in small groups consisting of three to four students, under supervision of a mentor, to create a scientific poster. The topics for the poster had to be related to research, animal experimentation, and alternative methods.

The objective of each poster was to present a comprehensive summary of the current knowledge on the chosen topic and to serve as a catalyst for further reflection on it. The posters were initially developed using PowerPoint, Adobe or Canva and then they were exported into a PDF file. Subsequently, for the purpose of visualization and distribution, those pdfs were digitized by the Valencian company Clon Digital (https://clondigital.com/) that created a blended educational platform, which supports 3D Web preview, as well as AR and VR uses.

2.3 Preparation of the environment and visualization

Digitized posters can be viewed in three ways:

- 3D Web preview,
- AR: Quick Response (QR) codes generated by an inner tool of the platform were displayed in the real exhibition hall and allowed access to the digitized posters in AR. The posters are virtual elements overlaid into reality via mobile devices. It is also possible to open posters in RA directly from a link generated by the platform. No specific application is needed for AR visualization. An electronic device with a camera that can recognize three-dimensional space is the only requirement. At present, all mobile devices are compatible with the Clon Digital platform,
- VR: The posters can be viewed in an immersive, multiuser and interactive classroom. This metaverse presents all the posters created by the students in a virtual clone of the exhibition hall. It is accessible through computers or mobile devices through a QR code or a link for remote participants. During the in-person TranspaVET event, a more immersive experience could be achieved using VR headsets with Android devices. The platform is fully compatible with most VR headsets currently available on the market. This includes all Meta headsets, such as the Meta Quest 2, Meta Quest Pro, and Meta Quest 3. Compatibility with Meta Quest 3 is comprehensive, allowing direct interaction within the immersive environment, without the need for additional devices for navigation as it recognizes the user's hands. In addition, the platform is also compatible with the headsets of other prominent brands, such as Pico, HTC Vive, HP Reverb, and Lenovo.

3 RESULTS

3.1 Elaboration of the posters and in-person TranspaVET event

In September 2022, the project was presented to the students stressing the opportunities of using AR and VR in an educational project. In October, 35 students and eight mentors joined TranspaVET and started to elaborate nine posters on four topics:

- **Basic principles in animal welfare**: The 3Rs, Bioterium: Life of a Laboratory Mouse,
- **Animal experimentation and scientific transfer**: Translational Medicine, Zebrafish, Xenopus laevis and Xenotransplantation,
- **Alternatives to animal experimentation**: Use of mannequins and simulators in the veterinary degree at UCH CEU and Organoids,
- **Societies that promote animal transparency:** The Spanish Confederation of Scientific Societies (COSCE).

In March 2023, the final versions of the posters were digitized. On April 21, the posters were presented by the students at the in-person TranspaVET event held in the University exhibition hall and aimed to the entire academic community. During the event, the posters could be viewed in 3D preview, in AR and in VR as explained later.

This event provided an opportunity for face-to-face discussions, idea sharing, and opinions exchange among approximatively 70 participants, including students, mentors and university teachers. The students could discuss their topic with professionals and receive feedback on their work (Fig. 1). To conclude the TranspaVET event, a closing lecture was given by Dr Lluis Montoliu, a Spanish expert in animal experimentation transparency. This allowed for the main ideas presented in the posters to be revisited, expanded upon, and further explored.

Figure 1. Students presenting their work and receiving feedback from Dr Lluis Montoliu during the in-person TranspaVET event held in the University UCH-CEU.

3.2 Posters in 3D Web preview

Code QR and links allow visualization of the posters in 3D Web preview on personal devices (Fig. 2).

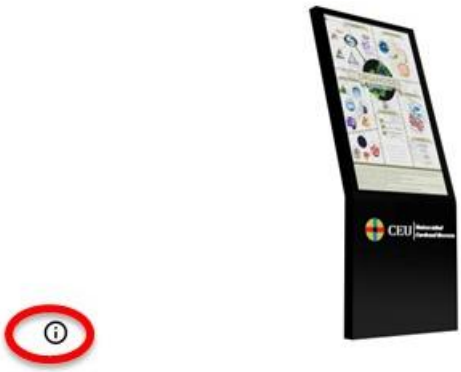

Figure 2. 3D Web preview of the poster on "Organoids".
The bottom left "information button" (red circle) enables the users to interact with the poster.

The posters in 3D Web preview have the appearance of traditional paper posters but offer additional features such as approaching the poster from different angles, zooming for readability, and allowing the opening of new windows to access additional information. Indeed, each poster can include one link,

providing access to any internet webpage. This option offers infinite possibilities, as it can link to videos, surveys, emails, interactive content, and more. However, this opportunity was not fully utilized in this experience, as only one poster ("Translational Medicine"), included a video as supplementary data.

3.3 Posters in AR

Visitors at in-person TranspaVET event could also view the posters in AR using their personal devices. They scanned a QR code available in the exhibition hall (Fig. 3) and followed the instructions (Fig. 4) to access the posters (Fig. 5). Importantly, no prior installation on the devices was required.

Figure 3. This QR code gives access to the TranspaVET poster collection.

Figure 4. This QR code provides access to a video demonstrating how to view posters in AR.

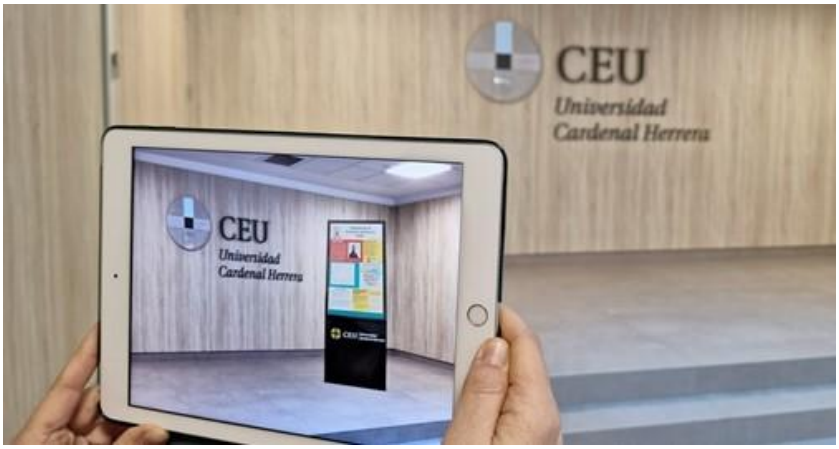

Figure 5: Poster in AR. Even if the poster is not physically present in the exhibition hall, it appears on the device as an image incorporated into reality.

Interestingly, remote visitors could also view the posters using QR codes or links. The posters in AR offer the possibility to visualize the poster in three dimensions, to zoom on the content and to interact with supplementary data, such as videos. Visitors also had the option to take photos and videos of the poster in AR using their camera devices. This enables for instance to take photos of the students around the poster they elaborated, even though the poster was not physically present (Fig. 6).

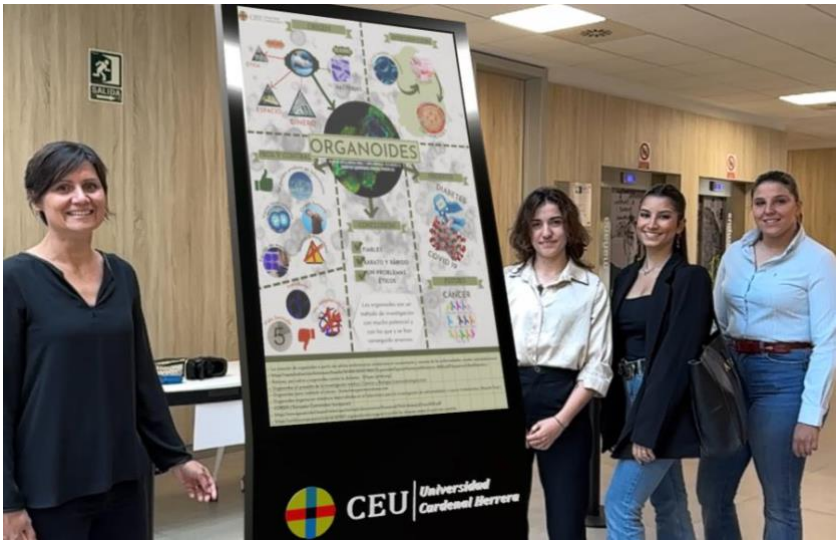

Figure 6: Picture of a poster in AR with three authors and the mentor.
The poster is integrated into reality and seems to be real although it is not physically present in the exhibition hall.

3.4 Metaverse: The TranspaVET virtual room

The virtual TranspaVET classroom was prepared by Clon Digital. It presents nine posters and a virtual screen where additional information is displayed via a video. It can be accessed through a link (https://www.clondigital.com/upload/41nmiofaolgosr3gl.html) that has been active since the TranspaVET event. Visitors can use their own device, without prior installation of any type of software, since they enter through the web browser. Access is defined as “cross-platform”, which means that it can be supported by multiple types of devices and different operating systems. Once inside the metaverse, the visitors choose an avatar and a nickname. Then they can interact with each other through chat and audio channels. They can view, download and share the posters. The sharing feature enables easy distribution of the poster link through applications such as WhatsApp, Telegram, Twitter, Facebook and LinkedIn. Additionally, the URL can be copied to the clipboard for dissemination (Fig. 7). Users could have a more immersive experience using VR headsets. The headsets, in this scenario, act as an interface that magnifies the device's screen using specialized lenses. This feature not only offers more interaction options, but it also enables deeper immersion into content.

Figure 7. This QR code provides access to a video of the metaverse and its potential.

3.5 Metrics

The Clon Digital platform provides various metrics that can be downloaded as a PDF or CSV file, thus offering the possibility to analyze and conveniently manage the data. The following metrics are available:

- **3D Web:** prior to viewing models in AR, the platform offers a 3D Web preview, this section indicates the exact number of users who have accessed the preview,
- **Seen in AR:** this section indicates how many users have viewed the posters in AR,

- **Total interactions:** this section indicates the number of users who have interacted with the poster, for example opening the video attached to the poster about “Translational Medicine”, clicking the information button (as indicated in Fig. 2),
- **Total reviews:** this section provides details on the recent viewing of each poster. The color of the number reflects the elapsed time since the last visit: green represents visits within the last week, black represents no visits in the last week but some in the last month, and red represents no visit in the last month.

The metrics are modified daily, depending on the number of users who accessed the platform. By January 7th, 2024, the posters were digitally viewed 1,795 times through 3D Web preview, 569 times in AR and 207 unique users entered the TranspaVET metaverse (Table 1). Interestingly, data showed that the users accessed the posters from different Spanish regions (Valencian Community, Castile and Leon, Andalusia, Madrid, Catalonia, Asturias, and Galicia), as well as from Argentina and Costa Rica.

Table 1. Metrics for the TranspaVET Project provided by the Clon Digital Platform.

POSTERS	*3D WEB*	*SEEN IN AR*	*INTERACTIONS*	*REVIEWS*
3R	177	47	0	GREEN
COSCE	240	91	4	GREEN
ZEBRAFISH	144	56	2	GREEN
XENOPUS	145	41	0	GREEN
XENOTRASPLANTS	134	45	0	GREEN
ORGANOIDS	238	71	1	GREEN
SIMULATORS	129	42	0	GREEN
TRANSLATIONAL	222	119	13	BLACK
BIPOTERIUM	159	57	3	BLACK
METAVERSE	207		6	GREEN
TOTAL	1795	569	29	

This data indicates that the number of remote views is significantly greater than the number of participants at the in-person TranspaVET event held at the University UCH-CEU. Moreover, most of the posters were still actively being viewed several months after the in-person TranspaVET event, as indicated by the green color of the indicator. All together, these results show that the use of the Clon Digital platform enhanced the visibility of the posters created by the veterinary students in a meaningful way.

4 CONCLUSIONS

In the TranspaVET project, nine posters on basic principles in animal welfare, animal experimentation and scientific transfer, alternatives to animal experimentation, and societies that promote animal transparency were created by 35 first-year veterinary students of the UCH-CEU.

These posters are accessible via links or QR codes and can be viewed through the Clon Digital platform in 3D web preview, AR and VR. This platform present two main advantages: it does not require any prior installation on devices, and its easy-to-use sharing feature favours scientific dissemination.

The posters were presented during an in-person event attended by approximatively 70 participants and have been viewed on-line 1,795 times through the Clon Digital platform from various Spanish regions and Spanish-speaking countries. This demonstrates that the platform enabled to reach wider audiences than traditional in-person presentation. Therefore, TranspaVET serves as a pioneering integration of educational innovation and dissemination of student works, representing an example of an immersive, technology-driven learning approach through a blended educational platform.

This experience has enabled the preparation of a functional platform adapted to support the future development of the TranspaVET project, with an increased number of students and the incorporation of new interactive features in the metaverse.

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