Azevedo Jr., D. P.
Muniz Jr., Jorge
Campo, Renato

Virtual and hybird immersive events from the knowledge management perspective : Brazilian Oil & Gas Company cases

http://hdl.handle.net/11067/7367
https://doi.org/10.34628/derq-6992

Virtual and hybrid immersive events from the knowledge management perspective – Brazilian Oil & Gas Company case

Azevedo Jr, D. P.[1], Muniz Jr., J.[2], Campos, R.[3]

[1] Petrobras University (UP)
delmir@petrobras.com.br

[2] São Paulo State University (UNESP)
jorge.muniz@unesp.br

[3] São Paulo State University (UNESP)
renato.campos@unesp.br

DOI: https://doi.org/10.34628/derq-6992

Abstract. The digitization of the economy, already quite advanced before 2020, accelerated significantly during the pandemic. Restrictions on holding face-to-face educational events during this period stimulated the development of its virtual and hybrid versions, bringing new challenges to workforce skills development. This paper discusses the use of 3D virtual environments and Metaverse in carrying out workforce training events, including considerations about pre, during or post-event, from the knowledge management perspective, a SWOT based on a multidisciplinary approach and a proposed checklist to operation management of virtual and hybrid events. A Brazilian Oil & Gas Company case supports the discussion with lessons learned from three events (2021 to 2022) involving 8,000 people and more than 104,000 man-hours of participation. The findings highlight the democratization of access to knowledge, the innovation´s effectiveness in knowledge management with 90% satisfaction among the participants.

Among the results are the 329% increase in employee participation in 2021 compared to previous editions.

Keywords: Immersive event; Metaverse; Knowledge management; Conferences; Immersive learning.

1. Introduction

The term "4.0" has been used to label the new paradigms achieved by the digital transformation on the economy sectors, such as Agriculture 4.0, Industry 4.0, Services 4.0 [1] and, more broadly, Economy 4.0 [2], characterizing an era of intense global digitalization of the economy. To be competitive in this scenario, it is necessary to develop new skills, as new technologies and processes require new knowledge for their adoption [3].

A large part of the activities is being automated, replacing human posts with robots and many others being transformed by digital facilities, such as AI resources, for example. In this context, knowledge sharing is an important factor to facilitate the innovation process, and to support transition periods [4], [5]. Therefore, it is imperative that organizations take an effort to ensure smooth acquisition, sharing and utilization of knowledge between individuals and teams [6]. It's important to investigate key factors and enablers to facilitate knowledge creation and promote knowledge sharing among workers in this new economy. How blue collars engage in learning and knowledge sharing to develop new competencies and skills is also an opportunity for research [5].

The covid-19 pandemic also added a new challenge to organizations during the period of social isolation: how to continue creating and sharing knowledge with a more distributed workforce? This challenge has accelerated the search for digital solutions in corporate education to support knowledge management in a hybrid work world, that is, with flexible working hours that combine face-to-face work with remote work. The pandemic period also initiated a great growth of interest in research on the digitization of education [7]. In this sense, also seeking new solutions based on digital transformation, the area of education, especially higher and workforce training, has also been experimenting with the application of new technologies and strategies for sharing knowledge, coining education 4.0 [8].

Education 4.0 is an emergent field, and no standard definition has yet to emerge, but it has been reacting to the use of disruptive technologies, the same as the basis of other economy 4.0 sectors, in education, enabling greater effectiveness in teaching-learning strategies. As developed economies move to mature stages of the fourth industrial revolution, the quality of education needs to keep up with the required technological changes brought about by the digital transformation created by these technologies [9].

Although distance learning supported by video calls and resource sharing has been a widely used alternative, it is far from desirable in learner engagement, a new and innovative method is needed to immerse them in the learning process, so as to develop their higher order and critical thinking skills and numerous empirical studies have demonstrated the effectiveness of Virtual Reality (VR) technologies on learner immersion and learning outcomes [10].

Among the applications of VR technologies in the learning process is the creation of immersive environments to promote learning, called edu-metaverses, with the differential of promoting greater contextualization and social collaboration, fundamental aspects for the creation and sharing of knowledge [11], [12]. The edu-metaverses has been explained as a kind of educational environment beyond reality, which has the immersion characteristics of the real world and the open and free characteristics of the virtual world [13]. Nonetheless, the theoretical support of the metaverse, the infrastructure construction of new technologies and ethical research still need to be further explored to move together toward a future of deep integration of technology and education [13]. In this exploration, the opinion of users is a relevant aspect for the adoption and evolution of the use of such environments, as well as for evaluating how they contribute to improving knowledge sharing and education in general [12].

Some academic congresses have already taken place in 3D immersive environments like that [10]. Holding seminars is an example of knowledge management practice in organizations that also began to use this kind of solution. This paper discusses the use of 3D virtual environments and edu-metaverses in carrying out workforce training events, as seminar events, with the aim of identifying strengths, weaknesses, challenges and opportunities for their use in corporate seminars from the company employee's perspective.

2. Literature Review

Using Virtual Reality to solve the well-known problem in higher education has been researched since 1995 and still going rapidly nowadays [14]. Applications were initially more present in the implementation of virtual environments, such as laboratories for learning various topics, such as the laboratory for automation systems simulated experiment presented by [15] and the Virtual Laboratory for teaching Calculus presented in [16]. In these works, the potential for collaboration provided by virtual reality was already highlighted.

With the technological evolution of 3D virtual environments, making the potential to simulate social relations in such environments more robust, the term metaverse began to be more used to name such environments. Although it is still a concept under

construction, the typology for metaverses, presented by [17], shows the evolution of the concept and classifies metaverses into four categories (Table1), depending on the degree of control that the user has over the environment and the interface technology. This typology of the metaverse [17] can help us understand how different metaverses create value for users in many ways in relation to the importance given to different metaverse features. In physical worlds, for example, participants move fluidly from one conversation to another. A simple 2D metaverse, like cited at first quadrant, can improve this aspect by allowing people to interact more naturally [17].

The 3D metaverses bring the benefits of a more realistic manipulation of objective that provides greater potential for use in simulations such as experiences in virtual laboratories [15], [16] and design of products and physical environments [18]. Other benefits are enhanced motivation, effective communication, flexibility, time, and cost-effectiveness [19]. Some universities are creating their campus versions in centralized 3D metaverses, which are being called metaversity (Meta-University). For example, the University of California, Berkeley rebuilt its campus in the sandbox game Minecraft and held an online graduation ceremony. An international virtual campus was created to replicate the dynamics and design of the campuses of the University of California, San Diego (UCSD) in California, USA and Waseda University in Tokyo, Japan [10].

Table 1. Diverse metaverses: A typology and examples. Source:[11]

Decentralized economy based on cryptocurrencies ➡ 3D VR/AR content ⬇	No	Yes
No	[1] › 2D virtual meeting spaces (for example, Gather Town)	[2] › 2D Web3 games (for example, Reality Chain, Crypto Quest, Osiris[13])
Yes	[3] › 3D metaverses in which users are within confines of a centrally controlled environment (for example, Fortnite, Roblox, and Horizon Worlds)	[4] › 3D metaverses based on decentralized blockchains (for example, Decentraland and The Sandbox)

In these mertaverses it is possible to have spatial union, interactive presentations, and collaboration work in real time. They can support several aspects of online class-

rooms with realistic senses, personalized teaching models, realistic 3D identities, interactive communication, and gamified learning [20].

Decentralized metaverses are in the early stages of their development and are built on the foundations of blockchain [21]. They are governed through a decentralized autonomous organization (DAO). Users can purchase portions of the environment, which can be used to build marketplaces and applications [22].

As long as the Digital Transformation is here to stay, probably the most promising aspects that are being studied, and will generate more scientific dialogue in the future, is the perception of the DT transformation of higher education by the different stakeholders involved in this change (managers, professors, administrative staff, students, employers, society as a whole…), as they hold very different points of view, but probably all of them are necessary to squeeze all the potential of this technological revolution [7]. This paper explores the holding of corporate seminars to knowledge-sharing, by the participants view, in immersive environments using a metaversity composed of a 3D immersive environment and a 2D centralized metaverse solution.

3. Methodology

Three corporate seminars were held in a metaversity composed of centralized 3D and 2D metaverse environments, in a Brazilian Oil & Gas Company. A questionnaire was applied to assess the satisfaction of the participants and the analysis of the answers generated a SWOT matrix and a Checklist.

The questionnaire consisted of an objective question, to quantify the overall satisfaction of the participants, and an open-ended question aimed at finding out what the participants liked or did not like the experience:

Question 1) How do you evaluate the virtual environment of this event?

Question 2) Describe the main highlights of this event and the aspects that need to be improved.

The answers were analyzed, and significant analysis criteria were identified in the view of the participants. This investigation has performed the Strength-Weakness-Opportunity-Threat (SWOT) analysis to evaluate the use of the immersive experiences on sharing knowledge. All the lessons learned in the experiment were consolidated into a checklist of requirements to be met for an immersive knowledge-sharing event.

3.1. Context of Study: Immersive sharing-knowledge events

The events were held in an immersive 3D navigation environment and complemented with a 2D metaverse for more interactive activities. They contemplated the reali-

zation of several keynotes and panels with the possibility of questions asked by the participants. The program was made up of external speakers, some international, and an internal speaker, sharing good practices implemented in the company. All events had both areas. Contents were made available in these areas in deteriorated formats for free exploration and channels of contact and interaction with exhibitors.

The case included three events and a total of 8,448 participants and more than 104,000 man-hours of participation. Table 2 details the events researched.

Table 2. Held Events.

Title	Year	Subject	Number of Participants	Format
Event 1	2021	Health, Safety, Environment and Climate.	4181	Virtual
Event 2	2022	New Educational Tecnowledges	1718	Hybrid
Event 3	2022	Soft Skills.	2549	Virtual

Figure 1 shows the virtual lobby and the meeting rooms access of one of the events. Participants were also able to participate in some gamified activities available in the environment. Some mini courses were held with active methodologies (think-pair-share, debates and role-playing) and a lot of interaction, using a 2D metaverse environment, illustrated in Figure 2.

Figure 1. Lobby and Meeting Rooms Access

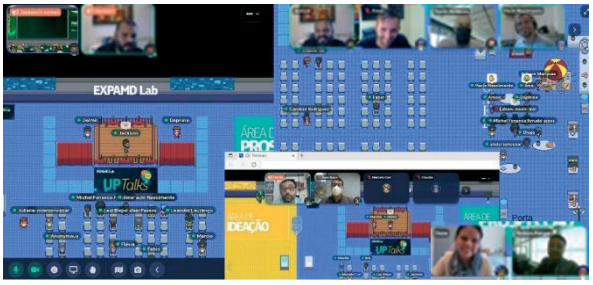

Figure 2. 2D Metaverse Networking Area.

4. Findings

As attendees form the main component of the experience, their feedback offers critical insights for conducting a SWOT analysis. The organization considered in this analysis was the metaversity where the events were held. Thus, strengths and weaknesses refer to metaversity aspects and opportunities and threats refer to other external issues that can impact the success of events held in such environments.

The answers were analyzed, and significant analysis criteria were identified in the participants view. These criteria were used to classify each item distributed in the SWOT matrix (Table 3). The SWOT analysis demonstrates that democratization of access to knowledge and collaboration, due to the high availability and ease of access are more significant strengths, whereas lack of an appropriate accessibility and competition of attention in digital with other demands of work are major challenges in holding the events.

Table 4 presents the consolidation of the satisfaction assessment regarding the experience, based on the answers to the objective question. The evaluation scale used was from 1 to 5, where 1 represents a bad experience and 5 an excellent experience. The general evaluation of the experience in the environment was favorable by 90% (grades 4 and 5).

In the open questions, recommendations were reported for more intensive use of this resource in the next events, relating it to a greater capacity for interaction and active learning. Event 1, which took place every two years in face-to-face format, for an equivalent audience of guests, had a participation increase of 329%. As for the sessions held in the 2D Metaverse with avatars, there was great demand, the vacancies were quickly exhausted, showing the interest by the new technology.

Table 3 – SWOT Analysis

(**Strengths**)	(**Weaknesses**)
Availability: Availability of access to content and programming prior to the event. Increased access to post-event content. Possibility of accessing the contents for those who cannot participate during the event, both the contents that were transmitted synchronously and those made available asynchronously. Access: Wide possibility of participation, without restrictions due to limited physical space. Visual Quality: Visual quality of the 3D environment, allowing a feeling of immersion. Interactivity: Participant's freedom to explore contents and environments. The metaverse feature enabled direct and extended interaction with speakers and other attendees. Organization: Organization of contents, facilitating the identification of information of interest. Architecture: Arrangement of the rooms in the 3D environment. Usability: Ease of navigation through the platform.	Programming: Few resources in programming consultation. Publicity: Lack of resources integrated with other means of communication to promote better publicity of the event. Accessibility: Not having Libras in all communication situations (Synchronous and asynchronous content). Accessibility: Not having a high-quality simultaneous translation both into a foreign language and into Portuguese. Connectivity: There were some access difficulties for employees on board platforms. Interaction in lectures: Interaction with lecturers during lectures was restricted to chats. Delay: The contents of asynchronous streams were not available instantly. In some events they were made available a few days later.
(**Opportunities**)	(**Threats**)
Availability: Access at any time and without queues. Geographic Dispersion: Enabled participants from all regions of the company. Globalization: made possible the participation of many international speakers.	Disclosure: Little advance notice of events makes it difficult to reserve agendas for participation. Interaction: Lack of a communication channel with participants before the event. Focus: Some reported greater difficulty concentrating because they were not in an isolated physical environment for the event. It is easier to shift attention to other demands. Agenda: Difficulty prioritizing time at work to participate in events.

Table 4. Attendees satisfaction

Event	1 (Bad)	2 (Poor)	3 (Average)	4 (Good)	5 (Excellent)
Event 1	0	2%	6%	43%	50%
Event 2	0	3%	16%	31%	50%
Event 3	0	2%	3%	43%	52%
Total Averages	0	2%	8%	39%	51%

Based on the lessons learned in the experience, fundamental aspects were identified so that immersive event environments promote knowledge sharing effectively. Table 5 presents the lessons learned in the form of a checklist organized in pre-event, during and pos-event times.

Table 5 - Checklist

Pre-event
• Do you have access to exhibitor information and content? • Do you have a communication channel with exhibitors? • Do you have early access to the schedule? • Does it have the possibility of navigating the areas of the event in advance? • Doesn't it require the participant to perform software installation procedures? • Does it have a communication feature to send instant messages to participants? • Do you have access to the detailed event schedule? • Does it have advanced search capabilities in the schedule (by date, speakers, keyword, and others)? • Does it have a schedule management feature, selecting favorite items on the schedule? • Does it enable confirmation of registration by email, guaranteeing the authenticity of the participant? • Does it have resources to limit the number of registrations per schedule item?
During-event
• Does it allow the configuration of the avatar with customized characteristics to better represent each participant? • Do avatar customization features allow for diversity in gender, race, aesthetic styles, physical characteristics and disabilities? • Does it have resources to zoom in and zoom out in the visualization of the environments? • Is the graphics resolution and sound quality satisfactory? • Is all available information legible? • Can the Participant select the desired audio channel within the available translation options? Are there facilities for simultaneous translation?
Post-event
• Are there resources to provide later access to knowledge shared during the event?

5. Conclusion

The virtual 3D immersive seminars presented in this case achieved high levels of satisfaction on the part of the participants regarding the digital format. The average satisfaction rating was 90%. The visual quality, the interactivity with content and participants, the architecture and ease of navigation in the environments, and especially the availability of access at any time, were highlighted as strengths perceived by the participants. One of the events had a 329% increase in the number of participants compared to the previous edition held in person. The sense of presence was also highlighted and perceived as a motivational factor, generating engagement in knowledge sharing.

Among the weak points were the lack of customization in programming access, translations, and mainly the lack of more accessibility resources, such as the use of Libras. In addition to criteria related to the environment, the survey also highlighted some opportunities for threats arising from the adoption of this event format. Among the opportunities, greater ease of international participation was highlighted, favoring the sharing of knowledge globally and the optimization of time. But it was also highlighted that this flexibility can be a threat by making it difficult to prioritize the time for the event due to other demands in the workplace.

The learning of the relevant aspects, in the view of the participants, was consolidated in a checklist that can contribute to the evaluation of other immersive virtual environments to be used for knowledge sharing. This work, however, was restricted to an analysis from the point of view of the participants. Complementary analyzes from the point of view of speakers and organizers of the event are recommended for future research.

References

1. Belk R W, Belanche D, Flavián C (2023) Key concepts in artificial intelligence and technologies 4.0 in services. Service BusinessOpen AccessVolume 17, Issue 1, Pages 1 - 9
2. Łukasiński W, Nigbor-Drożdż A(2022) STARTUP AND THE ECONOMY 4.0. International Journal for Quality ResearchOpen AccessVolume 16, Issue 3, Pages 749 - 766
3. Bühler M M, Jelinek T, Nübel K (2022) Training and Preparing Tomorrow's Workforce for the Fourth Industrial Revolution. Education Sciences Volume 12, Issue 11 Article number 782.
4. Karuppiah K, Sankaranarayanan B, D'Adamo I, Ali SM (2023) Evaluation of key factors for industry 4.0 technologies adoption in small and medium enter-

prises (SMEs): an emerging economy context. Journal of Asia Business Studies, 17:347–370.

5. Ribeiro VB, Nakano D, Muniz Jr. J, Oliveira RB (2022) Knowledge management and Industry 4.0: a critical analysis and future agenda. Gestão & Produção 29: e5222. http://doi.org/10.1590/1806-9649-2022v29e5222.
6. Ngereja BJ, Hussein B (2021) An examination of the preconditions of learning to facilitate innovation in digitalization projects: a project team members' perspective. International Journal of Information Systems and Project Management 9:23-41. http://dx.doi.org/10.12821/ijispm090202.
7. Díaz-García V, Montero-Navarro A, Rodríguez-Sánchez J.-L, Gallego-Losada R (2022) Digitalization and Digital Transformation in Higher Education: A Bibliometric Analysis. Front. Psychol 13:7718.
8. Bonfeld CA, Salter M, Longmuir A, Benson M, Adachi C (2020) Transformation or evolution?: Education 4.0, teaching and learning in the digital age. Higher Education Pedagogies 5: 223–246. https://doi.org/10.1080/23752696. 2020.1816847
9. Shenkoya T, Kim E (2023) Sustainability in Higher Education: Digital Transformation of the Fourth Industrial Revolution and Its Impact on Open Knowledge. Sustainability (Switzerland)15: 2473.
10. Wang M, Yu H, Bell Z, Chu X (2022) Constructing an Edu-Metaverse Ecosystem: A New and Innovative Framework. IEEE Transactions on Learning Technologies 15:685-6961.
11. Guo D, Suo J, Hu Q, Duan C (2022) The Impact of Technology in Educational Resources: a Survey and New Perspectives. In: Proceedings - 2022 International Conference on Culture-Oriented Science and Technology, CoST 2022. pp 114 - 118.
12. Ruwodo V, Pinomaa A, Vesisenaho M, Ntinda M, Sutinen E(2022) Enhancing Software Engineering Education in Africa through a Metaversity. 2022 IEEE Frontiers in Education Conference, FIE 2022.
13. Zhong J, Zheng Y (2022) Empowering Future Education: Learning in the Edu-Metaverse. In: International Symposium on Educational Technology, ISET 2022, Hong Kong. pp 292 - 295.
14. Sunardi HAN, Meyliana, PH (2022) Discipline, Impact, And Challenges Of Virtual Reality In Higher Education: A Systematic Literature Review. In: 7th International Conference on Information Management and Technology, ICIMTech 2022.

15. Schaf F M, Paladini S, Pereira, C E (2012) 3D AutoSysLab prototype: A social, immersive and mixed reality approach for collaborative learning environments. Engineering Education Conference, EDUCON 2012.

16. Tarouco L, Gorziza B, Correa Y, Amaral EMH, Muller T (2013) Virtual laboratory for teaching Calculus: An immersive experience. In: IEEE Global Engineering Education Conference, EDUCON, art. no. 6530195. pp 774-781.

17. Kshetri N (2022) A Typology of Metaverses. IEEE Computer. pp150-155.

18. Khansulivong C, Wicha S, Temdee P (2022) Adaptive of New Technology for Agriculture Online Learning by Metaverse: A Case Study in Faculty of Agriculture, National University of Laos. 7th International Conference on Digital Arts, Media and Technology, DAMT 2022 and 5th ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering, NCON 2022. Pages 428 - 432

19. Häfner P, Dücker J, Schlatt C, Ovtcharova J Decision support method for using virtual reality in education based on a cost-benefit analysis. In: 4th Int. Conf. Virtual Augment. Real. Educ. VARE 2018. pp 103.

20. Chen Z (2022) Exploring the application scenarios and issues facing Metaverse technology in education, Interactive Learning

21. Wilser J (2022) The people of Decentraland will greet you now: Decentraland is a little like Second Life, but built on a blockchain. Meet the folks making a strange virtual world a reality." CoinDesk. Accessed: Aug.30, 2022. [Online]. Available: https://www.coindesk.com/markets/2020/06/25/the-people-of-decentraland-will-greet-you-now/

22. Decentraland (MANA): A virtual world built on Ethereum." Gemini. Accessed: Aug. 30, 2022. [Online]. Available: https://www.gemini.com/cryptopedia/