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Research Article

Explore first approach in a virtual and immersive learning environment with ChatGPT

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ABSTRACT

Explore first pedagogical approach promotes the development of critical thinking and problem-solving skills. Promotes active involvement on the part of learners with the subject matter, which leads to exploring concepts through hands-on activities fostering a deeper understanding. The use of virtual and immersive learning environments (VILEs) in an educational context has raised interest among teachers and researchers. In this study, we design a short-training course supported by exploring first in a VILE. With this study, we investigate the perception of teachers who attended a short-training course about integrating VILEs in their teaching practice. Quantitative and qualitative methods have been used to collect teachers' perceptions. Quantitative data were subjected to statistical analysis, and qualitative data to content analysis. The results excitingly reveal teachers' openness to integrating immersive virtual learning environments in their teaching work and admit advantages. These teachers were interested in using immersive virtual learning environments as educational resources but recognized that they needed training to use them effectively. Therefore, it is thought that exploring first in an immersive virtual learning environment will contribute to distance education by online learning.

Keywords: virtual and immersive learning environments, ChatGPT, explore first, education, technology-enhanced Learning

INTRODUCTION

Technology is part of our daily lives, including education, offering numerous benefits (Al Mulhim, 2023). In the education area numerous digital instruments have surfaced, enabling the integration of virtual reality (VR) and augmented reality (AR) into the learning process (Zhang et al., 2022). The advancement of VR has enhanced the authenticity of simulations and real-time interactions, capable of engaging multiple sensory pathways to enhance student learning (Cruz & Torres, 2022). In tandem with this metamorphosis, artificial intelligence (AI) brings forth novel instruments to the educational context, holding the capacity to revolutionize traditional pedagogical approaches and learning methodologies (Adiguzel et al., 2023). The intelligent systems hold the capacity to revolutionize education through personalized learning experiences, automating repetitive tasks, to enabling educators to dedicate more time crucial aspects, such as providing individualized support to students (Opara et al., 2023). While AI in education offers numerous advantages, its implementation also presents noteworthy ethical and practical concerns for teachers. These aspects can

exacerbate existing educational inequalities and increase some existing distrust about the use of AI algorithms (Adiguzel et al., 2023). This way, AI with ChatGPT is still an emerging tool and many teachers are not aware of it or have only heard of it without trying or exploring it (Halaweh, 2023). In this study, we describe a short-training course on the pedagogical use of ChatGPT supported by exploring first pedagogical approach in virtual and immersive learning environments (VILEs). Explore first pedagogical approach proposes a change in the traditional role of the teacher and the student, encouraging active and independent learning. This instructional approach presents students with challenging problems to investigate independently before receiving explicit guidance. The goal is for students to collaborate, draw upon their existing knowledge to explore potential solutions, and then analyze and reach a solution (Sharples, 2019). VILEs work through VR or AR technologies and create interactive and immersive digital environments for educational purposes (Cruz & Torres, 2022). In this study, we created a VILE in ArtSteps, a web-based application, to introduce teachers to ChatGPT. With the creation of this VILE, we got teachers involved in a simulated and personalized learning experience about the pedagogical use of ChatGPT. With the realization of the lifelong learning concept becoming increasingly tangible, a growing number of individuals are engaging in online courses. Consequently, researchers are continuously investigating creative methods to inspire online learners and elevate the quality of the e-learning journey (Monahan et al., 2018).

With this study, we intend investigate the perception of teachers who attended a short-training course about integrating VILEs in their teaching practice. The methodological option was quantitative and qualitative. The methodology used in this study involved the application of an initial questionnaire to meet the participants and two focus groups, one initial and the other final, to perceive the perception of teachers who attended a short-training course about integrating VILEs and ChatGPT in their teaching practice. The training course sessions were recorded on video, and material produced by the teachers was collected.

The results obtained excitingly reveal that teachers are generally receptive to the in VILEs in their teaching practice. In addition, these teachers recognize the importance of training that allows them to use VILEs in their teaching practice pedagogically and effectively.

In this article, we present an example demonstrating how VILEs can be used with explore first pedagogical approach in distance education to foster teachers' critical thinking skills. In the next section, we give an overview of research on explore first pedagogical approach and VILEs in education. Finally, we provide insights into the results, analyzing teachers' opinions about integrating VILEs in their teaching practice, particularly before and after instruction.

LITERATURE REVIEW

Explore First

Explore first is a pedagogical approach that emphasizes the importance of discovery learning and understanding something through productive failure. This approach contrasts with the more traditional approach of planning first, then executing, which emphasizes careful planning and preparation before acting. This pedagogical approach was first described by Sharples (2019) in his book "Practical pedagogy–40 new ways to teach and learn." According to this author, explore first is an instructional approach that encourages students to tackle complex problems before receiving direct guidance. The objective is for students to collaborate and use their prior knowledge to explore potential solutions, evaluate them, and explain the most effective answer. Students develop a deeper understanding of the problem's structure and components through struggling and sometimes failing to find a solution. In this method, students attempt to solve intricate problems in small groups before being taught the relevant principles and correct practices. This pedagogical approach is also known as productive failure because initial problem-solving efforts may lead to failure or suboptimal solutions (Sharples, 2019). Productive failure is a pedagogical approach that incorporates a problem-solving phase to help students prepare for learning from subsequent instructions (Brand et al., 2023). Explore first represents a broader version of productive failure, where students first explore a complex topic in small groups and then receive direct instruction. This method can be implemented in traditional classrooms, online settings, or both (Sharples, 2019). In productive failure collaboration has been described as vital (Brand et al., 2023). Loibl et al. (2017) present three reasons to elucidate how participating in

productive failure through problem-solving attempts efficiently readies students for acquiring conceptual knowledge from subsequent instruction:

(1) the activation of prior knowledge,

(2) the awareness of knowledge gaps, and

(3) the identification of deep structures in the target concept.

Explore first pedagogical approach can be implemented in various learning environments, including the classroom, online, or a combination of both (Sharples, 2019). The use of various learning environments presents a valuable and dynamic approach to education, as it allows educators to meet the diverse needs of their students, encourages active engagement, and fosters essential skills (Amorim, 2023).

Immersive Virtual Learning Environments

VILEs refer to digital platforms and technologies that create simulated, interactive, and immersive experiences for educational purposes. These environments leverage VR or AR technologies to replicate real-life situations or simulate fictional scenarios, promoting in students to actively engage with the content and enhance their understanding through experiential learning (Cruz & Torres, 2022; Ma et al., 2023). A wide array of VR and AR devices is currently accessible for the purpose of delivering online learning content (Monahan et al., 2018). In this way, virtual and immersive learning settings might assume a crucial function in crafting dynamic, interactive, and captivating adaptable learning contexts that amplify the comprehension and practical application of material, whether in genuine or simulated scenarios (Vieira & Brazão, 2022).

The emergence of virtual worlds in various fields has facilitated their integration into education, enabling the adoption of different pedagogical approaches to support learning, which are more motivating for students (Vieira & Brazão, 2022). VILEs encompass a range of online environments constructed using diverse techniques and software tools, such as game-based learning, simulation-based learning, and virtual 3D worlds. The immersive learning environments represent virtual learning spaces distinguished by their ability to simulate realistic scenarios and environments, allowing learners to practice skills and interact in real-life settings (Cruz & Torres, 2022). In VILEs, students can explore and interact with 3D objects, environments, and scenarios, often using specialized VR headsets or other devices. These environments can recreate historical events, scientific experiments, or complex simulations that might otherwise be challenging or risky to experience in real life (Monahan et al., 2018). VILEs provide a sense of presence and involvement, fostering deep learning and retention of information. Learners can manipulate objects, collaborate with peers in virtual spaces, and solve problems through trial and error. The interactivity and hands-on nature of these environments encourage active participation, critical thinking, and creativity (Blasingame & Dede, 2017; Muthuswamy, 2022). Ceylan-Dadakoglu (2022), in a study involving 17 students with which he intended to understand the students' opinions related to using the second life application in higher education (HE) art and design education. This author concluded that second life application provides support for the analysis of 3D programs, virtual exhibition opportunities and simple 3D modelling and that the participants' application skills, 3D thinking skills, and creativity during the practice of the SL application improved. Also, Ma et al. (2023), in a study with 257 students, intended to investigate students' perceptions of physiology learning based on VR simulations. These authors realized that VR enhanced their interest in addressed content and facilitated the visualization of processes to improve their learning. They also concluded that the integration of VR technology into courses promotes active learning and can be an effective strategy for teaching since its integration into teaching processes not only stimulated the curiosity of students but also allowed them to obtain knowledge through diverse formats, participate in thought-provoking dialogue, and interact better with peers.

Potential & Pitfalls of ChatGPT in Learning Environments

The integration of AI, machine learning (ML), and natural language processing (NLP) technologies in education, particularly in HE settings, has become a focal point for researchers aiming to enhance the learning experience and outcomes. AlSobeh and Woodward (2023) emphasize AI's potential to provide personalized, real-time support to students, suggesting that AI can address student engagement, motivation, and achievement challenges while advocating for responsible AI implementation to ensure diversity, equity, and

inclusion in teaching and learning. Similarly, Alneyadi and Wardat's (2024) quasi-experimental study on the use of ChatGPT in quantum theory courses illustrates significant improvements in student achievement, particularly in the knowing, applying, and reasoning sub-skills, thanks to the personalized and interactive learning experiences facilitated by ChatGPT. This aligns with Alshater's (2022) and Terwiesch's (2023) exploration, which notes ChatGPT's capacity to automate educational tasks, enhancing productivity and allowing more time for crucial activities like student engagement.

Wardat et al. (2023) delve into the perspectives of stakeholders on using AI in mathematics education, acknowledging ChatGPT's capability to provide basic knowledge and assistance in subjects like geometry while cautioning against its limitations, such as the potential for generating inaccurate information and the need for guidelines to ensure its safe usage. Further exploration by Tashtoush et al. (2023) evaluates the learning loss experience among mathematics teachers in Oman, indicating a positive assessment of AI's role in teaching and learning despite the challenges faced in applying AI systems and applications in education. These authors highlight the transformative potential of AI and ChatGPT in education, underscoring the importance of collaborative efforts among policymakers, educators, and technology experts to navigate the benefits and limitations of these technologies. The research points to a burgeoning shift in the educational paradigm, emphasizing the need for a nuanced understanding of AI's role in facilitating personalized learning experiences, enhancing student engagement, and addressing the inherent challenges of integrating AI into educational practices.

Research by Alsobeh and Woodward (2023) emphasizes the transformative potential of AI in education, highlighting the integration of ML and NLP for personalized student support. However, the work of these authors acknowledges the necessity of addressing AI's limitations and ethical concerns, particularly around potentially exacerbating educational inequalities. Conversely, Wardat et al. (2023) study critically examines ChatGPT's application in mathematics education through a qualitative lens, revealing its strengths in providing basic mathematical knowledge and its limitations in depth and accuracy, particularly in geometry. This work highlights the cautious optimism surrounding ChatGPT's educational use, stressing the need for guidelines to ensure its responsible implementation. Despite its exploratory nature and the methodological limitation of focusing solely on qualitative analysis, this study contributes significantly to the discourse on AI in education, urging further research into chatbots' pedagogical integration while prioritizing human values and educational ethics.

"Explore first" method, highlighted by Sharples (2019), revolutionizes teaching by engaging students in complex problem-solving before formal instruction. This approach fosters deeper understanding through discovery and collaboration. By addressing challenges first-hand, learners identify gaps and apply prior knowledge more effectively, preparing for structured learning phases. Emphasized across various educational settings, like VILEs, this strategy supports active, participatory learning, enhancing students' critical thinking and problem-solving skills. VILEs allow students to engage deeply with content through digital storytelling, significantly improving their learning experiences.

METHOD

This work's main objective is to investigate the perception of teachers who attended a short-training course concerning integrating VILEs in their teaching practice. We intend to build a new paradigm in distance education by online learning to promote learners' engagement in solving real life problems using VILEs with an explore first pedagogical approach.

Process

We articulated the activities based on exploring first pedagogical approach to engage teachers in real situation problems. Then, the teachers explored the Pedagogical resource created in ArtSteps, a VILE. The Pedagogical resource created in ArtSteps was created to guide users in the pedagogical use of ChatGPT with a view to creating lesson plans, quizzes and obtaining content to aid teaching work (**Figure 1**). Following the guidelines of Monahan et al. (2018) in this VILEs, we are interested in presenting online course material in interactive and stimulating ways for teachers and creating an online learning community to promote communication, interaction, and resource sharing among learners.

Figure 1. Pedagogical resource created in ArtSteps for exploitation by teachers (https://www.artsteps.com)

ChatGPT was employed to augment and streamline the educational process. Specifically, it served multiple roles, primarily to assist educators in designing lesson plans tailored to their students' needs. Through examples presented in ArtSteps, ChatGPT guided teachers to insert specific educational goals or topics and leverage ChatGPT to generate detailed lesson plans that include objectives, activities, and assessment methods. Furthermore, teachers used ChatGPT to create quizzes and other assessment forms, allowing for a personalized approach to testing students' understanding of the subject matter. Teachers also used ChatGPT to obtain background information, summaries, and explanations on various topics, significantly reducing preparation time. Integrating ChatGPT into the ArtSteps VILE facilitated a more efficient and dynamic educational experience. ChatGPT enabled educators to view application examples and video tutorials while exploring ArtSteps, allowing them to focus more on the pedagogical aspects of teaching and less on the time-consuming tasks of content creation and lesson planning.

We used the explore-first approach in the online classroom (Sharples, 2019). As our goal was to get teachers to use their prior knowledge to consider possible solutions and work together to explain the best answer, we opted to resort to an immersive virtual learning environment to promote technology-enhanced learning and better interaction of teachers with the pedagogical resources. In **Figure 2**, we present an image with a schematic of the structure of our work.

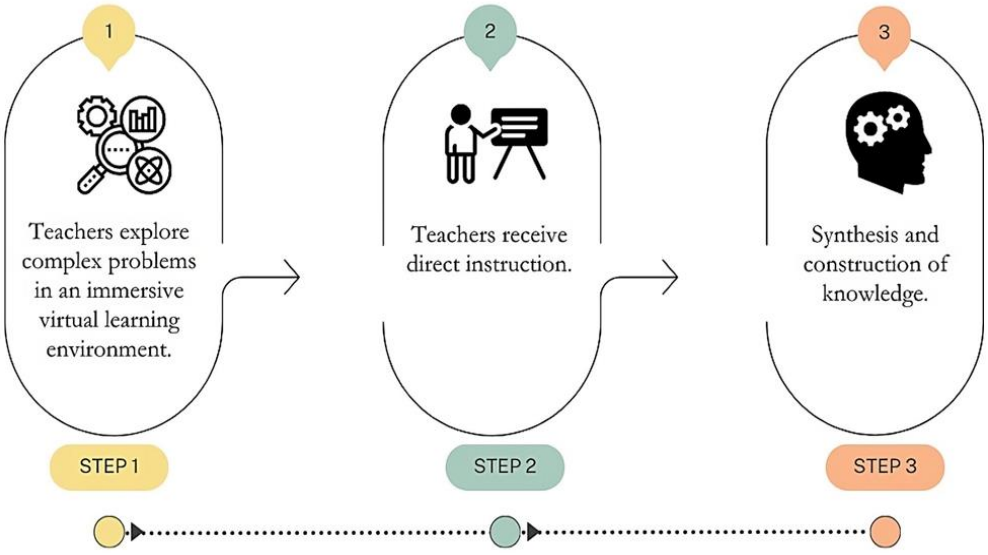

Figure 2. Explore first in a VILE (Source: Authors)

In this process, where we combine explore first pedagogical approach with VILEs, a student is a protagonist, and the teacher is a facilitator, just managing the process. The teacher pre-prepares content and assignments for students to explore through VILE, selecting or creating videos, readings, podcasts, or other educational resources. Then following the guidelines of Sharples (2019), we made VILE available to students with the resources, following the steps below:

1. **Step 1:** Making their own decisions, students are encouraged to complete the tasks best. Students develop autonomy and collaboration. Independently learners act and explore the pedagogical resources presented in VILE, requesting the teacher's help to clarify doubts.
2. **Step 2:** The teacher provides direct instruction by devoting more time to hands-on activities, group discussions, and problem solving.
3. **Step 3:** Students can apply the acquired knowledge and understand it.

The primary objective of explore first pedagogical approach is for students to collaborate and utilize their existing knowledge to explore potential solutions, followed by evaluating and explaining the most optimal answer (Sharples, 2019). So, throughout the process, teachers first explore a complex topic in small groups and then receive direct instruction. In this process, the teacher is a facilitator of learning while the student builds his knowledge of her. In this way, it is up to the teacher to:

(1) create opportunities for the student to learn individually and collaboratively,

(2) promote exploration of materials, content, and student confidence in their abilities, and

(3) encourage students to explore content and not be afraid to make mistakes and ask questions.

In exploring the first pedagogical approach, throughout the process, students must be encouraged to take risks in their learning and not fear making mistakes. Thus, throughout our learning process, the learner:

(1) explores the available resources,

(2) reflects on the information, and

(3) clarifies doubts with colleagues or the teacher.

Within this educational framework, the innovative use of ChatGPT introduces a nuanced blend of technology and pedagogy that significantly enriches the learning environment. The deployment of ChatGPT in the initial stages of student-led exploration and teacher-guided instruction represents a pivotal shift towards fostering a more autonomous and collaborative learning experience. This pedagogical approach, facilitated through a VILE like ArtSteps, allows for a highly tailored educational journey. Teachers-in-training are encouraged to navigate complex subject matter with ChatGPT's assistance, which offers instant access to a vast knowledge repository, thus enabling a more self-directed learning process. In step two of the pedagogical approach, educators leverage ChatGPT to craft lesson plans and assessments that resonate closely with students' needs and learning styles. The incorporation of ChatGPT thus represents a symbiotic integration of AI with traditional educational methods, offering a dynamic and adaptive framework that supports education.

Data Collection & Analysis

The short training course took place with online classes, through the Zoom platform, with all sessions recorded in video format. Data collection is based on a brief diagnosis to characterize the teachers involved in the study. The survey was implemented using the Google forms and a convenience sampling of teachers involved in the short-training course. The focus group was applied to teachers participating in the short-training course to gauge their perception about VILEs in their teaching practice.

With the first focus group we tried to answer the following questions: what VILEs you know, which VILEs do you usually use in your pedagogical practice, what kind of pedagogical approach do you promote with the use of VILEs and why. With the final focus group, we tried to answer the following questions: what VILEs they intend to continue to use in their practice, what advantages and limitations you admit to VILEs as pedagogical resources, what difficulties they expect to encounter when using VILEs in their work context and, what advantages and limitations admit to using ChatGPT in daily work.

The analysis of the teacher's answers was carried out based on the following analysis categories that emerged from the data analysis:

(1) enhanced engagement,

(2) active learning,

(3) accessibility, flexibility,

(4) collaborative learning, and

(5) limitations of integrating.

We use the designation *Ti* for student *i* to code the students' responses, with *i*=1, 2, ..., 74. Teachers were informed that their participation in this study was voluntary, anonymous, and confidential, having no relationship with their school; thus, their opinion is protected by anonymity. Throughout the sessions, we also collected material produced by the participants for analysis and took notes, which were recorded in a diary.

Both quantitative and qualitative methods were utilized in the study. Quantitative data were analyzed statistically, while qualitative data performed content analysis. The research followed a descriptive approach, the most appropriate for the research objective. The analysis of the focus group follows a qualitative descriptive paradigm to understand teachers' perceptions about VILEs in their teaching practice. We opted for an exploratory study because the topic addressed is recent, and the information described in this study can help to characterize the pedagogical context of the use explore first pedagogical approach in VILEs in online learning.

FINDINGS

74 teachers who work in public and private schools from Portugal participated in this short-training course. Of these, 70 are female (94.59%), and four are male (5.41%). Teachers from different years and places in Portugal participated in this study. Most of the teachers who participated in this are between 41 and 60 (82.43%), with a minimal number of teachers under 40 (8.10%), as shown in **Figure 3**.

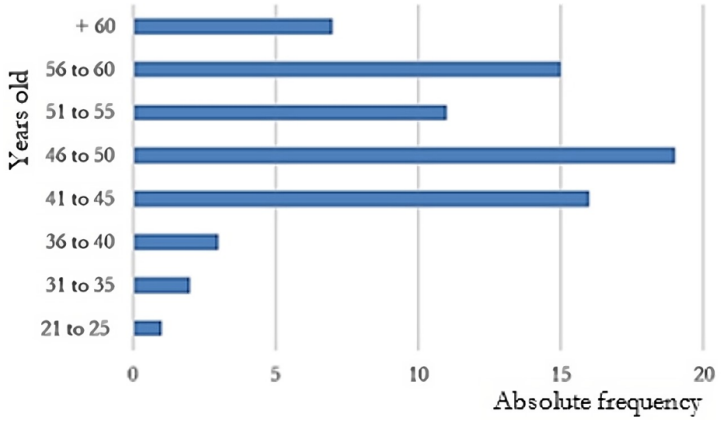

Figure 3. Age of teachers who participated in short-training course (Source: Authors)

In relation to academic qualifications, all 74 teachers have a degree in the field of teaching, with 20 of these (27.03%) also having a master's degree and 11 (14.86%) having a postgraduate degree. This study included a group of experienced teachers, most of whom 52 (70.27%) had between 15 and 30 years of teaching experience. In this group, only one teacher (1.35%) had less than five years of experience. **Figure 4** shows the teachers' answers regarding their experience as teachers.

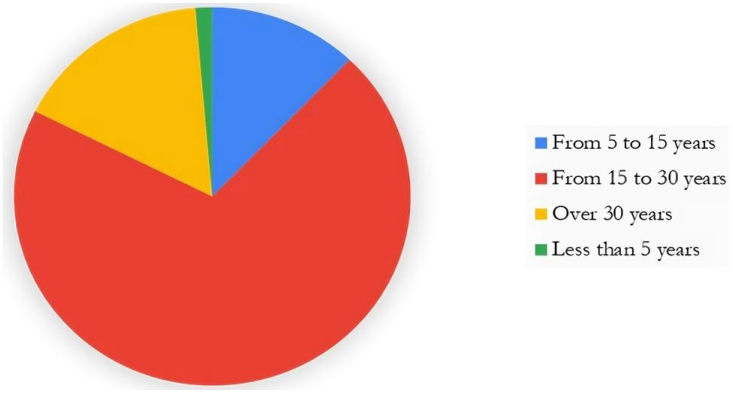

Figure 4. Years of experience as a teacher (Source: Authors)

Teachers were already familiar with several online learning platforms such as Moodle, blackboard and Canvas and video calling platforms such as Google Meet and Zoom. They also reported knowing learning environments based on games such as Kahoot and some simulation and VR environments. The data indicates that online learning platforms such as Moodle, blackboard, and Canvas and video calling platforms such as Zoom and Google Meet are the most popular among respondents, with approximately 68.92% and 72.97% of responses, respectively. Of these 74 teachers, a small part refers to knowing and using learning environments based on games such as Kahoot and Minecraft Education (9.46%), with a similar number (6.76%) of teachers referring to knowing and using simulation environments and VR. In addition, only six of these professors (8.11%) already knew and had tried ChatGPT. However, since the public launch of ChatGPT, educators have raised a range of concerns regarding its integration into educational environments (Halaweh, 2023).

In relation to what VILEs the participants know, most participants (37) do not know VILEs, representing 50.00% of responses. Among those familiar with immersive environments such as VR and AR, VR is better known than AR, accounting for 29.73% and 20.27% of responses from teachers, respectively. The results reveal a need to publicize immersive technologies so that more people can take advantage of their benefits and resources. Those who know about VILEs mentioned "*real-time escape games*" (T4, T31, T45, and T58), "*theme parks*" (T23, T44, and T60) and "*4D cinema rooms*" (T39). The teachers who have already used VILEs with students, they mentioned having already used the following AR apps in their pedagogical practice: "*GeoGebra 3D*" (T23 and T39), "*3DBear*" (T4), "*arloopa*" (T44 and T60), "*merge cube*" (T2 and T45), "metaverse" (T20, T36, and T67) and "*quiver*" (T36 and T58). These results show that a tiny part of educators use Immersive Environments with students, and those who use them only use AR apps. Regarding the pedagogical approach, most teachers who use AR apps refer to using them to "*motivate students*" (T23, T44, and T36), "*enhance them in learning concepts*" (T45), and "*design activities, where students can explore and manipulate virtual objects*" (T39).

In the final focus group with the teachers, we tried to understand if they intend to use VILEs and ChatGPT in their practice, what advantages they admit as pedagogical resources and what limitations they expect to find in their use in a work context. All teachers expressed curiosity and desire to return to using ChatGPT after the training course. In **Table 1**, we present the teacher's responses from in the final focus group about the advantages and limitations of using ChatGPT in daily work.

Table 1. Categories of analysis from teachers' responses about ChatGPT in focus group

Categories	Teacher response
Advantages & limitations	"Helps save time on preparing teaching materials" (T11).
	"Sometimes, ChatGPT's responses are wrong or not entirely accurate, requiring further verification" (T19).
	"Some students might use ChatGPT for quick answers without understanding" (T25).
	"Allows students to directly copy GPT Chat responses for homework" (T29).
	"I loved discovering that I can use ChatGPT to generate additional examples and explanations" (T43).
	"It is useful for helping reviewing texts and assignments, helping me identify errors easily" (T50).
	"Students can copy ChatGPT answers for their assignments, not learning in the process" (T58).
	"It is advantageous for class preparation, but students might become too reliant on technology for problem-solving" (T60).
	"I feel that there is a need for adequate training for teachers on how to use ChatGPT tool" (T71).

In **Table 2**, we present teachers' responses from the final focus group on using VILEs in their practice. All considered that using VILEs in an educational context can motivate students to learn. All participating teachers were unanimous in admitting that using VILEs can promote active learning of content. All of them showed interest in using it in their work context with VILEs students, and some of the teachers even admitted to having already created a resource in ArtSteps between sessions of short-training course, referring even that "*I have already used it with my students and will use it again*" (T31).

Table 2. Categories of analysis from teachers' responses about VILEs in focus group

Categories	Teacher response
Enhanced engagement	"Everything related to new technologies is important for teaching" (T5). "Making classes more appealing" (T27). "Will allow for more motivating learning" (T31). "Of course, to further stimulate the taste for learning content" (T59). "It is an added value to make the materials much more attractive, to launch challenges" (T22). "Allows you to plan creative and interesting lessons" (T46). "The motivation for learning" (T17). "It promotes interest and motivation in students" (T63). "They are environments that explore the contents motivating students for learning" (T55). "Makes learning fun, allowing you to create or use a perspective of illustrating some content more reliably" (T68).
Active learning	"It is another innovative tool enhancing active involvement of students in building their learning" (T14). "A digital environment of augmented virtual reality can bring students closer to the topics covered, leading them to play an active role" (T2). "Virtual world is increasingly present in our day-to-day & allows an active involvement of students" (T22). "I think it gives us the possibility to innovate and make our classes more dynamic" (T67). "Involving the student in the proposed activity, transporting him to a scenario that does not exist in reality, which can be very challenging" (T50). "Create interactive activities/explore new learning forms, where student experiences, acts, is active" (T71). "Students are always using the most innovative games and Virtual and Immersive Learning Environments meet students' experiences with different gamification scenarios, which will certainly motivate them to learn. Yes, within the current situation, these scenarios are very fruitful" (T62). "Learning must be more and more active, and these environments are an example of that" (T42). "They allow for greater motivation and the opening of new horizons of knowledge, allowing experimentation, greater interactivity" (T32).
Accessibility & flexibility	"VILEs are future of all sectors … education, health … but I believe they will play a fundamental role in the very near future" (T11). "Education has to keep up with the evolution of technology and digital tools" (T18). "Certainly, the future goes beyond the classroom. Beyond reality" (T49). "Create greater dynamism in the teaching-learning process" (T35). "It's good for curriculum flexibility" (T42).
Collaborative learning	"Entering a sense of parallel, collaborative reality will be a common experience in the near future and also in education" (T30). "Very good potential in didactic terms for appropriating essential learning from different subjects and collaborative learning" (T29).
Limitations of integrating	"I feel that I am not able to use it alone" (T15). "The graphics card of the school computers, which are not the best, is a limitation for the use of augmented reality and virtual reality in schools" (T8). "High costs, own infrastructure, lack of training for teachers in these resources and in these environments are a difficulty" (T66). "The lack of quality internet in schools makes it difficult to use these resources" (T13). "Associated technology is expensive and there are many limitations in free applications" (T11). "There is a lack of technological resources in schools" (T37).

DISCUSSION

Education systems undergo a continuous transformation, adapting teaching methods and environments to incorporate tools deemed suitable for the contemporary educational landscape (Mohammed & Kinyó, 2020). In our era, the driving force behind this evolution is digitalization. As the digital age unfolds, education is restructured to embrace technological advancements and leverage them to enhance learning experiences (Ceylan-Dadakoglu, 2022). VILEs can captivate students' attention and make the learning experience more enjoyable (Monahan et al., 2018). The interactive and dynamic nature of these environments can keep

students engaged, leading to better retention of information (Vieira & Brazão, 2022). Teachers generally consider that VILEs allow enhanced engagement in online education. For this group of teachers incorporating "*technologies is important for teaching*" (T5) because it can become "*more appealing classes*" (T27) and "*more motivating learning*" (T31). This approach not only "*stimulates the taste for learning content*" (T59) but also "*adds value to make the materials much more attractive*" (T22). Additionally, using VILEs allows for planning "*creative and interesting lessons*" (T46). The positive impact of using VILEs in an educational context includes student "*interest*" (T63) in content and student "*motivation for learning*" (T17). Ultimately, incorporating VILEs into education "*makes learning fun, allowing you to create or use the perspective of illustrating some content more reliably*" (T68). VILEs can engage multiple senses, making learning more impactful (Blasingame & Dede, 2017). Visual elements stimulate different parts of the brain, leading to better memory retention (Ortet et al., 2023). In an exploratory study on teacher training with VILEs, Cruz and Torres (2022) they were observed that each educator crafted a VILE to deploy among their students and developed a pedagogical tool in ArtSteps to address a curricular theme within their specific subject area. Like what happens in our study, in the study by Cruz and Torres (2022), every teacher recognized that the employment of virtual and immersive settings within an educational sphere could invigorate learners' enthusiasm for learning. Furthermore, in this latest study, all participating educators voiced their belief in the capacity of such environments to foster active engagement with the material, thereby encouraging students to take a more proactive stance in their learning journey. Using virtual learning spaces deepens understanding and concurrently facilitates social interaction among students and the application of knowledge in scenarios mirroring real life (Vieira & Brazão, 2022).

Immersive learning environments promote active learning, where students take an active role in their education (Cruz & Torres, 2022; Ma et al., 2023). They can manipulate objects, solve problems, and interact with simulations, fostering deeper understanding and critical thinking (Muthuswamy, 2022). Teachers consider VILEs "*another innovative tool that enhances the active involvement of students in building their learning*" (T14). By creating a "*digital environment of augmented VR can bring students closer to the topics covered*" (T2), in addition, VILEs are "*increasingly present in our day-to-day and allow an active involvement of students*" (T22). Teachers recognize their potential for "*innovating and making classes more dynamic*" (T67). In addition, these environments transport students to scenarios that challenge their understanding and involvement, "*involving the student in the proposed activity, transporting him to a scenario that does not exist in reality, which can be very challenging*" (T50). Allows "*create interactive activities and explore new forms of learning in which the student experiences, acts, is active*" (T71). Virtual environments can recreate real-world scenarios, providing students with practical experiences in a safe and controlled setting (Ceylan-Dadakoglu, 2022). This allows them to practice skills, experiment, and make mistakes without real-world consequences (Ma et al., 2023). Acknowledging students' familiarity with games, VILEs take them to "*experiences with different gamification scenarios, which will certainly motivate them to learn*" (T62). They also consider that "*learning must be more and more active, and these environments are an example of that*" (T42). By fostering greater motivation, experimentation, and interactivity, these environments "*open new horizons of knowledge, allowing experimentation, greater interactivity*" (T32). From these teachers' responses, we realized that embracing VILEs facilitates an active and engaging educational experience and inspires students to explore the vast possibilities of knowledge.

VILEs can be accessed remotely, enabling students to learn at their own pace and convenience, so it provides flexibility for students who may have different learning styles (Monahan et al., 2018). Teachers believe that "*education has to keep up with the evolution of technology and digital tools*" (T18), that "*the future goes beyond the classroom*" (T49), and VILEs "*will play a fundamental role in the very near future*" (T11) These learning environments "*create greater dynamism in the teaching-learning process*" (T35), are suited to a "*curriculum flexibility*" (T42), which facilitates integration and differentiation.

These environments facilitate collaborative learning experiences, where students can work together, discuss ideas, and solve problems as a team, promoting teamwork and communication skills (Monahan et al., 2018). When joining VILEs, students enter a "*sense of parallel, collaborative reality*" (T30) with "*potential in didactic terms for appropriating essential learning from different disciplines*" (T29). Literature offers insightful perspectives about collaborative learning experiences and highlights the efficacy of VILEs in enhancing teamwork, communication skills, and multidisciplinary learning. In a study, Llinares et al. (2023) contrast the psychological and physiological responses between real and virtual environments, illuminating the unique

benefits of immersive learning. Another comparative analysis investigates spatial ability improvements in immersive versus non-immersive settings, underscoring the enhanced engagement and learning potential within virtual realms (Thorp et al., 2024). Additionally, Slavova et al. (2023), in their study on immersive versus non-immersive VR learning environments, are scrutinized, revealing significant advantages of VR in creating realistic experiences conducive to learning complex procedures like surgery (Slavova et al., 2023). These comparative insights underscore VILEs' role in crafting a collaborative reality, where students actively engage with content across various disciplines (Monahan et al., 2018).

Technology has offered numerous conveniences for education, nevertheless, an excessive amount of technology can prove detrimental, potentially leading to adverse impacts on its users (Al Mulhim, 2023). Implementation and maintenance of VILEs may require significant resources and technical expertise. As expressed by these teachers, the integration of VIMEs in schools faces certain limitations and challenges. Teachers feel that "*not able to use it alone*" (T15), and one of the main limitations to its use is the lack of knowledge and training to use virtual and AR environments. The lack of training for teachers in utilizing these resources and "*the lack of quality internet in schools makes it difficult to use these resources*" (T13) and incorporating them into the curriculum. Moreover, "*lack of quality internet in schools makes*" (T13) making it challenging to access and fully utilize these immersive resources. Additionally, the school's computer hardware or software sometimes does not help and constitutes "*a limitation for the use of AR and VR in schools*" (T8). This could create inequalities in the learning experience, one of the significant barriers described by the teachers, is the "*high costs, own infrastructure, lack of training for teachers in these resources and in these environments*" (T66). Teachers also raised concerns about the "*expensive and there are many limitations in free applications*" (T11) and "*a lack of technological resources in schools*" (T37) that further limit their access and implementation. The widespread use of the Internet as a source of information has expanded significantly. Its vast scope and convenience make it an ideal platform for disseminating information (Monahan et al., 2018).

Teachers recognize ChatGPT as a valuable tool for saving time, "*helping me identify errors easily*" (T50) or on "*class preparation*" (T60) and enhancing teaching materials with additional examples. Furthermore, Teachers highlight the necessity for vigilance due to inaccuracies in responses and the potential for students to overreliance on technology for quick solutions "*without understanding*" (T25). Concerns were also raised about students "*can copy ChatGPT answers for their assignments*" (T58), underscoring the need for "*training for teachers*" (T71) to use ChatGPT in educational settings.

The findings of this study are of great importance because they showed that teachers are receptive to this approach, recognizing its potential to engage students and make learning more exciting and interactive. However, many teachers admitted to learning how to use these resources pedagogically. They recognized the lack of equipment in schools and their short heights. These findings underscore the importance of providing professional support and ongoing professional development to teachers to enable them to integrate VILEs into their pedagogical practices effectively.

CONCLUSIONS

With the increasing significance and prevalence of e-learning, it has become necessary to address the challenges associated with current online learning systems (Monahan et al., 2018). With this work, we investigate the perceptions of teachers who attended a short-training course on integrating VILEs in their teaching practice. Based on the results obtained, we realized that explore first pedagogical approach in a VILE allowed teachers to be involved in a hands-on activity in which they developed knowledge about the topic, such as using the ChatGPT pedagogically. On the other hand, the reflection of the teachers shows some benefits of explore first pedagogical approach in VILEs in developing competencies in cooperative and collaborative work between teachers of subject areas and different education levels. In this sense, it seems relevant to us in future research work to understand the contribution of explore first pedagogical approach in VILEs to developing Soft Skills, which is essential for current students and future workers. Teachers must prepare students for today's changing society (Muthuswamy, 2022). Teachers were active, mentioned that they liked working according to explore first pedagogical approach and showed interest in experimenting with this approach in their work context.

Using VILEs proved to be an opportunity for teachers to interact in a context close to reality. Explore first pedagogical approach, together with VILEs, emphasized hands-on learning and the active participation of teachers in hands-on activities and concrete experiences. The results we obtained are in line with those obtained by Cruz and Torres (2022), who, in a study with a group of teachers, realized that the teachers' receptivity to the use of VILEs seems relevant to us in future studies to understand its impact on students in a practical application of curricular contents. Integrating virtual and immersive technologies effectively into the curriculum requires careful planning and alignment with learning objectives. Most teachers in this study are "*not able to use it alone*" (T15), which reinforces the importance of teacher training in this area and research that allows us to understand whether these technologies are being used effectively to promote student learning. If VILEs are poorly integrated, they may become an add-on rather than a meaningful learning tool.

Explore first pedagogical approach has several advantages. On the one hand, the student can learn through access to online information, explore the resources available at their own pace and reflect on the content presented. Initially, learners who engaged in exploration demonstrated significantly more significant learning gains (Sharples, 2019). On the other hand, the fact that it promotes the possibility for the student to collaborate with colleagues to find the solution to the problem is an advantage for their learning. We realized that explore first pedagogical approach, combined with a VILE, offers a robust educational process to help students explore content in advance. Its use promoted a more collaborative and interactive learning environment in the group of learners. In this way, the joint use of these approaches can enhance teaching efficiency, increase student engagement, and promote a more personalized and meaningful education. Therefore, it seems relevant to us to understand the impact of this methodology on younger students in future studies. In the future, to enrich knowledge about how VILEs can improve learning in a school context, a comparative study between the levels of understanding of concepts between students exposed to VILEs and students who are not exposed to these pedagogical resources is recommended.

Based on the teachers' responses, the process presented in this study has led to significant learning about the pedagogical use of ChatGPT and the desire to use it in their work context. Explore first pedagogical approach combined with VILEs also stimulated the participants' curiosity and the need to investigate solutions, led them to reflect on the contents presented critically, and involved them in a virtual learning experience, practical and close to the real thing. Finally, we invite participants to apply the learned content in their professional practice, and the results excitingly reveal that everyone did or felt motivated to do so. The data we obtained suggest that explore first pedagogical approach in VILEs constitutes an effective method to involve learners in developing competencies in online education. So, the present study contributes to a new paradigm in distance education through online learning to encourage learners to solve real-life problems using VILEs with an explore first pedagogical approach.

Limitations

The study's design and methodology indicate a comprehensive approach to understanding teachers' perceptions of VILEs. The study used quantitative and qualitative data analysis methods to validate the results. Quantitative data provided statistical insights into the participants' responses, while qualitative content analysis enabled a deeper understanding of the nuances in teachers' perceptions and experiences. However, several potential biases and limitations could affect the reliability and generalizability of these findings:

(1) sample composition,

(2) convenience sampling,

(3) voluntary participation, and

(4) cultural and contextual limitations.

The sample comprised primarily female teachers (94.59%), with a significant majority aged between 41 and 60 years (82.43%). This demographic skew might influence the perceptions and experiences reported, as it does not fully represent the teaching population, including younger teachers who are more familiar with digital technologies or male teachers who have different perspectives.

We use convenience sampling because participants were selected based on their availability and willingness to participate rather than being randomly selected. This can introduce bias, as those who are more

interested or have positive experiences with VILEs might be overrepresented in the study, affecting the findings' representativeness.

We guarantee the voluntary participation of the teachers involved. While ensuring confidentiality and anonymity is crucial, the voluntary nature of participation might also skew the results towards more engaged and motivated teachers, possibly overlooking the perspectives of those less inclined towards using VILEs in their teaching practice.

It's important to note that our study focused specifically on teachers from Portugal. This geographical and contextual specificity, coupled with the potential differences in technological infrastructure, teacher training, and curriculum priorities, may limit the generalizability of our findings to other countries or educational contexts.

To mitigate these biases, future research could aim for a more stratified sampling method to ensure a diverse and representative sample of teachers across different demographics, including age, gender, and teaching experience. Additionally, expanding the study to include teachers from various countries and educational settings could enhance the findings' generalizability.

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