

RESEARCH

Open Access



Investigating the use of virtual reality to improve speaking skills: insights from students and teachers

Chinaza Solomon Ironsi^{1*} 

*Correspondence:
Solomon.chinaza@rdu.edu.tr;
ironsisolo@gmail.com

¹ Foreign Languages and English
Preparatory School, Rauf Denktaş
University, Mersin-10, North
Cyprus

Abstract

There is ongoing scientific discussion on the role of innovative technologies in enhancing teaching and learning. Technologies like augmented reality, virtual reality, mixed reality, artificial intelligence, and generative artificial intelligence have sparked debates in the broader literature. To contribute to ongoing discussions on these topics and to bridge gaps existing in works of literature on the potentials and challenges of innovative technologies like virtual reality, this paper provides insights from students and teachers on the use of virtual reality for teaching speaking skills so far lacking in academic prose in this domain. Given that this study only focused on obtaining student and teacher insights, a mixed-method research design that used questionnaires and interviews was implemented to investigate this study. After obtaining and analyzing data from 85 participants, the study found that although virtual reality could have improved students' speaking skills more efficiently, it was a fun and exciting learning experience for the students and teachers. Other novel findings of the study were instrumental in making pedagogical conclusions on the study's objective.

Keywords: Virtual reality, Augmented reality, Speaking skill, English language teaching, Education

Introduction

Virtual Reality is a 3D display artificial intelligence resource that provides users with an immersive virtual world experience. This has been applied across diverse disciplines and domains, including Education. Virtual Reality (VR) has shown great potential in transforming Education because it can provide immersive experiences that engage students and make learning more interactive and engaging. Scientific contributions in this domain suggest that VR allows students to explore historical events, scientific concepts, and complex subjects visually and experientially (Akman & Çakır, 2023). Equally, research provides insights to show that this technology and different technological resources like Augmented Reality (AR), mobile technology, and intelligent personal assistants can enhance understanding and retention, as well as facilitate practical training in various fields resulting in improved student achievements (Çelik & Yangın Ersanlı, 2022; Kuna et al., 2023; Rospigliosi, 2022; Ironsi, 2022). Moreover, research recognizes that using VR helps to improve students'

achievement and learning outcomes (Akman & Çakır, 2023; Alhalabi, 2016). Equally, using Virtual Reality (VR) in Education has sparked various arguments, with proponents and skeptics expressing their views.

For instance, some authors thought that VR provides immersive experiences that captivate students' attention and enhance their engagement with the content (Kavanagh et al., 2017). Some studies have acknowledged that complex subjects and abstract concepts can be better understood through visual and experiential learning, which VR enables (Bower et al., 2020). Of course, this is achievable as VR allows students to practice skills and scenarios in a controlled environment, making it particularly useful for vocational training, medical simulations, and more (Rospigliosi, 2022). These simulations and controlled environments have fostered global learning using VR to enable students to travel virtually to different parts of the world, expanding their cultural awareness and global perspectives (Kuna et al., 2023). These broad learning formats allow for a wide range of students with different individual differences; for example, students who struggle with traditional learning methods might find VR more accessible and accommodating to their learning styles (Campos et al., 2022). However, widespread adoption might need to be improved by cost, technical requirements, and the need for well-designed content.

Similar recent studies reiterate the areas to consider before implementing VR in classrooms. For instance, some authors in their recent study insist that VR equipment can be expensive, making it challenging for schools with limited budgets to adopt the technology (Kaimara et al., 2022); this could exacerbate educational inequalities. Some authors argue that prolonged VR use may cause motion sickness or discomfort in some users, raising concerns about the well-being of students (Souchet et al., 2022). Equally, some hardcore technology critics worry that VR might isolate students from their peers and the physical classroom environment, hindering social interaction and collaboration (Hwang & Chien, 2022; Zhang et al., 2022). Designing classroom instruction to fit the curriculum may be challenging, as the availability of high-quality, educational VR content can be limited, leading to concerns about the effectiveness of using VR for learning (Alismail et al., 2022). Besides, teacher training is required as teachers may require additional training to effectively integrate VR into their lesson plans, which could be time-consuming and resource-intensive (Araiza-Alba et al., 2022; Xi et al., 2023). Altogether, there is debate about whether VR is more effective than traditional teaching methods regarding long-term learning outcomes.

The arguments for and against using VR in Education highlight the technology's potential benefits and challenges. Ultimately, successful implementation depends on careful planning, well-designed content, and consideration of the unique needs and context of each educational setting. Achieving this depends on eliciting information from users like teachers and students on their technology experiences. This will help to implement technologies, especially VR, successfully in the classroom. On this premise, this study investigates students' and teachers' opinions on using VR to improve students' speaking skills.

Literature review

Students versus teachers: perspectives on VR

While the discussions continue on the potential of VR in stimulating instructional change in Education, students and teachers are essential in successfully implementing this innovative technology. However, there are widely varying views on Virtual Reality

(VR) in Education. For instance, some authors report that many students find VR exciting and engaging, as it offers a unique and immersive learning experience (Shen et al., 2022). They appreciate the ability to explore concepts more interactively and visually, making complex topics easier to understand (Marks & Thomas, 2022). However, some students might be concerned about motion sickness or discomfort using VR headsets (Souchet et al., 2022).

Additionally, not all students may have access to the necessary VR equipment, which could create disparities in learning experiences (Nicolaidou et al., 2023). Besides, security threats and privacy concerns may arise while using VR (Alismail et al., 2022; Silva et al., 2023). Overall, students who have had positive experiences with VR in Education tend to value its potential to make learning more dynamic and enjoyable, while those who have encountered challenges or limitations may have a more cautious view (Li & Liu, 2022; Rocha Estrada et al., 2022). Students' and teachers' opinions will likely evolve as VR technology evolves.

Concerning teachers' opinions, teachers' views on using Virtual Reality (VR) for teaching are also varied. Many teachers see the potential benefits of incorporating VR into their classrooms (Vergara et al., 2022). Recent studies show that teachers believe VR can enhance engagement, bring abstract concepts to life, and provide students with immersive and memorable learning experiences (Antón-Sancho et al., 2022). However, some teachers may have concerns about the practical aspects of using VR, mainly because they might worry about the cost of the necessary equipment, the technical challenges of implementation, and the time required to integrate VR into their lesson plans (Yakubova et al., 2022). Additionally, teachers might be concerned about ensuring that the content delivered through VR aligns with educational standards and learning objectives (Mys-takidis & Christopoulos, 2022). Overall, teachers open to technology and innovative teaching methods are more likely to embrace VR as a valuable tool in their classrooms (Su et al., 2022). As VR technology becomes more accessible and user-friendly, more teachers may see the potential benefits of incorporating it into their teaching practices.

Scientific discussions on implementing VR in foreign language teaching

Implementing virtual Reality (VR) in English language Education comes with challenges in the English language teaching domain, just like implementing other technologies, and research affirms this (Irons, 2023). For instance, developing high-quality VR content that effectively teaches language skills, such as grammar, vocabulary, and pronunciation, can be complex and resource-intensive (Bacca-Acosta et al., 2022; Bahari, 2022; Tai et al., 2022). Some authors noted the importance of language diversity, and VR content must accommodate various English language accents, dialects, and learning styles to ensure inclusivity and relevance for a global audience (Jamrus & Razali, 2019; Parmaxi, 2023). Importantly, personalized learning paths are crucial in language Education, and designing VR experiences that adapt to individual learners' proficiency levels and pace could be a challenge (Fransson et al., 2020; Thrasher, 2022).

Equally, creating natural and meaningful interactions in VR environments that encourage speaking, listening, reading, and writing may be difficult (Baniasadi et al., 2020; Cowie & Alizadeh, 2022). These interactions must simulate real-world language use. Moreover, educators need training to integrate VR into language lessons effectively,

guiding students through the VR experience and using it to supplement traditional teaching methods (Alalwan et al., 2020). Research is ongoing to determine the long-term educational impact of VR on language learning and whether it leads to better language acquisition than traditional methods (Zheng et al., 2022; Villena-Taranilla et al., 2022; Lege & Bonner, 2020). Addressing these challenges requires collaboration between educators, instructional designers, content creators, and technology developers (Silva et al., 2023). Despite these hurdles, VR has the potential to offer immersive and engaging language learning experiences that complement traditional teaching methods.

Theoretical framework

Theoretically, the technology acceptance model (TAM) and unified theory of acceptance and use of technology (UTUAT) assert that motives for technology use originate from users' benefits (Shuhaiber & Mashal, 2019; Venkatesh et al., 2016). These theories give a basic understanding that helps explain technology acceptance and rejection from the user's perspective. Furthermore, the theories explain how technological innovations can be improved through appropriate technology design to boost user experience (Dwivedi et al., 2019). Already, previous studies emphasized that the application of VR facilitates learning by making learning more interesting (Bower et al., 2020; Campos et al., 2022). In language teaching, novel scientific contributions insist that VR notably improves foreign language instruction through various means and approaches (Jamrus & Razali, 2019; Parmaxi, 2023).

Conceptually, this study hinges on the technology acceptance model (TAM), unified theory of acceptance and use of technology (UTUAT), and the assertions from the above studies to rationally posit that numerous factors like performance expectancy, effort expectancy, social influence, and facilitating conditions could affect users' experience while using technology. These factors have the potential to affect technology acceptance and use by users. Already, research has verified the challenges associated with using VR and learners' digitally enhanced learning.

This study foresees that these factors could affect the acceptance and use of VR in a learning environment. This study argues that revisiting this topic becomes imminent given the documented challenges of using VR in language teaching, the inadequate information regarding the use of VR in hybrid learning environments, and the current disposition of learners towards digitally enhanced learning. Besides, using VR without more research may result in more problems. On these premises, this study foresees that implementing VR in an English language beginner classroom will help students and teachers experience its use in the classroom, and their experiences while using these innovative resources will be valuable for future design or redesign of VR before implementation in the classroom. This conceptual framework is presented in Fig. 1.

However, it is worth noting that certain notable research studies strongly assert that specific factors can hinder the utilization of Virtual Reality (VR) in the context of teaching and learning (Parmaxi, 2023). Additionally, research reports suggest that second language learners might experience cognitive overload when engaging with VR technology, which could pose challenges during its setup for students (Shen et al., 2022; Souchet et al., 2022), although this experience could vary among students. The divergence

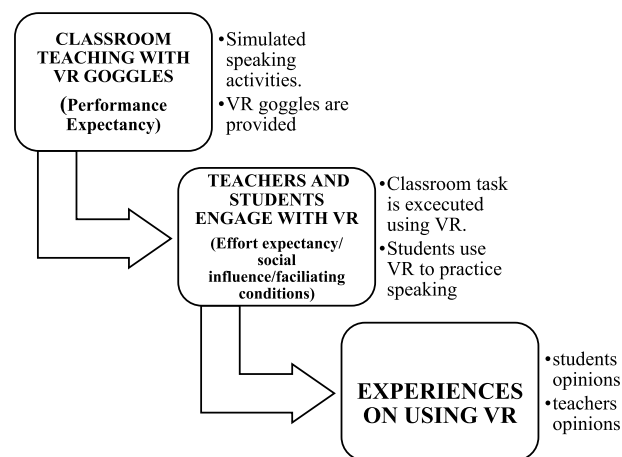


Fig. 1 Conceptual framework of the study

in conclusions across these studies indicates gaps in the existing scientific literature that require attention.

Furthermore, these differing research conclusions accentuate the existing gaps in the scientific literature regarding the implementation of VR, demanding further investigation. Prominent recent scientific contributions in this field predominantly focus on learners with intermediate and advanced English language proficiency, as seen in the works of many scholars (Antón-Sancho et al., 2022; Campos et al., 2022; Hwang & Chien, 2022; Kuna et al., 2023; Nicolaidou et al., 2023; Shen et al., 2022), with less emphasis on the application of VR in foundational or beginner English language classrooms. Additionally, there is a lack of evidence demonstrating the use of VR in English language studies within the specific context of North Cyprus, especially in beginner English classes.

The case of North Cyprus is made on the premise that in many educational settings like across Africa, some parts of Asia, North America, and the Middle East, with mediocre socio-economic status where educational technology is at the cradle stage as North Cyprus, using VR for classroom lessons is not prominent. In tandem with this assertion, some authors noted that issues of technology gap exist in some of the regions as mentioned above of the world (Al-Ansi et al., 2023; İskender & Erkan, 2023), necessitating more investigations in those regions. Besides, a careful scan of the works of literature on using VR for language instruction presents limited studies devoid of insights into the potentials and pitfalls of the technological resource. Analyzing the opinions of students and instructors on the potential of using VR in their classrooms will provide robust insight lacking in the broader literature on the strengths and challenges of using VR in similar regions globally.

Moreover, a recent principled review of studies on AR found limited studies on AR focusing on language skills (Punar Özçelik et al., 2022), preempting the need for more studies on AR and VR emphasizing language skills. The paucity of existing research underscores the need for further exploration. Investigating these less-studied facets will help gather insights from educators and learners regarding their perceptions of augmented Reality's effectiveness in hybrid and traditional learning environments.

Equally, educational research emphasizes the importance of revisiting topics with gaps in knowledge, particularly in contexts where studies are lacking (Müller-Bloch & Kranz, 2015; Miles, 2017). The need for more studies within this specific context, coupled with the absence of research on the application of VR in beginner English classes, underscores the necessity for additional investigation into this subject matter. Such an investigation will offer empirical evidence that sheds light on instructors' and learners' viewpoints regarding the integration of VR in language instruction. In pursuit of this goal, the study in question explored the following research questions:

1. What are students' perceptions of using VR during speaking lessons in North Cyprus?
2. What are the Turkish EFL instructors' opinions on using VR in teaching speaking skills in North Cyprus?

Method

Research design

This study utilized a mixed research design with a concurrent triangulation approach, given that data was collected through structured questionnaires and interviews. Additionally, this approach ensures that quantitative and qualitative data obtained validate the results generated by each method. This research design was adopted for this research on the propositions that mixed methods research designs that collect both quantitative and qualitative data are relevant in obtaining robust insights on a phenomenon investigated (Creswell & Creswell, 2005). In cognizance of the need for quantitative and qualitative data concerning this topic, which provide insights into students' and teachers' experiences while using VR, the study deemed this research design appropriate for this study. Equally, the questionnaires provide self-report data required to understand students' opinions on using VR, while the interviews provide data that elucidate participants' experiences while using the technological resource. These data provide valuable information in understanding students' and teachers' perspectives on using VR in a speaking skill classroom. A1/A2 common European framework of language references (CEFR) English language course was designed and implemented.

Participants

The participants for this study were students and language instructors from a school in a private university in Turkey. The students were A1/A2 CEFR level students who needed to be more proficient in English. The participants include male and female participants from different nationalities required to study at the English foundation school. They were chosen through a convenience sampling method given that the participants were readily available students studying at the foundation English school of the university. The instructors were teachers teaching at the English foundation school of the university. The instructors were male and female language instructors with master's degree certification in English language teaching. The instructors consist of native and non-native teachers. The participants comprised 75 students and ten instructors; 85 participants were adopted for the study. Written and oral consent was received from the participants before commencing the study.

Procedures

Virtual Reality was implemented in the lesson during the speaking session. Speaking drills were carried out using VR goggles. The VR-speaking sessions included simulated speaking drills in different real-life contexts, for example, supermarkets, police stations, hospitals, and greeting exchanges. The lessons were planned for 14 weeks, including the productive (speaking and writing) and receptive skills (listening and reading). However, during the speaking and listening sections, VR Goggles were used. The Goggle were incorporated with different activities including dialogues simulated in different context.

For instance, Unit One of the English course book is on "Greetings." During the speaking sessions, the students were equipped with the Goggles with speaking activities on "Greetings." Explicit instruction was given to the students on how to greet and different ways of greeting. The students were assigned to different groups where they performed tasks on greeting and obtaining information from group members. After this task, all the students were requested to wear the VR Goggles and perform the simulated speaking task on "Greeting." Given the limited number of Goggles, the students took turns practicing with the VR Goggles.

This was repeated for different unit topics until the seventh week. This strategy was applied for every 2 h of the speaking lesson for 5 days per week, 10 h per week, and 60 h for 7 weeks. At the end of the course, the students and the instructors were also asked to use the learning outcome and their personal experiences to give their opinions on using VR in language teaching.

Data collection

Questionnaires and Interviews were used to elicit information from the participants on their experiences after using the VR. The instrument was a 13-item questionnaire that was structured considering the UTAUT theory of technology acceptance model. This instrument consists of items structured to reflect relevant literature on technology use and acceptance. Also, questionnaires from previous studies that reflect the UTUAT theory were used to structure the questionnaire. These items reflect the basic constructs of UTAUT grafted in performance expectancy, effort expectancy, social influence, and facilitating conditions. The questionnaire items reflect these basic constructs of the UTAUT theory and were used as instruments for data collection.

It was structured on a 5-point Likert-type scale of Strongly Agree (5) Agree (4) Neutral (3) Disagree (2) Strongly Disagree (1). They consist of two versions: a Turkish version and an English version. The items were faced-validated by two experts in the field of Education to ensure that the items were correctly worded and appropriate. Afterward, it was piloted with 30 students to determine its reliability, and a Cronbach's alpha coefficient of 0.83 was obtained. This confirmed that the instrument was reliable in measuring the constructs it purports to measure, as indicated in the UTUAT theory. This version of the questionnaire was administered to the students to indicate their level of agreement with the question items. After collecting the questionnaires, they were analyzed descriptively.

Additionally, open-ended semi-structured interview guides were used to elicit more information from the 40 participants consisting of 30 students and ten teachers. They

were randomly chosen and interviewed on the objectives of the study. Their identities were anonymized as B1 to B30 for the students and G1 to G10 for the instructors. After recording the interviews, their responses were collected, transcribed, and analyzed thematically.

Data analysis

Descriptive statistics were used to analyze the questionnaire using the SPSS statistical package. A frequency distribution was used to determine the mean responses of the students and teachers concerning each question item. Their mean responses were relied on to make conclusions on their views concerning the use of VR in English language teaching and learning. The researcher analyzed the interviews using thematic analysis.

After transcribing the transcripts, the researcher requested the interviewees to review the transcripts. This ensures and confirms that the transcription appropriately describes their responses. Equally, the researcher read the transcripts to familiarize with the entire transcripts. Afterward, transcripts were carefully coded, and from the codes obtained, themes were generated. Reviewing the themes in relationship with the research questions and the study's objectives is essential. After reviewing the themes to ensure that all themes and descriptors were captured as they emerged, the researcher defined and named the themes. The results of the analysis are presented in the tables below;

Results

This section discusses the results obtained after administering the questionnaire and the interviews. They are presented in the tables below;

RQ1 What are students' perceptions of using VR during speaking lessons?

Table 1 presents a descriptive analysis of students' perceptions of using VR during speaking lessons. The table indicates that when participants were asked to indicate if using VR was impractical, a mean score of 1.56 (SD:0.67) was obtained, indicating that VR was perceived as effective during speaking lessons. Also, the students thought that VR enhances learning by using real-life situations helpful in speaking, although it does not improve students' speaking skills. Mean values of 4.05 (SD:0.53), 4.37 (SD1.04), and 4.22 (SD1.83) were obtained for these items.

Furthermore, the student thought that teaching through VR did not improve classroom performance in speaking or their speaking grades, yet they affirmed that using VR does not make speaking lessons boring. Mean values of 2.43 (SD:0.45), 1.08 (SD:0.68), and 2.90 (SD:0.93) were obtained for these items. Furthermore, the students indicated that VR was difficult to handle, as a mean value of 2.63 (SD: 0.82) was obtained for this item. The students were undecided on the efficiency of VR, as a mean value of 3.45 (SD:0.72) was obtained, while they acknowledged that VR gadgets were expensive to purchase; a mean value of 4.11 (SD:0.58) was obtained for this item. Equally, they disagreed that VR makes learning to speak easy or fun, as lesson objectives were not achieved, with mean values of 2.41 (SD:1.77) and 2.95 (SD:0.45). Equally, the students had privacy concerns; a mean value of 1.34 (SD:0.72) was obtained for this item.

Table 1 Descriptive analysis of students' perception of using VR during speaking lessons

Scale	N	Mean	SD
VR is not effective in foreign language acquisition classrooms	75	1.56	0.67
VR enhances learning, speaking	75	4.05	0.53
VR does not improve speaking skills	75	4.37	1.04
VR introduces virtual real-life situations helpful in speaking	75	4.22	1.83
Teaching through VR improved classroom performance in speaking	75	2.43	0.45
The use of VR improved my speaking grades	75	1.08	0.68
VR makes speaking lessons boring	75	2.90	0.93
It is not difficult for me to handle and use VR during speaking lessons	75	2.63	0.82
VR gadgets are expensive to purchase	75	4.11	0.58
VR is efficient in learning to speak	75	3.45	0.72
VR makes learning to speak easy and fun	75	2.41	1.77
VR helps to achieve lesson objectives on speaking	75	2.95	0.45
I am concerned about privacy and security issues	75	1.34	0.72

Table 2 Descriptive analysis of instructors' opinions on using VR in teaching speaking skills

Scale	N	Mean	SD
VR is not effective in foreign language acquisition classrooms	10	3.05	1.11
VR enhances learning, speaking	10	4.37	1.08
VR does not improve speaking skills	10	2.55	0.64
VR introduces virtual real-life situations helpful in speaking	10	4.12	0.98
Teaching through VR improved classroom performance in speaking	10	2.38	0.23
The use of VR in teaching improved my speaking grades	10	1.79	0.64
VR makes speaking lessons boring	10	1.95	0.57
It is not difficult for me to handle and use VR during speaking lessons	10	2.06	1.19
VR gadgets are expensive to purchase	10	4.95	1.26
VR is efficient in learning to speak	10	2.59	0.52
VR makes learning to speak easy and fun	10	4.16	1.38
VR helps to achieve lesson objectives on speaking	10	1.28	0.93
I am concerned about privacy and security issues	10	1.79	0.47

RQ2 According to your views, what are the instructors' opinions on using VR in teaching speaking skills?

Table 2 shows the descriptive analysis of instructors' mean responses to their opinions on using VR for teaching speaking skills. The teachers were neutral on the effectiveness of VR in foreign language acquisition classrooms, as a mean value of 3.05 (SD:1.11) was obtained. The teachers agreed that VR enhances learning to speak, as a mean value of 4.37 (SD:1.08) was obtained for this item. They disagreed that VR does not improve speaking skills, as they thought that speaking skills are improved through real-life situations introduced by VR. Mean values of 2.55 (SD:0.64) and 4.12 (SD:0.98) were obtained for the items.

However, the instructors thought that teaching through VR does not improve classroom performance in speaking or their grades; mean values of 2.38 (SD:0.23) and 1.79 (SD:0.64) were obtained for these items. Even with this, they thought VR does not make lessons boring, although they affirmed that it is difficult to handle and use

VR during speaking lessons. Mean values of 1.95 (SD:0.57) and 2.06 (SD:1.19) were obtained for these items. Equally, they affirmed through their responses that VR gadgets were expensive to purchase and inefficient in learning to speak, although speaking lessons are easy and fun given the use of VR—mean values of 4.95 (SD:1.26), 2.59 (SD:0.52), and 4.16 (SD:1.38). However, lesson objectives still needed to be achieved, and the teacher was worried about privacy and security issues, as mean values of 1.28 (SD:0.93) and 1.79 (SD:0.47) were obtained for these items.

Interviews

To further dig deep into the perceptions and views of students and teachers on the use of VR in English language learning and teaching, participants were interviewed, their responses were transcribed and analyzed, and these themes were obtained for the students;

Table 3 presented the themes when the students were requested to indicate their views on using VR during speaking lessons. From the table, three themes emerged: *fun-filled experiences, challenges, and extended use of influence speech*. An analysis of these themes reflects the participants' opinions on the question. They are discussed below.

Theme 1: fun-filled experience

This theme shows that the students thought using VR during lessons was a fun-filled experience. This reflects their notions and views on using VR during their speaking lessons. Some of their responses, which reflect this, are presented below;

I enjoyed my speaking lessons. B6

The most enjoyable lessons are the speaking lessons, given that the teachers use VR Goggle. B3

I enjoy practicing speaking using VR; it submerges you into a context like a real-life experience. B16

I like using VR; it is another good experience for me... this is my first time using it. B12

I have heard about VR, but my experience of using it for practicing speaking was enjoyable. B7

Table 3 Opinions of students on using VR during speaking lessons

Themes	f
Fun-filled experience	26
Challenges	14
Extended use influence speech	19

Some of the students' responses indicated that they thought using VR was a fun experience while practicing speaking skills during their English language lessons.

Theme 2: challenges

This theme indicates that the students thought VR was difficult to use during lessons. This further explains that students may have difficulty using VR during their lessons. Below are some of their responses that suggest this theme;

I enjoyed using VR for lessons, but it was not easy to use at first. B1

The teacher was helping students use Goggle; it was difficult at first, but with the teacher's assistance, the problems were resolved. B30

Another student explained in detail;

The teacher first experienced great difficulty in understanding how to use Goggle. The teacher had to read the manual carefully before she understood how to use it properly. The laboratory attendant also helped to ensure that we were fine while using it for the speaking lessons. B20

Some of the students' comments show they may have encountered some difficulties while using VR during their speaking lessons.

Theme 3: extended use influence speech

The students opine that using VR for a longer duration may assist in influencing students' speaking skills. This theme suggests that students' speaking skills were not influenced after using VR; however, longer use may influence their speaking skills. Some of their comments that reflect this theme are presented below;

I told my friends that we were using VR for learning, and they were optimistic that my speaking skills would improve, but they did not. If we use it for a more extended period, then it will be improved. B19

Another student commented,

My speaking skills were not improved, given that we only used the VR for a more extended period. We should continue to use it at the next level to improve our speaking skills. B17

Other students made similar comments; here are some of the comments;

My speaking skill was not improved...I think we should use it more. B22

I need to use VR more during lessons to improve my speaking skills. B11

My friend told me that to improve my speaking skills with VR, more time is required. B29

These are some of the comments of the students that reflect this theme. Below are the themes generated from the transcribed and analyzed interviews of the instructors.

Table 4 Opinions of teachers on using VR for teaching speaking skills

Themes	f
Innovation	9
Distraction	9
Require training	7
No impact	5

Table 4 presents the themes of instructors' views on using VR for teaching speaking skills. From the table, four themes emerged: *Innovation, distraction, require training, and no impact*. An analysis of these themes reflects the participants' opinions on the question. They are discussed below;

Theme 1: innovation

This theme suggests that the instructors perceive using VR for teaching speaking skills as an innovative experience in English language teaching. This indicates that it was a new experience for the teachers; here are some of their comments that indicate this theme;

This is my first experience of using VR in my teaching profession. It is a worthwhile experience. G8

I have heard a lot about VR and have seen other schools use augmented Reality (AR) and VR, but this was my first experience, and it was good to experience how to apply this to our English language lessons. G5

I do not like the overuse of technology for learning, but this one was a good experience for the teacher and me. G4

These were some of the comments of the teachers that reflect this theme.

Theme 2: distraction

The teachers thought that using VR creates distractions during lessons. From the teachers' comments, some students were distracted from the entire lesson while using VR during their speaking sessions. Here are some of their comments;

There were numerous distractions during the speaking sessions; I did not like this. G10

The classroom was rowdy...the study was over-excited, and this needs to be controlled. G3

I understand it was the student's first time using this, and they were too excited, but some parts of the lessons were uncontrollable. G2

I needed to yell for some students to listen to the instructions before using Goggle; the class was loud. G1

Making lessons with VR will be complicated with noisy classroom scenarios; thankfully, I managed my classroom. G9

These were the responses of some of the instructors, which suggest that the students were loud while using the VR, and this caused some distractions during the speaking sessions. This theme reflects instructors' opinions on using VR for teaching speaking skills.

Theme 3: require training

The teachers thought that training was required to use VR effectively. These opinions reflect this theme. Some of the comments of the instructors suggest this theme and are presented below;

At first, it took much work to understand how to use this gadget. G6

The technician helped me a lot during my lessons; I still need to learn a lot. G8

Using VR requires training and planning; we must be taught how to apply it, which will help implement it in the classroom successfully. G10

I struggled a lot to use it, but this was resolved afterward. G4

Teacher training is essential before using this in the classroom. Students should be informed about it and educated about it so the lessons are not rowdy... a lot of teacher training is still required. G6

These were some of the comments of the instructors that reflect this theme.

Theme 4: no impact

This theme explains that the instructors thought VR does not significantly influence students' learning outcomes. This further implies that using VR did not improve their speaking skills. Below are some of their responses that indicate this theme;

Some students thought using VR would make them speak better, but it does not. G2

A lot is required to improve students' speaking skills, and not only by using VR. VR is good and plays a good role, but more is required. G7

Improving students' speaking skills comes from something other than magic; effective pedagogical methods, strategies, and approaches must be applied. Implementing VR does not improve their speaking skills; they must use it more extended. G3

Some say that if VR is more extended, the students' skills will be improved, but I cannot entirely agree. Other practical approaches must be applied to improve students speaking skills, and not only the use of VR; much work needs to be done to achieve this. G1

Some of the instructors' comments indicated that using VR did not significantly improve their speaking skills. The results obtained from the questionnaires and the interviews are discussed in the next section.

Discussion

After careful analysis of the data, the following results emerged. The study revealed that students thought VR was effective during speaking lessons, although the teacher was neutral. This finding unveils the assertions of similar studies concerning the varied

conclusions on the effectiveness of VR (Antón-Sancho et al., 2022; Vergara et al., 2022). Also, the findings of this study unveil that the students and teachers thought that VR enhances learning speaking by using real-life situations helpful in speaking. However, it does not improve students speaking skills, classroom performance, or grades. Already, novel scientific contributions assert that teaching language skills can be complex and resource-intensive (Bacca-Acosta et al., 2022; Bahari, 2022; Tai et al., 2022). Besides, some authors noted that the absence of various English language accents and dialects in VR content might limit its success (Jamrus & Razali, 2019; Parmaxi, 2023).

Moreover, the students and the teachers indicated that VR was difficult to handle, expensive to purchase, and still deciding the efficiency of VR. This finding is in tandem with the conclusions of similar studies that reiterate that using VR has a cost implication that some educational centers may not afford (Kaimara et al., 2022; Yakubova et al., 2022). Besides, its ease of use bothers a lot in broader literature (Su et al., 2022). Nonetheless, our study found that VR was easy and fun for the students and the teachers, although the lesson objectives still needed to be achieved. Some authors noted that using VR introduces fun and excitement in learning (Shen et al., 2022), although the findings of the study contradict the suppositions of other studies that claim that using VR results in achieving positive learning outcomes (Akman & Çakır, 2023; Alhalabi, 2016). This study provided empirical evidence to show that the students and teachers had privacy and security concerns. These findings corroborate the authors' assertion that security risk assessments should be carried out before implementing VR (Silva et al., 2023).

Insights from the interviews show that students perceived using VR as fun and challenging. Meanwhile, some authors suggest that using VR introduces excitement into language teaching (Shen et al., 2022), while some authors have indicated in their earlier studies that difficulty in using technology, distractions during lessons, and the need for training before use may be many problems associated with using VR among students and teachers (Araiza-Alba et al., 2022; Lege & Bonner, 2020; Silva et al., 2023; Xi et al., 2023). Above all, a striking finding of this study was that using VR did not improve the student's speaking skills, which contradicts previous findings in similar studies on AR (Çelik & Yangın Ersanlı, 2022). While this may be contextual and another experimental study is required to validate this result, this provides some insights that other strategies may be required to ensure the optimal benefit is derived from VR. Already, some authors made similar suggestions that research is required to determine the long-term educational impact of using VR in language learning and whether it leads to better language acquisition compared to traditional methods (Zheng et al., 2022; Villena-Taranilla et al., 2022; Lege & Bonner, 2020). These are vital for determining the prospects of implanting VR in the classroom for teaching and learning.

Conclusion

This paper investigates students' and teachers' perspectives on using Virtual Reality in a beginner-level speaking skills classroom. This study aims to provide insights into innovative teaching practices like using VR in language learning settings. Given the study's findings, the following conclusions are made: The study provides empirical evidence that using VR may be perceived as effective during speaking lessons and helpful to the students; however,

applying VR without adequate planning may not improve students' speaking skills and grades. These novel findings provide robust insights into opportunities and possible pitfalls of innovative technologies like VR in English language teaching and Education.

Hinging on the above conclusions, this study provides hints that while VR brings innovative possibilities, neglecting careful planning and integration may result in several challenges. On these grounds, our study summarizes that VR was perceived as challenging to handle and expensive to purchase, and students and teachers were still deciding its efficiency in facilitating learning. While this may be contextual to the research setting, it provides clues that integrating VR without considering other technology training, practical methods, and strategies may not enhance teaching and learning. Nonetheless, VR was fun for the students and teacher, although lesson objectives still needed to be achieved. Again, this study insists that a technology worth implementing for teaching and learning should facilitate teaching and learning by influencing learning outcomes.

This paper is a timely contribution to ongoing scientific discussions on using innovative technologies like AR, VR, and generative artificial intelligence. Admittedly, there are skeptics of the use of technology in Education. However, it is reliant on practitioners and researchers to provide insightful empirical evidence to unveil the potential and challenges of these technological resources before engaging in destructive criticism. This study notes that given that our investigation lacks experimental evidence to determine the efficacy of VR in improving students' achievements, more studies are required in this direction. Future research can apply an experimental approach to determining VR's efficacy in improving all students' language skills. While this is necessary for providing a thorough conclusion on this topic, our study is a necessary addition to the corpus of scholarly literature, providing insights into the potential and pitfalls of integrating VR into Education.

Appendices

Appendix A

Lesson plan

COURSE NAME: FOUNDATION BASIC ENGLISH 1&2

COURSE CODE: ENG 001

COURSE DATE: 18.03.2022

COURSE CATEGORY: FOUNDATION ENGLISH PROGRAM

CATEGORY CHARACTERISTICS: NATIVE SPEAKERS OF FRENCH AND 6 NATIVE TURKISH SPEAKERS

ASSUMED KNOWLEDGE: ENGLISH ALPHABET, NUMBERS, AND SIMPLE GREETINGS IN THE ENGLISH LANGUAGE

SKILLS TAUGHT: GRAMMAR, VOCABULARY, SPEAKING, WRITING, READING, AND LISTENING

DURATION: 5 HOURS/14 WEEKS

AGE: 18 TO 25 YEARS

NUMBER OF STUDENTS: 75

SPECIFIC OBJECTIVES:

By the end of the course, students will be able to:

1. Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., very basic personal and family information, shopping, local geography, employment).
2. Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters.
3. Describe in simple terms aspects of his/her background, immediate environment, and matters in areas of immediate need.
4. Understand and express provided speech in a clearly and slowly articulated way.
5. Recognize brief, simple texts containing the highest frequency vocabulary.
6. Write short, simple, formulaic notes relating to matters in areas of immediate need.

Instructional materials

1. Saslow, J. & Ascher, A. (2015). *Top-notch Fundamentals* (3rd ed.). Pearson Education (e-text)
2. Saslow, J., Ascher, A. & Lynn, S. (2015). *Top-notch 1* (3rd ed.). Pearson Education (e-text)
3. Online English practice material: www.MyEnglishLab.com
4. Task-integrated VR goggles

Procedures

Weeks	Topics	TEACHER ACTIVITY	STUDENT ACTIVITY
	Unit 1: Exchanging greetings (Speaking and listening session)	<p><i>After introducing the topics and providing some context of greetings through videos and pictures</i></p> <p>Warm-up: The teacher greets all the students using greetings in the English language</p> <p>She introduced herself by providing her first name, surname, and country of birth</p> <p>Step 1: The teacher gave the entire student a paper with details of first name, surname, and country of birth. She requested the student to write details of their information</p>	<p>Some students respond</p> <p>The students listened to the teacher</p> <p>The students carried out this task by receiving the papers and their details on the paper</p>

Weeks	Topics	TEACHER ACTIVITY	STUDENT ACTIVITY
		Step 2: The teacher divided the students into groups of three and requested that they ask questions about the personal details of their colleagues. The teacher role-played this by asking a student the following questions; <i>Good morning!</i> <i>How are you?</i> <i>My name is... what is your name?</i> <i>I am from... where are you from?</i> <i>Are you from... (Congo)? So, where are you from?</i> <i>Okay, nice to meet you</i>	The students identified their colleagues and formed a group. They use the information they wrote to make simple greeting dialogues They responded to the conversations by saying, <i>Hi! I am fine, you</i> <i>My name Muhammad, you?</i> <i>I am from Turkey, you?</i> <i>Nice to meet you, too</i> <i>Goodbye</i>
		Step 3: After this task, all the students were requested to wear the VR Goggles and perform the simulated speaking task on "Greeting in a different context."	The students performed this task, asking questions and responding to the simulated conversation
		Step 4: After repeated speaking tasks in different contexts, the teacher asked for questions from the students	Students asked a few questions on grammar and received feedback from the teacher
		Step 5: The teacher gave some grammar exercises and requested the students to complete the exercises	The students completed the grammar exercises, and the teacher provided some immediate feedback to some of the students
		Step 6: The teacher repeated the lessons to summarize all the activities. She gave homework and closed the lessons	The students listened and took notes

Appendix B

Participants informed consent form

Investigating the use of virtual reality to improve speaking skills: insights from students and teachers

Dear Participants,

This questionnaire is part of a research study we are carrying out to find out students' and instructors' opinions on using Virtual Reality to improve speaking skills. You agree to participate in this study by filling out the following scale. Please note that your participation in the study is voluntary, and whether you agree to participate will not impact your grades for the courses you were enrolled in. The data collected during this study will be used for academic research and may be presented at national or international academic meetings. However, your identities will not be revealed to third parties and will be protected in line with ethical considerations for academic research. If you have any questions or concerns, please contact us using the information below.

Chinaza Solomon Ironsi (Ph.D.)
 Foreign Languages and English Preparatory School,
 Rauf Denktas University, Nicosia
 North Cyprus.
 solomon.chinaza@rdu.edu.tr

Appendix C

Questionnaire

Instructions: Please read the instructions carefully before answering the questions. Use the rating scale provided to assess the level of agreement with the statements on using Virtual Reality to improve speaking skills. Use the boxes to indicate your responses and tick the boxes that best apply to you.

Strongly Agree (5) Agree (4) Neutral (3) Disagree (2) Strongly Disagree (1)

Items	5	4	3	2	1
VR is not effective in foreign language acquisition classrooms					
VR enhances learning and speaking					
VR does not improve speaking skills					
VR introduces virtual real-life situations helpful in speaking					
Teaching through VR improved classroom performance in speaking					
The use of VR improved my speaking grades					
VR makes speaking lessons boring					
It is not difficult for me to handle and use VR during speaking lessons					
VR gadgets are expensive to purchase					
VR is efficient in learning to speak					
VR makes learning to speak easy and fun					
VR helps to achieve lesson objectives on speaking					
I am concerned about privacy and security issues					

Appendix D

Interview informed consent form

Dear Participant,

This is an interview consent form on "INVESTIGATING THE USE OF VIRTUAL REALITY TO IMPROVE SPEAKING SKILLS: INSIGHTS FROM STUDENTS AND TEACHERS." The form indicates your voluntary willingness to participate in the interview. If you have questions about this study, feel free to contact me at;

Chinaza Solomon Ironsi (Ph.D.)
 Foreign Languages and English Preparatory School,
 Rauf Denktas University, Nicosia
 North Cyprus.solomon.chinaza@rdu.edu.tr

Kindly tick the boxes where it applies to you;

- I agree to participate in an interview for the above research. ☐
- I confirm that I have read the interview questions. ☐
- I confirm that the nature of the interview has been explained to me. ☐
- I understand that my participation in the interview is voluntary. ☐
- I understand that I am free to withdraw at any time without reason. ☐
- I agree that this interview can be recorded and used for research purposes only. ☐
- I understand that any information collected during this interview will be treated as confidential. ☐

Name.....

Date

Signature.....

Appendix E

Interview protocol form

Dear Participants,

This interview aims to elicit information on your views, opinions, and experiences on using Virtual Reality to improve speaking skills. Data retrieved from this interview will be used for research purposes only. Also, your identities will be kept anonymous throughout the study. The interview will consist of 6 questions and will last only 30 min. Kindly respond to all questions as they relate to you.

Thanks for your kind cooperation.

Appendix F

Interview guides

1. How do you feel using Virtual Reality during your speaking lessons? Can you provide more details?
2. What are your experiences using Virtual Reality during the speaking class? Can you elaborate more?
3. Can you explain the level of improvement concerning your writing skills while using VR?
4. Can you explain any potential of using Virtual Reality in your speaking class?
5. Please explain if there were any challenges you experienced while handling Virtual Reality in class.
6. Do you have any worries concerning using VR for lessons? Can you explain?

Acknowledgements

The author wishes to acknowledge the contributions of all the participants who willingly participated throughout this study; thanks so much for your immense contribution.

Author's contribution

The author has read and approved the final manuscript.

Funding

The author declares that no funding was received for this article.

Availability of data and materials

The author declares that this study's information, materials, and data will be available to readers without restrictions.

Declarations**Competing interests**

The author declares that no competing interests exist among the authors.

Received: 19 August 2023 Accepted: 10 October 2023

Published online: 24 October 2023

References

- Akman, E., & Çakır, R. (2023). The effect of educational virtual reality games on primary school students' achievement and engagement in mathematics. *Interactive Learning Environments*, 31(3), 1467–1484.
- Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Alzahrani, A. I., & Sarsam, S. M. (2020). Challenges and prospects of virtual reality and augmented reality utilization among primary school teachers: A developing country perspective. *Studies in Educational Evaluation*, 66, 100876.
- Al-Ansi, A. M., Jabboob, M., Garad, A., & Al-Ansi, A. (2023). Analyzing augmented reality (AR) and virtual reality (VR) recent developments in Education. *Social Sciences & Humanities Open*, 8(1), 100532.
- Alhalabi, W. (2016). Virtual reality systems enhance students' achievements in engineering education. *Behavior & Information Technology*, 35(11), 919–925.
- Alismail, A., Altulaihan, E., Rahman, M. H., & Sufian, A. (2022). A systematic literature review on cybersecurity threats of virtual reality (VR) and augmented reality (AR). *Data Intelligence and Cognitive Informatics: Proceedings of ICDICI*, 2022, 761–774.
- Antón-Sancho, Á., Vergara, D., Fernández-Arias, P., & Ariza-Echeverri, E. A. (2022). Didactic use of virtual Reality in Colombian universities: Professors' perspective. *Multimodal Technologies and Interaction*, 6(5), 38.
- Araiza-Alba, P., Keane, T., & Kaufman, J. (2022). Are we ready for virtual Reality in K–12 classrooms? *Technology, Pedagogy, and Education*, 31(4), 471–491.
- Bacca-Acosta, J., Tejada, J., Fabregat, R., Kinshuk, & Guevara, J. (2022). Scaffolding in immersive virtual reality environments for learning English: An eye-tracking study. *Educational Technology Research and Development*, 70, 1–24.
- Bahari, A. (2022). Affordances and challenges of teaching language skills by virtual Reality: A systematic review (2010–2020). *E-Learning and Digital Media*, 19(2), 163–188.
- Baniasadi, T., Ayyoubzadeh, S. M., & Mohammadzadeh, N. (2020). Challenges and practical considerations in applying virtual reality in medical education and treatment. *Oman Medical Journal*, 35(3), e125.
- Bower, M., DeWitt, D., & Lai, J. W. (2020). Reasons associated with preservice teachers' intention to use immersive virtual reality in education. *British Journal of Educational Technology*, 51(6), 2215–2233.
- Campos, E., Hidrogo, I., & Zavala, G. (2022). Impact of virtual reality use on the teaching and learning of vectors. *Frontiers in Education*, 7, 702.
- Çelik, F., & Yangın Ersanlı, C. (2022). The use of augmented reality in a gamified CLIL lesson and students' achievements and attitudes: A quasi-experimental study. *Smart Learning Environments*, 9(1), 30.
- Cowie, N., & Alizadeh, M. (2022). The affordances and challenges of virtual reality for language teaching. *International Journal of TESOL Studies*, 4(3), 50–65.
- Creswell, J. W., & Creswell, J. D. (2005). *Mixed methods research: Developments, debates, and dilemma* (pp. 315–326). Berrett-Koehler Publishers.
- Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers*, 21, 719–734.
- Fransson, G., Holmberg, J., & Westelius, C. (2020). The challenges of using head-mounted virtual reality in K-12 schools from a teacher perspective. *Education and Information Technologies*, 25, 3383–3404.
- Hwang, G. J., & Chien, S. Y. (2022). Definition, roles, and potential research issues of the metaverse in Education: An artificial intelligence perspective. *Computers and Education: Artificial Intelligence*, 3, 100082.
- İskender, M. U. Z., & Erkan, Y. Ü. C. E. (2023). Virtual reality (VR) in education: The case in Türkiye. *Bartın University Journal of Faculty of Education*, 12(3), 603–616.
- Jamrus, M. H. M., & Razali, A. B. (2019). Augmented reality in teaching and learning English reading: Realities, possibilities, and limitations. *International Journal of Academic Research in Progressive Education and Development*, 8(4), 724–737.
- Kaimara, P., Oikonomou, A., & Deliyannis, I. (2022). Could virtual reality applications pose real risks to children and adolescents? A systematic review of ethical issues and concerns. *Virtual Reality*, 26(2), 697–735.
- Kavanagh, S., Luxton-Reilly, A., Wuensche, B., & Plimmer, B. (2017). A systematic review of virtual reality in education. *Themes in Science and Technology Education*, 10(2), 85–119.
- Kuna, P., Hašková, A., & Borza, L. (2023). Creation of virtual reality for education purposes. *Sustainability*, 15(9), 7153.
- Lege, R., & Bonner, E. (2020). Virtual reality in education: The promise, progress, and challenge. *Jalt Call Journal*, 16(3), 167–180.
- Li, M., & Liu, L. (2022). Students' perceptions of augmented reality integrated into a mobile learning environment. *Library Hi Tech*. <https://doi.org/10.1108/LHT-10-2021-0345>
- Marks, B., & Thomas, J. (2022). Adoption of virtual reality technology in Higher Education: An evaluation of five teaching semesters in a purpose-designed laboratory. *Education and Information Technologies*, 27(1), 1287–1305.

- Miles, D. A. (2017). A taxonomy of research gaps: Identifying and defining the seven research gaps. In *Doctoral student workshop: finding research gaps-research methods and strategies*, Dallas, Texas (pp. 1–15).
- Müller-Bloch, C., & Kranz, J. (2015). A framework for rigorously identifying research gaps in qualitative literature reviews. Retrieved from <https://core.ac.uk/download/pdf/301367526.pdf>
- Mystakidis, S., & Christopoulos, A. (2022). Teacher perceptions on virtual reality escape rooms for stem education. *Information*, 13(3), 136.
- Nicolaidou, I., Pissas, P., & Boglou, D. (2023). Comparing immersive virtual reality to mobile applications in foreign language learning in higher education: A quasi-experiment. *Interactive Learning Environments*, 31(4), 2001–2015.
- Parmaxi, A. (2023). Virtual reality in language learning: a systematic review and implications for research and practice. *Interactive Learning Environments*, 31(1), 172–184.
- Punar Özçelik, N., YanginEksi, G., & Baturay, M. H. (2022). Augmented reality (AR) in language learning: A principled review of 2017–2021. *Participatory Educational Research*, 9(4), 131–152.
- Rocha Estrada, F. J., Ruiz-Ramírez, J. A., George-Reyes, C. E., & Glasserman-Morales, L. D. (2022). Evaluation of a virtual campus adapted to web-based virtual reality spaces: Assessments of teachers and students. *Frontiers in Education*, 7, 918125.
- Rospigliosi, P. A. (2022). Metaverse or Simulacra? Roblox, Minecraft, Meta, and the turn to virtual reality for education, socialization, and work. *Interactive Learning Environments*, 30(1), 1–3.
- Shen, S., Xu, K., Sotiriadis, M., & Wang, Y. (2022). Exploring the factors influencing the adoption and usage of augmented reality and virtual reality applications in tourism education within the context of the COVID-19 pandemic. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 30, 100373.
- Shuhaiber, A., & Mashal, I. (2019). Understanding users' acceptance of smart homes. *Technology in Society*, 58, 101110.
- Silva, T., Paiva, S., Pinto, P., & Pinto, A. (2023). A survey and risk assessment on virtual and augmented reality cyberattacks. In *2023 30th international conference on systems, signals and image processing (IWSSIP)* (pp. 1–5). IEEE.
- Souchet, A. D., Philippe, S., Lourdeaux, D., & Leroy, L. (2022). Measuring visual fatigue and cognitive load via eye tracking while learning with virtual reality head-mounted displays: A review. *International Journal of Human-Computer Interaction*, 38(9), 801–824.
- Su, Y. S., Cheng, H. W., & Lai, C. F. (2022). Study of virtual reality immersive technology enhanced mathematics geometry learning. *Frontiers in Psychology*, 13, 760418.
- Tai, T. Y., Chen, H. H. J., & Todd, G. (2022). The impact of a virtual reality app on adolescent EFL learners' vocabulary learning. *Computer Assisted Language Learning*, 35(4), 892–917.
- Thrasher, T. (2022). The impact of virtual reality on L2 French learners' language anxiety and oral comprehensibility: An exploratory study. *CALICO Journal*, 39(2), 219–238.
- Venkatesh, V., Thong, J. Y., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, 17(5), 328–376.
- Vergara, D., Antón-Sancho, Á., Dávila, L. P., & Fernández-Arias, P. (2022). Virtual reality as a didactic resource from the perspective of engineering teachers. *Computer Applications in Engineering Education*, 30(4), 1086–1101.
- Villena-Taranilla, R., Tirado-Olivares, S., Cozar-Gutierrez, R., & González-Calero, J. A. (2022). Effects of virtual reality on learning outcomes in K-6 education: A meta-analysis. *Educational Research Review*, 35, 100434.
- Xi, N., Chen, J., Gama, F., Riar, M., & Hamari, J. (2023). The challenges of entering the metaverse: An experiment on the effect of extended Reality on workload. *Information Systems Frontiers*, 25(2), 659–680.
- Irons, C.S. (2022). Navigating learners towards technology-enhanced learning during post-COVID-19 semesters. *Trends in Neuroscience and Education*, 100189.
- Irons, C.S. (2023). Integrating technology and CAPE framework towards improving the language skills of learners. *Educational Technology Research and Development*, 71(2), 717–736.
- Yakubova, G., Kellems, R. O., Chen, B. B., & Cusworth, Z. (2022). Practitioners' attitudes and perceptions toward the use of augmented and virtual reality technologies in the education of students with disabilities. *Journal of Special Education Technology*, 37(2), 286–296.
- Zhang, X., Chen, Y., Hu, L., & Wang, Y. (2022). The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics. *Frontiers in Psychology*, 13, 6063.
- Zheng, C., Yu, M., Guo, Z., Liu, H., Gao, M., & Chai, C. S. (2022). Review of the application of virtual reality in language education from 2010 to 2020. *Journal of China Computer-Assisted Language Learning*, 2(2), 299–335.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.