



Exploring the effectiveness of Virtual Reality in teaching Maltese

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ABSTRACT

Virtual Reality (VR) has gained popularity in education, but its potential in language learning, specifically for teaching a minor language like Maltese, has been understudied. To address this gap, a mixed-methods study was conducted to explore the effectiveness of VR in language learning and identify the advantages and challenges of teaching Maltese as a second language (ML2) with a focus on improving language skills. Qualitative research involved a focus group, while quantitative analysis utilized an online survey with a Likert scale and 25 Maltese teachers as participants. The results revealed that younger respondents were more inclined to believe in the significant impact of VR on improving learning outcomes compared to older respondents. VR was found to effectively engage students in immersive environments and enhance the learning context with entertainment features. However, challenges related to costs, bulky headsets, and technical issues were also uncovered. Although VR tools are not currently utilized in teaching Maltese, this research explored their potential effectiveness in ML2 instruction and provided suggestions for effective integration into language teaching. The findings provide quantitative evidence supporting the effectiveness of VR tools in education and their potential to facilitate ML2 learning. Most participants expressed a positive perception, emphasizing the importance of integrating VR technology into Maltese teaching practices to create more engaging and immersive learning experiences for ML2 learners.

1. Introduction

1.1. Research background

Virtual Reality (VR) is a technology that can create a simulated environment and has three types: *non-immersive*, *semi-immersive*, and *fully immersive*. The non-immersive type manipulates a user's physical environment through computer-generated imagery (Zhao et al., 2020), while the semi-immersive type is primarily used for educational purposes (Garduno et al., 2021; Parmaxi, 2023). Fully immersive VR is still under development, but developers are working to make it as realistic as possible (Garduno et al., 2021).

VR is a valuable tool in the process of second language acquisition because it allows learners to operate or test scenarios that may be impossible or difficult to access in real life, encouraging active participation and interaction (Zhao et al., 2020). Additionally, VR can transform practical experience into knowledge and skills, making it an ideal tool for learners to acquire knowledge, develop competencies, and practice skills (Liu et al., 2020).

Studies suggest that VR is an effective tool for teaching a second language (L2) as it immerses students in an environment where they can

practise their listening and speaking skills in conditions that are similar to real-life settings (Zhao et al., 2020; Zheng et al., 2022). It is widely accessible as long as the student has a VR headset.

1.2. Problem statement

Malta is quickly becoming one of Europe's top tourist destinations, with approximately one million visitors in 2021 despite the ongoing COVID-19 pandemic (Malta Immigration, 2021). Third-country nationals who wish to reside in Malta must integrate into Maltese society by learning about Maltese culture, the Maltese language, and English (Euromed Rights, 2022). Therefore, exploring new technologies that can help learners become proficient in Maltese as quickly as possible is a relevant research area.

This research investigates the effectiveness of using VR technology in teaching Maltese as a second language (ML2). While previous studies have demonstrated the efficacy of VR in language learning for various widely spoken languages such as English, Chinese, French, and Japanese (Peixoto et al., 2021), there is a lack of academic literature exploring its application specifically for teaching Maltese. This study aims to address a significant research gap by exploring the use of VR as a pedagogical

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tool for teaching a minority language like Maltese, which is spoken by approximately half a million people. The findings of this research hold potential benefits for both ML2 learners and teachers seeking innovative language learning approaches.

1.3. Research goal and objectives

This study aims to investigate the effectiveness of using VR tools to teach Maltese to international students (Gardner, 2020; Zheng et al., 2022). This research will contribute to the academic literature by addressing the research gap on the use of VR in teaching a minority language such as Maltese. Furthermore, it will offer insights into the use of VR in language learning from the teacher's perspective, which will be a valuable contribution to the broader academic research on VR (Li and Huang, 2021). This research aims to contribute to the academic literature by bridging the research gap regarding the use of VR in teaching a minority language like Maltese. While previous studies have highlighted the effectiveness of VR as a pedagogical tool for language learning (Gardner, 2020; Zheng et al., 2022), there is a dearth of research specifically examining its application in the context of teaching and learning Maltese. By exploring the use of VR technology in Maltese language instruction, this study will fill this research gap and provide valuable insights into the potential benefits and challenges associated with VR-based language learning. Additionally, this research will contribute to the broader academic research on VR by offering insights from the perspective of teachers, thereby enhancing our understanding of the role of VR in language education (Li and Huang, 2021). The specific objectives of this research are shown in Fig. 1.

1.4. Theoretical framework

The theoretical framework of the study is based on the following assumptions.

- VR technology can enhance language learning by providing an immersive and interactive environment that engages students in the learning process (Garduno, et al., 2021).
- VR can enrich the learning context by providing entertainment features that make learning more enjoyable and engaging (Liu et al., 2020).
- The use of VR in language learning can overcome some of the limitations of traditional teaching methods and provide new opportunities for language learners (Graeske & Sjöberg, 2021).
- The potential benefits of using VR in language learning need to be balanced against the associated challenges, such as high costs, bulky headsets, and technical issues (Yoshimura & Borst, 2021).

- The use of VR in language learning is still in its early stages, and further research is needed to identify best practices and effective strategies for using VR in teaching and learning (Parmaxi, 2023).

2. Literature review

2.1. The benefits of VR for language learning

VR technology is increasingly being integrated into educational settings, including language learning classrooms, to cater for diverse learning styles (Garduno et al., 2021). This literature review examines the key advantages and potential risks of VR in language learning.

VR provides a highly immersive learning experience by simulating environments (Hamilton et al., 2021). This unique feature allows students to engage with language learning in a realistic and interactive manner. For kinesthetic learners, the interactivity offered by VR is particularly beneficial, as it provides hands-on experiences that enhance language acquisition (Garduno et al., 2021). Since physical travel to practice a target language with native speakers may not always be feasible, VR can offer a simulated environment for students to communicate with native speakers, facilitating second language acquisition (Panagiotidis, 2021).

VR can make language learning lessons more memorable, leading to improved vocabulary retention (Yoshimura & Borst, 2021). The immersive nature of VR allows students to engage multiple senses, reinforcing their understanding and memory of new words and phrases. By experiencing language in context, students are more likely to retain L2 vocabulary and reinforce their language skills.

Nonverbal communication, such as body language and facial expressions, plays a crucial role in language learning (Hamilton et al., 2021; Parmaxi, 2023). VR offers an opportunity for students to practice and understand nonverbal communication in a simulated environment, building their confidence in real-life interactions. VR also eliminates the fear of making mistakes when interacting with locals in a foreign country, thus providing a safe space for language practice (Panagiotidis, 2021; Zheng et al., 2022).

The element of entertainment provided by VR captures students' attention and promotes engagement during language learning (Liu et al., 2020). VR offers an active learning experience that surpasses passive reading, as students interact and apply their language skills, leading to better learning outcomes (Yildirim et al., 2020). Moreover, VR helps to eliminate distractions and keeps learners focused on the learning process, thus improving their language acquisition (Lege & Bonner, 2020).

One of the significant advantages of VR in language learning is its accessibility. VR technology allows learners to access language lessons from anywhere, overcoming geographic barriers (Garduno et al., 2021).

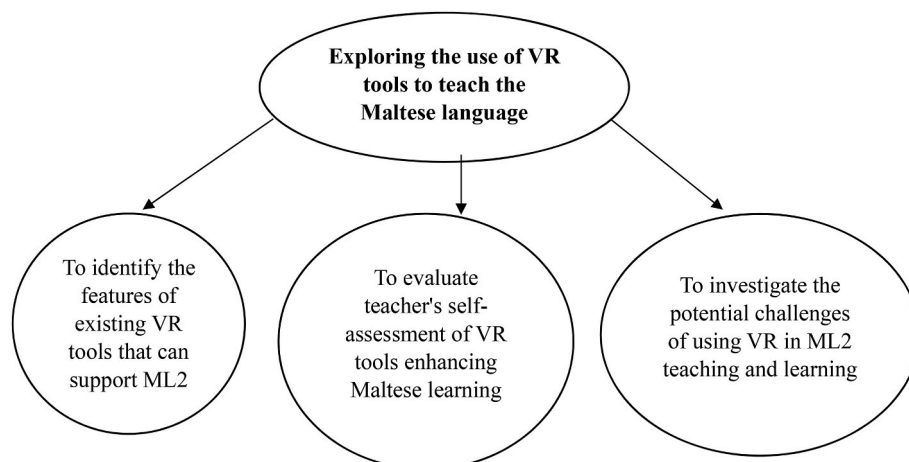


Fig. 1. Research objectives of the study.

It also enables professionals from remote locations to participate in lessons, enriching the learning experience (Lege & Bonner, 2020). The accessibility of VR has become even more apparent during the COVID-19 pandemic, as students can continue their language learning remotely (Ball, et al., 2021). Additionally, VR facilitates connecting learners from different locations, fostering a sense of community and collaboration (Hu-Au & Lee, 2018).

VR applications, such as gaming and virtual scenarios, allow students to create avatars and interact with peers and educators, providing opportunities for real language practice (Hu-Au & Lee, 2018). By immersing themselves in a new environment, students can engage in various experiences, situations, and experiments, thereby enhancing their language learning process while reducing costs and resource consumption (Panagiotidis, 2021). VR offers a platform for students to engage in authentic language practice, as they can interact with virtual native speakers, participate in realistic conversations, and navigate real-life scenarios (Hamilton et al., 2021). This real language practice in a simulated environment helps students build confidence and fluency in their target language (Liu et al., 2020).

Language learning through VR is not limited to traditional classroom settings. VR can create immersive and interactive language learning experiences outside the classroom, such as virtual field trips or cultural experiences, allowing students to explore and engage with the target language and culture in a more meaningful way (Cardullo & Wang, 2022). These experiences offer opportunities for contextualized language use, cultural understanding, and global perspectives (Garduno et al., 2021).

Furthermore, VR facilitates language learning in specific contexts, such as business or professional settings. Students can practice language skills in simulated business scenarios, such as negotiations or presentations, which are essential for their career growth (Liu et al., 2020).

The immersive nature of VR enables learners to develop the necessary language proficiency and cultural competence required for effective communication in professional contexts.

2.2. Challenges and limitations

While VR presents numerous benefits for language learning, it is essential to acknowledge its challenges and limitations. VR should be used as a complementary tool alongside traditional teaching methods, and it cannot completely replace the role of teachers in the classroom (Cook et al., 2019; Radianti et al., 2020). Effective implementation of VR requires careful planning, teacher guidance, and the provision of supporting materials to make the experience relevant and effective (Yildirim et al., 2020).

Additionally, the potential risks and limitations of VR must be considered. VR has the potential to cause addiction, leading to excessive use beyond educational purposes (Cook et al., 2019; Yoshimura & Borst, 2021). Moreover, the cost and resources required for developing and maintaining effective VR language applications can be substantial (Cook et al., 2019). Health effects, such as eye strain, motion sickness, and other physical discomforts, may arise from prolonged VR use (Eunhee et al., 2020). These factors and other disadvantages of VR which are mentioned in Fig. 2, should be carefully managed and monitored to ensure the well-being of learners.

The use of VR in language learning offers a range of benefits, but it is crucial to acknowledge and address the limitations and potential risks associated with VR (Graeske & Sjöberg, 2021). By balancing the use of VR with traditional teaching methods and carefully managing its implementation, educators can harness the potential of VR to enhance language learning outcomes and provide students with valuable language experiences. However, it is crucial to use VR in conjunction with

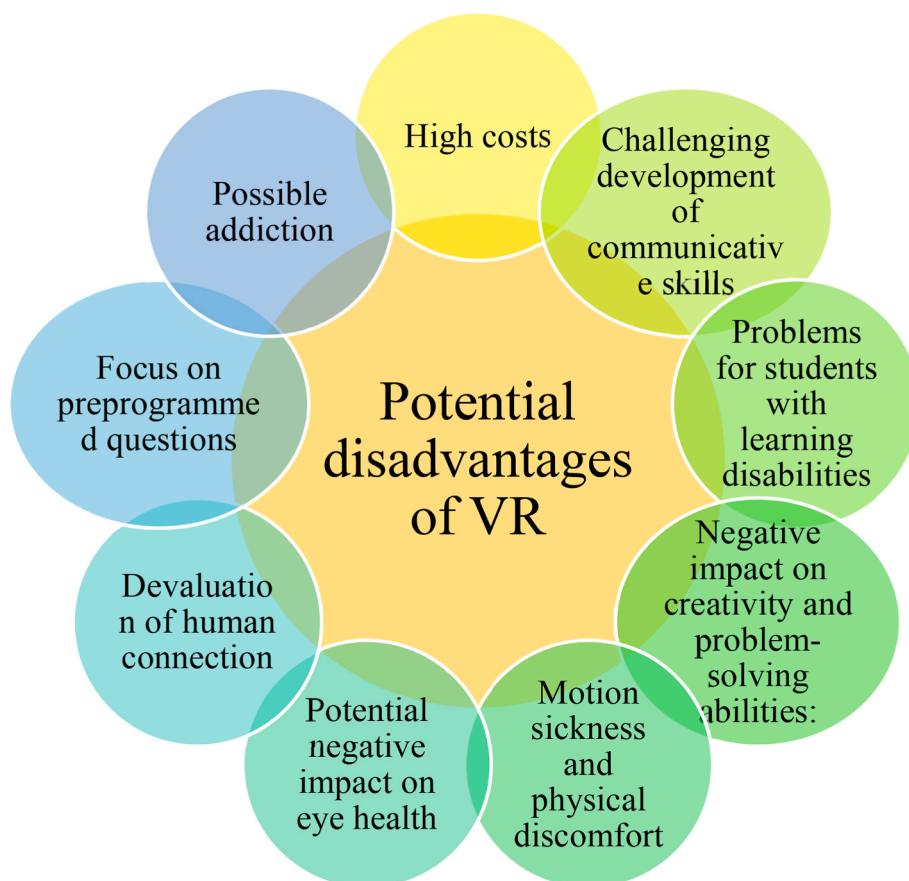


Fig. 2. Disadvantages of VR

traditional teaching methods and to remain aware of its limitations.

2.3. Challenges in traditional pedagogy and the promise of VR in teaching Maltese

Maltese as a second language (ML2) is a relatively new subject, and the teaching of ML2 has been introduced recently, since 2019 (Camilleri Grima & Żammit, 2020). There is also a lack of academic research concerning ML2.

International learners of ML2 have reported that they are taught in a traditional manner, primarily relying on a “chalk and talk” approach, with lists of verbs, grammar rules, and vocabulary notes provided for rote memorization (Żammit, 2021). The traditional pedagogical approach in teaching ML2 can present several challenges for adult students. As reported in Żammit (2021), the emphasis on memorization and rote learning may hinder the development of practical language skills, such as speaking and listening comprehension. Learners may struggle to apply the learned grammar and vocabulary in real-life communicative situations. Additionally, the lack of interactive and immersive learning experiences may limit students’ engagement and motivation, as the learning process can become monotonous and disconnected from authentic Maltese language use (Żammit, 2021).

VR presents a promising alternative to traditional pedagogy in teaching ML2 by addressing these challenges. One of the main advantages of VR in ML2 instruction could be its ability to enhance speaking and listening skills. Traditional methods in ML2 often provide limited opportunities for learners to engage in authentic conversations, practice pronunciation, or receive immediate feedback (Żammit, 2021). In contrast, VR can offer a safe space for learners to interact with virtual characters and practice their speaking skills without fear of judgment (Garduno, et al., 2021). By simulating authentic contexts, VR can provide ML2 learners with meaningful language practice and promote active participation in the learning process (Liu et al., 2020). Learners can engage in realistic dialogues, role-play various scenarios, and receive immediate feedback on their ML2 pronunciation and intonation.

Another advantage of VR is its potential to foster cultural immersion and contextualized language learning (Garduno et al., 2021). Traditional pedagogy may struggle to provide learners with authentic cultural experiences and exposure to the nuances of the Maltese language and culture. VR can create virtual environments that replicate real-life settings, allowing learners to explore Maltese culture, visit historical landmarks, and interact with virtual natives in simulated contexts, while simultaneously developing their language skills.

Furthermore, VR can offer a more personalized and adaptive learning experience. Traditional pedagogy often follows a standardized curriculum, where learners progress at a fixed pace regardless of their individual needs and proficiency levels (Tarmo & Kimaro, 2021). In contrast, VR can provide tailored content and adaptive exercises that align with ML2 learners’ specific goals and proficiency levels (Qian et al., 2020). ML2 learners can receive targeted practice, instant feedback, and personalized guidance, creating a more individualized and effective learning experience.

By leveraging VR technology, teachers can overcome the limitations of traditional pedagogy and provide ML2 learners with engaging, immersive, and interactive learning experiences. VR can scaffold learners in overcoming the challenges posed by rote memorization, limited communicative practice, and lack of cultural immersion. By embracing VR as a tool for ML2 instruction, teachers can foster more meaningful language acquisition and equip learners with practical language skills necessary for real-life communication in the Maltese language.

3. Research methodology

3.1. Participants

A purposive sampling method was used in this study to select 25 Maltese teachers as participants for this study (Ames et al., 2019). The sampling strategy aimed to include teachers who had experience and exposure to VR technology and its applications in language learning. Although there was a lack of research and VR apps for the Maltese language, the participants, who taught Maltese at primary, middle, and secondary schools, had explored and experienced various VR apps and tools in the context of language learning.

Table 1 illustrates the participants’ engagement with VR in different contexts, primarily in English language settings or other foreign languages. This indicated their willingness to use VR technology and their familiarity with its potential in language learning. The participants’ VR experience and training ranged from 1 to 4 years, showcasing a diverse level of familiarity and exposure to VR technology and its applications in language learning.

The participants’ VR experience and training varied in terms of duration and sources. Some participants attended local or international VR workshops and training sessions, while others conducted personal exploration and experimentation with VR. Additionally, some participants observed VR activities and simulations in language lessons, collaborated with language institutes that utilized VR, or participated in VR-based language learning pilot programs.

The observed VR language learning apps used by the participants included *Immerse*, *VRChat*, *AltspaceVR*, *MondlyVR*, *LingoVR*, *Rosetta Stone*, *Babbel VR*, *VR Language Lab*, *Language Zen VR*, and *MondlyARChat*. The participants also utilized VR tools such as *Oculus Quest*, *Oculus Rift*, *Tilt Brush*, *Unity*, *Unreal Engine*, *Oculus Medium*, *SteamVR*, *VIVEPORT*, *Blender*, and *Gravity Sketch*.

Although the participants did not incorporate VR into their Maltese language teaching, their exposure to VR technology and exploration of VR apps and tools provided valuable insights into their familiarity and potential readiness for integrating VR into language education (see Table 1). The diverse range of VR experiences and training among the participants enhanced the richness and validity of the study’s findings and strengthened the overall understanding of the potential benefits and limitations of VR in the context of teaching ML2.

Based on the information presented in Table 1, the selected participants had a substantial background in using VR and had engaged with VR technology in various contexts, making them qualified to answer the research inquiries proposed in the study.

3.2. Research design

3.2.1. Quantitative phase

The study involved an online survey given to the 25 focus group participants to obtain quantitative evidence on the potential effectiveness of VR tools in teaching ML2. Google Forms was utilized to conduct the survey, and each participant received a link to the questionnaire.

3.2.2. Qualitative phase

To obtain qualitative data on teachers’ opinions and experiences of using VR in ML2 instruction, the study conducted focus groups. This approach was chosen for its ability to encourage interaction among participants and generate a wide range of ideas (Nyumba et al., 2018).

3.3. Data collection

3.3.1. Ethical considerations

Before data collection, the study obtained authorization from the University Research Ethics Committee (UREC) in Malta (reference number EDUC-2022-00082). Ethical aspects were discussed during virtual meetings with teachers to ensure participant privacy and respect.

Table 1
Participalnts' VR experience and training.

Teacher	Student Group	VR Experience/ Training (Years)	VR Language Learning Apps Observed	VR Tool/s Observed
Teacher 1	Secondary	2 years of observing English teachers abroad	VRChat, Immerse, MondlyVR, Babbel VR	Oculus Quest, Oculus Rift, Tilt Brush Unity, Unreal Engine Oculus
Teacher 2	Middle	2 years of attending VR workshops and training sessions locally	Immerse, AltspaceVR, VRChat, Babbel VR	Oculus Quest, Oculus Rift, Tilt Brush Unity, Unreal Engine Oculus
Teacher 3	Primary	1 year of personal VR exploration and experimentation	LingoVR, Rosetta Stone	Oculus Quest, Oculus Rift, Tilt Brush Oculus
Teacher 4	Primary	4 years of visiting museums abroad in which VR is integrated	MondlyVR, VR Language Lab, AltspaceVR, VRChat, Babbel VR, Language Zen VR	Oculus Quest, Oculus Rift, Unity
Teacher 5	Secondary	2 years of attending international conferences on VR in education	AltspaceVR, VRChat, Babbel VR	Oculus Quest, Oculus Rift, Unity
Teacher 6	Secondary	1 year of participating in a virtual reality pilot program in a school	LingoVR, Rosetta Stone	Oculus Medium, Oculus Quest, Oculus Rift, Tilt Brush Unity, Unreal Engine, VIVEPORT
Teacher 7	Secondary	3 years of attending international English teaching conferences with VR showcases	Immerse, Babbel VR, VR Language Lab, Language Zen VR	Oculus Quest, Oculus Rift, Tilt Brush Unity, Unreal Engine, VIVEPORT
Teacher 8	Middle	2 years of collaborating with a language institute abroad that utilized VR for ESL instruction	AltspaceVR, VRChat, ImmerseMe, Rosetta Stone	Oculus Quest, Oculus Rift, Tilt Brush, Unity, Unreal Engine
Teacher 9	Middle	1 year of attending VR training course in Malta	LingoVR, Rosetta Stone	Oculus Quest, Oculus Rift, Tilt Brush
Teacher 10	Primary	2 years of conducting VR-based English lessons as part of an exchange program	Immerse, MondlyVR, ImmerseMe, VR Language Lab	Oculus Quest, Oculus Rift, Tilt Brush, Unity, Unreal Engine
Teacher 11	Secondary	1 year of attending VR language learning workshops during professional development sessions	AltspaceVR, VRChat, Rosetta Stone	Oculus Quest, Oculus Rift
Teacher 12	Middle	1 year of conducting virtual reality language exchange sessions with partner schools abroad	LingoVR, Rosetta Stone	Oculus Quest, Oculus Rift, SteamVR, Tilt Brush
Teacher 13	Middle	1 year of observing a VR startup that developed	Immerse, MondlyVR, MondlyARChat	Oculus Quest, Oculus Rift,

Table 1 (continued)

Teacher	Student Group	VR Experience/ Training (Years)	VR Language Learning Apps Observed	VR Tool/s Observed
			educational language learning apps	Tilt Brush, Unity, Unreal Engine Oculus
Teacher 14	Secondary	2 years of attending international language conferences with VR showcases and demonstrations	AltspaceVR, VRChat, Rosetta Stone, Babbel VR	Quest, Oculus Rift, Unity
Teacher 15	Middle	1 year of participating in a research project focused on the integration of VR in language curriculum	LingoVR, Rosetta Stone, MondlyAR	Oculus Medium, Unreal Engine, Oculus Quest, Oculus Rift, Tilt Brush
Teacher 16	Primary	4 years of using VR tools for language learning during teaching practicum in a foreign country	Immerse, MondlyVR, AltspaceVR, LingoVR, Babbel VR, ImmerseMe, Rosetta Stone, Language Zen VR	Oculus Quest, Oculus Rift, Tilt Brush Unity, Unreal Engine, VIVEPORT
Teacher 17	Primary	2 years of attending VR workshops conducted by international language learning organizations	AltspaceVR, VRChat, VR Language Lab	Oculus Quest, Oculus Rift
Teacher 18	Middle	3 years of visiting a museum abroad that incorporated VR in their educational programs	LingoVR, Rosetta Stone, MondlyAR, Language Zen VR	Gravity Sketch, SteamVR, Oculus Quest, Oculus Rift, Tilt Brush, Unity, Unreal Engine
Teacher 19	Secondary	1 year of attending VR language learning webinars	Immerse, Babbel VR, MondlyARChat	Oculus Quest, Oculus Rift, Tilt Brush, Unity, Unreal Engine
Teacher 20	Secondary	3 years of observing VR activities and simulations in language lessons at schools abroad	Altspace VR, VRChat, MondlyVR, Language Zen VR	Oculus Quest, Oculus Rift
Teacher 21	Middle	2 years of participating in an international exchange program that emphasized VR in language education	LingoVR, Rosetta Stone, Altspace VR	Oculus Medium, Oculus Quest, Oculus Rift, Tilt Brush, Unity
Teacher 22	Secondary	1 year of conducting research on the use of VR in language learning during their postgraduate studies	Immerse, MondlyARChat	Blender, Tilt Brush, Unity, Unreal Engine
Teacher 23	Secondary	1 year of attending VR language learning workshops	AltspaceVR, VRChat	Oculus Quest, Oculus Rift.

(continued on next page)

Table 1 (continued)

Teacher	Student Group	VR Experience/ Training (Years)	VR Language Learning Apps Observed	VR Tool/s Observed
Teacher 24	Primary	2 years of participating in a VR language learning pilot program	LingoVR, Rosetta Stone, MondlyAR, VR Language Lab	Oculus Quest, Oculus Rift, SteamVR, Tilt Brush, Unity, Oculus
Teacher 25	Secondary	3 years of collaborating with a foreign language institute that specialized in VR-based language courses	Immerse, MondlyVR, MondlyARChat	Quest, Oculus Rift, Tilt Brush, Unity, Unreal Engine

Informed consent forms were signed by focus group participants, guaranteeing their anonymity and providing them with the option to withdraw their data.

3.3.2. Quantitative data collection

An online survey consisting of 9 questions was administered to the 25 focus group participants. The survey aimed to gather quantitative evidence on the potential effectiveness of VR tools in teaching ML2. Google Forms were used to conduct the survey, and participants received a link to the questionnaire.

3.3.3. Qualitative data collection

Focus group discussions were conducted and recorded via Zoom to obtain qualitative data on teachers' opinions and experiences of using VR in ML2 instruction. The discussions addressed inquiries related to the potential of VR for language learning, integrating VR into the classroom, engaging aspects of using VR in Maltese language instruction, overcoming obstacles in digital language learning, key features of effective VR language learning, and methods for incorporating VR applications in Maltese lessons.

3.4. Data analysis

3.4.1. Quantitative data analysis

The quantitative data collected from the survey was analyzed using a Likert scale, a commonly used rating scale that allows respondents to indicate their level of agreement or disagreement with specific statements (Liddell & Kruschke, 2018). In this study, the survey focused on two main aspects: participants' opinions on the effectiveness of VR for educational purposes and the effectiveness of VR in facilitating language learning.

To collect data on these aspects, the survey included carefully designed questions that aimed to capture participants' perceptions and attitudes towards VR technology in the Maltese language classroom. The questions were structured to elicit numerical ratings on a scale typically ranging from 1 to 5 or from strongly disagree to strongly agree (see Appendix 1 for the full survey).

Following data collection, the responses were manually processed using MS Excel. Regression analysis was then conducted to explore the potential impact of teachers' age on their views regarding the effectiveness of VR tools in ML2 classroom settings. This analysis aimed to provide insights that can inform the development of strategies for implementing VR technology in ML2 learning.

3.4.2. Qualitative data analysis

Thematic Analysis was employed to analyze the qualitative data obtained from the focus group discussions with the 25 Maltese teachers. This method involved coding and categorizing the data to identify recurring ideas, concepts, and patterns, which were then organized into

themes (Nowell et al., 2017). NVivo, a computer-assisted qualitative data analysis software, was used to facilitate the organization, management, and analysis of the data (Aspers and Corte, 2019).

Thematic Analysis allowed for the identification of key themes (Maguire & Delahunt, 2017). Related to the effectiveness of VR in teaching ML2, as presented in Table 2. These themes, derived from the narratives provided by the participants, highlighted the potential benefits and challenges associated with VR technology.

To enhance the reliability and validity of the findings, member checking was conducted with the participants (Candela, 2019). The participants were provided with the transcripts and were given the opportunity to review and provide comments or make any necessary changes. It is important to note that both the qualitative and quantitative phases of the research explored similar issues, which further strengthens the validity of the study.

4. Results and discussion

4.1. Quantitative results

The study sought to obtain quantitative evidence on the potential effectiveness of VR in teaching Maltese. As shown in Table 3, the majority of the participants, 19 out of 25 (76%), strongly agree that VR is effective for educational purposes. This indicates a high level of confidence and positive perception among the participants regarding the potential of VR in education. Additionally, 6 participants (24%) agree that VR is effective for educational purposes. This further supports the overall positive sentiment towards VR as an educational tool. It is noteworthy that none of the respondents expressed a neutral stance, disagreement, or strong disagreement regarding the effectiveness of VR for educational purposes. This suggests a consensus among the participants that VR has potential and can be effective in an educational setting.

4.2. Effectiveness of VR in facilitating language learning

Table 4 presents the reported effectiveness of VR in facilitating language learning based on the responses of the participants. The table displays the number and percentage of respondents for each response category.

The majority of the participants, 14 individuals (56% of the respondents), strongly agreed that VR is effective in facilitating language learning. Additionally, 11 participants (44% of the respondents) agreed with this statement. Notably, none of the respondents expressed a neutral, disagree, or strongly disagree opinion regarding the effectiveness of VR in language learning.

The participants were also asked to rate the positive impact of VR on students' learning outcomes based on their professional knowledge and experience, using a 5-point rating scale. The average score of 3.40 indicates that the majority of the participants were confident that using VR could significantly influence their students' learning outcomes. This assessment was somewhat based on their experience, despite not having

Table 2
Themes.

Themes	The number of codes
VR offers a fully immersive experience.	24
With VR, there are no physical limitations to overcome.	22
VR provides virtual or real tours of historical sites.	20
VR merges education and entertainment.	16
VR is a forward-thinking tool in the realm of education.	14
VR requires further development.	11
VR caters to language learners of all ages.	7
Integrating VR in lessons can be challenging, and finding the right balance is essential.	6

Table 3

Respondents' Opinion on the Effectiveness of VR for educational purposes.

	Number of respondents	% of respondents
Strongly agree	19	76%
Agree	6	24%
Neutral	0	0%
Disagree	0	0%
Strongly disagree	0	0%

Table 4

Reported effectiveness of VR in facilitating language learning.

	Number of respondents	% of respondents
Strongly agree	14	56%
Agree	11	44%
Neutral	0	0%
Disagree	0	0%
Strongly disagree	0	0%

implemented VR in their classrooms yet. Therefore, the risk of bias related to this question was minimal. The study's findings on the effectiveness of VR in language learning, as reported in [Parmaxi \(2023\)](#), provide compelling evidence for the potential of VR to improve ML2 teaching.

4.3. Effect of age on opinion regarding VR tools

A linear regression analysis was conducted to explore the relationship between the respondents' age and their opinion on the effectiveness of VR tools in facilitating Maltese language learning. The study utilized regression analysis to explore the relationship between the respondents' age (an independent variable) and their opinion on the effectiveness of VR tools in facilitating Maltese language learning (a dependent variable).

Regression analysis allows researchers to understand the relationship between two or more variables by estimating the mathematical relationship between them ([Sarstedt & Mooi, 2014](#)). In this case, this research aimed to determine whether a relationship exists between age and opinion on VR tools. It employed linear regression analysis, which assumes a linear relationship between the variables, to analyze the data.

The current study involved 25 participants aged between 18 and 45 years old. The respondents' age was used as the independent variable for the regression analysis. This approach allowed the researcher to conduct a generalized comparison between the opinions of younger and older individuals regarding the effectiveness of VR tools in facilitating Maltese language learning. Through the regression analysis, the study aimed to explore any potential differences in opinions on a broader scale.

This study calculated regression coefficients, t-statistics, and p-values to evaluate the relationship between the respondents' age and their opinion on the effectiveness of VR tools.

The negative coefficient for age (−9.99) indicates that as age increases, the value of the dependent variable (the opinion on VR tools) decreases. The t-statistic and p-value suggest that this relationship is statistically significant, indicating that it is unlikely to have occurred by chance.

The intercept coefficient of 77.22 represents the expected value of the dependent variable when age is zero, although it lacks a meaningful interpretation since age cannot be zero. Nonetheless, it provides additional insights into the regression model. The F-value and its associated p-value indicate the overall statistical significance of the regression model, suggesting that the age variable significantly influences the opinion on the effectiveness of VR tools.

The regression analysis conducted in the research, presented in [Table 5](#), reveals a significant effect of the age variable on the opinion regarding the effectiveness of VR tools in facilitating Maltese language

Table 5

Results of the regression analysis.

	df	SS	MS	F	Significance F
Regression	1	614.40	614.40	12.49	0.0018
Residual	23	1131.04	49.18		
Total	24	1754.44			

	Coefficients	Standard Error	t Stat	P-value
Intercept	77.22	12.96	5.96	4.48E-06
Age	−9.99	2.83	−3.53	0.0018

learning (p-value = 0.0018). The statistical evidence provided by the regression coefficients, t-statistics, and p-values supports the observation that younger respondents demonstrate a stronger belief in the positive impact of VR.

These findings suggest a positive perception among the participants regarding the effectiveness of VR in facilitating Maltese language learning. However, it is important to consider that these results are based on self-reported opinions and may be influenced by various factors such as individual experiences, perceptions, and preferences. Nonetheless, the overwhelmingly positive responses suggest a general belief among the participants in the effectiveness of VR for ML2 or any other language learning.

4.4. Qualitative results

4.4.1. Immersion

The qualitative findings support the notion that VR is perceived as an immersive approach that can enhance student engagement in language learning. All 25 participants agreed on the immersive nature of VR and its potential to improve student engagement in lessons.

Teachers expressed their beliefs and expectations regarding the use of VR in Maltese language learning. Teacher 2 from a middle school mentioned the potential of "VR headsets with sensors and controllers" to grant students the freedom to explore and engage in a virtual environment. Teacher 2 anticipated that this freedom would increase student participation and interest in Maltese lessons. Similarly, Teacher 3 from a primary school highlighted that their students, who are fond of "games, magic, and fantasy", would be more engaged and motivated to learn Maltese in a virtual environment.

My pupils may be more engaged and driven to learn Maltese in a virtual environment since they adore games, magic, and fantasy.

(Teacher 3, primary school)

In addition to increased engagement, teachers emphasized the benefits of VR immersion for ML2 learning. Teachers 9 and 16 acknowledged that VR provides a unique opportunity for students "to practice and improve their speaking skills". Through avatars, students can engage in conversations with their teacher and peers in a virtual setting ([Zheng et al., 2022](#)), which is challenging to replicate in traditional or online classrooms. According to these teachers, VR creates an environment free from disruption and code-switching between English and Maltese, by facilitating focused language practice.

VR can help with two major issues in learning languages: motivation in adults and involvement in elementary students. On the surface, it gives that little boost, that thrilling and enjoyable element, but it also allows ... deeper connections with people through participation, role-play, and practice that is free of all the disruptions found in the classroom and online learning.

(Teacher 16, primary school)

4.5. VR eliminates physical barriers to language learning

According to the feedback from 22 teachers, VR offers a solution to

overcome physical barriers in language learning. Teacher 1 highlighted the benefit for students residing in countries with a substantial Maltese community, such as Australia, the UK, and Canada (Attard, 1989), who can practice Maltese with native speakers through VR. In VR, these native speakers can exclusively speak Maltese, allowing students to enhance their speaking skills without the interference of English, which often occurs in real-life conversations due to Maltese bilingualism. Therefore, VR is considered as a valuable tool for students to improve their speaking skills in Maltese.

(Teacher 8, middle school)

A VR app, in my opinion, promotes realistic scenarios that reduce mental burden, allowing students to focus on language acquisition rather than attempting to envision a scenario.

(Teacher 19, secondary school)

Fluency in a foreign language frequently demands a completely immersive approach. I know several adults, especially those living in Australia, the UK, and Canada, who would like to learn Maltese but are unable to visit or reside in Malta, making it impossible to practice with native Maltese speakers. Therefore, students residing abroad might use VR headsets to practically immerse themselves in Maltese language learning without any interference from English as usually happens when speaking to Maltese people.

(Teacher 1, secondary school)

4.6. An immersive experience for language and culture

According to 20 teachers, VR headsets offer an immersive experience by simulating real-life situations, that could enable students to experience Maltese language and culture. Teacher 17 specifically mentioned that VR can take students on virtual tours of historical places, providing social engagement and connectedness that is often lacking in distance learning.

I feel that VR can bridge the gap between the traditional classroom and the Teams online classroom. It could help students practice and interact with one another on a more advanced level than just face to face on the screen. It gives social involvement and connectedness that distance learning does not deliver.

(Teacher 17, primary school)

4.7. Practical and simulated tours

Twenty participants highlighted that VR can facilitate practical or simulated tours that help students develop language skills and apply them in real-life situations, as Teacher 7 described:

A VR game can give the one-of-a-kind, immersive experience that many learners of Maltese seek—namely, the opportunity to use their language skills in an authentic context. If these games include multiple players, it would be simple to develop a community language center for language learners.

(Teacher 7, secondary school)

Teacher 9 pointed out that VR allows students to interact with objects and other learners in realistic scenarios, by creating a dynamic learning environment.

By wearing 3D glasses or using avatars, students can interact with objects and other learners in some scenarios. These environments can include 3D objects, scenery, and simulations from the real or fictional world.

(Teacher 9, middle school)

4.8. Concentration and language acquisition

Seventeen teachers, including Teachers 8 and 19, emphasized that VR enables students to concentrate on language acquisition.

VR apps can help students master grammatical forms such as the use of 'hemm' there is/there are while asking them to describe what they observe in the VR world.

4.9. VR combines education and entertainment

Sixteen teachers mentioned that VR combines educational and entertaining aspects, providing a multisensory approach that can enhance vocabulary memorization and student engagement in real-life situations. Teachers 3, 5, 13, 24, and 25 pointed out the limitations of learning Maltese from textbooks and how VR can provide a more immersive and interactive learning experience.

VR allows students to enter in previously inaccessible areas when unaccompanied by adults, such as hospitals and restaurants, and then they can role-play.

(Teacher 3, primary school)

A VR app can transport teachers and students to locations they would be unable to visit in person owing to time and distance, or safety concerns. For example, after reading Dun Karm's poem about Wied Qirda, a VR app could transport us to Qirda Valley during the battle between the Zebbug people and the French army in 1798. Hence, thanks to VR, students can be in the midst of the battle, providing them with a first-hand experience that goes beyond simply reading poems, viewing photographs, or watching movies on how the French army was defeated by the Zebbug people. In fact, depending on the novel students are reading, VR can take them on a sailing trip around Gozo or Comino, on an underwater walking tour, on a tour of the moon, or to the national poet, Dun Karm Psaila's house in Zebbug, where they could see him writing poems and talking to his bird, or on a fantasy tour.

(Teacher 5, secondary school)

VR can also inspire students to solve riddles like Sherlock Holmes. Students can participate solving mysteries such as ghost stories, the missing children of the Hypogeum, the elongated extraterrestrial skulls discovered at the Hypogeum, or the secret pathway in St Gregory's Church in Zejtun that was packed with human bones. And what about the curious carvings throughout the countryside in the shape of holes in the ground which we were told, were Punic graves, or the parallel grooves going from nowhere to nowhere which we were told ... are cart ruts, and even pans carved into the shore that are still used as saltpans nowadays. Therefore, VR can inspire students to confront some of our time's biggest mysteries and to solve them while learning Maltese.

(Teacher 13, middle school)

Pupils can learn Maltese by playing VR games like billiards or paintballing. Students will surely remain motivated and engaged in the lessons by playing such games.

(Teacher 24, primary school)

Students can use VR software that has shopping scenarios where they are physically given a shopping list, say, to follow a recipe and bake a birthday cake, and then they are instructed to go and fetch these products, place them in their shopping trolley, and go to the cashier. They can purchase the goods and hold a conversation, and everything feels so real.

(Teacher 25, secondary school)

4.10. Innovative tool in ML2 learning

Eleven teachers expressed that VR can be an innovative tool in ML2

learning, serving as a bridge between traditional and online classroom settings. Teacher 5 highlighted the value of VR language games like “Mondly” in language learning.

Several businesses have begun to invest time and money in developing language learning VR games. Mondly, for example, is a VR game that lets players improve their language abilities in various realistic scenarios. Users can talk to a bus passenger, order meals at a restaurant, and check into a hotel. Although this game has its challenges, spanning from technical issues to critiques of a difficult language learning curve, it would be fantastic if we could have Mondly in Maltese.

(Teacher 5, secondary school)

4.11. Challenges and balance in integrating VR

While VR holds great potential, there are challenges that need to be addressed. Teacher 6 highlighted the lack of consistent Wi-Fi connections in many schools, making it difficult to download substantial resources simultaneously onto students’ devices. Furthermore, the technology for realistic simulations of speaking activities is not yet advanced enough, and there are ongoing technical challenges in building fully immersive language learning games, including audio issues and voice recognition (Mealy, 2018).

Technology is not yet advanced enough to provide a smooth, realistic simulation of speaking activities. Technical challenges will impede VR games for years to come, and given the difficulty of building a fully immersive language learning game, those issues will be amplified. Any audio issues with voice recognition will quickly spoil the user experience.

(Teacher 6, secondary school)

Six teachers acknowledged the challenge of incorporating VR into lessons and emphasized the importance of striking a balance between using VR and traditional teaching techniques. While recognizing the academic value of VR and its ability to provide exceptional learning experiences, they highlighted the need for a hybrid approach (Radianti et al., 2020) that combines VR with established teaching methods.

There really is no denying that VR has academic value since it produces exceptional and unforgettable learning experiences. However, like with other technology, the challenge of introducing VR into our lessons is to find the best balance. VR cannot replace real-life teachers, but when educators combine VR with traditional teaching techniques, this hybrid strategy can modify the learning process that we know.

(Teacher 1, secondary school)

4.12. Overcoming challenges and enhancing writing skills with VR

Another disadvantage mentioned by both the focus group and the literature review is the potential difficulties associated with adopting VR in ML2 learning. These challenges could include the high cost for some schools, the inconvenience of bulky headsets, and the reliance on a stable internet connection (Yoshimura & Borst, 2021). Teachers 5 and 22 highlighted these concerns:

Fortunately, HTC (Hi-Tech Computer) is developing a VR headset that is so lightweight that it feels like wearing glasses [instead of] the clunky, weighty, and unpleasant goggles we currently have.

(Teacher 5, secondary school)

A possible technical challenge at many schools is a lack of a consistent Wi-Fi connection to download all of the large resources on student devices at the same time. However, some VR app developers have already discovered a solution to this problem by making virtual

tours available for download on the teacher’s laptop/smartphone/tablet. That device then acts as a local server for all connected student laptops/tablets.

(Teacher 22, secondary school)

While there were similarities between the findings of this study and the existing literature, there were also some differences. The participants did not mention the devaluation of human connection associated with VR, which has been noted in previous studies (Radianti et al., 2020; Yoshimura & Borst, 2021). However, effective communication skills are crucial for language learners and deserve attention. Additionally, the participants did not discuss the potential negative effects of VR on students’ health, such as addiction, eye strain (Cook et al., 2019; Yoshimura & Borst, 2021), and motion sickness (Eunhee, et al., 2020). This lack of mention may be due to the educators’ limited experience with VR.

One significant finding of this study is that VR can play a crucial role in developing writing skills in the Maltese language. Students often struggle with storytelling and varied writing styles when composing narrative, descriptive, or persuasive essays. However, by providing visualizations of concepts, VR can assist in the development of these skills.

For example, when writing an expository essay, a learner using VR can engage in role-playing, explore relevant concepts, and fill out a chart. This hands-on experience allows students to gain insights into how to write this type of essay. Similarly, for descriptive essays, students can wear VR glasses and navigate through a virtual house, observing people and objects to gather vivid details for their writing. Sharing their observations with peers could further enhance the students’ presentation and writing skills.

In persuasive writing tasks, VR can be highly beneficial. For instance, if the writing task is to describe a football player’s emotions after winning a championship game, students can use VR to immerse themselves in a virtual football stadium, experiencing the electrifying atmosphere of the victory firsthand. This immersive experience adds depth and authenticity to their writing.

Existing research provides strong support for the notion that VR enables detailed observation and access to unique experiences that may not otherwise be available (Fromm et al., 2021). By leveraging VR technology, Maltese learners can enhance their writing skills and engage in more immersive and compelling narratives.

While there are challenges to overcome in the adoption of VR, its potential to enhance language learning, particularly in developing writing skills, is evident. With the ongoing advancements in VR technology and the integration of innovative teaching approaches, educators can harness the power of VR to create transformative Maltese learning experiences for their students.

5. Study limitations

It is important to note that this research has some limitations. Firstly, the participants had some familiarity with VR from their personal experiences, but they had not used it in their classroom. Thus, their opinions may be influenced by biases, as their assessments of the potential effectiveness of VR tools are not based on direct experience. Secondly, the sample size was small because there are only a few ML2 teachers in Malta, and it is not a compulsory subject in all schools yet. Thirdly, this study relied on the subjective comments of the teachers, which were not objectively tested. Moreover, the participants had some familiarity with VR from their personal experiences but had not used it in their classrooms. Therefore, the findings of this study cannot be generalized.

Another limitation is that this study solely focuses on the educators’ perspectives, whereas the students’ viewpoints are not taken into consideration. Secondly, the findings are only applicable to VR apps that concentrate on language learning and may not be generalizable to VR apps designed for other subject areas.

6. Recommendations

Based on the findings of this study, it is recommended that educators and researchers focus on the development of VR applications specifically tailored to Maltese language teaching and learning. Currently, there is a lack of VR apps available in Maltese, which presents an opportunity to enhance language learning experiences for Maltese learners. By creating immersive and interactive VR experiences that focus on teaching Maltese vocabulary, grammar, and pronunciation, students can engage in a dynamic and engaging learning environment that promotes Maltese language acquisition.

To effectively incorporate VR into Maltese language learning, teachers should have first-hand experience and training with VR technology before introducing it to their students. This will allow them to become familiar with the VR tools, understand their potential applications, and effectively guide students in their VR language learning experiences.

Furthermore, educators should set reasonable time limits for students' VR use to ensure a balanced approach. While VR can be highly engaging and immersive, it is important to strike a balance between VR activities and other forms of Maltese language practice. Integrating VR into lesson plans as a supplemental tool, alongside traditional teaching methods, can be an effective approach.

Teachers should also be prepared to address any questions or concerns that may arise during students' VR experiences. VR applications may not cover all Maltese language learning aspects or cater to individual student needs. Therefore, teachers should be equipped with the necessary knowledge and resources to support students and provide additional explanations, clarification, and practice as needed.

In addition, further research is needed to explore the practical implications of implementing VR in Maltese language learning. This includes evaluating the availability of VR hardware and software resources in educational settings, considering the time required for teachers to prepare and integrate VR tools effectively, and examining the potential benefits and risks associated with using VR for different Maltese language learner profiles.

It is also essential to consider the potential health impacts of prolonged VR use and take appropriate measures to mitigate them. Educators should ensure that students take regular breaks, maintain proper posture during VR activities, and be aware of potential discomfort or adverse effects. By promoting a safe and healthy VR learning environment, international students learning Maltese can fully benefit from the immersive language learning experiences VR offers.

Finally, future research should focus on developing guidelines and best practices specifically for using VR in Maltese language teaching and learning. These guidelines should address pedagogical considerations, effective integration of VR into the curriculum, assessment methods for evaluating the impact of VR on language learning outcomes, and strategies for fostering learner engagement and motivation within the VR environment.

7. Conclusion

This study employed a mixed methods approach, combining quantitative and qualitative analyses to investigate the perspectives of 25 educators on the potential of using VR in ML2 classrooms. The educators had prior knowledge of VR but had not yet incorporated it into their language teaching practices due to lack of VR apps in Maltese. The findings revealed that despite the lack of practice of VR in Maltese classes, the majority of educators recognized its usefulness as a tool for ML2 acquisition. Notably, younger educators exhibited a stronger belief in the potential of VR to enhance language learning compared to their older counterparts. The study also identified several issues associated with VR, including technical challenges, the need for further improvement of VR apps, and cost considerations. However, it underscored the potential of VR to create a fully immersive language learning

experience. The participants demonstrated varying degrees of VR experience and training, exposure to diverse VR language learning apps and tools, active engagement in professional development, practical experience with VR implementation, and exposure to international settings. Nevertheless, the lack of availability of VR resources and research in the context of the Maltese language highlights a potential gap that needs to be addressed to fully leverage the benefits of VR in Maltese language learning. Based on the findings, it is suggested that VR could emerge as one of the most effective techniques for teaching and learning Maltese in the future. Further research and efforts to expand VR resources and support in the ML2 context are recommended to harness the full potential of VR technology.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cexr.2023.100035>.

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