

Review

# Application of the Extended Reality Technology for Teaching New Languages: A Systematic Review

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**Abstract:** Much attention has been given to the use of extended reality (XR) technology in educational institutions due to its flexibility, effectiveness, and attractiveness. However, there is a limited study of the application of XR technology for teaching and learning languages in schools. Thus, this paper presents a systematic review to identify the potential benefits and challenges of using XR technology for teaching new languages. This review provides a basis for adopting XR technology for teaching languages in schools. This research also provides recommendations to successfully implement the XR technology and ways to improve motivation, engagement, and enhanced accessibility of learning and teaching resources on both students and teachers. To fulfil the aims of this research, previous studies from 2011 to 2021 are collected from various academic databases. This study finds that there is still a need to develop appropriate strategies for the development and implementation of XR technology for teaching new languages to school students.

**Keywords:** extended reality technology; technology adoption; language teaching; benefits and challenges



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## 1. Introduction

Learning a new language is often found to be complicated [1]. Hossain [2] and Kanwal and Khurshid [3] point out that there are challenges with teaching a new language. They state that some students show a lack of motivation in learning a new language. Meanwhile, Mohd et al. [1] observed that plenty of students found it difficult to grasp the language, while other students were not able to relate to the context and found the traditional learning process to be boring. A study on identifying the issues with teaching English language in Indian undergraduate colleges found that students are not usually motivated in the learning process [4]. Kanwal and Khurshid [3] believe that students are not motivated to learn a new language seriously, because they are not satisfied with the teaching programs. For example, Rababah [5] highlights that teachers find students were not interested in learning the English language, because these students faced many issues including the lack of suitable teaching methodologies. Prior studies investigating the issues associated with teaching the Arabic language noted that students were unable to grasp the concepts well due to insufficient teaching resources [6,7].

In recent years, mixed reality (MR) technology has gained popularity in the education sector. Canada and China are among the list of countries exploring the possibility of embedding MR technology into the learning and teaching processes [1,8]. MR technology is a combination of both digital and physical worlds to present a new visual experience. It combines the aspects of augmented reality (AR) and virtual reality (VR), and allows users to interact with a virtual environment [8].

Integrating technology in the education system has enhanced the accessibility of learning and teaching resources for improving language learning and teaching experience [9]. Burden and Kearney [10] believe that proper adoption of technology in learning and teaching will positively result in improving teaching quality, motivating teachers, and increasing their fluency and engagement in learning and teaching languages. Wibowo et al. [11]

explain that the use of technology in the educational system has grown remarkably because of its flexibility, availability, and effectiveness. The proper adoption of technological equipment in the learning and teaching process can positively result in the best improvements and development of the quality of teaching, motivation of the students, and solve some students' learning problems [1,10–12]. Wekke and Hammid [12] highlight the effect of using MR technology for improving authenticity, personalization, and collaboration. Meanwhile, Lin and Lan [13] believe that most students in higher education become more interested in using new MR technology for learning a language. In addition, Mohd et al. [1] point out that the use of technology is very beneficial for improving the teaching quality, supporting students' motivation and solving students' challenges. Bonner and Reinders [14] believe that teachers' attitudes change, becoming a facilitator, counsellor, and resource person more than a decision-maker after the adoption of MR technology. The new role of teachers in the classroom is not only to transmit new information and knowledge, but also to teach learners the way to acquire the data and value electronically. On the contrary, if teachers have negative and pessimistic attitudes toward using technology in education, they will have negative cultural perspectives [15]. It is noticed that many Arabic teachers still need to take more courses and workshops in learning new technological programs to achieve success [16]. Consequently, Na [17] clarifies that teachers who have deep consciousness and awareness of using technological devices will have successful and positive attitudes towards the adoption of technology in the educational system [16–18].

Al-Busaidi et al. [19] found that the abilities of some Omani schools' students in learning Arabic exhibited notable improvements, particularly in analysis, comprehension and dialogue skills when learning or teaching is supported by software technology. Cheng et al. [20] believe that most higher education students developed a greater interest in language learning with the support of MR technology. They believe that using MR technology is very beneficial for improving the teaching quality, supporting students' motivation, improving students' concentration, increasing students' intention, and solving students' challenges. Al-Busaidi et al. [19] also argue that the use of immersive educational games with pictures and sounds in learning Arabic helps to increase students' engagement, generate higher learning outcomes, and support effective learning. Ismail et al. [21] found that Arabic teachers positively employ more modern technologies in classrooms if they have higher degrees of computer self-efficacy. Albirini [16] point out that technical knowledge is an essential requirement for improving and developing teachers' attitudes and awareness, and teachers' knowledge of the cultural non-neutrality of information and technology may have a substantial influence on their attitudes and teaching approach. Cheng et al. [20] state that the use of technology for achieving a high level of computer experience in the education system can improve the teacher's teaching behaviors, attitudes, performance, confidence, and skills. The authors also state that virtual e-activities help to develop teachers' level of knowledge, grammar competence, writing skills, discourse competence and confidence in teaching a second language. Al-Busaidi et al. [19] notice that students who spend more time using e-learning are more likely to have higher satisfaction with the technology experience. However, if a student is dissatisfied with the technology, they are more inclined to enroll in another study program with a different institution.

With the COVID-19 pandemic, online teaching has become the norm across most schools and universities around the world. While it has created opportunities to continue providing education to students, teachers are required to undergo training programs to learn ways to deal with online educational programs and how to run new educational activities. A study conducted by Baran and Alzoubi [22] on digital learning program for preservice teachers at Midwestern University shows that teachers need to effectively manage technology in classrooms, have efficient leadership around technology, and evaluate technology equipment suitable for learning and teaching activities. The above studies have also shown that XR technology can have a significant positive impact in learning and teaching languages. Thus, it is critical for teachers to focus on the effective use of XR technology to motivate students in their learning process.

Based on a review of existing literature, this study has identified two research gaps. Firstly, prior studies have explored the challenges associated with teaching a new language, but there is limited literature on the use of technologies to enhance students learning experience. XR technology is being used in various sectors including engineering, entertainment, and healthcare as it enables users to interact with virtual objects. Literature sheds light on the use of innovative technologies for teaching. While there are opportunities with using XR technology in the education sector, there is a shortage of studies investigating the applicability of XR technology in teaching the Arabic language, let alone in schools. Secondly, this study considers the challenges associated with teaching the Arabic language to school students in Australia for understanding the challenges faced by the Australian students. In addition, studying the potential benefits of using XR technology in teaching the Arabic language can help school teachers to enhance students learning experience. Therefore, this study aims to conduct a systematic review to identify the potential benefits and challenges of using XR technology for teaching a new language to school students in Australia. In line with the aim, two research questions are presented:

- What are the benefits and challenges faced by language teachers in teaching languages in schools?
- What recommendations can be made to support the adoption of XR technology for teaching languages in schools?

This paper consists of six sections. Section two outlines the systematic review method this study uses. Section three presents the results on the development of XR technology for teaching languages. Section four presents the discussion on the adoption of XR technology in schools. Section five presents the key findings and future research opportunities. Finally, section six presents the recommendations.

## 2. Systematic Review Method

This section followed the preferred reporting items for systematic review and presents a review on the potential application of the XR technology for learning and teaching. This review provides an opportunity to gain an insight into the benefits of using XR technology for teaching purposes. For this research project, relevant journal articles are selected from ERIC, JSTOR, Science Direct, Emerald, Web of Science and IEEE databases by using keywords including 'Arabic language', 'learning technologies', 'virtual reality', 'extended reality' and 'teaching language'. To ensure relevancy and to access up-to-date knowledge, articles published between the years 2011 and 2021 were selected.

### 2.1. Search Strategy

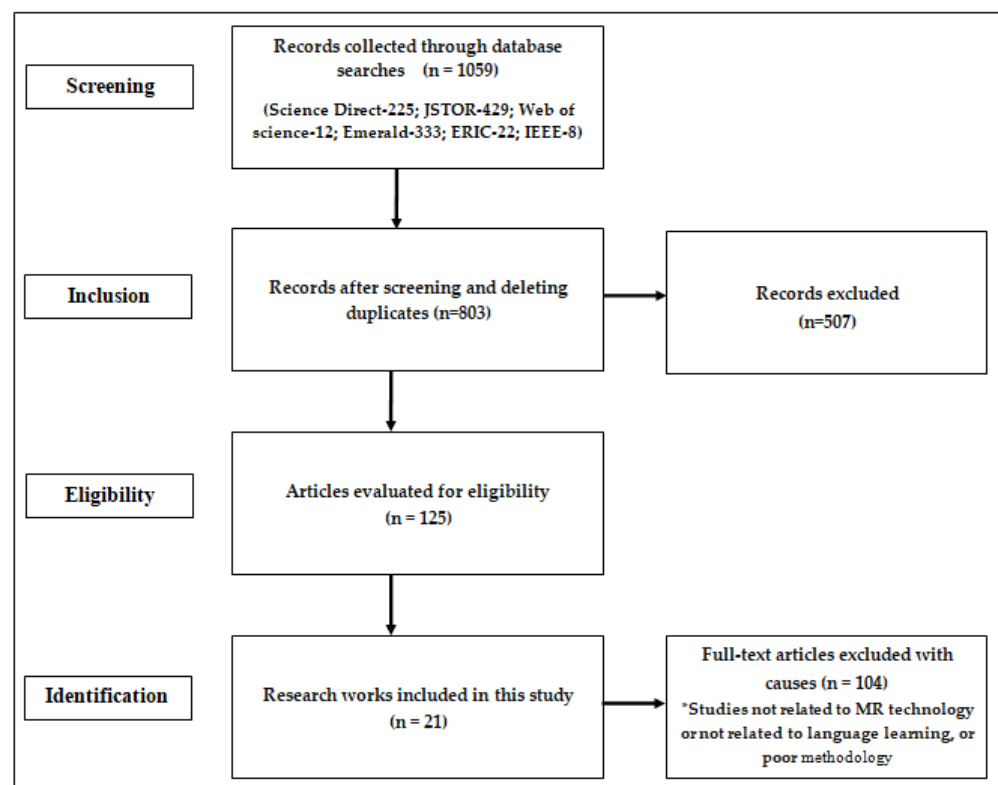
A systematic search for journal articles was performed in academic databases including Science Direct, Web of Science, Emerald, JSTOR, IEEE and ERIC. Initially, Science Direct and Web of Science databases were searched. The search was conducted using the terms: XR technology or Arabic language or learning technology or teaching language or teachers or learning a second language or education environment or virtuality or language learning or online learning or challenges in learning. The search results included journal articles on technology, science, and teaching language. The search was limited to articles published from 2011 until 2021. Moreover, the reference lists of the articles chosen for inclusion from the database search were checked to distinguish any missed articles because of several keywords. The database search yielded 242 articles from the Science Direct database, 12 articles from the Web of Science database, 429 articles from JSTOR, 333 articles from Emerald, 8 articles from IEEE and 22 articles from ERIC.

### 2.2. Inclusion and Exclusion Criteria, and Selection of Studies

In this systematic review, it is aimed to characterize the current adoption of XR technology in education. For this purpose, it has been set specific inclusion and exclusion criteria to identify documents that describe XR technology and teaching language from articles. All journal articles on XR technology and teaching language must meet the

following criteria: all articles were tested for inclusion or exclusion criteria, for example the following exclusion criteria for articles published before 2011 and with no full text available. In addition, articles not published in English language, posters, reports, abstracts only and not published in a peer-reviewed paper, were excluded. Documents falling outside 'learning technologies', 'XR technology', and 'teaching and learning language' have been excluded.

Selected studies were identified through the search were imported from the database. In line with the standard PRISMA flowchart, the literature which emerged from the databases has been screened in two steps to ensure relevancy and review quality [9]. In the first step, a review of article titles and abstracts was conducted to see if they are relevant to the study and meet the inclusion criteria. Then, in the next step, the articles with full-text were retrieved, and the articles not related to XR technology or related to language learning were removed. The approach adopted for screening the articles is shown in Figure 1.



**Figure 1.** The PRISMA flowchart.

### 2.3. Data Analysis and Synthesis

Based on the search outcomes, 21 articles were selected for further analysis and review. In this systematic review, data were collected, analyzed, identified, and reported. To identify the recurrent themes a six-step process was followed. In the first step, thematic analysis was conducted to gain an in-depth understanding of the data. Then, initial codes were developed. In the third and fourth steps, sub-themes were identified and reviewed the sub-themes. In the fifth step, relevant concepts were compiled. In the final step, the data were checked to ensure their relevance to the goals of this study [9].

This review is aimed to provide an overview of the pedagogical usage of XR technology in teaching the Arabic language in Australian schools. The research papers that emerged from the databases have been screened in two stages. Firstly, a review of abstracts and titles of the retrieved literature is conducted to see if they meet minimum inclusion criteria [23]. Secondly, the full text of the included articles was reviewed and retrieved

using the CQUniversity database tool. A total of 1059 articles were retrieved from the databases. This was reduced to 803 articles after screening and deleting duplicates and inappropriate articles. Then, 125 articles were obtained after the eligibility evaluation process. In the last step, the remaining articles that were not related to MR technology, language learning, or having poor methodology were excluded from the study. Thus, a total of 21 articles were used for this study as shown in Figure 1. However, it is found that there was no study on the use of XR technology for teaching Arabic language, which further justifies the need for this study. Figure 2 shows the distribution of published articles from 2011–2021. Results indicate that majority of the papers were published from 2018 onwards and the research on technology use for teaching new languages increased in 2020 as compared to previous years.

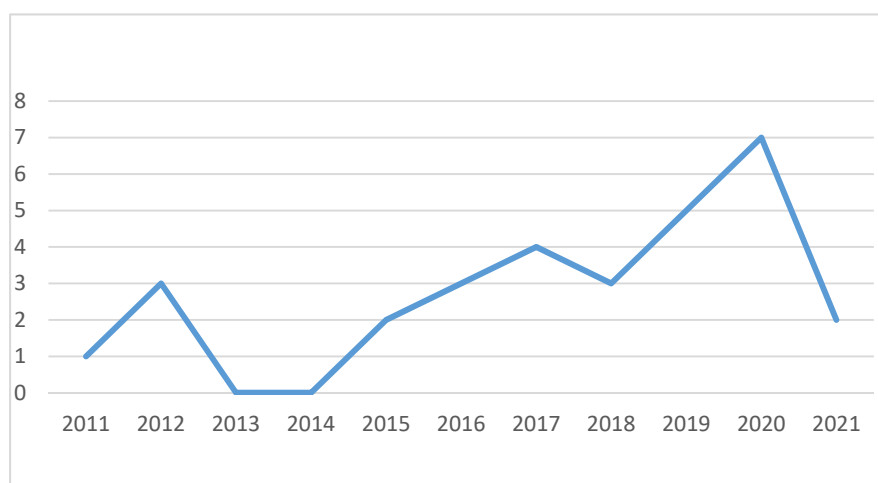


Figure 2. Distribution of the selected papers by the year of publication.

### 3. Results

This section presents the results obtained from the selected articles. This study identified three main themes from the articles in the use and benefits of XR technology in education. These are (a) facilitating language learning, (b) increasing students' fluency, achievement and engagement, and (c) motivating students to learn a new language. In addition, two challenges in relation to the implementation of XR technology were identified. The challenges include the difficulties of using XR devices and applications, and the limitations of the learning and teaching process.

#### 3.1. Facilitating Language Learning

Eleven articles reported that MR technology has been a successful tool to facilitate the process of learning amongst educational institutions [24–30]. Franciosi [26] states that the use of computer game-based lessons positively impacts vocabulary acquisition, vocabulary learning, vocabulary retention and writing tasks. Petrove and Atanasova [30] explored the effects of MR technology on students' learning performance and revealed that MR technology has a notable positive effect on language learning and achievements due to the nature of its flexibility, efficiency, and accessibility. Meanwhile, Dolgunsoz et al. [31] showed that most students found MR technology enjoyable and effective, because it could present a real appearance like learning in a class environment and created a feeling of engagement. Garcia and Silva [27] believe that MR technology can facilitate collaborative learning and increase students' fluency in a language, leading to a better understanding of the education materials. Furthermore, Lew et al. [28] claim that the MR technology improves the quality of the learning experiences and supports students' motivation and creative self-sufficiency.

### 3.2. Increasing Learners' Fluency, Achievement and Engagement

Prior studies [25,27,32] point out that MR technology can increase learners' fluency and engagement in learning a new language. Lin and Wang [29] assert that MR technology can enhance collaborative learning, increase learners' fluency in learning a language, help understand education materials, improve the quality of the learning experiences, strengthen the learning system, and support students' motivation and creative self-efficiency [27,30]. Alfadil [33] states the impacts of applying the VR game 'House of Languages' on language vocabulary acquisition revealing that students who used the game 'House of Languages' had better achievements in vocabulary acquisition than before. Dalim et al. [34] applied AR educational games for learning a new language. Their study revealed that AR helps students to improve their knowledge, language fluency, and finish certain tasks faster and more easily. They found that AR empowers students to be self-directed, take ownership of language learning, and participate in learning activities [35].

### 3.3. Motivating Students to Learn a New Language

Lin and Wang [29] examined the positive impacts of a VR creative project on English language learners' creative self-efficacy, inspiration, and motivation toward using VR technology in teaching university students. They found that VR technology can motivate students to participate in learning activities and it helped improve students' writing performance [36]. Studies point out that computer game-based lessons help with vocabulary acquisition, vocabulary learning and memory, vocabulary retention, writing tasks, and had a motivational effect on students' attitudes [26]. Virtual multimodal teaching and learning environments can invoke less proficient students' attention and motivation, and enhance collaboration and language performance [37]. Studies into the use of AR mobile language learning tools suggest that an AR-based learning tool 'Explorenz' can help bridge the gap between gaming and education, making language learning more motivating and exciting [38].

### 3.4. Difficulty with Using XR Devices and Applications

In the beginning, there was insufficient knowledge about using VR, which led to problems in using the technology and achieving the expected outcomes [29]. A study by Dalim et al. [34] on children's experience in terms of knowledge gain and enjoyment when learning through AR technology revealed that students had difficulties using a computer mouse and speech recognition. This can be attributed to a lack of sufficient knowledge about using VR technology. Technical limitations such as physical discomfort caused by wearing VR goggles and low video resolution can limit its use. Besides the technical limitations, social anxiety can limit the use of new technologies. For example, shyness and fear of criticism may prevent learners from using VR devices [27]. Sometimes, too much learning anxiety and difficulty with using AR educational games can lead to worse performance and may adversely affect the students' motivation and intention to use it [39].

### 3.5. Use of XR Technology in Learning and Teaching Processes

Over the years, new technologies have been adopted by the education sector for learning and teaching. Although AR technology has been adopted in many educational applications, most applications are still limited to learning a few subjects and limited curricula [40]. Alfadil [33] highlights that there is limited research on teaching language vocabulary through XR technology. This presents an opportunity to conduct further research on the use of new technologies for learning a new language. Moreover, it is important to create awareness among students and teachers that the use of new technologies such as MR technology is an efficient vocabulary acquisition procedure in the learning and teaching process to be engaged in all school stages. It will not only develop vocabulary acquisition, but also support the degree of awareness and achievement [33]. Bonner and Reinders [14] explain that there are limited MR training courses. Hence, providing both teachers and students with an introductory training program on using new technologies such as AR

and VR will help students to exploit the full benefits of these technologies [41]. Table 1 provides details of the selected articles including authors names, the focus of the study, study participants, challenges, influencing factors, methods, drivers, challenges, delivery mechanism, and impacts.

**Table 1.** Study characteristics and summary of the factors associated with XR technology.

Categories Reflect Factors Affecting the XR Technology Adoption								
Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts	
1	Garcia and Silva [27]	Mixed method	72 third year university students	Virtual environment of second life and Avatar	Virtual environment can increase learners' fluency and engagement in English	Shyness and fear of negative criticism	Enhanced collaborative learning, increasing learners' fluency in English and improved the quality of the learning experience	
2	Bonner and Reinders [14]	Review	Teachers	AR and VR technologies	AR and VR devices are becoming cheaper and more flexible and available	Expensive price of structures, privacy concerns and practical issues of classroom implementation.	AR and VR technology can encourage and motivate students to participate actively in language learning environment	
3	Sanchez-Gomez et al. [41]	Mixed method	A total of 451 pre-service teachers	Wiki software and virtual environment	The effectiveness of wiki program in developing pre-service teachers' writing skills	Teaching flexibility	Effectiveness of the technology for improving the confidence and quality of pre-service teacher's English language	
4	Can et al. [11]	Mixed method	36 foreign language students	Three-dimensional virtual learning environment and the Second Life Platform	Most students were very highly engaged in using the technology	Some students encountered technical problems and culture issues	Students have shown high participation in the use of the technology	
5	Li et al. [40]	Qualitative method	English language students	AR technology	After implementing AR technology, the classroom becomes more joyful and pleasant	Most AR applications are limited to the particular learning subjects and curricula	Students are enthusiastic about the technology	
6	Dolgunsoz et al. [31]	Mixed method	24 EFL students	VR technology	Most EFL students thought that VR technologies were promising, motivating and enjoyable	Issues relating to technical limitations such as physical discomfort and low video quality	Students had positive improvements towards using VR technology in learning English language	

Table 1. Cont.

Categories Reflect Factors Affecting the XR Technology Adoption								
Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts	
7	Lew et al. [28]	Applying MR technology classroom simulations to ESOL teacher preparation	Qualitative method	English language pre-service teachers	MR technology in learning language	Creation of a safe environment and teaching flexibility	Further development and improvement in interactional scaffolding for English language progress	The technology is flexible and creates a safe environment
8	Aljowaysir et al. [32]	Applying MR technology and artificial intelligence technologies for learning and teaching	Qualitative method	Non-native English students	Applying MR technology and artificial intelligence technologies in education	Unique combination of physical and virtual worlds	Working with hearing disabilities and students with language-based learning disabilities makes teaching more challenging	Students become more engaged in learning language when using new technologies and strategies
9	Petrov and Atanasov [16]	Exploring the effects of an AR technology on learners' learning performance	Quantitative method	80 secondary school students	AR adoption facilities for a STEM Enrichment Program	Supporting learning by using a combination between the AR and physical facilities for a STEM Enrichment Program. These technologies allow for collaboration and possibility to run many different applications	Experts are still trying to study the effects of AR on student's learning	The effect of biology learning environment mediated by AR technology, adopted to support and strengthen the learning system and understanding of the education material
10	Lin and Wang [29]	Examining the impacts of a VR technology on English language learners' creative self-efficacy, inspiration and motivation	Mixed method	39 university students	Virtual technology	Motivating students to learn English language by using the VR technology	In the beginning, there were insufficient knowledge about using VR led to problems in using the technology and achieving the expected results	The technology can be efficiently integrated into an English language classroom to support student's motivation and creative self-efficiency
11	Danaei et al. [42]	Investigating the influence of apply AR storybook on reading comprehension of students	Qualitative method	34 school students	Applying augmented storybook	Motivating and encouraging students to have better retelling story and comprehension	Limited number of respondents	AR technology motivates students and makes them better in retelling stories and answering comprehension questions



Table 1. Cont.

Categories Reflect Factors Affecting the XR Technology Adoption								
Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts	
12	Hsu [39]	Application of AR educational games for learning English language	Quantitative method	A total of 38 students	AR educational game system	The students had excellent learning effectiveness and achievement	Too much learning anxiety can lead to worse performance and may adversely affect student motivation and intention	Students using the self-directed or task-based AR educational game system had high learning effectiveness more than those using the self-directed system
13	Dalim et al. [34]	Investigating students' experience in terms of knowledge gain and enjoyment in using AR technology	Quantitative method	120 school children	Using AR, VR technologies and speech recognition technologies	More enjoyable and easier	Young students had difficulty with using a computer mouse and speech recognition	Increase in knowledge gain and enjoyment and finishing the certain task faster and easier
14	Huang et al. [36]	Using VR technology to develop students' communication skills	Mixed method	45 school students	VR technology	VR technology can motivate students in the classroom and improve students' writing performance	Technology complexity and challenges	Improvement on students' progress and performance
15	Alfadil [33]	Understanding the impacts of VR on learning English language vocabulary	Mixed method	Intermediate school students	VR technology	VR technology empowering and inspiring students	The limitation of this work is its gender-limited nature	Students had better achievement in vocabulary acquisition than ever before
16	Franciosi [26]	Exploring English language classes at a Japanese university using computer game-based lessons	Quantitative method	First and second year students enrolled in four English language courses at a university level in Japan	Virtual computer game-based learning	Positive impacts on vocabulary acquisition, vocabulary learning and memory, vocabulary retention, writing tasks and motivational effect on students	The technology does not necessarily work well with other demographics.	Positive motivational effect on students and their vocabulary acquisition
17	Ho et al. [43]	Developing a learning instruction system with Augment Reality features to improve the performance of English language learning	Quantitative method	90 college students	Augmented reality and virtual environment	Employing AR technology positively improve students' learning performance	English language learners mostly confront problems when they have to speak English in real life settings	Learning strategies and users' cognitive techniques impact language learning performance

Table 1. Cont.

Categories Reflect Factors Affecting the XR Technology Adoption								
Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts	
18	Lee and Kim [37]	Showing the positive learning impact of formulating English language sentences and writing activities via Social Network Service in virtual space.	Mixed method	62 University students	Virtual multimodal teaching and learning environment	Invoking less proficient students' attention and motivation also enhancing their collaboration and language performance	It is important to explore more effective methods of applying cutting-edge-technology for timid learners with less voluntary involvement	Virtual multimodal teaching and learning environment can invoke less proficient students' attention and motivation also enhancing their collaboration and language performance
19	Ou Yang et al. [35]	Use of a 3D learning system to provide students with an authentic setting to facilitate communicative ability development	Mixed method	72 students in a high school	VR technology	Increasing language learning, attention and engagement	High cost of the equipment	Students were empowered with the ability to self-direct learning, thus contributing to increased ownership of language learning, attention and engagement in lower level of anxiety
20	Yeh et al. [24]	Use of a 3D VR system to create a story	Qualitative method	65 students	A 3D virtual environment	Allow students to actively interact with learning contexts, decreasing the anxiety level of learning, and giving a relatively authentic learning experience	Age of the participants	Teachers can establish a learning system without much intervention during their collaboration
21	Perry [38]	Assessing the use of a mobile language learning tool	Mixed method	First-year University French students	MR technology and quest-based learning	Development and improvement of students' language skills	Technical difficulties.	Increased student motivation and excitement to learn

#### 4. Discussion

The use of information technology (IT) for learning and teaching practices has been increasing in the last decade, as it is flexible and presents opportunities to use different instructional methods to facilitate learning [44]. For example, IT-enabled instructional methods include simulated practical experiences, technology-assisted visual explanations, and collaborative learning through the use of online discussion forums [45].

Scholars have investigated the role of IT to enhance learning and teaching methods. Das [46] investigates the impact of multimedia and web technologies and developed teaching methods to enhance students' learning experience. Similarly, Shimba et al. [47] adopted web-based course management tools to facilitate active learning and promote paperless teaching. The results suggest that IT does not only help in teaching, but also helps with monitoring students' progress and providing feedback to students in real-time.

A study by Leung et al. [48] suggests that the use of gaming applications enhanced student's learning experiences and meeting of learning objectives. Lu et al. [49] highlights

the possibility of using technologies such as AR for teaching different subjects. Their study found that AR technology helped retain students' engagement. Prior studies [47–49] suggest that AR, VR and XR technologies can be used not only for teaching a particular language, but can also be used to teach various subjects and languages in different contexts. Considering the potential of AR, VR, and XR technologies for teaching various subjects, the possibility of adopting these technologies for teaching new languages and with a view to adopt XR technology for teaching the Arabic language, this study reviewed the literature on the use of AR, VR, and XR technologies for teaching language.

This study is considered one of the first systematic literature reviews investigating and synthesizing the benefits and challenges of applying XR technology in learning and teaching language in educational institutions.

A review of the selected articles presents valuable insights into the application of XR technologies for teaching new languages. Prior studies mainly focused on applying new technologies for language teaching. Based on the authors' experience and knowledge in teaching Arabic language in Australia, there is a scarcity of resources in relation to using XR for teaching the Arabic language in Australian schools from a teacher's perspective. Thus, the selected papers present opportunities to understand how XR technology has been applied in different contexts, challenges with adopting XR technology, and its impact on teaching language. The knowledge gained from these papers can help develop strategies to adopt XR for teaching the Arabic language in Australian schools.

This study identified that one of the benefits of using XR technology in educational institutions is to facilitate learning and teaching new languages. Literature suggests that adopting computer game-based lessons positively impacts vocabulary acquisition, vocabulary learning, vocabulary retention, and writing tasks [26]. A study by Can et al. [25] showed that learners presented positive improvements when using VR technology for learning a new language. Several studies were conducted to test the use of technologies in teaching languages. For example, the recent European AVATAR Project provides a chance for students and teachers at the same time to take advantage of new technologies and gain the necessary skills to revive the traditional classroom with a 21st-century environment. Another project at Istanbul University involved employing a learning application on the 3D Second Life Platform for teaching language by preservice Turkish teachers [25]. Based on the authors' experience and knowledge in teaching Arabic language in Australia, a similar technology like the Second Life Platform technology can help teachers improve the learning experience of school students in Australia. While there are several benefits with using XR technologies, prior works reported technical, cultural, and time-related issues when using these technologies. Franciosi [26] noted that virtual computer games appeared to be effective and efficient with a specific group and they may not work well with other demographics due to cultural differences. Petrove and Atanasova [30] made a similar observation during their study on the effect of AR technology to enhance learner's learning performance, strengthening the learning system, and understanding the education material. They noted cultural limitations with using AR technology to improve students' learning process. These studies highlight that XR technology can help overcome the challenges associated with teaching a new language. Based on the empirical evidence on the use of XR technology for teaching language, it can be argued that XR technology is capable of aiding language teachers in delivering and supporting students with learning new contents.

Recent studies outlined the use of new technologies for teaching school children and the technical issues encountered while using these technologies. A study by Hsu [39] explains that children who used and experienced augmented storybooks were much better at retelling stories and answering the questions. They reported technical obstacles to using AR educational game systems for learning and teaching purposes. The technical issues encountered include slow system response, failures of tablet devices and breakdowns of software. Dalim et al. [34] found that applying AR educational games for learning language can improve knowledge and help complete certain tasks faster and more easily, but the technical issues can limit the students' ability to complete the tasks faster. They

also found that young students had difficulty with using the computer mouse and speech recognition. To overcome these technical problems and system delays, every school should have experienced technicians to solve any technical problems that may be faced by the students or teachers.

Alfadil [33] points out that there is still limited research on teaching language vocabulary through XR technology. Thus, it is important to create awareness among students and teachers that the use of the new XR technology helps improve students' language vocabulary and keeps students engaged in the learning process. XR technologies such as VR and MR will not only help with vocabulary acquisition but also support the degree of awareness, progress, and achievement. For example, students using the VR game House of Languages had higher language vocabulary acquisition and better achievements in vocabulary learning than ever before. This shows that XR technology presents opportunities for Arabic language teachers to improve their teaching delivery and students' learning experience. On the other hand, there are still many technological obstacles with employing XR technology for learning and teaching purposes. To gain an in-depth understanding of the technological obstacles, more studies on using XR technology for teaching languages need to be conducted. This will help schools and teachers to (a) understand the key issues concerning the use of XR technology and (b) develop appropriate strategies for the effective use of XR technology in an Australian educational context.

XR technology increases learners' fluency, achievement, and engagement. Some studies in this systematic review suggest that XR technology and virtual environments can increase learners' fluency and engagement in learning a new language. As a result, students are notably becoming very interested and engaged in learning a new language after having a virtual classroom environment [25,27,32]. However, it can be seen that many challenges such as misunderstandings and delayed responses can affect language learning progress, such as working with disabled students that would make the teaching process more challenging and slower. Hence, new techniques should be implemented to support both learners and teachers in challenging environments.

VR technology empowered students with self-directed learning and contributed to students taking ownership of language learning. Most importantly, it enhanced student engagement and lowered anxiety levels when learning a new language [35]. It can be seen that MR technology can have a positive impact on enhancing language learning and achievements due to its flexibility, effectiveness and accessibility. However, it is noted that MR technology still has expensive cost structures, privacy concerns, and practical issues in classroom implementation [14].

While VR technology is proven to assist in learning and teaching, the high cost of the devices makes it difficult to be widely applied in classroom settings regularly. As cloud-based technologies are the new norm for delivering services via smart devices, combining VR technology with applications on smart devices such as iPads will make VR-based learning more accessible and cheaper. Applying virtual environment can enhance collaborative learning, increase learner's fluency in learning new languages, learners' understanding of the education materials, improve the quality of the learning experiences, strengthen the learning system, support student motivation, and improve self-efficacy [27,29,30]. Once MR technology becomes more accessible, secure, cheaper, and easier to implement, AR classrooms may become standard classrooms around the world for all students at all stages in the future [24]. The most important obstacles that prevent learners from using VR devices efficiently are related to shyness, fear of negative criticism, and fear of insufficient knowledge that led to difficulties in using the technology and achieving the expected results.

VR technology can motivate students in the classroom and improve students' language skills, knowledge, collaboration, communication competence, and writing performance [36]. However, the impact is found to be dependent on the users' skills to effectively use the technology. For example, Lin and Wang [29] investigated English language learners' creative self-efficacy, inspiration and motivation and their relevance to VR technology-based teaching in universities. They found that insufficient knowledge on using VR

technology led to problems in achieving expected results. Lack of technical competence may lead to poor outcomes [36]. If both learners and teachers are competent enough to use the technology, then they would be able to overcome the minor technical issues. For example, a new AR mobile language learning tool 'Explorez' was introduced to bridge the gap between AR gaming and education to motivate learners. Despite the technical issues with the AR interactive storytelling platform (ARIS), it is being used successfully [25]. Prior studies [14] also encouraged providing all teachers and students with an introduction of how to use AR and VR technologies in the teaching and learning process. Thus, it is crucial to develop appropriate pre-training programs to help both language teachers and students for exploiting the benefits of these technologies to their advantage.

Besides technical competence, system quality is critical to keep learners engaged and motivated to use the technology. For example, Dolgunsoz et al. [31] tested the relevance of VR technology features to students' participation. They found that VR technology students' participation is impacted by the VR technology features such as system quality, user-friendliness, ease of use, and portability. Considering the importance of system quality, it is important to test the technology before implementing it in the learning and teaching space [40,41].

Furthermore, the use of a 3D virtual environment like wikis, e-activities and discussion boards can significantly improve pre-service teachers' digital competence, knowledge and writing skills. This also promotes student's collaborative learning in a 3D learning environment [41]. For example, Lin and Wang [29] believe that e-activities can help and support students to be familiar with some traditions and the history of some countries. This positively influences their level of understanding of the second language since they considered that culture and history are part of the learning of the second language. Several studies [31,35,39] have also indicated that there is a significant influence of the virtual e-activities on the students' level of knowledge, grammar competence, writing skills, discourse competence, and confidence in learning a second language.

## 5. Conclusions

This systematic review explored the potential benefits and challenges of using XR technology in learning and teaching languages. At the same time, integrating XR technology in the education system has enhanced accessibility of learning and teaching resources and improved language learning and teaching process. The use of XR technology can improve teachers' digital competence, knowledge, writing skills and promote their collaborative learning in the learning environment. Most teachers considered that XR technology and 3D virtual activities provided adequate practices to notably improve and develop writing skills, grammar, and vocabulary related to the topics developed. Results of the analysis show that the benefits of using the XR technology include increased motivation, improved learning, and support. Meanwhile, there are several challenges associated with teaching and learning language when using XR technology. Some of the challenges include technical problems, expensive price structures or services, and a lack of technical competence to use the technology. Thus, there is a need to develop proper strategies for the development and implementation of XR technology for teaching new languages in schools. The outcome of this systematic review provides critical information for using XR technology for learning and teaching new languages.

### 5.1. Theoretical and Practical Implications

From a theoretical point of view, the review has presented an in-depth understanding of the challenges and benefits associated with the application of extended technology in teaching and learning languages that can form a basis for the adoption of XR technology for teaching new languages. This review provided an avenue to conduct further studies that would help improve teaching languages and students' learning experience through the adoption of XR technology.

Practically, this study gave insights into the challenges associated with using XR technology for teaching new languages. Prior to adopting technologies such as XR for teaching languages, it is important to develop training programs to exploit the benefits of XR technology. Second, this study presented the implications of XR technology for language teaching. The study results can be used by education providers and policymakers to develop appropriate mechanisms for the successful adoption of XR technology. The results can be used by language teachers to understand the challenges of using new technologies, and gives appropriate strategies to adopt to enhance students' learning experiences.

### 5.2. Limitations and Future Research Opportunities

One of the shortcomings of this study is that the information and analysis of previous studies are limited to the Arabic language only. The other limitation is that the study limited to reviewing the literature from the years between 2011 and 2021. Future research should include the use of other technologies for improving the delivery of teaching. It can also be expanded into the use of such technologies for teaching different languages.

The study noted that there are limited studies on the use of VR, AR and XR technologies for teaching new languages in middle schools. Future studies into the use of new technologies for teaching languages in middle schools will help reveal the relevance of students' age to the impact of new technologies on enhancing students' learning experience.

This study is limited to reviewing XR technology used for teaching language in middle schools. However, future studies into the issues of motivation and language acquisition and how they differ by age, gender and class will help develop appropriate teaching practices to support both language teachers and students.

## 6. Recommendations

This study has investigated the use of XR technology in educational institutions. The following recommendations are provided for teaching the Arabic language in middle schools:

- This study identified technical issues such as slow system response and frequent software crashes with using XR technologies. To overcome these issues, it is important to consult the information technology team about the potential issues prior to adopting XR technologies for learning and teaching.
- Provide awareness among students and teachers to enable them to employ MR technology efficiently in learning and teaching the Arabic language.
- Further studies are needed to create more XR applications and equipment that can be connected with smart devices to make it more available, accessible, secure, cheaper, and easier to use in teaching and learning the Arabic language in educational institutions.
- There is a need to develop a framework for the adoption of XR technology for language teaching, in order to ensure that educational activities more effective and accessible.

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