Extended Reality Technology for Teaching New Languages

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 for 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.

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][11][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][17][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.

2. Facilitating Language Learning

Eleven articles reported that MR technology has been a successful tool to facilitate the process of learning amongst educational institutions [23][24][25][26][27][28][29]. Franciosi [25] states that the use of computer game-based lessons positively impacts vocabulary acquisition, vocabulary learning, vocabulary retention and writing tasks. Petrove and Atanasova [29] 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. [30] 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 [26] 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. [27] claim that the MR technology improves the quality of the learning experiences and supports students' motivation and creative self-sufficiency.

3. Increasing Learners' Fluency, Achievement and Engagement

Prior studies [24][26][31] point out that MR technology can increase learners' fluency and engagement in learning a new language. Lin and Wang [28] 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 [26][29]. Alfadil [32] 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. [33] 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 [34].

4. Motivating Students to Learn a New Language

Lin and Wang [28] 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 [35]. 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 [25]. Virtual multimodal teaching and learning environments can invoke less proficient students' attention and motivation, and enhance collaboration and language performance [36]. Studies into the use of AR mobile language learning tools suggest that an AR-based learning tool 'Explorez' can help bridge the gap between gaming and education, making language learning more motivating and exciting [37].

5. 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 [28]. A study by Dalim et al. [33] 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 [26]. 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 [38].

6. 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 [39]. Alfadil [32] 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 [32]. 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 [40]. **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 [26]	Analyzing the virtual world of Second Life for the development of English language	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

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	Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts
2	Bonner and Reinders [14]	Providing teachers with an introduction of using AR and VR technologies in teaching foreign language	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. [40]	Exploring pre-service teachers' perspectives towards using wiki software to improve writing skills in English language classrooms	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]	Applying learning applications on the 3D Second Life Platform for language teaching	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. [39]	Utilizing AR technology to integrate virtual 3D objects into the real learning environment for language learning	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. [30]	Examining the effect of VR experience on developing English language writing skills	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
7	Lew et al. [27]	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. [31]	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

	Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts
						Categories Reflect Factors Affecting the XR Technology Adoption		
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 [28]	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. [41]	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
12	Hsu [38]	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. [33]	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

	Authors	Focus of Study	Approach	Participants	Delivery Mechanism	Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts
					Categories Reflect Factors Affecting the XR Technology Adoption			
14	Huang et al. [35]	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 [32]	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 [25]	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. [42]	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
18	Lee and Kim [36]	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. [34]	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

	Authors	Focus of Study	Approach	Participants	Delivery Mechanism	**Categories Reflect Factors Affecting the XR Technology Adoption**		
						Reported Drivers and Enablers	Reported Challenges or Barriers	Impacts
20	Yeh et al. [23]	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 [37]	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

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