Virtual Reality (VR) in Education:
The Case in Türkiye

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Abstract

The current study aims to identify and analyse the scientific literature to find the primary focuses and findings of the research studies regarding virtual reality (VR) in education in Türkiye. Also, it searches for the strengths and weaknesses of VR use in education in Türkiye. For this purpose, the present study adopted a systematic review methodology. The research studies, conducted from 2013 to 2022, indexed in the SCOPUS, ERIC, and Web of Science (WoS) were analysed in line with predetermined criteria. The results revealed that VR use in education contributes to students' academic achievement, motivation, permanent learning, class attitude, participation, positive thought, thinking skills, and encouragement. Also, the results indicated that VR is more effective in education when applied as an alternative training method than traditional teaching methods. Additionally, the study identified several strengths and weaknesses of VR use in education in Türkiye. This study found that the important factors affecting the weaknesses of VR are cost, isolation from the real world, online safety, student access, technology gap and security. Based on these findings, the current study could provide information for both future research studies and education contexts concerning VR-based implementations in education.

Keywords: Virtual reality (VR), education, systematic review.

Eğitimde Sanal Gerçeklik (SG): Türkiye'deki Durum
Öz

Bu çalışma, Türkiye'de eğitimde sanal gerçeklik (SG) ile ilgili araştırma çalışmalarının başlıca odak noktalarını ve bulgularını bulmak için bilimsel alan yazını belirlemeyi ve analiz etmeyi amaçlamaktadır. Ayrıca Türkiye'de eğitimde SG kullanımının güçlü ve zayıf yanlarını araştırır. Bu amaçla, bu çalışma bir sistematik inceleme metodunu benimsemiştir. 2013-2022 yılları arasında yürütülen ve SCOPUS, ERIC ve Web of Science (WoS) indekslerinde taranan araştırma çalışmaları önceden belirlenmiş kriterler doğrultusunda analiz edilmiştir. Sonuçlar, eğitimde SG kullanımının öğrencilerin akademik başarılarına, motivasyonlarına, kalıcı öğrenmelerine, sınıf tutumlarına, katılımlarına, olumlu düşünmelerine, düşünme becerilerine, cesaretlerine vb. katkı sağladığını ortaya koymuştur. Ayrıca sonuçlar, SG'nin alternatif bir eğitim yöntemi olarak uygulandığında geleneksel öğretim yöntemlerine göre eğitimde daha etkili olduğunu göstermiştir. Dahası çalışma, Türkiye'de eğitimde SG kullanımının çeşitli güçlü ve zayıf yönlerini belirlemiştir. Bu çalışma, SG'nin zayıf yönlerini etkileyen önemli faktörlerin maliyet, gerçek dünyadan kopuş, çevrimiçi güvenlik, öğrenci erişimi, teknoloji açık ve güvenlik olduğunu bulmuştur. Bu bulgulara dayanarak, mevcut çalışma, eğitimde SG tabanlı uygulamalarla ilgili olarak hem gelecekteki araştırma çalışmaları hem de eğitim ortamları için bilgi sağlayabilir.

Anahtar kelimeler: Sanal gerçeklik (SG), eğitim, sistematik derleme

INTRODUCTION

Digital technologies are widely used for learning and teaching (Zawacki-Richter & Latchem, 2018). Among them, virtual reality (VR) is actively being implemented in educational contexts in almost all disciplines, e.g., Science (Trindade et al., 2002), Technology (Berg & Vance, 2017; Burdea & Coiffet, 2003), Engineering (Abulrub et al., 2011; Alhalabi, 2016; Salah et al., 2019), Mathematics (Su et al., 2022; Xie et al., 2022), and Medical Science (Aggarwal et al., 2007; Gallagher et al., 2005; Silva et al., 2018). In addition, the development of technology has caused an increase in the use of VR applications in educational environments.

VR is considered one of the influential technologies. The basic idea behind VR is that its users are immersed entirely in a virtual world (Rojas-Sánchez et al., 2022). Users can virtually perform many tasks, such as visualising abstract concepts, observing microscopic and macroscopic events, making trips and experiencing hazardous environments through VR technology (Altan et al., 2022; Cheng & Tsai, 2019; Liu et al., 2017; Yıldırım et al., 2020).

Various studies found that VR can contribute to learning and teaching when appropriately incorporated into classroom activities (Kickmeier-Rust et al., 2019; B. Yıldırım et al., 2020; Zhou et al., 2018). Moreover, the VR environment allows us to visualise both real-life and imaginary events and provides us with a series of sensory experiences (Tan et al., 2022). Undoubtedly, VR has several advantages compared to conventional training methods. However, technical issues or disadvantages still need to be addressed. For example, some technical difficulties may be experienced since VR-based courses' design, development and practice are time-consuming and costly (Koreňová et al., 2022). Besides, VR could isolate and distract users from the real world (Çoban et al., 2022). In this context, VR as a rapidly developing technology and its use in education environments require continuous research and analysis of educational dimensions. As VR use in education is quite a recent phenomenon, there seems to be a gap in the literature. One aim of this study is to contribute to the growing body of research studies on, and to learn more about, the potential of and the trends in the use of VR for educational purposes. Furthermore, the current study also aims to provide a detailed systematic review of previous research studies conducted in Türkiye. It is thought that this study will provide insights for students, teachers, and educational environments by presenting the findings of research studies performed in Türkiye. Likewise, this study would guide researchers about the trajectory of VR implementations in educational environments.

Research Questions

1. What are the results of descriptive analyses regarding year, research design, field, population, data collection tool, data analysis method, and frequency of the most repeated words in research studies of VR use in education in Türkiye?
2. What are the primary focuses and findings of research studies regarding VR use in education in Türkiye?
3. What are the strengths and weaknesses of VR in education contexts in Türkiye?

METHOD

Research design

The present study followed a systematic review research design. The systematic review refers to synthesising findings that can provide broader evidence in a specific field of research (Aydın, 2021; Given, 2008). Adopting a systematic review helps researchers locate and choose the relevant studies, evaluate, analyse, and synthesise their findings, and reach some conclusions (Denyer & Tranfield, 2009). However, a systematic review is not a review of literature from a conventional point of view since it explores particular research questions based on actual problems with its explicit methods and principles (Harris et al., 2014; Torgerson, 2003).

The current study adopted a systematic review design for various reasons. Firstly, the study required a comprehensive and multipliable strategy since the study concentrated on virtual reality (VR) in education contexts in Türkiye. Secondly, the research problems necessitated clarifying and analysing all of the literature-related studies. Lastly, all of the findings from the reviewed studies demanded an evaluation from both a holistic and analytic perspective for an unbiased summary.

Data collection

A research protocol was designed before conducting the literature review after clarifying the research questions. The researchers determined several inclusion and exclusion criteria prior to the literature searching, scanning, and analysis procedures. Accordingly, the research studies were screened, filed, and saved. Publication years, authors' names, study designs, target groups, the focus of the studies, and main findings were noted to

analyse the studies. The researchers benefited from Microsoft Excel (2016) spreadsheet to compile and analyse the findings obtained from the processes.

The procedure followed three steps. Firstly, only the scholarly papers indexed in the Web of Science (WoS), SCOPUS, and ERIC were considered for the review process. These databases were chosen to reach only high-quality papers on VR in education contexts. Furthermore, the study intended to limit the scope of journals to those publishing scientific papers in education contexts. Therefore, the keywords "virtual reality" and "sanal gerçeklik" were utilized as key terms to locate papers in English or Turkish in the educational domain in Türkiye. Next, the keywords were restricted to the last ten years (2013-2022) and Türkiye as the country. The VR has become popular recently and does not have a long history, and the study only deals with VR studies in educational contexts in Türkiye. Last, the keywords were limited to only the social sciences and educational domains since the search engines presented these domains as related areas for educational sciences.

The researchers reached five papers in the WoS, nineteen papers in the ERIC, and forty-one papers in the SCOPUS database. Duplicated papers from the databases (n=5), unrelated papers (n=1), and the ones with no full texts (n=2) were excluded from the study during the screening process. Finally, only the papers abiding by the inclusion criteria (n=23) were processed for the final literature sample.

As seen in Figure 1, all of the papers regarding VR in educational contexts were included in the review process. All of the publications were in the English language. The publication period was between 2013 and 2022. Quantitative, qualitative, and mixed methods were used as research inquiries in the papers, and (semi)/experimental designs, surveys, interviews, questionnaires, observations, scales, and case studies were utilized as the research tools of the papers. The study groups of the papers involved K-12 students, undergraduate students, and teachers. In addition, the VR studies only dealing with educational contexts in Türkiye were considered.
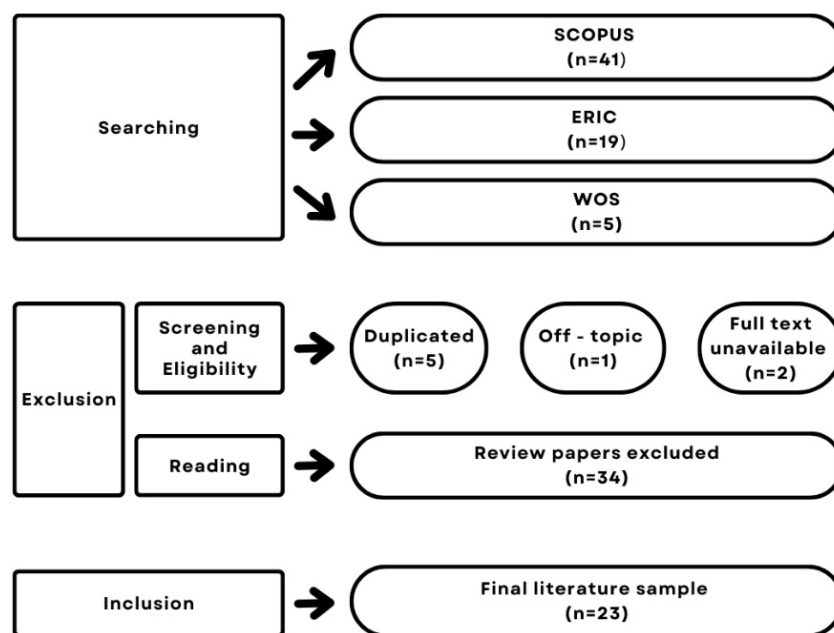

Figure 1. *Flowchart for the Selection Process.*

FINDINGS

The first RQ investigated the distributions of findings regarding year, research design, field, population, data collection tool, data analysis method, and frequency of the most repeated words in the research studies of VR use in education in Türkiye. Accordingly, the distribution of twenty-three articles by year is presented in Figure 2. In total, 23 papers were published from 2013 to 2022. The first was published in 2014. However, there are no articles published in 2013, 2015 and 2016. Most articles were published in 2020 (n=7) indicating the desire for investigating innovative ways of teaching.
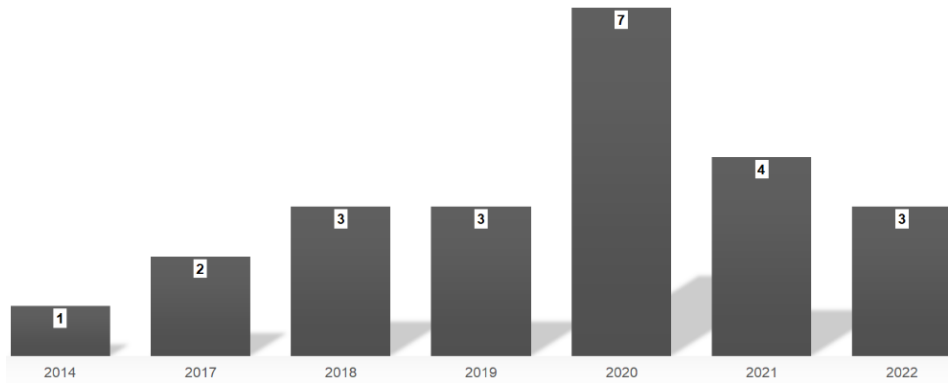
Figure 2. *Chronological Publication Trend from 2013 to 2022 (n=23).*

Figure 3 shows the research methods followed in the studies. Research designs consist of qualitative, quantitative and mixed research methods. Authors used qualitative research methods in 11 studies (48%). Quantitative research methods were employed in 9 (39%) studies. The remaining three papers (13%) followed a mixed-method research design (see Figure 3).
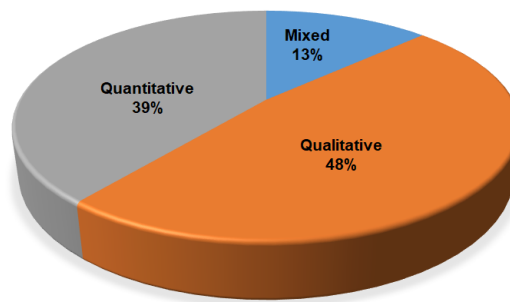

Figure 3. *Percentage of Research Methods.*

Figures 4-5 show the research patterns and data collection tools used in the studies. The research papers used a wide range of research patterns, with the most prominent being case study with 35% (n=8) for qualitative research methods and experimental study with 22% (n=5) for quantitative research methods (see Figure 4).
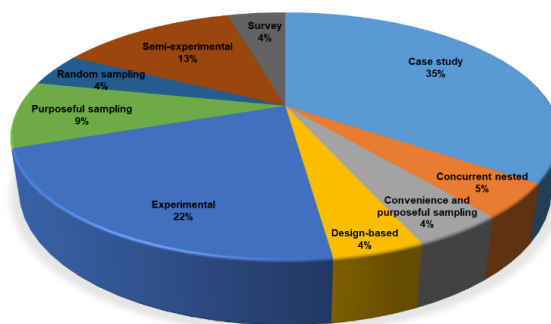

Figure 4. *Percentage of Research Patterns.*

When the data collection tools were compared, scales 26% (n=6) and interviews 26% (n=6) (Figure 5) were the most frequently used tools.
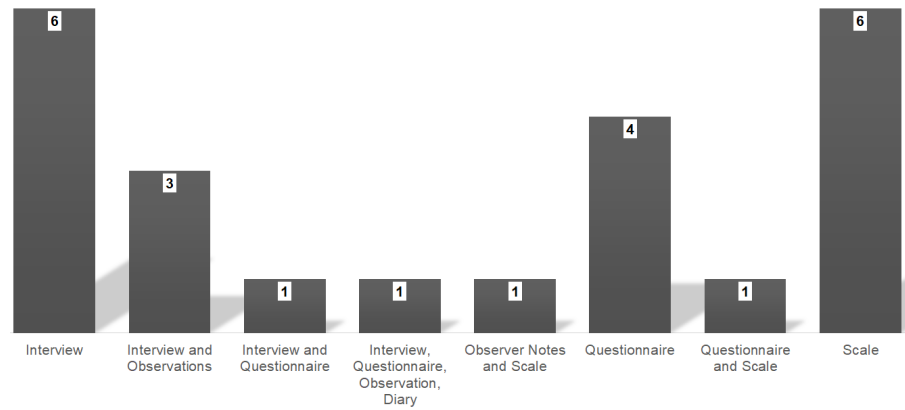
Figure 5. *Data Collection Tools (n=23).*

Figure 6 shows the participant groups preferred in the studies. The groups consist of undergraduates, K-12 students, and teachers. In our findings, most of the research studies focused on undergraduates. Also, undergraduate research covered 61% (n=14) of the 23 papers. This ratio is followed by elementary and high school (K-12) students 35% (n= 8). Only one research study (4%) involved teachers as participants (see Figure 6).
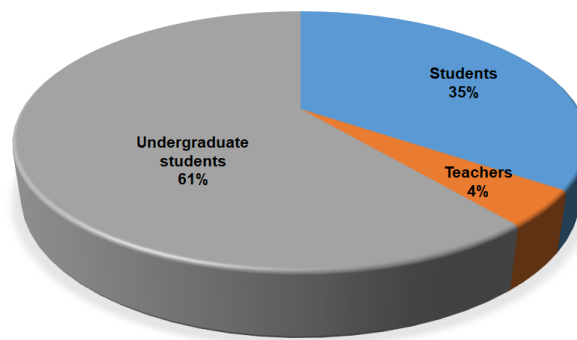

Figure 6. *Percentage of Participant Groups.*

Figure 7 illustrates the diverse range of fields in which the studies were conducted. Notably, computer and instructional technologies and nursing each accounted for 13% of the papers (n=3). Science education and mathematics were represented by 8% of the papers (n=2). Additionally, other fields targeted in the research papers included architecture, chemistry, classroom education, computer engineering, education, geography, music, occupational health and safety, physical therapy and rehabilitation, physics, safety education, and science (Figure 7).
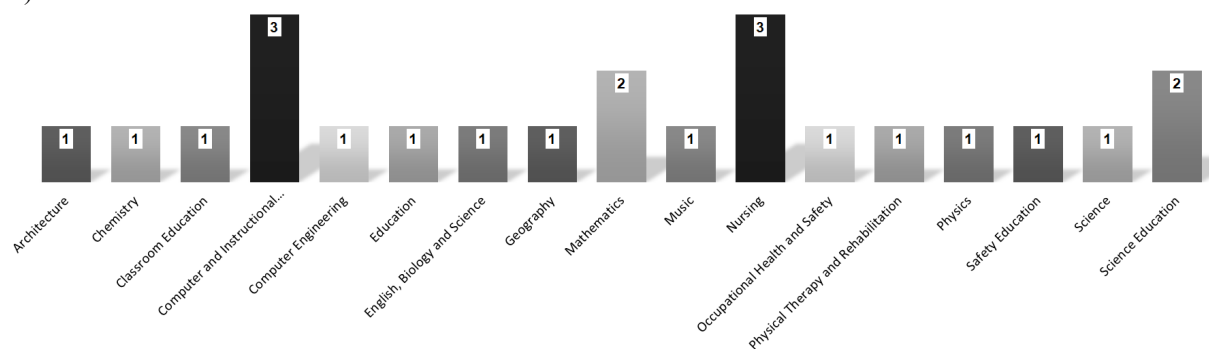
Figure 7*. Research Interests (n=23).*

As visual representations, word clouds present the frequency and importance of words in a given text (Chi et al., 2015). They are created by highlighting the recurring vocabulary items, usually through larger font sizes or different colors. Word clouds are often used to summarise the main points of a document or to visualise the most critical terms in a text. They can be a helpful tool for understanding the key themes in a large body of text. Figure

8 shows a graphical representation using word cloud, created using the R statistical programming language, to determine some of the most general trends in the research studies. R was set to demonstrate the 300 most frequently occurring terms relative to their frequency. It revealed that the most repeated words around VR are students, learning, technology, environment, research, experimental, participants, training, and game. Also, 20 of the most frequently occurring terms are shown in Figure 9.

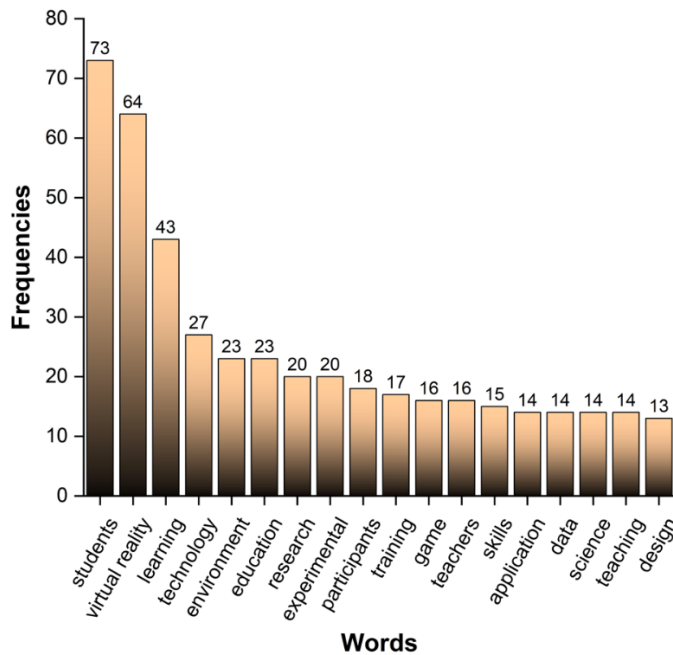**Figure 8**. *A 'Word Cloud' Derived from Article Abstracts.*

Figure 9. *The Frequencies of Words Used in Abstracts.*

The second RQ probed the primary focuses and findings of research studies regarding VR use in education in Türkiye. The distributions of the research studies by authors (first author and year), study design, research groups, focus and findings were analysed, and the results are summarised in Table 1.

Table 1. Summary of Research Articles on Virtual Reality in Educational Contexts

N	Author	Study Design	Groups	Focus	Findings
1	(Civelek et al., 2014)	Quantitative / Semi-experimental/ Questionnaire and Scale	Students	VR environment, academic achievement, attitude towards physics	Positive impact on motivation, academic achievement, courage, autonomy and learning quality
2	(Yildirim, 2017)	Qualitative / Case study / Interview, Questionnaire, Observation, Diary	Undergraduate students	Opinions and recommendations on the use of VR glasses, VR experiences and implications for teaching	Interest in the course, motivation, permanent and easy learning, equal opportunity in learning of individuals with various disabilities
3	(Ucar et al., 2017)	Quantitative / Survey / Scale	Students	VR environment, gifted students, facilitating and accelerating the learning process, permanent learning	Positive thoughts and attitudes in gifted students, alternative to traditional teaching methods, increase in educational efficiency
4	(Akbulut et al., 2018)	Quantitative / Experimental / Questionnaire	Undergraduate students	A VR-based application, software engineering course	Complementary to traditional teaching methods in teaching
5	(Tepe et al., 2018)	Qualitative / Case study / Interview and Observations	Undergraduate students	VR application development, integration into traditional learning environments, student insights	Beneficial to students, permanent learning, motivation and class participation, savings, prevents cost losses
6	(Yıldırım, Elban, & Yıldırım, 2018)	Qualitative / Case study / Interview	Undergraduate students	Student opinions and suggestions, use in history education	Useful in lesson activities
7	(Bayram & Caliskan, 2019)	Quantitative / Experimental / Scale	Undergraduate students	VR-based game application, impact on education	Effective in skill acquisition in practice
8	(Çakiroğlu & Gökoğlu, 2019)	Qualitative / Design-based / Interview and Observations	Students	VR-based design, impact on fire safety skills	Positive skill impact, an alternative approach
9	(Akman & Çakir, 2019)	Qualitative / Purposeful sampling / Interview	Students	A developed game based on VR, student opinions	Fun, open to student interaction in a VR environment
10	(Kurul et al., 2020)	Quantitative / Experimental / Scale	Undergraduate students	Impact on anatomy education	Suitable for education, an alternative to traditional teaching methods
11	(Artun et al., 2020)	Mixed / Experimental / Interview and Questionnaire	Undergraduate students	Science teacher candidates, acquisition of scientific process skills	The increase in experimental group scores was significant regarding the overall score and experimentation sub-dimension.
12	(Taçgın, 2020a)	Quantitative / Purposeful sampling / Questionnaire	Undergraduate students	VR learning environment, learning, attitude, and trust	Designed taking into account abilities and expectations, increased confidence
13	(Tacgin, 2020)	Qualitative / Convenience/Purposeful sampling / Interview	Undergraduate students	VR learning environment, learning situation, behaviour, and attitude	Sufficient to teach concepts and complex procedures, learning by doing, recalling
14	(Sarioğlu & Girgin, 2020)	Quantitative / Semi-experimental / Questionnaire	Students	VR application, success, and attitude towards the lesson	Effective on achievement and attitude towards the course, easier understanding of abstract concepts

15	(Akman & Çakır, 2020)	Mixed / Concurrent nested / Observer Notes and Scale	Students	VR-based game application, academic achievement, and class participation	Increasing interest and participation in the course, more effective than traditional teaching methods.
16	(Yıldırım et al., 2020)	Qualitative / Case study / Interview	Teachers	VR experiences	Visualising abstract subjects, enriching teaching
17	(Doganyigit & Islim, 2021)	Qualitative / Case study / Interview	Undergraduate students	VR experiences, vocal training	Breath control, comfortable and easy sound reproduction, powerful sound
18	(Çakıroğlu et al., 2021)	Qualitative / Case study / Interview and Observations	Students	Perceived learning	Sense of presence, increased motivation, positive perception
19	(Özgen et al., 2021)	Quantitative / Experimental / Scale	Undergraduate students	Basic design training, problem-solving skills	Strong problem-solving skills, a complementary tool
20	(Çoban & Kayserili, 2021)	Qualitative / Case study / Interview	Undergraduate students	VR environment, presence perception, and experience	Variable presence perception, positive perception and experience
21	(Ozdemir & Ozturk, 2022)	Mixed / Random sampling / Scale	Students	VR teaching materials, geography education	Significant results in favour of the experimental group
22	(Çoban & Göksu, 2022)	Quantitative / Semi-experimental / Scale	Undergraduate students	Distance learning, motivation and perceived sociability	Increase in motivation and socialisation
23	(Çoban et al., 2022)	Qualitative / Case study / Questionnaire	Undergraduate students	Information and communication technology, prospective teachers, STEM education, perception, expectation, and experience	Developing skills through positive influence, critical thinking, imagination and creativity; isolation from the real world, expensive

Twenty-three research studies were identified that complied with the inclusion criteria of the current study. Firstly, Civelek et al. (2014) investigated the achievement and attitudes of students in VR environments. They found that VR enhanced the education environment and positively affected students' achievement in and attitudes towards physics. Secondly, Yıldırım (2017) investigated the views and preferences of learners on the use of various multimedia tools in VR environments. They reported that VR technologies could create permanent and active learning environments for learners. Thirdly, Uçar et al. (2017) inspected the effect of feedback-based haptic applications developed in VR environments on gifted learners' attitudes toward chemistry education. They found that VR environments positively affected gifted students' attitudes toward chemistry education. Fourthly, Akbulut et al. (2018) interrogated the influence of VR use on engineering students' performances. They found that VR technology-assisted engineering software courses are more effective and helpful compared to traditional teaching methods. Fifthly, Tepe et al. (2018) examined learners' views regarding a VR-based fire drill application in conventional learning environments. They revealed that VR technology integration into learning environments could support learning through increased usefulness, persistency, motivation, engagement, and practice opportunity. Sixthly, Yıldırım et al. (2018) analysed preservice history teachers' views and suggestions regarding using VR glasses in history lessons. They uncovered that preservice history teachers expressed positive views towards VR implementations in history education. Seventhly, Bayram and Çalışkan (2019) probed the influence of a game-based VR tool on nursing students in tracheostomy care education. They noted that the game-based VR phone application was effective in the education of nursing students, especially in training psychomotor skills. Eighthly, Çakıroğlu and Gökoğlu (2019) delved into the effect of VR-based training on fire safety behavioural skills, and they identified that VR-based fire training increased students' fire safety skills and helped them transfer these skills to real-life environments. Ninthly, Akman and Çakır (2019) scrutinised the use of a VR-based game, "Keşfet Kurtul", in teaching the fractions subject in the maths curriculum of 4th-grade students, and they reported that students enjoyed the game and they experienced flow during this educational game. Tenthly, Kurul et al.

(2020) questioned the role of interactive VR technology on physical therapy students' anatomy training, and they informed that VR implementation was beneficial for health students' anatomy training at the physical therapy department. In the eleventh place, Artun et al. (2020) inspected the VR-integrated laboratory activities' on preservice teachers' science processing skills. They explored the positive effects of VR-enhanced laboratory activities on preservice teachers' science process skills. In the twelfth place, Taçgın (2020a) investigated an immersive VR environment's features and its perceived effectiveness concerning learning, confidence and attitude; and they revealed that a VR-based learning environment assisted nursing students in enhancing their confidence in practical skills. In the thirteenth place, Tacgin (2020b) examined the nursing students' learning progress and the obstacles they faced in an immersive VR environment and uncovered that a VR-based learning environment was sufficient for teaching concepts and complex procedures in nursing education. In the fourteenth place, Sarıoğlu and Girgin (2020) scrutinised the effect of VR integration in science teaching on primary school students. They revealed that VR technology positively affected achievement and attitudes in science and technology courses. In the fifteenth place, Akman and Çakır (2020) analysed the influence of an educational VR game, "Keşfet Kurtul", on the achievement and engagement of primary school students in math courses, and they unearthed that the VR game increased students' academic achievement and assisted students in maintaining engagement in a math course. In the sixteenth place, Yıldırım et al. (2020) probed the STEM teachers' reflections on VR use in courses. They displayed that VR-based implementations enable teachers to visualise abstract subjects and enhance instructions. However, the teachers also stated that there might be problems with student access, technology gaps, and online safety and security. In the seventeenth place, Doğanyiğit and İslim (2021) inquired about the VR influence on music department students' vocal training. They found that VR use by fine arts faculty contributed to students' vocal training. In the eighteenth place, Çakıroğlu et al. (2021) examined the animations and VR on elementary school students' perceived learning. They discovered that VR-based learning affected learners' perceived learning in science education. In the nineteenth place, Özgen et al. (2021) investigated the applicability of VR technology in basic design training with specific reference to problem-solving activities. They uncovered that VR technology as a complementary tool promoted architecture students' problem-solving skills in basic design education. In the twentieth place, Çoban and Kayserili (2021) explored preservice teachers' presence in VR environments regarding their opinions and experiences. They determined that preservice teachers held positive views on their VR experiences. In the twenty-first place, Özdemir and Öztürk (2022) investigated the students' academic achievement, presence, and interaction in geography education integrated with a VR application. They reported that VR application was influential in facilitating achievement, presence, and interaction of students in geography education. In the twenty-second place, Çoban and Göksu (2022) delved into the effect of synchronous distance courses on VR and Web-based environments regarding students' motivations and perceived sociability levels. They noted that VR environments significantly affected students' motivation and perceived sociability compared to Web-based environments. Lastly, Çoban et al. (2022) inspected the views of information and communications technology (ICT) preservice teachers on using VR in STEM courses. They revealed that ICT preservice teachers considered VR a positive technology in various ways in STEM education. However, some participants expressed concern that VR could disconnect students from the real world and be a costly tool.

The third RQ targeted the strengths and weaknesses of VR in education contexts in Türkiye. Table 2 summarizes the codes regarding the strengths and weaknesses of VR use in education in Türkiye as follows:

Table 2. VR in Education

Themes	Codes	f
Strengths	Being effective	9
	Being motivating	6
	An alternative method	6
	Enhancing participation	5
	Increasing achievement	4
	Developing positive attitudes	3
	Providing permanent learning	3
	Developing positive views	3
	Enhancing thinking skills	2
	Being encouraging	2
	Providing equal learning opportunity	1
	Fostering student interaction	1
Weaknesses	Being costly	1
	Isolation from the real world	1
	Online safety	1
	Student access	1
	Technology gap	1
	Security	1

According to Table 2, being effective (f=9), being motivating (f=6), an alternative method (f=6), enhancing participation (f=5), increasing achievement (f=4), developing positive attitudes (f=3), providing permanent learning (f=3), developing positive views (f=3), enhancing thinking skills (f=2) being encouraging (f=2), providing equal learning opportunity (f=1), and fostering student interaction (1) are among the strengths reported by the research studies regarding VR use in education in Türkiye, while being costly (f=1), isolation from the real world (f=1), online safety (f=1), student access (f=1), technology gap (f=1), and security (f=1) are among the weaknesses reported by the research studies regarding VR use in education in Türkiye.

Discussion & Conclusion

First, the current study analysed the research papers regarding variables such as study design, study group, subject area, data collection tools, and data analysis methods. Twenty-three research papers concerning VR use in education were examined in this regard. In addition, the preliminary research topics and key phrases handled in research papers were analysed using word cloud analysis. Most studies included qualitative research methods, followed by quantitative and mixed research methods. Besides, the research studies often contained case studies and experimental designs. The participants were generally preservice teachers, and only a few studies were implemented on students. Experts and technology suppliers of VR generally state that people of all ages can use such technologies. However, as with any technology, it is vital to use it responsibly and in a way that is appropriate for the user's age and developmental stage. For younger children, it is generally recommended to use VR technology under adult supervision and to ensure that the viewing content is age-appropriate (Araiza-Alba et al., 2022). That may be one reason why most sstudies have been conducted on undergraduate students in higher education while few studies have been done on primary and secondary school students (Çankaya, 2019).

Next, the current study probed the primary focuses and findings of research studies regarding VR use in education in Türkiye. This study revealed that the vast majority of VR studies provided a learning benefit in a classroom environment, especially in terms of achievement, motivation, attitude, courage, participation, and efficiency. In addition, the findings focused on the overall impact of VR in education and raised several issues. An essential characteristic of VR technology is its use as a powerful learning tool in education. Moreover, it allows students to immerse themselves in realistic and interactive environments, making learning more engaging and effective. VR as a learning tool can be used in several ways, such as virtual field trips, hands-on learning, interactive learning (or role-playing), and collaborative learning. For example, recent studies report that VR takes students on virtual school trips to places which they might not otherwise be able to visit, such as historical sites, museums, and even other countries (Büyüksalih et al., 2020; Cheng & Tsai, 2019; Markowitz et al., 2018). The VR use helps bring lessons to life and gives students a meaningful and deeper understanding of the subject (Çalişkan, 2011). For example, VR provides students with the opportunity to participate in hands-on learning activities, such as studying abstract concepts in physics (Civelek et al., 2014; Ucar et al., 2017), building a virtual structure in architecture (Özgen et al., 2021), and robot programming in the industry (Garg et al., 2021). This is especially helpful for subjects that might be difficult to demonstrate in a traditional classroom environment. A recent study shows that most students demonstrate promising results in benefiting from VR as a learning tool in the classroom (Saniyyati et al., 2021). Besides, VR creates interactive experiences where students can practice their decision-making and problem-solving skills in a controlled and safe environment (Akman & Çakır, 2020; Chang et al., 2020). For example, VR is used as a powerful tool for learning about and understanding the human body and can be especially useful for those in the medical field (Cagiltay et al., 2019), for students studying anatomy and physiology (Kurul et al., 2020), and for children developing fire safety skills (Çakiroğlu & Gökoğlu, 2019). The VR use provides practice for students and healthcare professionals to respond to a crisis. Furthermore, VR facilitates collaborative learning activities, allowing students to work virtually to solve problems or complete projects (Cho et al., 2017; Jiang & Zhang, 2020; Kreijns et al., 2007). This study also supports that the VR learning environment positively affects variables such as students' motivation, socialisation, and permanent learning in distance education (Çoban & Göksu, 2022). In light of all these results, it can be concluded that VR can enhance learning in many ways, making it a valuable tool for educators to consider when designing lessons.

Last, the current study searched for the strengths and weaknesses of VR in education contexts in Türkiye. When comparing the strengths of VR as an alternative learning tool to traditional methods, it provides a positive attitude and permanent learning in education environments. On the other hand, VR was mainly researched as an alternative method to traditional methods in educational environments; this suggests that its effect on social and psychological domains remains less examined. To ensure that VR is employed correctly with its full potentials, it is necessary to base the applications of the technology on solid experimental and theoretical grounds. The reality underlying the low number of studies conducted with in-service teachers and experimental designs may stem from the deadlock of bringing teachers from similar branches together (Kurtoğlu & Seferoğlu, 2013). However, conducting implementation studies is essential to enhance technology integration into courses. It is inevitable that teachers can use such technologies effectively in their lessons, depending on their knowledge of how to use

technology and integrate technology into lessons. Therefore, the integration of VR technology into the curriculum is essential. The Ministry of National Education should organize in-service teacher training seminars to increase the use of VR as a training tool in classrooms.

In conclusion, this systematic review shows that VR technology is a valuable educational tool in education in Türkiye. VR has the potential to revolutionise the way students learn in education. It provides many possibilities to visualize abstract concepts, observe very small and large objects, take trips and experience dangerous environments. Several conclusions about the VR use in education in Türkiye may include:

• VR provides an interactive and immersive experience, increasing interest, engagement and motivation in the course.

• VR offers important experiential learning activities by enabling students to take part in virtual environments and simulations.

• VR allows students to communicate and collaborate in real time with others who are also online in a virtual environment.

• VR allows students to learn according to their plans and offers a more personalized learning experience tailored to the individual needs of each student.

The research studies regarding the negative aspects of VR use in education have not been adequately studied in Türkiye, and thus it seems to be a promising future research area. For example, the literature revealed only one research study on in-service teachers' use of VR in education while most of the research studies focused on students and their experiences or views on VR use in education. Accordingly, more research studies focusing on teachers should be designed in future.

Limitations

The current study involved research studies regarding VR use in education only from Türkiye. Further systematic reviews on VR use in education from different countries may contribute to the literature. This study collected findings from three different databases in English and Turkish languages. Future studies searching key terms in various languages and databases may reach more research studies concerning VR use in education from various contexts across the globe. New research studies questioning the implementation of various technological tools of this kind in educational contexts can be designed.

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