Trend and research the use of virtual reality to increase student's negotiation skills in realizing Sustainability

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Abstract. This study aims to investigate the relationship between the utilisation of virtual reality technology (VR) in educational contexts and students' perceptions of their capabilities. This research employs a quantitative methodology utilising Biblioshiny, which was conducted through a comprehensive literature review of 644 papers discussing virtual reality and self-efficacy in the field of education from Scopus. The search results were refined using Biblioshiny, which yielded 50 papers deemed pertinent to this study. The results of the data analysis indicate a significant relationship between the use of virtual reality in learning and the improvement of students' self-efficacy, which aligns with the Sustainable Development Goals (SDGs) mission number 4, 'Quality Education', and number 9, 'Industry, Innovation and Infrastructure'. These findings offer new insights into the potential of virtual reality as a learning support tool, which can enhance students' confidence and motivation to learn. The paper also considers the implications of these findings for further research and learning practice.

1 Introduction

The achievement of the Sustainable Development Goals (SDGs) is a matter of urgency, and efforts to this end must be regarded as an obligation. The United Nations set 17 SDGs and 169 targets that emphasize the importance of quality education in achieving these goals [1]. Hsiao [2] states that implementing digital learning media—robot education—in schools can reach the fourth goal of the SDGs. This is particularly true in light of the significant challenges posed by the proportion of youth and adults with information and communication technology skills, as well as the number of human resources in science and technology. Universities, as institutions of higher education, occupy a pivotal position in this endeavour. They serve as centres of knowledge and innovation, producing invaluable scientific research, educating future leaders, and promoting sustainable practices.

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The use of Virtual Reality (VR) technology has become an increasingly interesting topic in the context of academic education [3]. In recent years, VR has shown great potential in enhancing the learning experience, particularly in the development of motor skills, concept understanding, creativity and student motivation. Several studies have been conducted to explore different aspects of the use of VR in academic environments, ranging from motor skills training to language learning [4]. The use of VR is in line with the SDGs mission number 4, namely 'Quality Education', which focuses on ensuring inclusive and quality education and promoting lifelong learning opportunities for all. VR technology can play an important role in creating innovative and engaging learning environments that can improve the quality of education and expand access to quality learning for all students, including those in remote areas or with physical limitations.

Research supports the educational benefits of VR, improving learning, interest, creativity and performance. It improves the efficiency of teaching, helps to understand complex concepts through direct experience, and provides deep, engaging learning experiences. VR enhances spatial visualisation skills, provides realistic, interactive environmental simulations, and enriches learning through exploration and experimentation [3]. VR, which is widely accepted in education, refers to a three-dimensional environment that presents virtual or real interaction [5]. VR merges virtual images with reality, creating a computer simulation system for learners to experience virtual worlds. It uses computers to create simulation environments in which learners are immersed. VR makes users feel present and immersed by combining real data with computer-generated electrical signals [6].

Self-efficacy refers to the belief that learners can perform learning behaviours to achieve learning goals or predetermined educational outcomes [7]. The use of VR technology does not cause significant changes in learners' self-efficacy, but positive effects on self-efficacy have been found in VR-based conditions. In general, educators can design immersive VR models by considering various influencing factors such as interest, motivation, self-efficacy, embodiment, cognitive load and self-regulation [8].

Research by [3] suggests that designers and educators should tailor VR-based courses to meet learners' needs. Introducing VR into learning environments can enhance learners' creativity by encouraging risk-taking, divergent thinking and mental flexibility. VR training also increases self-confidence and self-efficacy, especially when it comes to improving overall performance. In addition, VR is effective in reducing anxiety in real-life situations [9].

The integration of VR technology in education also supports SDG mission number 9, Industry, Innovation and Infrastructure, which focuses on building durable infrastructure, promoting inclusive and sustainable industrialisation, and encouraging innovation. By adopting VR in education, we are not only improving the quality of learning, but also encouraging innovation in teaching methods and creating a more sophisticated and adaptable education infrastructure. This technology can act as a catalyst for the development of more creative and efficient educational solutions, thereby stimulating the growth of the education technology industry and supporting sustainable development.

2 literature review

2.1 Use of VR in Education

A real-world example of the implementation of virtual reality (VR) in education is the Google Expeditions programme. Google Expeditions is an immersive learning platform that allows teachers and students to go on virtual 'expeditions' to hundreds of locations around the world and even into space [10]. Using VR devices such as Google Cardboard or more advanced

VR devices, students can have interactive and immersive learning experiences. For example, in geography classes, students can explore the Grand Canyon or the Himalayas [11]. Google Expeditions provides democratic access to high-quality learning resources, allowing schools in remote locations with limited resources to provide similar learning experiences to schools with better access to technology and infrastructure [12]. VR increases concept comprehension, information retention and student motivation [13].

2.2 Influence VR

2.2.1 Creativity

VR offers students immersive, interactive learning experiences that help them understand abstract concepts more concretely. It enables interaction with virtual environments, encouraging exploration and experimentation without physical constraints. This encourages creative skills such as problem-solving, critical thinking and collaboration in engaging new ways [14]. VR stimulates students' imaginations, offering different perspectives and broadening views of concepts and ideas. It effectively enhances creativity and provides valuable, meaningful learning experiences [15].

2.2.2 Learning process and creative performance

VR creates immersive learning environments that allow students to experience abstract concepts first-hand. They can engage in realistic simulations and safely develop practical skills. This improves understanding, cognitive skills and problem-solving [16]. VR also promotes creativity by allowing experimentation in a stimulating virtual space. Interacting with impossible objects encourages new ideas and sharpens creative thinking. Overall, VR has great potential to enhance learning and creativity [17].

2.2.3 Motor and cognitive skills

The impact of virtual reality (VR) on a student's motor and cognitive skills is highly significant. In terms of motor skills, VR can provide in-depth experiences in different contexts, such as flight simulations, sports games, or medical training [18]. VR supports the development of hand-eye coordination, visuospatial skills, and fast, accurate motor responses. Thus, VR significantly contributes to the development of students' motor and cognitive skills [19].

2.2.4 Learning experiences and student engagement

The use of VR has an impact on students; they can experience more enjoyable, engaging and relevant learning. They can engage in immersive and interactive learning environments, which allows them to learn more directly and practically [20]. VR helps students understand complex concepts and develop practical skills in relevant contexts. VR has significant potential to enhance the learning experience and student engagement in education [21].

2.2.5 Social skills

In a virtual environment, students can interact with avatars and environments that are captured with realism, similar to real-life situations. This allows them to practice communication, negotiation and collaboration skills in a safe and controlled context [22].

The use of VR in education can help improve students' social skills and prepare them to interact effectively in an increasingly complex society [23].

2.2.6 Self-Confident

VR exposes students to situations that require courage and confidence, such as public speaking or complex challenges. VR in education boosts students' confidence and better prepares them for future challenges [24].

2.2.7 Presence

In VR experiences, students feel as if they are actually in the recorded environment, creating an intense and real sense of presence. This can increase students' engagement and focus in learning as they feel they are directly experiencing the material being taught [25]. The use of VR in education can enhance learning effectiveness by creating a deeper and more meaningful experience for students [26].

2.3 Virtual reality in real environments

The metaverse enhances education with diverse environments, aiming for a virtual platform separate from reality. The metaverse can enhance teaching and learning, especially in blended learning contexts, across disciplines [27]. It allows users to engage with digital avatars, enhancing learner-centred education and enriching learning experiences [28, 29].

The metaverse and computer games can be used in education, supported by virtual reality and physical reality technologies [30], leading to enhanced entertainment and positive learning attitudes towards the use of the metaverse. Virtual reality can be combined with metaverse platforms to sustain educational outcomes, enhance learning adaptability, and cultivate positive learning attitudes [31].

2.4 Interactions at the virtual

The versatility of the metaverse enhances interactions and serves as a digital tool for university teaching. It supports both synchronous and asynchronous methods of knowledge delivery and acquisition, complemented by mobile, collaborative or flipped teaching approaches. In addition, platforms such as Second Life offer game-based education, further enhancing interactions in education. These interactions stimulate student interest, improve knowledge sharing and encourage the exchange of opinions, ultimately improving educational outcomes [32, 33]. The metaverse enhances education by providing virtual environments, which were particularly useful during COVID-19, enhancing learning through realistic environments, and complementing online education with VR [34]. Linking virtual reality to metaverse platforms supports educational outcomes, enhances learning adaptability, and promotes positive learning attitudes [30, 31].

To date, few studies provide a bibliographic review and chronological trends of the use of the metaverse in education. Therefore, the researchers propose the following research question to fill the missing link in previous research:

RQ1: What are the chronological research trends in the use of VR in the world of education?
RQ2: Mention the top ten authors, organizations, and countries in the study of the use of VR technology in the world of education
RQ3: What level of education is relevant to the use of VR?
RQ4: Can VR enhance self-efficacy?

RQ5: Can the use of VR enhance educational outcomes?
RQ6: What are the challenges of using VR in negotiation education?

3 Methods

This research uses the systematic literature review method to summarise and analyse previous studies on the relationship between Virtual Reality (VR) in learning and the improvement of students' self-efficacy. Using biblioshiny, the study aims to determine this relationship by coding and grouping data from previous studies based on the influence of VR on various domains, including creativity scores, learning process and creative performance, motor and cognitive skills, learning experience and student engagement, social skills, self-confidence and presence. The systematic literature review method allows the establishment of clear inclusion and exclusion criteria and a comprehensive search strategy.

A total of 644 documents were identified from the search results in Elsevier ScienceDirect, citations from relevant previous studies and some relevant studies from other sources. In Elsevier ScienceDirect we found 392 documents based on the keywords 'virtual reality' AND 'self-efficacy' AND 'learning' OR 'student'. Meanwhile, 231 other documents were based on citations from multiple documents relevant to the discussion of our research, and 21 documents were relevant to research studies from other sources.

4 Result and Discussion

4.1 Category of studies used

Table 1. The Focus Categories in the Included Studies

Focus	Study
Creativity	[14], [15], [35], [36], [37], [38], [39], [40]
Learning Process and Creative Performance	[3], [10], [12], [16], [17], [41], [42], [43], [44]
Motor and Cognitive Skills	[18], [19], [45], [46]
Learning Experiences and Student Engagement	[4], [11], [13], [20], [21], [45], [47], [48], [49], [50], [51]
Social Skills	[4], [22], [23], [38], [40], [45], [48], [49], [50], [51]
Self-confident	[24], [38], [40], [41]
Presence	[4], [25], [26], [48]

Table 2. Top 10 Authors In VR And Education Research

Authors	Articles	Authors	Articles
Makransky G	17	Huang Y	4
Klingenberg S	6	Hwang G-J	4
Petersen Gb	6	Liu L	4
Brinkman W-P	4	Wang Y	4
Hedman L	4	Chen C-Y	3

The table (TABLE 2) shows the top 10 authors with the highest number of research publications on the impact of virtual reality in education. Makransky G leads with 17 articles, followed by Klingenberg S and Petersen GB with 6 articles each. This data suggests that

Makransky G is a prominent researcher in this area, with Klingenberg S, Petersen GB and others also actively contributing.

4.2 Top 10 countries

Table 3. Top 10 Countries in VR and Education Research

Countries	Freq	Countries	Freq
USA	76	Germany	11
China	63	Australia	10
Denmark	20	UK	10
South Korea	20	Netherlands	9
Canada	11	New Zealand	8

Table 3 shows the number of documents or papers published on the impact of virtual reality (VR) in education in 10 countries. The United States (US) leads with 76 papers, followed by China with 63 papers. This indicates a strong commitment in both countries to developing and implementing VR technology in schools. Although countries such as Denmark, South Korea and Canada have fewer papers, they still show significant interest in VR in education.

4.3 Annual scientific production

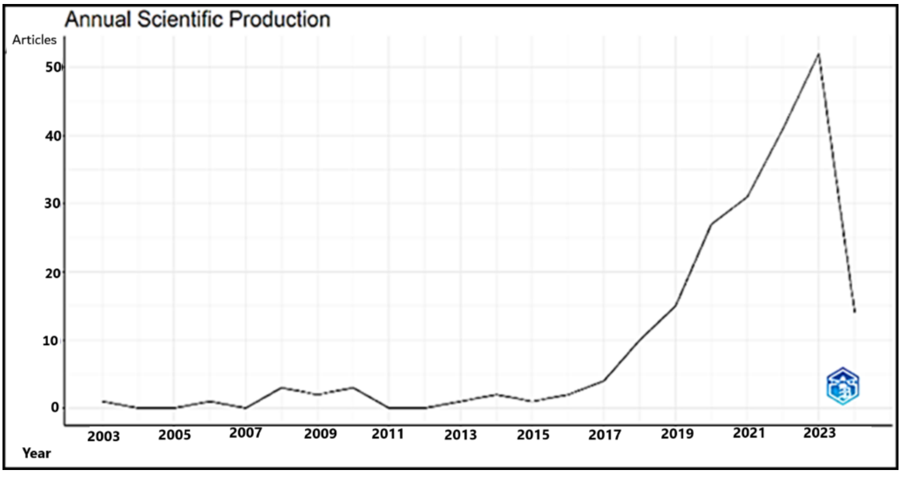

Fig. 1. Annual Scientific Production

From Figure 1, we can see that the number of research articles in this field is low from 2003 to around 2017, mostly below 10 per year. Starting in 2018, there's a significant increase, peaking in 2021 with almost 50 articles. Then there's a sharp decline in 2022. This suggests a growing interest in and relevance of VR in education. The decline in 2022 could be due to changing research priorities, funding issues or incomplete data for that year.

4.4 Co-Occurrence network

In (Fig. 2), each node represents a word, with the size of the node indicating its frequency in a data set (e.g. scientific articles). The lines between the nodes show words that often occur together. The large, red 'virtual' node is the most dominant keyword, the main focus of the dataset. Medium-sized nodes such as 'learning', 'education' and 'training' are important, related concepts. Smaller nodes represent less dominant but relevant concepts. Words grouped, such as 'immersive', 'video', 'game' and 'system' in the orange cluster, are often used together and are highly correlated, especially with 'virtual'.

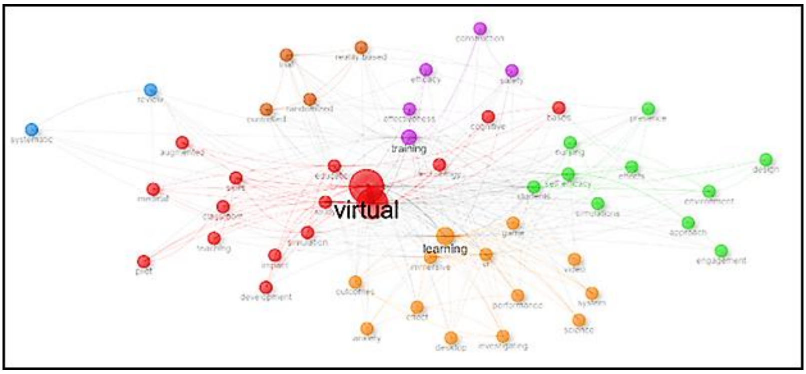

Fig. 2. Co-Occurrence Network

The co-occurrence network helps to identify major themes, conceptual relationships and research trends in virtual reality (VR). In education, VR is linked not only to 'learning' and 'education', but also to 'skills', 'classroom' and 'teaching', showing its application in different aspects of education.

4.5 Thematic map

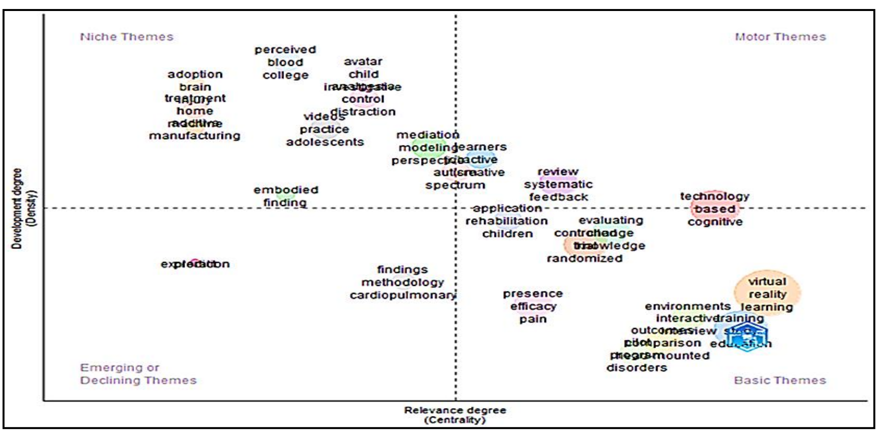

Fig. 3. Thematic Map

The thematic map in Figure 3 is divided into four quadrants, each with a specific focus. The first quadrant is the Motor Theme, which represents dominant or highly influential themes in an area. The second quadrant is the Basic Theme, which contains important but less dominant themes. The third quadrant is the Emerging Themes, representing emerging themes that are gaining attention. The fourth quadrant is the Declining Themes, representing themes that have declined in popularity or research interest. Finally, the Niche Themes represent very specific themes limited to a particular subfield.

4.6 Thematic Evolution

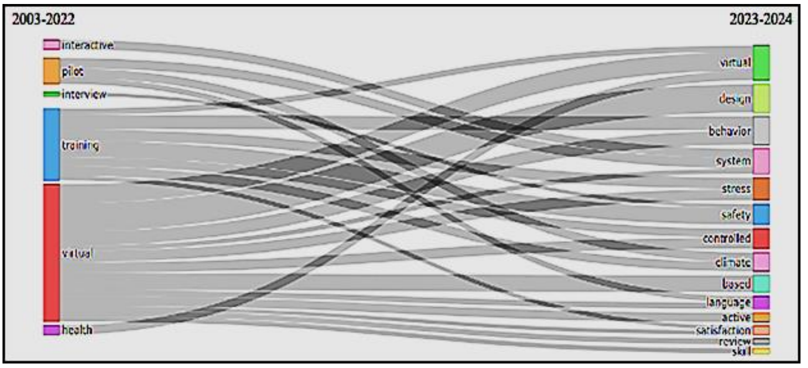

Fig. 4. Thematic Evolution

In the thematic evolution analysis (Fig. 4), which was carried out using biblioshiny to determine how the literature evolves from year to year, the thematic evolution is divided into two-time slices. The first time slice focuses on the research period 2003-2022, while the second time slice emphasises the research period 2023-2024. In the Thematic Evolution of the first-time slice, six scopes are the focus of research during the period 2003-2022. Each scope reflects the main theme or dominant area of research during this period. In the Thematic Evolution of the second time slice, these six scopes are broken down and refined due to the diversity of research areas that have emerged in 2023-2024.

5 Conclusion

This research explores the potential of Virtual Reality (VR) to enhance education and student self-efficacy. Through a quantitative approach and bibliometric analysis, the study shows that VR has a significant impact on learning, creativity, motor and cognitive skills, as well as student engagement and learning experience. The implementation of VR, as demonstrated in cases such as Google Expeditions and other applications, provides opportunities for deep and interactive immersive learning, allowing students to explore abstract concepts more concretely and engagingly. In addition, VR enhances social skills and self-confidence by providing simulations of real-life situations that prepare students for real-world challenges. The analysis of chronological trends shows an increasing interest in VR in education, particularly in the last decade, indicating a sustained growth in its application in the education sector. These findings are in line with SDG goal number 4, which aims to ensure inclusive and equitable quality education and increase lifelong learning opportunities for all by 2030. The use of technology is also in line with SDGs goal number 9, building resilient infrastructure, increasing inclusive and sustainable industries and fostering innovation.

Future research on VR in education should prioritise long-term evaluations of its impact on students' academic and non-academic skills, including self-efficacy and motivation to learn. Exploring the use of VR across different disciplines and educational levels is crucial to assessing its adaptability and effectiveness in different contexts. The integration of VR with AI and machine learning can create more personalised learning experiences, which warrants further investigation. Research should also focus on measuring the social and emotional effects of VR, including its impact on mental health and social interactions. Addressing issues of accessibility and equity is essential to ensure that all students benefit from VR, especially those in remote or disadvantaged areas. Developing innovative VR content and involving teachers in the design process will increase its relevance and pedagogical effectiveness. By focusing on these areas, we can better understand VR's potential to enhance learning experiences and address educational challenges.

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