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SYSTEMATIC REVIEW

Transforming Vocational Education through Augmented Reality: A Systematic Review of Current Trends, Challenges, and Future Opportunities

Transformando la Educación Vocacional mediante la Realidad Aumentada: Una Revisión Sistemática de Tendencias Actuales, Desafíos y Oportunidades Futuras

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ABSTRACT

In recent years, the potential of Augmented Reality (AR) to revolutionize vocational education has garnered significant attention, offering innovative solutions to bridge the gap between theoretical knowledge and practical skills. This systematic literature review aims to explore the latest trends, challenges, and opportunities related to the implementation of AR in vocational training over the past decade. The data utilized in this study were sourced from articles published between 2014 and 2024, extracted from the Scopus and Web of Science (WoS) databases to ensure comprehensive and high-quality coverage. The PRISMA method was applied to guarantee a transparent and reproducible process, consisting of several stages: identifying relevant studies, filtering based on predefined inclusion and exclusion criteria, assessing study quality, and extracting data. Following the PRISMA protocol, 67 research papers were initially identified, and after multiple stages of refinement, 24 papers were selected for detailed analysis. The findings indicate that Augmented Reality (AR) can enhance engagement and learning effectiveness in vocational education. However, its implementation is still hindered by limitations in infrastructure and the need for improved teacher training. To fully harness the potential of AR, further research is essential to develop more inclusive pedagogical models and support the integration of AR into vocational education curricula.

Keywords: Augmented Reality; Vocational Education; Vocational Training; PRISMA; Educational Technology.

RESUMEN

En los últimos años, el potencial de la Realidad Aumentada (RA) para revolucionar la educación vocacional ha captado una atención significativa, ofreciendo formas innovadoras de cerrar la brecha entre el conocimiento teórico y las habilidades prácticas. Esta revisión sistemática de la literatura tiene como objetivo explorar las tendencias, desafíos y oportunidades más recientes relacionadas con el uso de la RA en la formación vocacional durante los últimos 10 años. Los datos utilizados provienen de artículos publicados entre 2014 y

2024, recopilados de las bases de datos Scopus y Web of Science (WoS), asegurando una cobertura integral y de alta calidad. Se aplicó el método PRISMA para garantizar un proceso transparente y reproducible, que incluye varias etapas: identificación de estudios relevantes, selección según criterios de inclusión y exclusión predefinidos, evaluación de la calidad de los estudios y extracción de datos. A través del procedimiento PRISMA, se seleccionaron 67 artículos de investigación, de los cuales 24 se analizaron en profundidad tras un proceso riguroso de filtrado. Los hallazgos de este estudio demuestran que la Realidad Aumentada (RA) puede mejorar significativamente el compromiso y la eficacia del aprendizaje en la educación vocacional, aunque su implementación sigue enfrentándose a limitaciones relacionadas con la infraestructura y el desarrollo de habilidades pedagógicas. Para maximizar el potencial de la RA, se requiere investigación adicional que diseñe modelos pedagógicos más inclusivos y apoye su integración en los currículos de la educación vocacional.

Palabras clave: Realidad Aumentada; Educación Vocacional; Capacitación Vocacional; PRISMA; Tecnología Educativa.

INTRODUCTION

In recent years, ICT-based learning media in vocational education have garnered significant interest from researchers and vocational educators due to their potential to transform traditional teaching methods.[1,2,3] Vocational education, which prepares students with specialized skills,[4] often encounters challenges in providing practice-based learning opportunities that are essential for skill development.[5] The integration of Augmented Reality (AR) into classrooms offers a promising solution by creating immersive environments that simulate real-world scenarios. These environments enable students to practice skills and engage in situations that would otherwise be difficult or costly to replicate in physical settings.

Traditional vocational education heavily relies on face-to-face training and hands-on experiences in workplace environments.[6] However, the increasing complexity of modern work environments makes it progressively challenging to equip students with the comprehensive skills needed to succeed across various fields.[7] In sectors such as healthcare, manufacturing, and engineering, the demand for dynamic, interactive, and practical learning has become paramount. Technologies like Augmented Reality (AR), Virtual Reality (VR), and various forms of Mixed Reality (MR) serve as powerful tools to bridge this gap, offering more practical, flexible, and scalable approaches to delivering realistic training experiences.

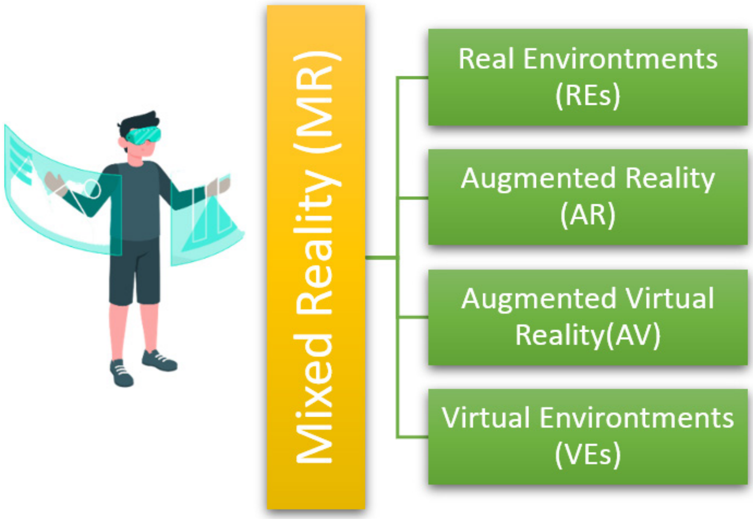

Figure 1. Virtuality Continuum adapted from Steinhaeusser et al.[8]

Chen et al.[9] emphasize that AR technology can simulate a variety of vocational tasks, ranging from operating machinery to performing medical procedures, all within a virtual space. This not only enhances student engagement but also enables repetitive practice without the risk of injury or equipment damage. The ability to interact with digital layers further promotes deeper understanding and retention of complex concepts. Liu et al.[10] note that AR provides real-time feedback, which helps students correct errors and improve their skills immediately.

Begeout et al.[11] argue that the implementation of AR aligns with the growing demand for digitally skilled workers across global industries. As technology advances, the need for workers who can adapt to and leverage

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new tools and innovations continues to rise.[12] Vocational education systems must adapt to these changes by integrating technologies that prepare students for a digital future.[13] AR is one of the most promising tools to meet this challenge, offering an engaging and effective way to teach modern skills.

While the benefits of AR in vocational education are evident, there remain significant challenges to its widespread adoption. Bardoe[14] highlights obstacles such as the high cost of AR technology, the need for specialized training for educators, and the integration of AR into existing curricula. However, these barriers are not insurmountable, and many educational institutions are already taking steps to address them. Collaborative efforts between industry stakeholders and educational institutions will be crucial to overcoming these challenges and ensuring the successful integration of AR.[15]

As AR technology continues to evolve, its applications in vocational education are expected to expand. Future trends point to the increased use of mobile AR platforms, which will make training more accessible and flexible. Additionally, the development of more sophisticated AR tools will enable more realistic simulations and tailored learning experiences. These advancements have the potential to revolutionize vocational education, equipping students with the skills and confidence they need to excel in their careers.

Exploring Augmented Reality (AR) in vocational education through a systematic literature review (SLR) is crucial for understanding its full potential and addressing the challenges that still hinder its broader adoption. As time progresses, it becomes imperative to examine current trends, identify future directions, and assess the barriers preventing effective AR integration in vocational training. Given the growing demand for a skilled workforce equipped with both technical and soft skills, understanding how AR can enhance vocational education is increasingly urgent.

By conducting an SLR, researchers can systematically gather evidence, highlight gaps in the existing literature, and provide recommendations to overcome the obstacles limiting AR's impact on vocational training. This exploration will not only inform future research but also assist policymakers and educators in effectively integrating AR to meet the evolving needs of students and industries alike.

METHOD

This study employs a Systematic Literature Review (SLR) to explore the use of Augmented Reality (AR) in vocational education. The process is organized into three main subsections: search strategy, inclusion and exclusion criteria, and search procedure.

Search Strategy

The search strategy in this study involved retrieving relevant articles from two major electronic databases, namely Scopus and Web of Science (WoS), to ensure comprehensive coverage and high-quality sources. The search was conducted using keywords related to Augmented Reality, Vocational Education, and additional terms such as training, skills development, learning, and future directions, structured with Boolean operators. This search focused on articles published between 2014 and 2024 to ensure the relevance and currency of the collected data. Searches were performed within the titles, abstracts, and keywords of the articles to identify the most relevant studies for the research topic. The query used is as follows:

Table 1. Advanced search Query on Databases

Advanched Search query	Term /Keywords	F
Scopus	TITLE-ABS-KEY ("Augmented Reality" AND "Vocational Education" AND (training OR "skills development") OR (trends OR barriers OR "future directions"))	51
WoS	TS=("Augmented Reality" AND "Vocational Education" AND (training OR "skills development") AND (trends OR barriers OR "future directions"))	5
Eric	("Augmented Reality" AND ("trends" OR "challenges" OR "barriers") AND "Vocational Education")	9

Inclusion and Exclusion Criteria

The articles that met the following inclusion criteria were considered for inclusion in this review: (1) articles that discuss the use of Augmented Reality in the context of vocational education, (2) articles published in English, (3) articles published in journals or conference proceedings indexed in Scopus, Web of Science, or ERIC, and (4) articles published between 2014 and 2024. Articles that did not meet these criteria were excluded through the selection process, with the following exceptions: (1) articles that do not discuss Augmented Reality or its application in vocational education, (2) articles that are literature reviews, theoretical papers, or those that do not provide full text, and (3) articles that require a subscription or cannot be accessed openly.

Search Procedure

The search procedure began by identifying relevant articles based on the predetermined keywords. The

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articles found through the initial search in Scopus and Web of Science were then filtered according to the keywords present in their abstracts. This process resulted in 67 articles, which were further examined to verify their alignment with the inclusion criteria. Articles that were deemed irrelevant or did not meet the criteria were gradually excluded through a step-by-step reduction process.

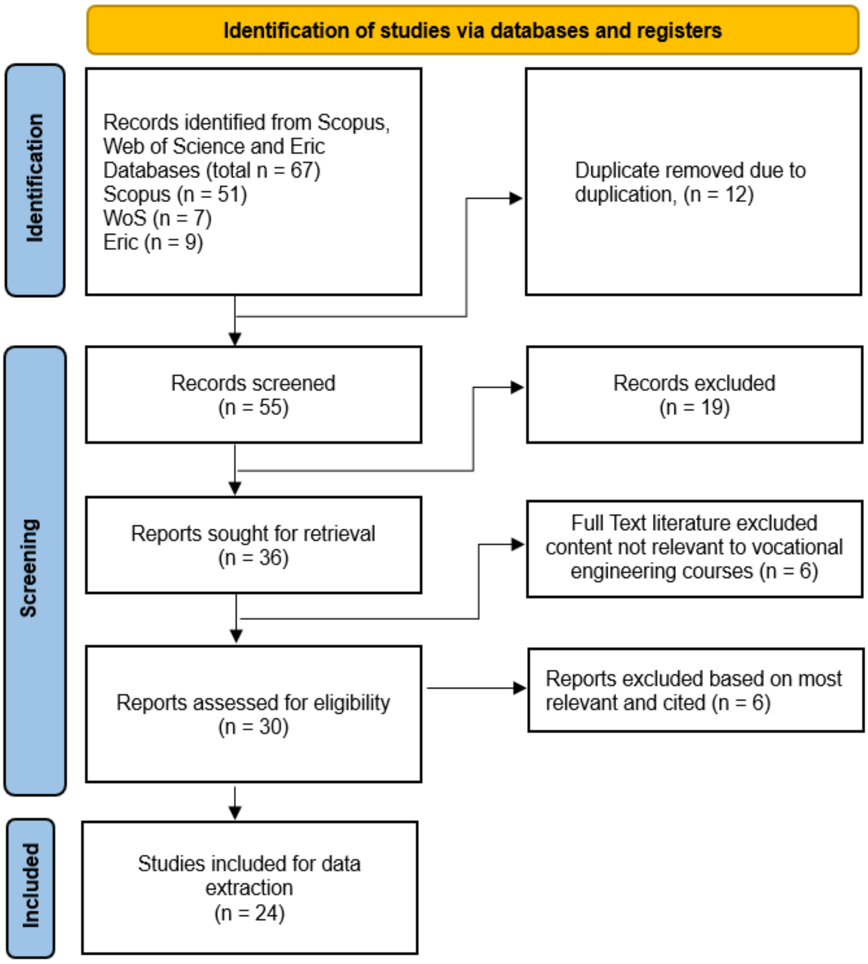

Figure 2. PRISMA Search Procedure Flow

Based on the review of previous studies, the research questions (RQ) formulated are as follows:

RQ1: What are the current trends in the study and application of augmented reality (AR) in vocational education?

RQ2: What are the key barriers to implementing augmented reality (AR) in vocational education?

RQ3: What are the potential future opportunities for augmented reality (AR) in vocational education?

Bibliographic Review

After identifying relevant articles following the PRISMA protocol, a deep understanding of the bibliographic perspective is necessary. To determine the direction and map the transformation of education using AR from various viewpoints, such as the authors' country of origin, frequently occurring keywords, and the demographic relationships between one paper's topic and others, R Studio was chosen for its strengths in mapping.

The metadata used in this study was obtained from three leading databases: Scopus, Web of Science (WoS), and ERIC. From Scopus, metadata was extracted in .bib format directly from the selected articles, while WoS data was retrieved in plain text format, and ERIC data was collected in .ris format. These three files were then unified into a consistent format through processing in RStudio, allowing for optimal data integration for bibliometric analysis. The merging process was carried out carefully to ensure consistency in data structure and avoid redundancy, ensuring that the entire metadata could be analyzed comprehensively.

After merging, the metadata was analyzed using Biblioshiny, an interactive interface within RStudio designed for bibliometric exploration. This analysis covered various aspects, such as identifying publication trends, the geographical distribution of authors, institutional collaboration, and keyword networks. The use of Biblioshiny facilitated the visualization of complex data in the form of informative graphs and network maps. The combination of these diverse metadata sources provides a holistic view of the development of

Augmented Reality (AR) research in vocational education, revealing patterns and relationships between the articles analyzed.

RESULT

The findings of this study are organized into four main subsections. The first subsection focuses on the improvement of student performance and learning outcomes, while the second subsection discusses the challenges and opportunities of implementing AR in vocational training. The third subsection addresses AR as an innovative methodology and learning framework. The fourth subsection explores the future directions and opportunities for AR research. This division is based on the primary focus of each study to facilitate a comprehensive analysis and ensure relevance to the research questions.

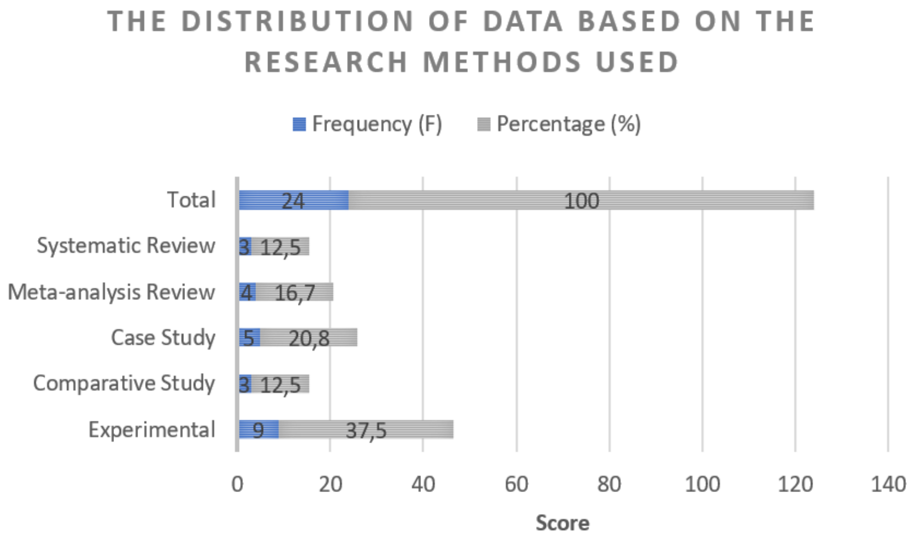

Figure 3. The distribution of data based on the research methods used

Based on the analysis, experimental research dominates, accounting for 37,5 % of the total studies analyzed. This method is often used to directly measure the impact of Augmented Reality (AR) on students or training programs, as demonstrated by Zihao Jiang(16) and Jorge Bacca(17). Comparative studies make up 12,5 % of the total, using an approach that compares control and experimental groups to evaluate the effectiveness of AR, such as the research conducted by Slavica Radosavljevic(18). Case studies contribute 20,8 % of the total, providing in-depth analysis of specific AR applications, such as Jens Hofmann's(19) research on the use of AR hardware in vocational education. Furthermore, 16,7 % of the studies are meta-analysis reviews, focusing on identifying key patterns and variables across various previous studies, like the research by Mustafa Sirakaya(20). Systematic reviews comprise 12,5 %, and are used to analyze broader trends, challenges, and opportunities, such as the study conducted by Garzon(21). This distribution indicates that experimental research is the main focus for evaluating the direct impact of AR in vocational education, while theoretical reviews provide insights into future development directions and opportunities.

According to the analysis, journal articles are the most dominant publication type, accounting for 62,5 % of the total studies analyzed. Journal articles offer a more in-depth and structured discussion on the use of Augmented Reality (AR) in vocational education. These articles are often the primary references for analyzing trends, barriers, and potential solutions for AR implementation. On the other hand, conference papers account for 37,5 % of the total studies analyzed. Conference papers typically reflect early or exploratory research findings, providing up-to-date insights into the developing AR technology.

Distribution based on production time

The analysis of publication distribution based on production time is crucial for understanding the trends and dynamics of research within a specific field of study.(22) By examining the fluctuations in the number of articles published each year, we can identify factors that influence research intensity, such as technological advancements, educational policies, or practical challenges faced by researchers.

The Annual Scientific Production graph above illustrates the trend in the number of scientific articles published from 2014 to 2023. The data shows a fluctuating pattern with a general upward growth trend, as visualized by the rising trend line. In the early years (2014-2016), the number of articles was very low, averaging only one article per year. However, the trend began to rise significantly in 2017, peaking in 2020 with

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six articles published, indicating a surge in research activity.

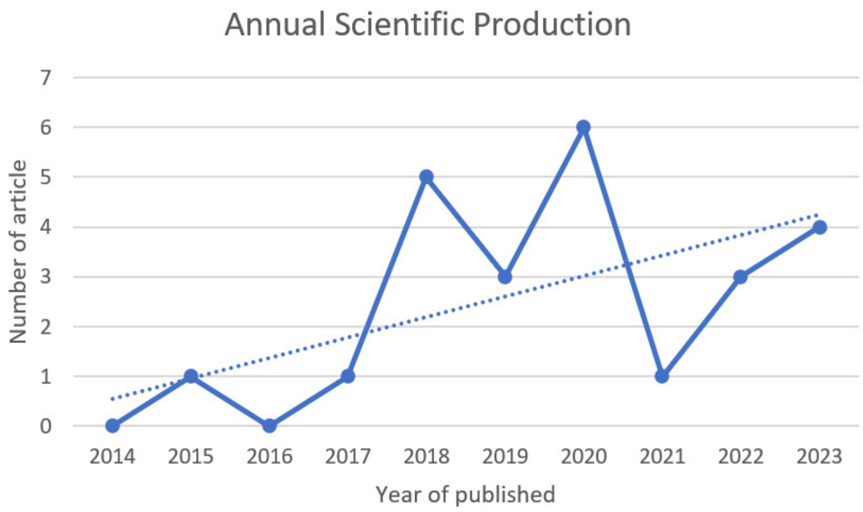

Figure 4. Article distribution based on Annual Scientific Production

After the peak in 2020, there was a sharp decline in 2021, followed by a gradual recovery in 2022 and 2023. Overall, the graph reflects an increasing interest in the research topic under analysis, despite significant fluctuations between years. The surge in 2020 may reflect the influence of technological advancements or supporting policies, while the decline in 2021 could be attributed to external factors such as the global pandemic. The rising trend line indicates the potential for sustained growth in research on the transformation of vocational education through Augmented Reality.

Distribution based on author's country

The analysis of the distribution of author countries using Biblioshiny, utilizing Multiple Country Collaboration (MCP) and Single Country Collaboration (SCP), aims to understand the patterns of research collaboration at both national and international levels. MCP provides insights into the extent to which a country is involved in the global research network through cross-border collaborations, while SCP indicates the focus of collaboration among researchers within a single country. This analysis helps identify a country's role in the global scientific community, both as a hub for international collaboration and as a driver of domestic research partnerships. Furthermore, the findings can be used to support strategic policymaking, such as strengthening international connections or enhancing national synergies, to bolster the overall research ecosystem.

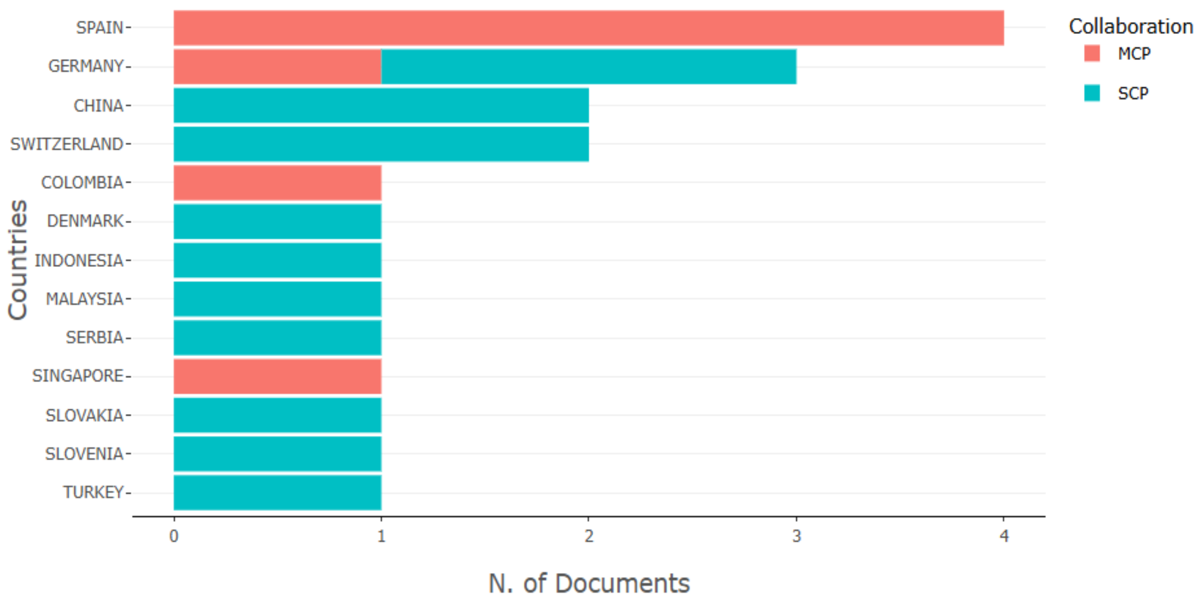

Figure 5. The distribution of author collaboration by country and type of collaboration

The chart illustrates the number of documents from various countries based on author collaboration types, namely Multiple Country Collaboration (MCP) and Single Country Collaboration (SCP). Spain stands out as the country with the highest contribution to MCP, reflecting a very strong international collaboration. A similar trend is observed in Germany, although with a lower MCP contribution compared to Spain, indicating both countries' significant roles as global hubs for scientific collaboration. In contrast, countries such as China, Denmark, Indonesia, and Singapore are predominantly involved in SCP, suggesting that researcher collaborations in these countries are primarily focused within national boundaries.

Countries with fewer documents, such as Serbia, Slovakia, Slovenia, and Turkey, exhibit more limited involvement in both MCP and SCP. Germany is an exception, with a balanced distribution between MCP and SCP, reflecting active participation at both national and international levels. Overall, the data indicates that international collaboration (MCP) is more prominent in countries that serve as global research centers, while local collaboration (SCP) tends to dominate in countries where research activities are more internally focused.

Keywords analysis

Identifying the main themes of research based on frequently used keywords is crucial for understanding the focal areas of a field. The relationships between these keywords help to highlight important subtopics, such as "immersive learning" or "technical skills training." By analyzing keyword co-occurrences, researchers can discern patterns and identify emerging trends in the literature. These insights can also guide future research directions and provide a clearer picture of how augmented reality (AR) is shaping vocational education. Additionally, examining the evolution of keyword usage over time can reveal shifts in the focus of AR applications in training and skill development.

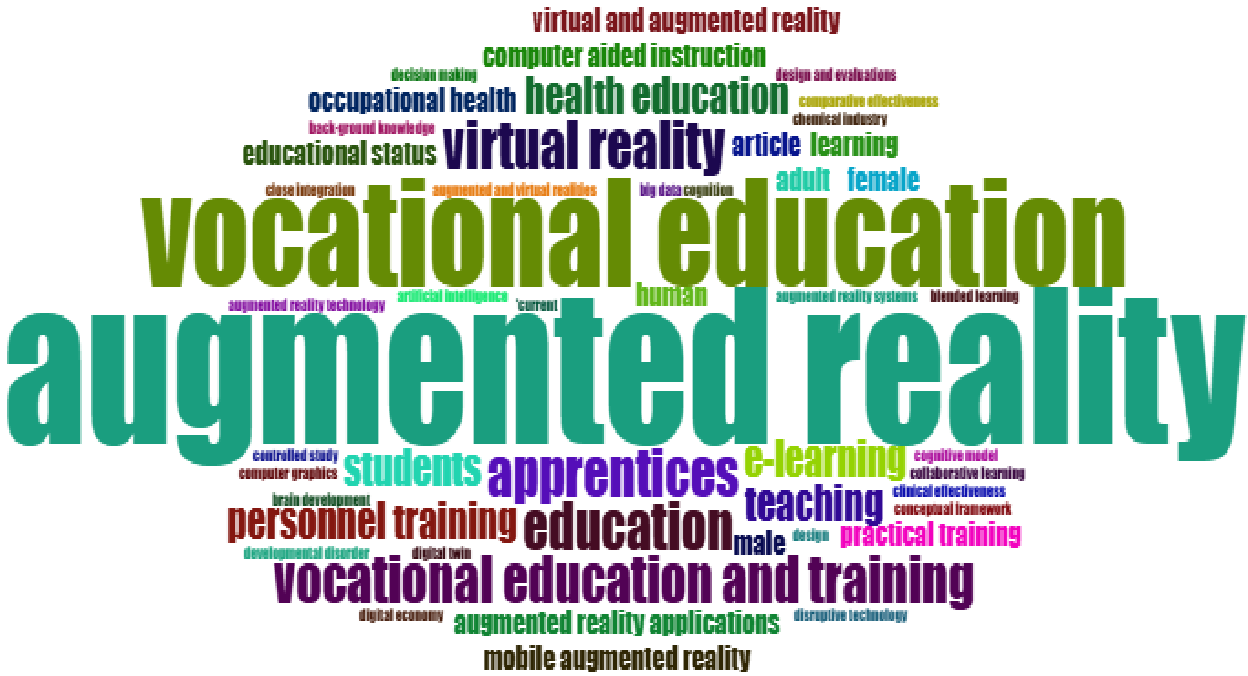

Figure 6. Wordcloud mapping

The word cloud above illustrates the distribution of frequently used keywords in the literature related to augmented reality (AR) in vocational education. The two most dominant words, "vocational education" and "augmented reality," highlight the primary focus of research connecting these two concepts. These keywords are centrally positioned and larger in size, indicating their significant relevance in discussions about the application of AR in vocational education.

Additionally, terms such as "e-learning," "students," "apprentices," and "training" also stand out, reflecting the focus on distance learning, technology-based training, and the roles of students and apprentices within vocational education systems. Keywords like "virtual reality" and "mobile augmented reality" further demonstrate the integration of AR with other technologies, such as virtual reality and mobile applications, in learning. Overall, the keywords provide an overview of how AR is being used in vocational education, addressing both practical and technological aspects.

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RQ1: *What are the current trends in the study and application of augmented reality (AR) in vocational education?*

Recent research indicates that a key trend in the application of augmented reality (AR) in vocational education focuses on developing specific applications for particular areas of expertise, such as car maintenance in the study conducted by Jorge Bacca[23] and woodworking in the study by Slavica Radosavljevic[18]. These applications are designed to enhance practical skills through interactive and immersive simulations, allowing students to visualize complex technical processes. Furthermore, studies highlight AR's potential to improve student engagement, motivation, and learning outcomes by offering intuitive, sensory-rich experiences.[20,21,24]

Another trend is the integration of AR into blended learning environments to support both collaborative and independent learning approaches. For instance, Zihao Jiang[16] demonstrates the success of AR in enhancing practical training and theoretical understanding through hybrid programs. Inclusivity efforts are also a significant focus, with frameworks like Universal Design for Learning (UDL) ensuring that AR is accessible to students with special needs.[25]

Moreover, several studies provide future directions for AR research, emphasizing the need for stronger pedagogical models and long-term impact evaluations.[21,26] These trends suggest that research continues to evolve with a focus on strengthening methodologies, improving accessibility, and adapting to the demands of Industry 4.0. Overall, AR plays a pivotal role in transforming vocational education through innovative approaches that enhance the quality of learning and student workforce readiness.

RQ2: *What are the key barriers to implementing augmented reality (AR) in vocational education?*

The implementation of augmented reality (AR) in vocational education faces several significant challenges related to technical, pedagogical, and resource limitations. Research has shown that the adoption of AR technology is often hindered by expensive infrastructure and hardware, particularly in institutions with limited resources.[19,25] Another challenge is the lack of training for educators to effectively integrate AR into the curriculum, which limits its effectiveness in enhancing the learning experience.[16]

Additionally, pedagogical barriers arise due to the absence of standardized learning models for AR implementation. Existing approaches are often experimental and have not been fully tailored to meet the needs of students and industries.[21,26] Studies also note that the high cognitive load on students when using AR technology can disrupt the learning process, particularly in complex practical scenarios.[27,28]

Other obstacles include the lack of support from stakeholders, such as insufficient funding and policies that promote technological innovation in vocational education.[29] To overcome these challenges, collaboration among stakeholders, intensive training for teachers, and the development of more inclusive pedagogical models are required. Addressing these barriers will enable AR to enhance the effectiveness of learning in vocational education more widely.

RQ3: *What are the potential future opportunities for augmented reality (AR) in vocational education?*

Augmented Reality (AR) offers significant opportunities to address challenges in vocational education and expand the potential for practical learning. This technology can be used to simulate real-world work environments safely, allowing students to gain relevant practical skills without the risk of accidents or equipment damage.[26] Additionally, AR has the potential to support personalized learning through interactive experiences tailored to individual needs, such as assisting students with learning difficulties or special educational needs.[30]

In the context of workforce development, AR can be integrated into industry-based curricula, accelerating the transfer of skills that align with the demands of the modern job market.[16,29] Innovations in AR software development could pave the way for broader adoption, such as integration with e-learning systems that enable remote technology-based training.[31] Further research is needed to develop pedagogical models that support self-directed and collaborative learning using AR, which can directly enhance the efficiency and effectiveness of vocational education.

Looking ahead, AR can be used to bridge resource gaps by providing access to virtual simulation tools in underdeveloped regions.[19] Furthermore, collaboration between educational institutions, industries, and policymakers could accelerate the adoption of this technology, maximizing its benefits in producing a workforce that is prepared to face the challenges of Industry 4.0. With these opportunities, AR has the potential to be a transformative solution in vocational education in the future.

DISCUSSION

Challenges in Implementing AR

Although Augmented Reality (AR) offers significant potential in vocational education, studies indicate several challenges hindering its widespread implementation. These include issues related to infrastructure, resource limitations, and the lack of skills among educators to effectively integrate this technology.[26,31]

Implementing AR in vocational education presents a number of challenges that educators and educational institutions need to address. While AR shows great promise in enhancing student engagement and understanding, its widespread adoption is still constrained by several significant barriers. One of the main challenges in implementing AR is the technological infrastructure required to support effective AR applications. AR applications necessitate robust technological infrastructure, such as high-speed internet and compatible hardware. However, not all vocational education institutions have adequate access to such infrastructure, which hinders the optimal implementation of AR in classrooms.(32) Moreover, the cost of developing AR content is often very high, requiring time and technical skills that are not always available in educational settings. The development of high-quality AR content demands expertise in technology and design, which may not be available at all educational institutions.(33)

Furthermore, issues related to teacher training and student acceptance also pose significant challenges. Many educators lack adequate training to effectively integrate AR into their curricula. A lack of knowledge and skills in utilizing this technology may result in ineffective use of AR, even if infrastructure and resources are in place.(34) On the other hand, students' adaptation to new technologies can also be a barrier. Some students may feel more comfortable with traditional learning methods and may resist using AR as part of their learning experience, which could reduce the positive impact of this technology.(35) Therefore, efforts are needed to ensure that both educators and students are prepared and open to adopting AR in their learning processes.

Gap Between the Potential and Implementation of AR in Vocational Education

Several studies have identified that, although AR can enhance learning effectiveness and student engagement, its implementation remains limited by factors such as technology costs, institutional readiness, and a lack of support from stakeholders in both the education and industry sectors.(25,36)

The gap between the potential and the actual implementation of Augmented Reality (AR) in vocational education remains significant, despite the transformative potential of this technology. While numerous studies highlight how AR can enhance student engagement, understanding, and practical skills, the integration of AR into vocational education curricula is still in its early stages. This creates a substantial gap between the expectations of AR's benefits and the reality of its implementation on the ground.

One of the greatest potentials of AR is its ability to create immersive and interactive learning experiences. With AR, students can learn complex concepts in a more intuitive and engaging manner, which can enhance their understanding and retention of the material.(37) Additionally, AR can increase student engagement through the integration of gamification elements, which have proven effective in boosting motivation and participation in vocational training.(32) This technology also supports the development of practical skills by providing students with opportunities to practice directly in a simulated, safe, and controlled environment, allowing them to acquire the essential hands-on skills required in vocational education.(10) However, the implementation of AR in practice is still hindered by various factors, resulting in this great potential not yet being fully realized within vocational education curricula.

The Need for Further Research on Augmented Reality in Vocational Education

Many studies suggest further research to explore solutions to the challenges of integrating AR, including the development of more effective pedagogical models and providing training for educators to maximize the use of AR in vocational education contexts.(20,38)

Further research on Augmented Reality (AR) in vocational education is crucial to maximize its benefits in creating more effective learning experiences. AR technology can create interactive and immersive learning environments, enhancing student engagement, critical thinking skills, and access to quality education. This section discusses the key areas where research is needed to support the broader integration of AR into vocational education.

Studies have shown that the implementation of AR can significantly increase student motivation and participation in learning. With the inclusion of gamification elements, AR provides a more engaging and enjoyable learning experience.(32) Additionally, this technology enables students to visualize abstract and complex concepts through interaction with virtual objects, making learning more dynamic and contextual.(35) Further research is needed to explore how this technology can be tailored to specific vocational fields.

Preliminary studies indicate that the application of AR, particularly on mobile devices, can enhance students' critical thinking skills. AR encourages students to engage in analysis, evaluation, and problem-solving through simulations and real-world scenarios.(39) Continued research is needed to evaluate the effectiveness of this approach across various vocational sectors, such as engineering, healthcare, and business services, as well as to develop evaluation tools to measure its impact comprehensively.

Trend analysis shows a significant increase in research related to AR in vocational education, with the number of publications steadily rising over the past decade.(40) This indicates AR's great potential for innovating teaching methods and expanding access to education.(33) However, challenges such as uneven technological infrastructure and the need for teacher training remain barriers to the widespread adoption of this technology.

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Future research should focus on innovative solutions to bridge these gaps.

Thus, while AR offers significant opportunities to improve vocational education, further research is essential to address these challenges and ensure its effective implementation. Focusing on student engagement, critical thinking skill development, and improving technology accessibility is key to driving the transformation of vocational education in the digital era.

CONCLUSSION

Augmented Reality (AR) technology plays a key role in transforming vocational education by enhancing interactive and practical learning, particularly in fields that require high technical skills. Since 2017, its implementation has grown significantly, proving effective in providing students with deeper understanding through realistic visualizations and simulations. However, challenges such as infrastructure limitations, lack of teacher skills, and high implementation costs hinder widespread adoption in vocational education.

Despite these challenges, AR offers great potential for further development across various vocational disciplines. It can enrich practical experiences through AR-based simulations and training, and increase learning flexibility via e-learning platforms. To maximize AR's potential, further research is needed to address existing barriers and identify efficient integration strategies, ultimately improving the quality and accessibility of vocational education globally.

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CONFLICT OF INTEREST

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