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Educational application of virtual reality in English education in vocational colleges: a bibliometric analysis

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ABSTRACT

Virtual reality (VR) technology has been widely adopted in education field for a period and its application keeps developing continuously. The bibliometric analysis was conducted to provide a comprehensive understanding of VR technology application about research strengths, research theme, scope, hot topics and evolution to enrich further study on VR technology adoption in English education in vocational colleges. The search of literature over the past decade in the Web of Science (WoS) database and 930 articles remained based on inclusion and exclusion criteria. Subsequently, VOSviewer used to analyze data from selected articles. The study finds out that research on VR technology shows an upward trend. The influential country is China, while most research institutions and authors are also from China. Research topics were identified using keyword co-occurrence analysis and four thematic clusters emerged: i) positive impact of VR on English education; ii) VR used in English education for special purpose; iii) VR is used in actual situation with the consideration of its' features and positive effect; and iv) users' acceptance of VR. The findings highlight current developments and offer guidance for promoting VR technology utilization in English education. Furthermore, educators could use the findings to design more effective VR-integrated curricula.

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1. INTRODUCTION

To some extent, to learn and practice skills timely in natural environment is a way to provide learning activities and to master knowledge efficiently for learners [1], [2]. Meanwhile, it also provides opportunities for technologies that could provide environment for mastering and practicing knowledge integrate into education procedure [3]. Especially for vocational education, which pays more attention to cultivate talents who can meet the needs of labor market and keep up with rapid social development [4], [5]. As the developments of globalization, "intercultural communicative competences" are becoming an indispensable working ability and English as lingua franca, has also become an important subject in vocational education [6], [7]. Many scholars have noticed the phenomenon and have conducted literature reviews or empirical researches on the virtual reality (VR) technology adoption in English education in the vocational education context [8].

However, studies usually with different emphases, like focuses on general study of VR technology application in education field [9], [10], focuses on the characteristics and advantages of VR technology application in English education [11], focuses on the VR adoption in vocational education for practical courses [12], and focuses on the skill-specific training and converse resources that VR provided [13].

However, some studies paid attention to the use of VR in English education, especially for vocational colleges [14], [15].

This study tries to fill the research gap adopting bibliometric approach to delve into the research landscape of VR technology application in English education within the context of vocational education in terms of its evolution, hot topic, and strengths, and based on the research, some suggestions and prospects for further research are provided. This study comes to identify research directions to serve as enrichment of study in this domain and provide guidance for researchers to deepen research in this field. The study also distinguishes itself by achieving precision and comprehensiveness in time span and search term selection, offering current understanding of VR utilization condition and potential. This study also hopes to illustrate and synthesize the trend of VR in English education within vocational education context that underscores the need for this research. Consequently, this study addresses the following research questions:

i) What is the condition and evolution of research on VR technology in English education in vocational colleges over past decade?
ii) Who are the most active authors, institutions, and countries publishing articles on the use of VR in English education in vocational colleges?
iii) What are the main topics in the research on VR application in English education in vocational colleges?
iv) What are the future research directions of VR research field in English education in vocational colleges?

2. REVIEW OF BIBLIOMETRIC ANALYSIS

Bibliometric analysis was adopted in this study as it can be applied across various research fields to quantify the process [16]. As a powerful research approach, bibliometric analysis tracks and analyzes scholarly literature using a set of quantitative methods [17]. It helps researchers identify and summarize relevant publications by authors, institutions, even the literature contents, including keywords, and references [18]. Generally, bibliometric analysis provides an overview of any field, since it involves large number of research materials [19]. As for the scientific of bibliometric analysis, the five research steps named as, study design, data collection, data analysis, data visualization, and interpretation should be followed step by step in this study [20].

Considering the power of bibliometric analysis in VR application in certain educational fields, many scholars also used it to support their studies. Measuring hot topics and frontier evolution about technology supported learning environments and ensured that technology-supported learning environments are both innovative and responsive to the diverse needs of the educational landscape by using bibliometric analysis [21]. Bibliometric analysis used to review the application of VR in computer science education. Meanwhile, it not only summarized the research status, but also shown its usefulness in this study [22]. Several research [23], [24] used bibliometric analysis to explore the impact of VR on education and VR application status in educational fields. Bibliometric analysis was adopted to understand VR in nursing professional skills training in the work of Hong and Wang [24]. It helps researchers make comprehensive overview of the use of VR in nursing professional skills training and highlights the importance of developing VR-based distance education [25]. This study adopted bibliometric analysis to complete the research.

3. METHOD

This study adopted bibliometric analysis to examine the VR research in English education in vocational colleges, based on five-step research process put forward by Öztürk *et al.* [26], including research design, data collection, data analysis, data visualization, and interpretation, which illustrated in Figure 1. To explain research procedure clearly, this study follows the steps and reasonably determine the research topics [27]. Then, determining the research objectives described in the introduction part. Accordingly, the keywords will be chosen based on research scope [18]. As WoS is a powerful database that offering high quality academic materials, this study intends to collect data from it by using the keywords [28]. This study therefore considered “VR”, “virtual reality” and “virtual reality technology” combined with “English” or “English education” and “vocational education” or “vocational college” as the primary keywords to search the WoS database using Boolean operators “OR” and “AND” in the “all fields” search field.

In data collection procedure, this study first choose the Web of Science core collection (WoSCC), the high quality database recognized by many scholars [29]. And literatures are selected that published only from Science Citation Index Expanded (SCIE) and Social Sciences Citation Index (SSCI), which are regarded as authoritative publishers [30]. Meanwhile, the data were extracted based on inclusion and exclusion criteria, including publication time, research scope, type and language. Based on the limited period, articles published from 2015 to 2024. Six were selected to catch up with the research trend recently. Initially, large number of documents (32,666) related to VR-focused research were extracted for screening. Firstly, the documents were narrowed down to 1,038 using WOS category “education educational research”, means

documents were not within the educational research area were excluded. Secondly, 108 articles, including proceeding papers, book reviews, and editorial materials excluded, since only journal articles were reviewed. Thirdly, remaining 930 articles that were not published in English were excluded, still leaving 930 journal articles to be analyzed. Then, all these articles obtained in Tab delimited file from WoS database.

All the documents were analyzed by using VOSviewer software in data analysis procedure [31]. VOSviewer was used to help do network analyzation and find out the most productive and influential authors, countries and institutions, identify networks among publications and authors as well. Furthermore, keyword co-occurrence analysis was performed to explore relationships among topics within publications by calculating author keywords and creating thematic clusters [26]. Therefore, the themes and future trends in a field were explained. The co-occurrence network of keywords and overlay visualization both displayed to represent topics and identify recent trends [32]. Finally, the results were described and interpreted in this study.

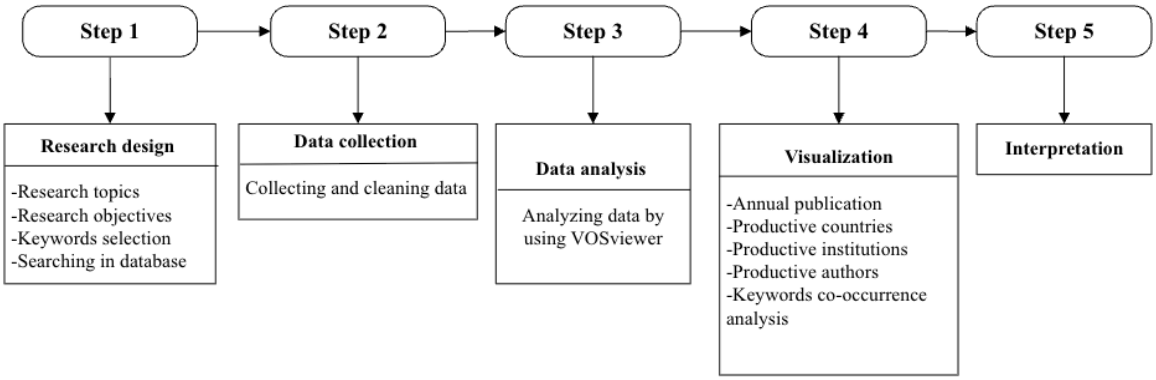

Figure 1. Research procedure

4. RESULTS

4.1. The evolution of annual production

The VR application in education had attracted researcher's attention since 2015, with 18, a small number of journals were published. Then, the publications increased steadily in the next five years and reached around 50 articles in 2019. Until 2020, which is considered as a turning point, the number of publications soar up and reached 95, twice as many as that of previous years. In the next few years, the number of publications growth rapidly, up to 231 in 2023. Although the number of publications in 2024 is less than that of 2023, it is still an upward trend in general, as the 176 journals are only counted from the first half of year. In all, the overall number of annual publications shows an upward trend, with relatively slow growth in the first five years and faster growth in the last five years over the past decade, as seen in Figure 2.

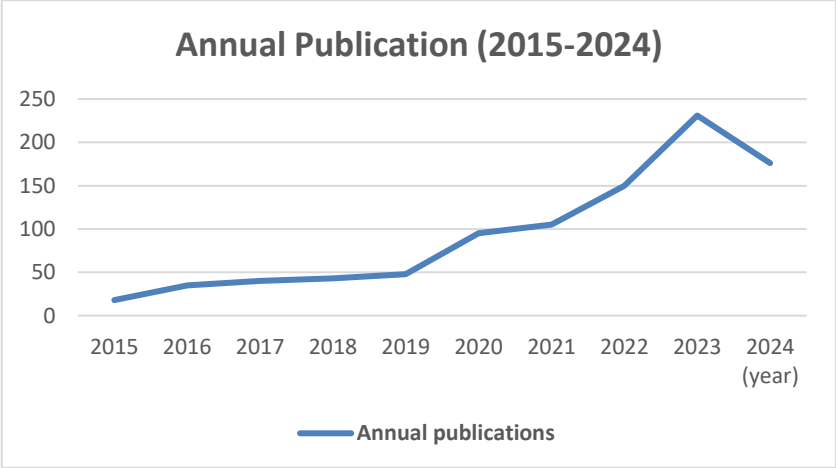

Figure 2. Number of annual publications

4.2. Research countries

The results in Table 1 show that after merging synonymous, China was the most productive country. It has contributed the highest number of publications (305) in the domains of VR application in English education in vocational education context over the past decade, it accounts for over 30% among total publications around the world. Following by USA, which was the secondary productive country with 196 publications in past ten years. Of the total number of articles, 501 journals with highest citation (over half of the total number) were published in the 2 countries. England and Australia are following ranked as top 3 and top 4, with 56 and 55 published journals respectively. The lines on the map in Figure 3, indicate the degree of cooperation between different countries, with the thickness of the lines reflecting extent of cooperation. It is evident from the map that Australia, Canada, Japan and other countries are highly co-related with China, United States has actively collaborated with South Korea, Finland, South Africa and other countries, while England, Germany, Demark, and Spain are cooperated closely.

Table 1. Countries with the highest publications and total citation count, ranked by the top 10

No.	Country	Documents	Citations
1	China	305	5,474
2	USA	196	4,954
3	England	56	1,310
4	Australia	55	1,532
5	Germany	48	1,155
6	Spain	44	1,578
7	Turkey	38	822
8	Denmark	29	1,999
9	Netherlands	29	381
10	South Korea	26	156

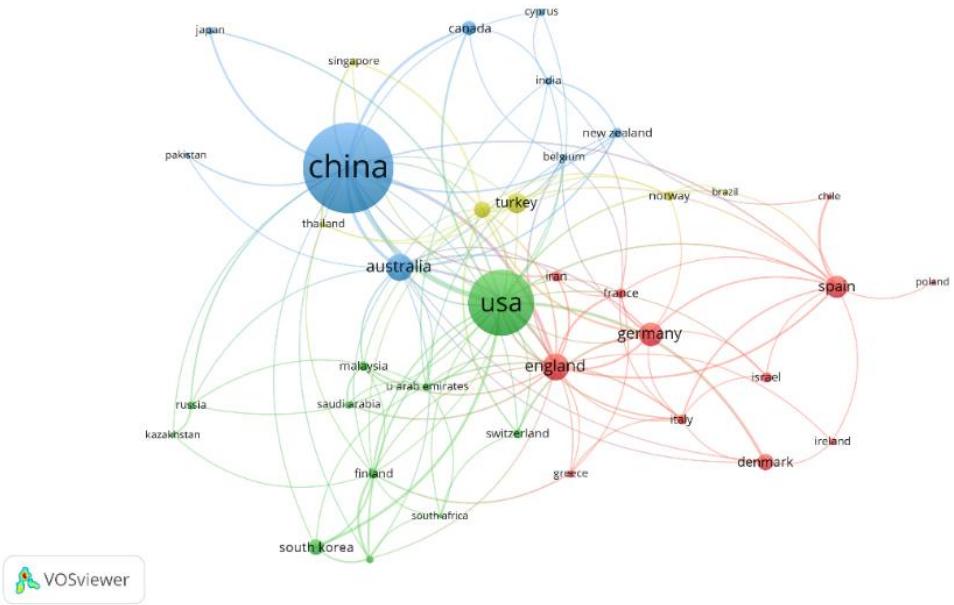

Figure 3. Research collaboration between countries

4.3. Research institutions

From Figure 4, National Taiwan Normal University was the powerful institution in China with 42 publications during the past decade, while National Taiwan University of Science and Technology followed closely behind, with 34 publications. The Chinese University of Hong Kong also plays a role in the research of VR application in education. Meanwhile, these research institutions are highly interrelated, and each institution has different scopes of influence and research focuses. Other institutions play an important role in this field in different research directions. As shown in Table 2, University of Copenhagen, National Taiwan Normal University and University of California, Santa Barbara had published influential journals and had been citated frequently. Additionally, there are two things need to be mentioned, shown in Table 2: first, the institutions in China account for the majority of the top ten research institutions, with a total of 6; second, although the institution in Denmark did not publish the most, the number of citations is the highest.

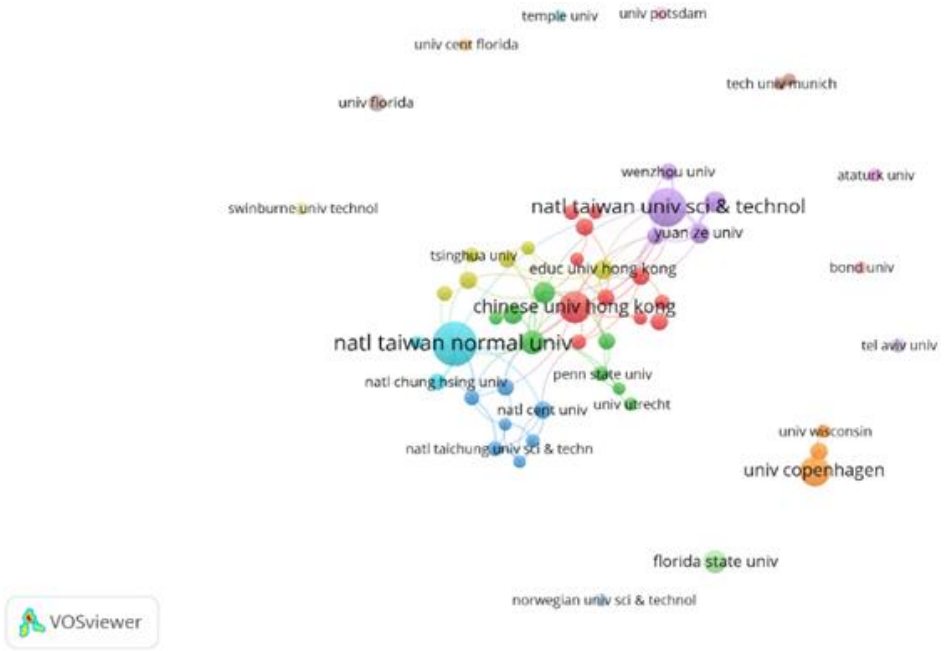

Figure 4. Research collaboration between institutions

Table 2. The institutions ranked in the top 10 based on the total number of citations

No.	Organization	Country	Citations	Documents
1	University of Copenhagen	Denmark	1,849	22
2	National Taiwan Normal University	China	1,246	42
3	University of California, Santa Barbara	USA	1,049	9
4	The Chinese University of Hong Kong	China	818	24
5	National Taiwan University of Science and Technology	China	672	34
6	Curtin University	Australia	526	5
7	East China Normal University	China	475	12
8	Atatürk University	Turkey	383	6
9	National Cheng Kung University	China	263	15
10	China Medical University	China	242	5

4.4. Co-authorship analysis

This study imposes the minimum number of citations is 5 and authors at least have coauthored two articles during the analyzation. There are 25 authors meeting the requirements and 14 clusters represented by different colors. The strongest co-authorship network, which colored in red is Hwang, Gwo-Jen from National Taiwan Normal University; Jong, Morris Siu-Yung from The Chinese University of Hong Kong; Chang, Shao-Chen from Yuan Ze University; Chien, Shu-Yun from National Taiwan University of Science and Technology; Li, Ming from Zhejiang Normal University. The second strongest co-authorship is marked in dark blue; the authors are Makransky, Guido from University of Copenhagen; Mayer, Richard from University of California, Santa Barbara; and Klingenberg, Sara from University of Copenhagen. According to Table 3, authors from the strongest networks are also productive and their works had large number of citations, Makransky, Guido gained 1,849 number of citations with his 22 articles; and Mayer, Richard followed behind by publishing 8 articles and gaining 1,024 number of citations. Jong, Morris Siu-Yung published 15 articles with 590 number of citations. Additionally, Hwang, Gwo-Jen had most publications, 25 articles and had 495 number of citations. The remaining 12 networks are shown in Figure 4 in different colors, like Tsai, Chin-Chung from National Taiwan Normal University; Cheng, Kun-Hung from National Chung Hsing University; and Lan, Yu-Ju from National Taiwan Normal University.

4.5. Key-words co-occurrence analysis

This study identified 2,310 author keywords in 930 published journals of VR application in English education in vocational colleges over past decade. The keywords analysis enables summary of research topics in the field and exploration of research hotspots. To create the keyword cluster map, this study imposes requirements that at least ten occurrences of a keyword is a threshold which result in 52 items that were grouped under four clusters in different colors, as shown in Figure 5. The keywords that have similar

meanings are merged. In addition, the keywords which are the same in meaning but different in spelling are also combined. For instance, “immersive virtual reality”, “VR”, “spherical video-based virtual reality” and “virtual reality (VR)” are written as “virtual reality”. Each cluster represents a keyword and shows the most linked and repeated keywords in the publications. As expected, the keywords “virtual reality” is the frequently used keyword with 608 occurrences and 662 total link strengths. The four clusters in different colors also show different trends of research. The first cluster (red color) including 15 items and the major items including “cognitive load”, “higher education”, “creativity”, “experiential learning”, “motivation”, “spatial ability”, among others. Second cluster (green color) contains 15 items, “educational technology”, “game-based learning”, “gamification”, “mobile learning” and “education” are significant themes. There are 13 items in third cluster that colored in blue, while “improving classroom teaching”, “learning strategies”, “secondary education”, “application in subject areas”, “interactive learning environments” and “media education” are displayed as major item in this cluster. The fourth cluster (yellow color) contains 9 items, “collaborative learning”, “empathy”, “three-dimensional displays”, “technology acceptance model” and “usability” are the major items.

Table 3. The authors ranked in the top 10 based on the total number of citations

No.	Authors	Citations	Documents
1	Makransky, Guido	1,849	22
2	Mayer, Richard E.	1,024	8
3	Jong, Morris Siu-Yung	590	15
4	Hwang, Gwo-Jen	495	25
5	Chang, Shao-Chen	238	6
6	Tsai, Chin-Chung	233	6
7	Klingenberg, Sara	217	6
8	Cheng, Kun-Hung	211	8
9	Chien, Shu-Yun	199	5
10	Lan, Yu-Ju	184	6

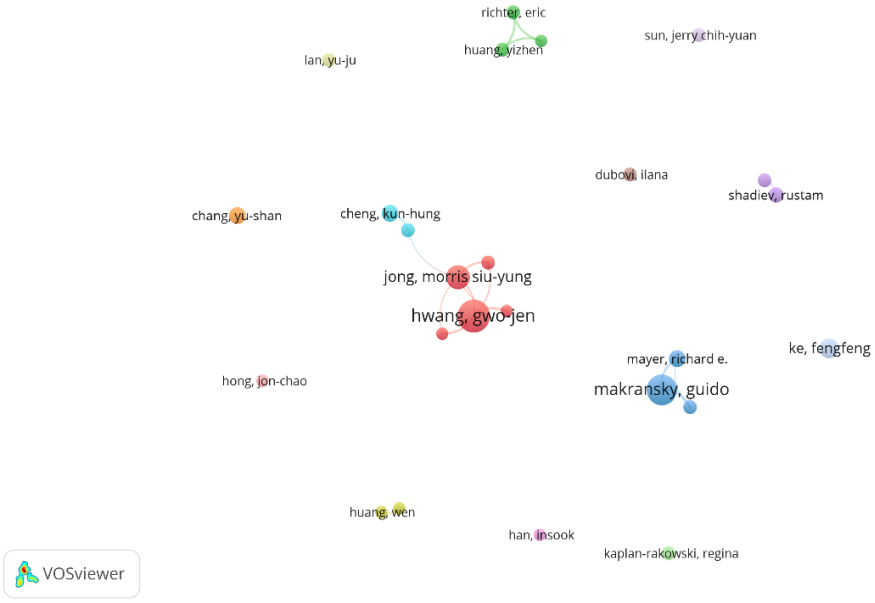

Figure 5. Research collaboration between authors

As illustrated in Figure 6, the overlaid co-occurrence network of keywords, which depicts the temporal distribution of topics with colors ranging from purple to yellow and demonstrates that thematic research directions in VR studies within the English education in the context of vocational colleges have scattered from 2015 to 2024. Topics appearing in the most recent studies are represented with yellow, which indicating the frequency of appearance. Observing the overlay visualization, as shown in Figure 7, it is easy to deduce that more recent articles also focused on the “metaverse” in addition to “gamification” which indicates that gamification learning strategy is emerging and currently trending topics. Additionally, “virtual reality”, “higher education”, “training”, “learning strategy”, and other topics are also keeping pace with research hotspots.

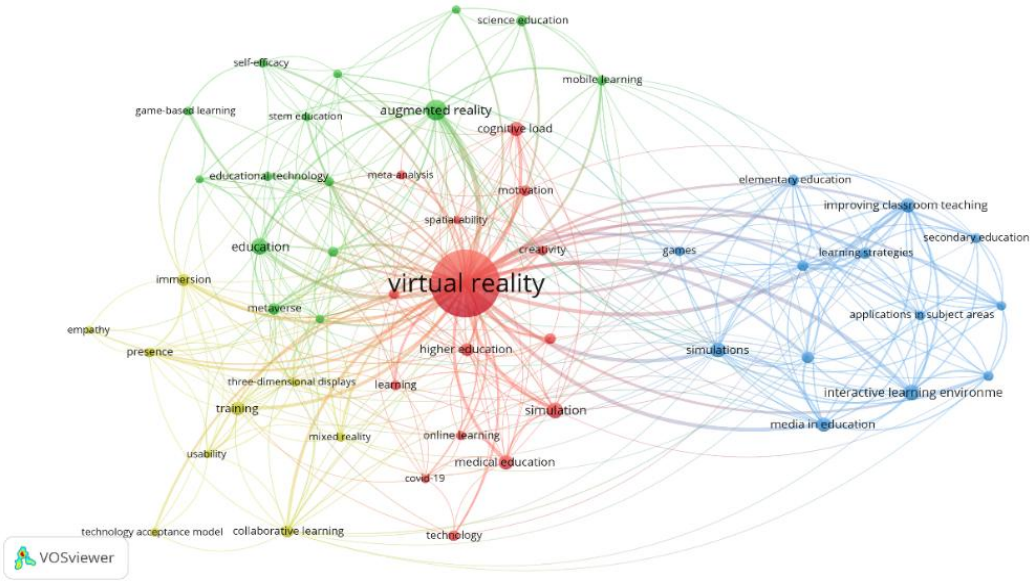

Figure 6. Key-words co-occurrence analysis

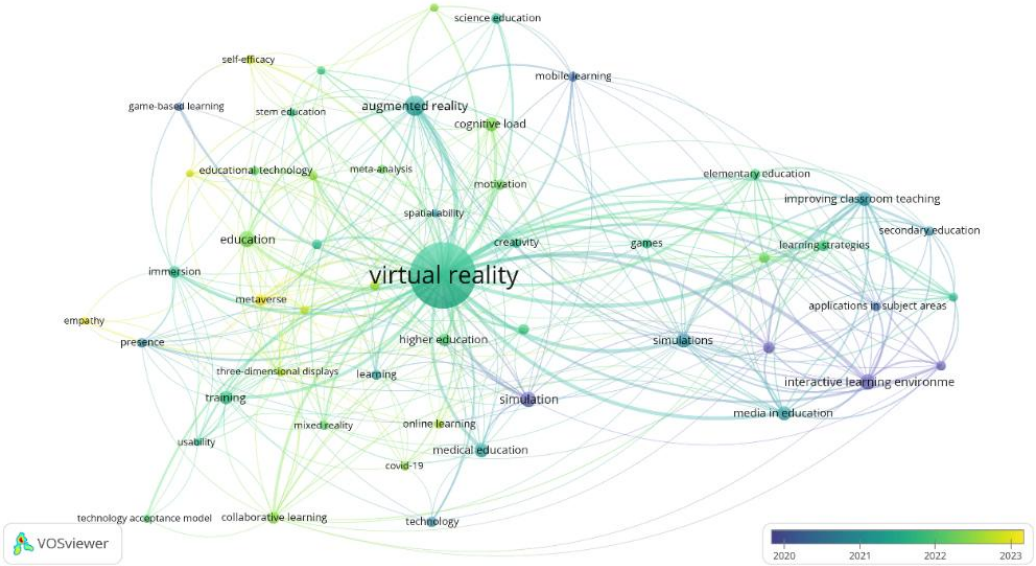

Figure 7. Overlay visualization of keyword co-occurrence analysis

5. DISCUSSION

The overview results reveal that the studies on VR application in educational field keep upward trend in general. In sustained growth over the past decade, the significant growth trend shows in 2020, with the publication number soaring up to 95, which twice as many articles published as the previous year. It is thanks to the outbreak of pandemic COVID-19 at the end of 2019 [4]. While most of papers discussed the role of VR in the pandemic within all research field, some of them highly introduced VR into educational context, even into school education system and compared the virtual education with in person education [33]. Since 2020, research continue to grow, with the number of publications so far accounting for approximately 82% of the total number of published in the past decade. This result indicates that there is an ongoing scholarly interest in researching VR within English education domain, while scholars are continue to explore the application of VR in teaching from different perspectives and to verify usefulness of VR in actual situation [34]. The possible explanation for this development would be attributed to recent technological advancements, coupled with the fact that traditional educators and learners easily embrace VR technology [35], VR is likely to continue attracting users [36], and VR has positive impact on teaching and learning outcomes [37].

Findings from bibliometric analysis supported by VOSviewer, the main contributors to VR research in English education domain within vocational colleges context were explained, including countries, institutions, authors and prominent topics as well. In terms of productive country, China ranks the first, followed by US and England. It demonstrates the widespread interest toward research on VR application in English education field. Related to productive countries, most of the influencing research institutions are from China, like National Taiwan Normal University, The Chinese University of Hong Kong and National Taiwan University of Science and Technology and other three institutions among the top ten research institutions. However, it is worth noting that although University of Copenhagen in Denmark does not have the highest number of publications, it has the most citations. To some extent, it demonstrates that articles in University of Copenhagen are more qualified and influential. Based on analyzation, the most productive authors were Hwang, Gwo-Jen, with 25 articles; Makransky Guido, who has higher number of citations (1,894), with his 22 articles.

According to the results of keyword co-occurrence analysis, this study identified four major thematic clusters that related research directions. The first cluster focuses on utilization of VR technology in education, since its usefulness reflects on teaching or learning outcomes through effecting cognitive load, stimulating motivation and cultivating creativity. VR has been underlined as effective tool to engage learners in learning, as it can stimulate learner's motivation with reduced cognitive load, through empirical study [38]. Consistently, this study recognized that first cluster encompassed the significant topics, including VR and technologies and online learning, which focuses on VR's potential to improve learning outcomes and enhance learners' experiment by providing immersive environment [39], while also demonstrates VR as widespread tool to learners' perception toward English in online learning method [40]. English education among learners that with lower level academic background can thus gain advantages and improve outcomes from VR application in English education within vocational colleges [37]. Some studies highlighted how VR applicated in English with its contribution to training qualified learners and educators [41].

The second cluster centers on VR employed in English education context with focuses on the learning outcomes for special purpose, like English in science, technology, engineering, and mathematics (STEM) education and science education. For instance, the language ability and STEM skill are increasingly demand is mentioned and it's concept would be better understand by visualizing invisible processes that provided by VR [42]. In systematic meta-analysis of effects of VR on education, Cromley *et al.* [43] demonstrates that VR has positive effects for all learning outcome types and shifts learners' focus from irrelevant to learning-relevant aspects of the VR learning environment. Other studies, Shu and Huang [44] elaborates the significant impact on learning effectiveness through experimental research; Shadiev *et al.* [45] has proven that VR technology was beneficial for knowledge development and helped learners acquire cross-culture knowledge. VR technology has thus received verification in education context as promotional tool for enhancing learning outcomes for special language requirement.

The third thematic cluster indicates that the majority of related research focuses on the real application in education with basic features of VR, including "interactive learning environment", "application in subject area", and "improving classroom learning". Chien *et al.* [46] used VR learning environment to situate learners in virtual English-speaking context, which has proven helpful for English-speaking performance, Żammit [47] concerned that VR has ability to create engaging learning environment with entertaining features, however, it also underscored VR as its' high costs. The attitude of users toward VR utilization in education was examined in the study of Nikimaleki and Rahimi [48], the positive attitude towards educational values of VR and users' high motivation to use VR has been shown. The high acceptance of VR was derived from its' ability to enrich classroom instruction, particularly in terms of conveying intricate details [49]. Moreover, some studies hold that researchers should consider update learning strategy through integrating VR with education, since VR supported teaching method is good for cultivating learning motivation and self-efficacy [50].

The fourth cluster centers on users' acceptance of VR in English education and utilization of technology acceptance model, which deem as commonly used theory. As argued by Guo *et al.* [51], technology acceptance model can serve as valuable tool for educators to develop novel learning strategies for encouraging learners to use VR in learning procedure, the learning performance thus be enhanced. Study of Fussell and Truong [52] states that VR is suitable for dynamic learning programs after testing hypotheses with the support from technology acceptance model in their research. Fussell and Truong [52] explore the educational capability of VR within technology acceptance model, while Shen *et al.* [53] extend technology acceptance model theory and complete research by integrating theory and practical VR implication in education context. Technology acceptance model was helpful for enhancing educational practice and guide VR application in education field [54].

Additionally, the research trend is shown through overlay visualization of keywords. Recently, scholars focus more on improving learners' empathy [55] and self-efficacy [56] through VR utilization in education. Trace back to former trend, during last 1 year (2021 to 2022), VR attracts scholars' attention and its' implementation in several educational areas, including VR used in English education for special purpose [57], VR used in higher education [58], design VR learning and teaching experience in stem education and

VR used for improving users' intentions in elementary education [59]. The fundamental research started relatively early, and many scholars have been continuing to do the research. For instance, research centered on features of VR and used it (like interactive learning environment VR provided in real instructional context [60]. Meanwhile, educators apply VR to assist learning by employing game-based learning features and improve learners' knowledge gains in virtual learning environment [61].

This study presents a comprehensive bibliometric analysis of VR technology in English education within vocational colleges, an area that has received limited attention in previous research. By examining 930 articles from the WOS database, the study systematically evaluates research strengths, thematic trends, scope, and developments in this field, offering valuable insights into the role of VR in vocational English learning. Unlike prior research that predominantly explores general VR applications in education, this study identifies four key thematic clusters, including VR's positive impact, its use for specific educational purposes, real-world applications considering its characteristics, and user acceptance, providing a more refined understanding of VR's pedagogical significance. Furthermore, VOSviewer was utilized for keyword co-occurrence analysis, revealing China as the leading country in VR research for English education, a finding that had not been explicitly highlighted in earlier bibliometric analyses. The study's findings contribute to the ongoing discourse on VR integration by offering empirical insights for designing more effective vocational English curricula. This targeted approach addresses a critical gap in VR-enhanced language learning and serves as a valuable guide for educators, policymakers, and researchers in optimizing VR's role in vocational education.

6. CONCLUSION

The study provides an overview of the current state of VR research in English education in vocational colleges through a bibliometric analysis of literature data from the WoS database. The results show that an increasing research trend on VR applications in English education. Analysis of published countries revealed that China as the most productive country. Influenced by convergence of research collaborations within countries, the most productive institutions and influential authors are largely from China. The co-occurrence of keywords analyzation indicates that the research centered more on VR application in education as its' positive impact on eliminate cognitive load, stimulate learning interests, cultivate creativity and enrich learning methods. The different research trend of research on VR implementation is reflected through overlay visualization. Research topics have shifted from employing VR features to integrating VR for improved educational outcome. However, the focus on VR research is has only increased without guiding research suggestions. Therefore, this study expected that more papers could be coming out in the future with suggested future research directions.

Despite advancements, there are some directions worthy for further research. For instance, a comprehensive understanding of VR application in vocational education is needed, since the research in such context is relative limited. Meanwhile, a more in-depth studies from English education perspective would be meaningful. Therefore, future research can focus on filling research gaps advance the field of VR adoption in both English education and vocational education. Finally, the research provides insights for policymakers, educators, learners and hold potential to play a role in promoting English education or vocational education development.

The limitations are also shown in this study. The source of data is derived from WoS and only English academic journals are included. Thus, articles in other language, conference papers and other types of works cannot be analyzed. Further, the database can extend the scope, like Scopus and Google Scholar. While VOSviewer was used for the bibliometric analysis, other tools such as Citespace could be employed in future research for comparative analysis. As VR is still a relatively new area of research, there is significant room for further exploration and practical application.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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Marilssa Omar	✓	✓					✓			✓	✓	✓	✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are openly available in Web of Science at https://www-webofscience-com. The data that support the findings of this study are available on request from the author, [LY]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions. Derived data supporting the findings of this study are available from the author, [LY] on request.

REFERENCES

[1] Amin, I. Widiaty, C. Yulia, and A. G. Abdullah, "The Application of Virtual Reality (VR) in Vocational Education," in *Proceedings of the 4th International Conference on Innovation in Engineering and Vocational Education (ICIEVE 2021)*, 2022, pp. 112–120, doi: 10.2991/assehr.k.220305.024.

[2] S. C. Michalski, C. Ellison, A. Szpak, and T. Loetscher, "Vocational training in virtual environments for people with neurodevelopmental disorders: A systematic review," *Frontiers in Psychology*, vol. 12, p. 627301, Jul. 2021, doi: 10.3389/fpsyg.2021.627301.

[3] M. Zhang, "Research and Application of VR situational Learning Resources Construction under the Blending Teaching Mode of Higher Vocational Education," in *Proceedings of the 2023 8th International Conference on Distance Education and Learning*, Jun. 2023, pp. 115–120, doi: 10.1145/3606094.3606132.

[4] T. M. Wut and M.-L. P. Ng, "Virtual Reality and Augmented Reality of Tourism Research: A Review and Research Agenda," *Journal of Quality Assurance in Hospitality & Tourism*, pp. 1–24, Apr. 2024, doi: 10.1080/1528008X.2024.2338774.

[5] M. Ozer and M. Perc, "Dreams and realities of school tracking and vocational education," *Palgrave Communications*, vol. 6, no. 1, p. 34, Feb. 2020, doi: 10.1057/s41599-020-0409-4.

[6] K. G. Skarpaas and G. O. Hellekjær, "Vocational orientation – A supportive approach to teaching L2 English in upper secondary school vocational programmes," *International Journal of Educational Research Open*, vol. 2, p. 100064, 2021, doi: 10.1016/j.ijedro.2021.100064.

[7] O. M. Trubitsyna, O. Kanibolotska, I. Y. Zozulia, A. S. Stadnii, and M. Y. Martynenko, "Professional Foreign-Language Training as a Component of Higher Vocational Education," *International Journal of Higher Education*, vol. 9, no. 7, pp. 187–195, Aug. 2020, doi: 10.5430/ijhe.v9n7p187.

[8] F. P. Sari and Y. Wirza, "Needs Analysis of English for Specific Purposes in Vocational High School Level," in *Proceedings of the Thirteenth Conference on Applied Linguistics (CONAPLIN 2020)*, 2021, pp. 188–194, doi: 10.2991/assehr.k.210427.029.

[9] F. Sholichin *et al.*, "Virtual reality learning environments for vocational education: a comparative study with conventional instructional media on two-stroke engine," *IOP Conference Series: Materials Science and Engineering*, vol. 979, no. 1, p. 012015, Nov. 2020, doi: 10.1088/1757-899X/979/1/012015.

[10] G. Al Farsi *et al.*, "A Review of Virtual Reality Applications in an Educational Domain," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 15, no. 22, pp. 99–110, Nov. 2021, doi: 10.3991/ijim.v15i22.25003.

[11] M. Mulders, J. Buchner, and M. Kerres, "Virtual Reality in Vocational Training: A Study Demonstrating the Potential of a VR-based Vehicle Painting Simulator for Skills Acquisition in Apprenticeship Training," *Technology, Knowledge and Learning*, vol. 29, no. 2, pp. 697–712, Jun. 2024, doi: 10.1007/s10758-022-09630-w.

[12] H. Chang, J. Park, and J. Suh, "Virtual reality as a pedagogical tool: An experimental study of English learner in lower elementary grades," *Education and Information Technologies*, vol. 29, no. 4, pp. 4809–4842, Mar. 2024, doi: 10.1007/s10639-023-11988-y.

[13] C. Chen, H. Hung, and H. Yeh, "Virtual reality in problem-based learning contexts: Effects on the problem-solving performance, vocabulary acquisition and motivation of English language learners," *Journal of Computer Assisted Learning*, vol. 37, no. 3, pp. 851–860, Jun. 2021, doi: 10.1111/jcal.12528.

[14] Y. Liu, Q. Zhan, and W. Zhao, "A systematic review of VR/AR applications in vocational education: models, affects, and performances," *Interactive Learning Environments*, vol. 32, no. 10, pp. 6375–6392, 2024, doi: 10.1080/10494820.2023.2263043.

[15] X. Cheng and K. Liu, "Application of Multimedia Networks in Business English Teaching in Vocational College," *Journal of Healthcare Engineering*, vol. 2021, pp. 1–9, Apr. 2021, doi: 10.1155/2021/5519472.

[16] A. Gokhale, P. Mulay, D. Pramod, and R. Kulkarni, "A Bibliometric Analysis of Digital Image Forensics," *Science & Technology Libraries*, vol. 39, no. 1, pp. 96–113, Jan. 2020, doi: 10.1080/0194262X.2020.1714529.

[17] T. S. Guray and B. Kismet, "VR and AR in construction management research: bibliometric and descriptive analyses," *Smart and Sustainable Built Environment*, vol. 12, no. 3, pp. 635–659, Apr. 2023, doi: 10.1108/SASBE-01-2022-0015.

[18] R. N. Lodhi, C. D. Gesso, M. Asif, and C. Cobanoglu, "Exploring virtual and augmented reality in the hospitality industry: A bibliometric analysis," *Tourism and hospitality management*, vol. 30, no. 1, pp. 67–84, 2024, doi: 10.20867/thm.30.1.6.

[19] J. Huang *et al.*, "A bibliographic study reviewing the last decade of hydrochar in environmental application: history, status quo, and trending research paths," *Biochar*, vol. 5, no. 1, p. 12, Mar. 2023, doi: 10.1007/s42773-023-00210-4.

[20] S. Secinaro, V. Brescia, D. Calandra, and P. Biancone, "Employing bibliometric analysis to identify suitable business models for electric cars," *Journal of Cleaner Production*, vol. 264, p. 121503, Aug. 2020, doi: 10.1016/j.jclepro.2020.121503.

[21] Y. Jing, C. Wang, Z. Chen, S. Shen, and R. Shadiev, "A bibliometric analysis of studies on technology-supported learning environments: Hot topics and frontier evolution," *Journal of Computer Assisted Learning*, vol. 40, no. 3, pp. 1185–1200, Jun. 2024, doi: 10.1111/jcal.12934.

[22] F. J. Agbo, I. T. Sanusi, S. S. Oyelere, and J. Suhonen, "Application of Virtual Reality in Computer Science Education: A Systemic Review Based on Bibliometric and Content Analysis Methods," *Education Sciences*, vol. 11, no. 3, p. 142, Mar. 2021, doi: 10.3390/educsci11030142.

[23] M. A. Rojas-Sánchez, P. R. Palos-Sánchez, and J. A. Folgado-Fernández, "Systematic literature review and bibliometric analysis on virtual reality and education," *Education and Information Technologies*, vol. 28, no. 1, pp. 155–192, Jan. 2023, doi: 10.1007/s10639-022-11167-5.

[24] C. Hong and L. Wang, "Virtual Reality Technology in Nursing Professional Skills Training: Bibliometric Analysis," *JMIR Serious Games*, vol. 11, p. e44766, Aug. 2023, doi: 10.2196/44766.

[25] S. Mystakidis, E. Berki, and J.-P. Valtanen, "Deep and Meaningful E-Learning with Social Virtual Reality Environments in Higher Education: A Systematic Literature Review," *Applied Sciences*, vol. 11, no. 5, Mar. 2021, doi: 10.3390/app11052412.

[26] O. Öztürk, R. Kocaman, and D. K. Kanbach, "How to design bibliometric research: an overview and a framework proposal," *Review of Managerial Science*, vol. 18, no. 11, pp. 3333–3361, Nov. 2024, doi: 10.1007/s11846-024-00738-0.

[27] P. Kalia, D. Mladenović, and Á. Acevedo-Duque, "Decoding the Trends and the Emerging Research Directions of Digital Tourism in the Last Three Decades: A Bibliometric Analysis," *Sage Open*, vol. 12, no. 4, pp. 1–23, Oct. 2022, doi: 10.1177/21582440221128179.

[28] B. Anthony *et al.*, "Blended Learning Adoption and Implementation in Higher Education: A Theoretical and Systematic Review," *Technology, Knowledge and Learning*, vol. 27, no. 2, pp. 531–578, Jun. 2022, doi: 10.1007/s10758-020-09477-z.

[29] X. Ding and Z. Yang, "Knowledge mapping of platform research: a visual analysis using VOSviewer and CiteSpace," *Electronic Commerce Research*, vol. 22, no. 3, pp. 787–809, Sep. 2022, doi: 10.1007/s10660-020-09410-7.

[30] J. Paul and M. Barari, "Meta-analysis and traditional systematic literature reviews—What, why, when, where, and how?" *Psychology & Marketing*, vol. 39, no. 6, pp. 1099–1115, Jun. 2022, doi: 10.1002/mar.21657.

[31] J. Martins, R. Gonçalves, and F. Branco, "A bibliometric analysis and visualization of e-learning adoption using VOSviewer," *Universal Access in the Information Society*, vol. 23, no. 3, pp. 1177–1191, Aug. 2024, doi: 10.1007/s10209-022-00953-0.

[32] Z. Xu, X. Wang, X. Wang, and M. Skare, "A comprehensive bibliometric analysis of entrepreneurship and crisis literature published from 1984 to 2020," *Journal of Business Research*, vol. 135, pp. 304–318, 2021, doi: 10.1016/j.jbusres.2021.06.051.

[33] B. Hamamra and A. Qabaha, "Boredom and alienation during online education in Palestinian universities: a socio-philosophical perspective," *Interactive Learning Environments*, vol. 32, no. 9, pp. 5445–5458, 2024, doi: 10.1080/10494820.2023.2215289.

[34] L. Janssen *et al.*, "Reflect to interact – fostering medical students' communication through reflection-focused e-learning," *BMC Medical Education*, vol. 24, no. 1, p. 541, May 2024, doi: 10.1186/s12909-024-05368-4.

[35] R. Yung and C. Khoo-Lattimore, "New realities: a systematic literature review on virtual reality and augmented reality in tourism research," *Current Issues in Tourism*, vol. 22, no. 17, pp. 2056–2081, Oct. 2019, doi: 10.1080/13683500.2017.1417359.

[36] H. Go and M. Kang, "Metaverse tourism for sustainable tourism development: Tourism Agenda 2030," *Tourism Review*, vol. 78, no. 2, pp. 381–394, Apr. 2023, doi: 10.1108/TR-02-2022-0102.

[37] E. İbili, M. Ölmez, A. B. İbili, F. Bilal, A. Cihan, and N. Okumuş, "Assessing the effectiveness and student perceptions of synchronous online flipped learning supported by a metaverse-based platform in medical English education: A mixed-methods study," *Education and Information Technologies*, vol. 29, no. 14, pp. 18643–18673, Oct. 2024, doi: 10.1007/s10639-024-12542-0.

[38] A. Skulmowski and K. M. Xu, "Understanding Cognitive Load in Digital and Online Learning: a New Perspective on Extraneous Cognitive Load," *Educational Psychology Review*, vol. 34, no. 1, pp. 171–196, Mar. 2022, doi: 10.1007/s10648-021-09624-7.

[39] K. G. Kim *et al.*, "Using immersive virtual reality to support designing skills in vocational education," *British Journal of Educational Technology*, vol. 51, no. 6, pp. 2199–2213, Nov. 2020, doi: 10.1111/bjet.13026.

[40] Y.-C. Chang and Y.-T. Tsai, "The effect of university students' emotional intelligence, learning motivation and self-efficacy on their academic achievement—online English courses," *Frontiers in Psychology*, vol. 13, 2022, doi: 10.3389/fpsyg.2022.818929.

[41] J. Bacca-Acosta, J. Tejada, R. Fabregat, Kinshuk, and J. Guevara, "Scaffolding in immersive virtual reality environments for learning English: an eye tracking study," *Educational technology research and development*, vol. 70, no. 1, pp. 339–362, Feb. 2022, doi: 10.1007/s11423-021-10068-7.

[42] H. M. Abu-Dalbouh, "Using a Modified Technology Acceptance Model for a Learning Management System Platform: A Questionnaire Design for Evaluating the Blackboard Learning Management System," *Computer and Information Science*, vol. 15, no. 3, p. 61, Jul. 2022, doi: 10.5539/cis.v15n3p61.

[43] J. G. Cromley, R. Chen, and L. Lawrence, "Meta-Analysis of STEM Learning Using Virtual Reality: Benefits Across the Board," *Journal of Science Education and Technology*, vol. 32, no. 3, pp. 355–364, Jun. 2023, doi: 10.1007/s10956-023-10032-5.

[44] Y. Shu and T.-C. Huang, "Identifying the potential roles of virtual reality and STEM in Maker education," *The Journal of Educational Research*, vol. 114, no. 2, pp. 108–118, Mar. 2021, doi: 10.1080/00220671.2021.1887067.

[45] R. Shadiev, X. Wang, X. Chen, E. Gayevskaya, and N. Borisov, "Research on the impact of the learning activity supported by 360-degree video and translation technologies on cross-cultural knowledge and attitudes development," *Education and Information Technologies*, vol. 29, no. 7, pp. 7759–7791, May 2024, doi: 10.1007/s10639-023-12143-3.

[46] S.-Y. Chien, G.-J. Hwang, and M. S.-Y. Jong, "Effects of peer assessment within the context of spherical video-based virtual reality on EFL students' English-Speaking performance and learning perceptions," *Computers & Education*, vol. 146, p. 103751, Mar. 2020, doi: 10.1016/j.compedu.2019.103751.

[47] J. Żammit, "Could virtual reality be the next approach for international students learning Maltese?" *Educational Technology Research and Development*, vol. 72, no. 6, pp. 3471–3493, Dec. 2024, doi: 10.1007/s11423-024-10375-9.

[48] M. Nikimaleki and M. Rahimi, "Effects of a collaborative AR -enhanced learning environment on learning gains and technology implementation beliefs: Evidence from a graduate teacher training course," *Journal of Computer Assisted Learning*, vol. 38, no. 3, pp. 758–769, Jun. 2022, doi: 10.1111/jcal.12646.

[49] M. Oubibi and K. Hryshayeva, "Effects of virtual reality technology on primary school students' creativity performance, learning engagement and mental flow," *Education and Information Technologies*, vol. 29, no. 17, pp. 22609–22628, Dec. 2024, doi: 10.1007/s10639-024-12766-0.
[50] H. Lin, G. Hwang, K. Chou, and C. Tsai, "Fostering complex professional skills with interactive simulation technology: A virtual reality-based flipped learning approach," *British Journal of Educational Technology*, vol. 54, no. 2, pp. 622–641, Mar. 2023, doi: 10.1111/bjet.13268.
[51] H. Guo, F. Ma, and Z. Zhou, "Validation of technology acceptance model for virtual reality usage in collaborative learning to enhance learner performance," *Innovations in Education and Teaching International*, vol. 62, no. 2, pp. 429–443, Mar. 2025, doi: 10.1080/14703297.2024.2307994.
[52] S. G. Fussell and D. Truong, "Accepting virtual reality for dynamic learning: an extension of the technology acceptance model," *Interactive Learning Environments*, vol. 31, no. 9, pp. 5442–5459, Dec. 2023, doi: 10.1080/10494820.2021.2009880.
[53] S. Shen, K. Xu, M. Sotiriadis, and Y. Wang, "Exploring the factors influencing the adoption and usage of Augmented Reality and Virtual Reality applications in tourism education within the context of COVID-19 pandemic," *Journal of Hospitality, Leisure, Sport & Tourism Education*, vol. 30, p. 100373, Jun. 2022, doi: 10.1016/j.jhlste.2022.100373.
[54] A. B. Mahmoud, "Exploring the public's beliefs, emotions and sentiments towards the adoption of the metaverse in education: a qualitative inquiry using big data," *British Educational Research Journal*, vol. 50, no. 5, p. 2320, 2024, doi: 10.1002/berj.4026.
[55] T. Patterson, I. Han, and L. Esposito, "Virtual reality for the promotion of historical empathy: A mixed-methods analysis," *Theory & Research in Social Education*, vol. 50, no. 4, pp. 553–580, Oct. 2022, doi: 10.1080/00933104.2022.2118091.
[56] C.-Y. Chen, S.-C. Chang, G.-J. Hwang, and D. Zou, "Facilitating EFL learners' active behaviors in speaking: a progressive question prompt-based peer-tutoring approach with VR contexts," *Interactive Learning Environments*, vol. 31, no. 4, pp. 2268–2287, May 2023, doi: 10.1080/10494820.2021.1878232.
[57] T. Teo, S. Khazaie, and A. Derakhshan, "Exploring teacher immediacy-(non) dependency in the tutored augmented reality game-assisted flipped classrooms of English for medical purposes comprehension among the Asian students," *Computers & Education*, vol. 179, p. 104406, Apr. 2022, doi: 10.1016/j.compedu.2021.104406.
[58] J. Radianti, T. A. Majchrzak, J. Fromm, and I. Wohlgenannt, "A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda," *Computers & Education*, vol. 147, p. 103778, Apr. 2020, doi: 10.1016/j.compedu.2019.103778.
[59] Y. Huh, "360° virtual reality project to inspire future educators to be creators," *Journal of Education for Teaching*, vol. 46, no. 3, pp. 421–423, May 2020, doi: 10.1080/02607476.2020.1766833.
[60] T. Lee *et al.*, "Investigation of virtual & augmented reality classroom learning environments in university STEM education," *Interactive Learning Environments*, pp. 1–16, Dec. 2022, doi: 10.1080/10494820.2022.2155838.
[61] C. Chen and J. Syu, "Effects of integrating a role-playing game into a virtual reality-based learning approach on students' perceptions of immersion, self-efficacy, learning motivation and achievements," *British Journal of Educational Technology*, vol. 55, no. 5, pp. 2339–2356, Sep. 2024, doi: 10.1111/bjet.13436.

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