A Bibliometric Analysis of Creative Design Education Practices: Enhance teaching- learning process through Virtual reality (VR)

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Abstract-

This study presents a bibliometric analysis of the integration of Virtual Reality (VR) in creative design education, focusing on its role as a strategic tool to enhance the teaching-learning process. Through a systematic review of literature, we explore how VR technology has been employed to expand information acquisition, modify attitudes, and develop practical skills in design education. Key practices identified include the creation of virtual design studios, where students can collaborate in a shared virtual space, enabling real-time feedback and fostering a collaborative learning environment. The organization of virtual exhibitions allows students to showcase their designs in immersive VR environments, providing opportunities for broader audience engagement and interactive feedback. Virtual field trips to iconic art and design landmarks offer students firsthand exposure to diverse design styles and techniques, enriching their learning experience. The development of VR simulations that replicate real-world design challenges, such as garment design or interior layout, enables students to experiment with solutions and receive immediate feedback, accelerating the learning process. Additionally, the use of Augmented Reality (AR) technology to overlay annotations onto physical prototypes during critique sessions enhances the feedback process, facilitating iterative improvement of designs. The bibliometric analysis reveals the growing impact of AR/VR technologies in design education, highlighting the potential of these tools to create immersive and engaging learning experiences that prepare students for the evolving demands of the design industry.

Keywords: Virtual Reality, Design Education, VR Technology, Teaching-learning process.

Introduction

The introduction of Virtual Reality (VR) technology has resulted in a total revolution in the area of creative design education. This revolution has been brought about by the provision of students with learning experiences that are both immersive and interactive. This work presents bibliometric research of the inclusion of virtual reality (VR) into creative design education methods. The study was conducted by the authors of this work. This investigation is being carried out with the intention of determining the impact that virtual reality (VR) has on the

process of education and study. Virtual reality (VR), which has been identified as a good tool for this purpose (Huang et al., 2019; Lee et al., 2020), has the potential to dramatically boost students' creativity, spatial awareness, and design thinking. This is particularly true for students who are learning design thinking. The virtual reality technology may simulate the environment of the actual world and provide a hands-on experience.

One of the most significant applications of virtual reality (VR) in the area of creative design education is the establishment of virtual design studios online. The students are able to overcome geographical barriers and create an atmosphere that supports collaborative learning via the use of these studios, which offer them with the ability to work together and engage in a virtual environment (Schnabel & Kvan, 2020; Wang & Schnabel, 2020). As a consequence of this, students not only cultivate their design skills, but they also become more equipped to deal with the increasingly globalised nature of the design industry. Additionally, virtual exhibits and field trips that are made possible by virtual reality technology offer students one-of-a-kind opportunities to present their work and investigate a wide variety of design styles and processes from all over the world, thereby enhancing their educational experience (Chen et al., 2021; Zheng & Chan, 2021). These opportunities are made possible by the technology.

Students are provided with the ability to experiment with a range of solutions and get rapid feedback within the context of virtual reality (VR) simulations that simulate real-world design issues. Some examples of these tasks include garment design and interior layout. (Lin et al., 2020; Zhou et al., 2021) This helps to speed up the learning process and enhances students' capacity to solve issues. There are two studies that support this claim. In addition, the use of Augmented Reality (AR) in critique sessions, in which comments are projected onto actual prototypes, provides a new level of interactive feedback, which makes it possible to conduct conversations that are both more comprehensive and constructive (Kim & Cho, 2019; Park & Kim, 2020).

To improve the teaching and learning process via the use of virtual reality (VR), it is necessary to make use of technologies that are both immersive and interactive in order to provide educational experiences that are appealing to students. The virtual reality (VR) technology has the potential to revolutionise the conventional methods of instruction by presenting pupils with a computer-generated world that is three-dimensional and allows them to explore and interact with it. This immersive experience has the potential to result in higher engagement, enhanced knowledge retention, and a deeper grasp of difficult subjects. According to research conducted by Radianti et al. in 2020, virtual reality (VR) has the potential to facilitate active learning by providing students with the opportunity to carry out activities and make choices inside virtual settings. This may result in more efficient learning outcomes.

According to Huang et al. (2019), virtual reality (VR) may also be used to imitate real-world settings, which gives students the opportunity to practise their abilities and apply their knowledge in a setting that is both safe and under control. According to Akçayır and Akçayır (2017), the use of virtual reality (VR) in the field of education presents the possibility of personalised learning, since it can be customised to cater to the specific requirements and learning styles of every single student. In general, the incorporation of virtual reality (VR) into the teaching and learning process has the potential to bring about improvements in educational

experiences and to better prepare students for the requirements of the workforce of the 21st century.

Through the use of bibliometric analysis, the objective of this work is to do a mapping of the academic landscape of virtual reality (VR) in the field of creative design education. The identification of significant publications, authors, and research trends will be made easier as a result of this. The purpose of this research is to demonstrate the growing impact that virtual reality technology is having on design education and to identify areas that need further examination. Evaluation of citation networks and patterns of co-authorship will be the means by which this objective will be realised. It is expected that the findings of this research will provide valuable insights to educators and scholars who are interested in exploiting the potential of virtual reality (VR) to enhance creative design education. If this is the case, then the study will be successful.

Literature Review

In recent years, the use of Virtual Reality (VR) into creative design education has gained traction due to technological developments and a rising acknowledgment of its ability to improve the teaching and learning experience. Virtual reality (VR) provides immersive and interactive experiences that help enhance comprehension of design ideas, enhance spatial visualisation abilities, and stimulate creativity (Radianti et al., 2020). This literature review provides a bibliometric analysis of the latest research on the use of virtual reality (VR) in the field of creative design education. It aims to find significant patterns, recurring themes, and practical implications.

Virtual reality (VR) in design education is often based on constructivist and experiential learning theories. These theories prioritise active involvement, exploration, and reflection (Huang et al., 2020). Research has shown that virtual reality (VR) has the potential to enhance learning outcomes by improving spatial reasoning, boosting motivation, and increasing knowledge retention (Lee et al., 2020; Wang & Cheng, 2020). In research conducted by Lin et al. (2020), it was discovered that virtual reality (VR) had a substantial positive impact on the comprehension of spatial connections and design aesthetics among interior design students.

An important use of virtual reality (VR) in creative design education is the virtual design studio. This allows students to work together on projects in a shared virtual environment. This promotes collaboration and the development of effective communication abilities, enabling immediate feedback and the process of making improvements (Schnabel & Ham, 2019). The study conducted by Zhou et al. (2021) emphasises the capacity of virtual design studios to overcome geographical barriers and provide equitable learning opportunities for students from all backgrounds.

The incorporation of virtual reality (VR) into design education presents difficulties, such as technological obstacles, limited accessibility, and the need for educators to undergo specialised training (Dalgarno & Lee, 2010; Merchant et al., 2014). Moreover, there is a current discussion over the equilibrium between virtual and conventional experiential learning encounters, with some research indicating that a combination of both methods may provide the most favourable results (Huang et al., 2019).

The bibliometric research reveals an increasing fascination with the use of virtual reality (VR) in the realm of creative design education. This interest mostly centres on collaborative learning, immersive experiences, and the acquisition of practical skills. Subsequent studies should examine the enduring effects of virtual reality (VR) on educational achievements, study methods for seamlessly incorporating VR into educational programmes, and tackle concerns related to accessibility and inclusion. VR technology's ongoing development shows potential for revolutionising design education and enhancing students' readiness for the creative industry's challenges.

Methodology

Bibliometrics is an area within the fields of information science and libraries that use quantitative methods to analyse bibliographic information (Broadus, 1987; Pritchard, 1969). This study will use Bibliometric analysis using the 'Biblioshiny' R studio programme to investigate the research topics. The platform offers several customisation options, including source recognition, monitoring document release, identifying authors for relevant research, developing a conceptual framework based on inferred themes, and creating social and network structures (Aria & Cuccurullo, 2017). Furthermore, the research examines the formation of significant keywords and trends related to Creative Design Education Practices. Bibliometric analysis is a technique used to analyse the patterns and trends present in scientific publications. Bibliometric analysis may provide useful insights into the research trends and subjects linked to the usage of Virtual Reality (VR) in creative design education, which is increasingly being used to enhance the teaching-learning process. The Scopus database is used because of its extensive range of subjects covered and advanced search features. The research comprises five primary procedures: study design, data selection, data analysis, data visualisation, and data interpretation. This study makes a valuable contribution to the subject by analysing the existing literature on Creative Design Education Practices and investigating the impact of Virtual Reality on improving the teaching and learning experience.

Study Design

The research used Scopus as the database for analysis, including the time frame from 1994 to 2024. Scopus is widely recognised for its ability to assess the quality of academic journals and authors by analysing the number of citations received for each unique work (Burnham, 2006). This study primarily examined a collection of academic journals published in English between 1994 and 2024. The area of interest was the intersection of creative design education and virtual reality. The document type was limited to "articles" to guarantee relevance and accuracy.

The search was narrowed down to just contain journal articles, therefore removing different types of documents such as conference proceedings, thesis, and book chapters. The screening technique provided 1208 items only in English from Scopus. The data that was obtained was exported in a comma-separated file (.csv) format. It consisted of citation information, bibliographic details, abstracts, keywords, and references for each article that was chosen. This dataset is used as the basis for a bibliometric study that aims to understand and improve the teaching and learning process in creative design education by using virtual reality technology.

Data Selection

Data is retrieved from the Scopus database by querying it based on its compatibility with R-studio, as well as its coverage of articles and classification of journals.

Data Analysis

The findings of the study were evaluated with a particular focus on descriptive analyses, which included the frequency of document creation, trends in scientific publications, relationships between countries, the principal writers of the area, and the keywords that were used. In the case of keywords, the terms were normalised because several of the most significant keywords contained both single and plural variants. This technique was put into action to ensure that the keywords, author links, and nations were consistent with one another.

Data Visualisation

Following the completion of the data analysis, data reduction methods were used to visualise the findings.

Interpretation

After thoroughly evaluating and analysing the available information, we reached a decision. The descriptive analysis approach is used to find bibliometric data pertaining to the core characteristics of the data collection. It is crucial to highlight that these attributes include (1) documents, (2) writers, (3) terms, and (4) countries. This article conducts a thorough investigation on the following topics and presents the results obtained from a detailed review of these topics:

- Main information
- Word Cloud
- Tree Map
- Factorial Analysis

Results

Main Information

The graphic presents a bibliometric study that illustrates the research trends over a period of three decades. It highlights a strong and increasing interest in the area, with a total of 1,208 papers written by 3,591 authors since 1994. The field's yearly publishing growth rate of 14.49% is remarkable, and it is further highlighted by the high level of cooperation seen, with an average of 3.56 co-authors per document and a 16.89% rate of international co-authorship. These statistics clearly demonstrate the field's increasing and global character. The presence of 683 sources and 2,681 author keywords indicates the wide range of topics and the intellectual depth of the subject. In addition, the significant citation effect, with an average of 11.15 citations per document, together with a substantial corpus of 35,780 references, demonstrates both the present significance and historical breadth of the study. The data indicates that the average age of documents is 4.53 years, suggesting that the academic community is actively involved in current research topics show in fig 1.

Figure 1: Main Information

Word Cloud

The word cloud provides a visual representation of important ideas associated with "virtual reality," which is prominently included, highlighting its crucial role in transforming educational methods. The words "e-learning," "engineering education," and "students" emphasise the incorporation of technology in educational systems, especially in the area of engineering. On the other hand, "augmented reality" indicates the progression towards immersive learning environments. The concepts of "human," "computer simulation," and "learning systems" indicate a merging of human-computer interaction, simulation-based learning, and systematic educational techniques show in fig 2. The contrast between "teaching" and "students" highlights the emphasis on instructional practices. The word cloud provides an overview of how VR and related technologies are used in creative design education to improve teaching methods via a comprehensive and multidisciplinary approach.
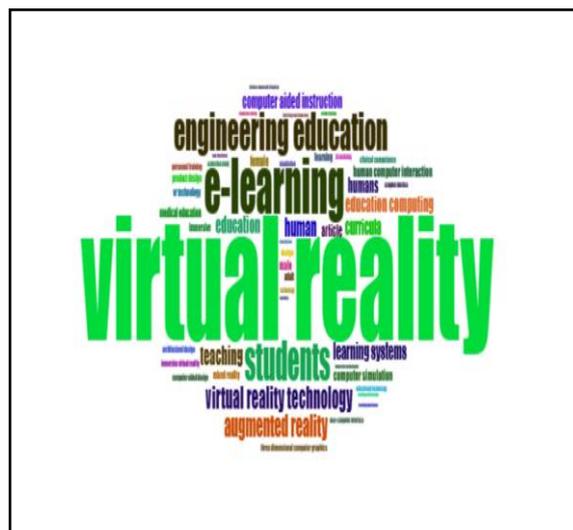

Figure 1.2: Word Cloud

Tree Map

The Tree Map visualisation highlights the significant influence of "virtual reality" in creative design education research, capturing an 18% market share and solidifying its position as the primary subject in the area. The term "E-learning" accounts for 8% of the total, indicating the importance of digital platforms in the field of education. Both the terms "students" and "engineering education" each represent a 6% portion, emphasising the emphasis on educational results and curricular structures, specifically within engineering fields. The terms "augmented reality" and "learning systems," each accounting for 3%, represent investigations into improved, immersive educational experiences and organised learning methods. The terms "teaching," "human," "education," and "humans" emphasise the incorporation of human-centred methods and pedagogy, each accounting for 2-3%. In addition, concepts such as "mixed reality," "VR technology," "computer simulation," and "human-computer interaction" enhance the variety of study by connecting actual technological applications with design and learning Fig 3. This Tree Map represents a sophisticated and multidisciplinary research environment, where virtual reality technologies play a central role in driving educational innovation and pedagogical progress.
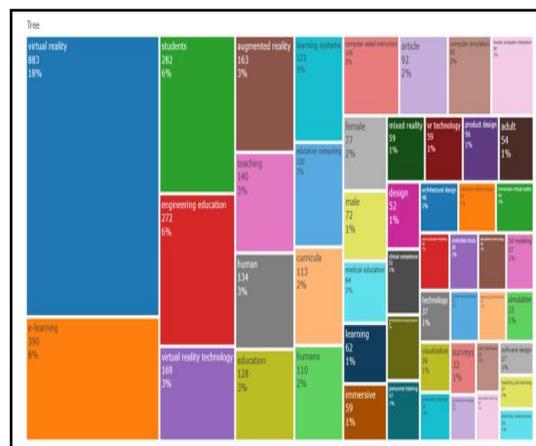

Figure 3: Tree Map

Factorial Analysis

Factorial analysis A scatterplot is used to visually represent the concentration of themes within a bibliometric dataset, specifically looking at the overlap between virtual reality and education. The dominant factor along the horizontal axis, accounting for 90.08% of the variance in the dataset, reveals a distinct division between technology-focused terms such as "virtual reality," "personnel training," and "architectural design" in the centre, and human-centered aspects like "human," "controlled study," and "user. computer. interface" on the right. The term "mixed reality" is positioned separately in the lower part of the hierarchy, indicating that it is a distinct but interconnected subject area. The cluster on the right side represents a focused emphasis on human aspects, gender studies, and user interface design. On the other hand, the cluster on the left side, which includes themes like "simulation" and "medical education," revolves on the utilisation of immersive technologies in certain educational settings. The entire distribution encompasses the wide-ranging applicability and complex nature of virtual and mixed worlds in educational operations show in fig 4.
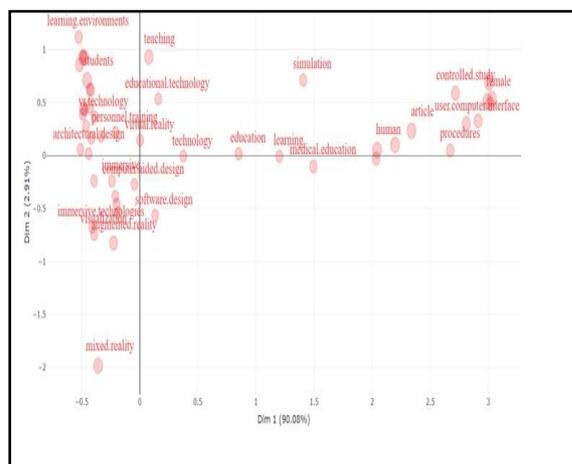
Figure 4: Factorial Analysis

Conclusion

According to the findings of a bibliometric study of creative design education methods, there is a rising interest in the use of virtual reality (VR) to improve the teaching and learning process. The use of virtual reality (VR) into design education provides students with immersive and interactive experiences that have the potential to dramatically increase their overall comprehension of difficult ideas, spatial reasoning, and creative abilities. The use of virtual design studios, virtual exhibits, and virtual reality simulations has shown that it has the potential to empower students to work together, be creative, and develop their ability to solve practical problems. However, the use of virtual reality (VR) in training for creative design is not without its difficulties. There are a number of obstacles that need to be overcome in order to fully exploit the promise of virtual reality (VR) in this industry. Some of these obstacles include accessibility concerns, technical restrictions, and the need for educator training. Furthermore, the relationship between conventional hands-on learning experiences and virtual learning experiences continues to be a contentious matter of discussion. Virtual reality (VR) looks to have a bright future in the field of creative design education. The potential for learning experiences that are both immersive and interactive are growing as technology continues to accelerate its pace of advancement. According to the findings of the bibliometric study, further research is required to investigate the long-term effects of virtual reality (VR) on learning outcomes, to create efficient ways for incorporating VR into design curriculum, and to guarantee that virtual reality technologies are accessible and inclusive for all students with disabilities. The incorporation of virtual reality (VR) into creative design education has the potential to revolutionise the teaching-learning process by providing new options for interaction, collaboration, and the development of skills. It is possible for educators and researchers to use the full potential of virtual reality (VR) technology to improve creative design education if they overcome the obstacles that are now being faced and continue to investigate the opportunities that VR presents.

Limitation

Several limitations are visible in the bibliometric analysis of creative design education practices, particularly as it pertains to the utilisation of Virtual Reality (VR) to enhance the teaching-learning process. To begin, the scope of the literature review can be limited to certain databases or journals, which might result in the omission of pertinent research or developing trends. Second, there is a possibility that the analysis is affected by publication bias. This is because research that have favourable findings are more likely to be published, which might lead to an inaccurate understanding of the usefulness of virtual reality (VR) in design education. The third point is that the reliability and generalizability of the results might be affected by changes in the quality and rigour of the research that were included in the analysis. In addition, since virtual reality technology is advancing at such a fast pace, the studies that were examined may rapidly become out of date, which will reduce their applicability to both existing and potential future applications. The research may not effectively address contextual issues such as institutional support, resource availability, and student demographics, all of which have the potential to dramatically affect the effectiveness of virtual reality (VR) integration. Furthermore, the results may be limited in their relevance to a variety of educational settings due to the fact that the majority of the viewpoints covered in the research were cultural or regional in perspective. With that being said, it is possible that the bibliometric study does not adequately represent the multiple factors involved in the incorporation of virtual reality (VR) as well as the multidisciplinary character of creative design education. Despite these limitations, the study offers interesting and useful insights into the present state of research and draws attention to areas that need additional examination in the context of the incorporation of virtual reality (VR) into creative design education.

References:

1. Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educational Research Review, 20, 1-11.

2. Aria, M. and Cuccurullo, C., 2017. A brief introduction to bibliometrix. Journal of Informetrics, 11(4), pp.959-975.

3. Broadus, R.N. (1987), "Toward a definition of bibliometrics", Scientometrics, Vol. 12 Nos 5/6, pp. 373-379.

4. Burnham, J. F. (2006). Scopus database: a review. Biomedical digital libraries, 3(1), 1-8.

5. Chen, Y., Luo, H., Liu, X., Liu, Y., & Yuan, Z. (2021). VR/AR-based digital twin platform for personalized and smart learning in the context of smart education. Tsinghua Science and Technology, 26(6), 759-773.

6. Huang, H. M., Rauch, U., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. Computers & Education, 55(3), 1171-1182.

7. Huang, T.-C., Chen, C.-J., & Chou, Y.-W. (2019). Animating eco-education: To see, feel, and discover in an augmented reality-based experiential learning environment. Computers & Education, 132, 21-34.

8. Kim, G., & Cho, Y. (2019). Interactive feedback in mixed reality-based design communication. Journal of Computing in Civil Engineering, 33(5), 04019032.

9. Lee, E. A.-L., Wong, K. W., & Fung, C. C. (2020). Learning with Virtual Reality: Its Effects on Students with Different Learning Styles. Journal of Educational Technology & Society, 23(1), 187-200.

10. Lin, Y., Lu, Y., Cheng, K., & Yang, M. (2020). Exploring the application of virtual reality in clothing design education. International Journal of Fashion Design, Technology and Education, 13(2), 171-181.

11. Park, Y., & Kim, B. (2020). The effects of virtual reality on architectural design education: An empirical study using BIM-based virtual reality environments. Architectural Science Review, 63(1), 56-69.

12. Pritchard, R.D., 1969. Equity theory: A review and critique. Organizational behavior and human performance, 4(2), pp.176-211.

13. Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education, 147, 103778.

14. Schnabel, M. A., & Kvan, T. (2020). Spatial understanding in immersive virtual environments. International Journal of Architectural Computing, 18(4), 358-375.

15. Wang, X., & Schnabel, M. A. (2020). Exploring the potential of virtual reality for architectural design education. Frontiers of Architectural Research, 9(3), 611-624.

16. Zheng, X., & Chan, A. P. C. (2021). Virtual reality in architectural and construction education: A systematic review. Frontiers of Engineering Management, 8(3), 412-422.

17. Zhou, M., Xu, X., & He, L. (2021). Application of virtual reality in architectural design education: An experimental study. Education Sciences, 11(5), 221.