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A Study of Digital Educational Resources in Higher Education using Vos Viewer and SWOT Analysis

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Abstract

With the rapid development of information technology, Digital Educational Resources (DER) have been widely used in higher education. This study takes SWOT analysis method as the core to explore the current practice of DER in higher education and its potential value. The study firstly sorted out the concept, characteristics and advantages of DER, and combined with relevant research results at home and abroad to clarify the theoretical basis and practical significance of the study. It also analyzes the keyword co-occurrence, clustering and time evolution of DER literature in the Web of Science (WOS) database in the past five years through VOS Viewer to reveal the research focus and development trend of digital resources in higher education. It is found that DER have a significant role in improving teaching quality and promoting educational equity, but they also face problems such as insufficient technical facilities, lack of teachers' skills and data security. Based on the results of SWOT analysis, this study puts forward a number of targeted recommendations, including strengthening the quality management of DER, improving the teacher training system, and optimizing the policy support environment. In addition, it also looks forward to the future development trend of DER, pointing out that it will play an important role in promoting the digital transformation of higher education. This study provides scientific decision-making references for university administrators, educators and relevant decision-makers, and helps to better utilize DER to realize the innovative development of higher education.

Keywords: digital educational resources, higher education, SWOT analysis, VOS viewer, teaching quality.

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1. Introduction

In recent years, global informatization has been advancing, digital technology continues to influence every corner of society, higher education shoulders the mission of cultivating talents, and traditional teaching methods are facing new challenges and opportunities (Xie, Zhang, 2024; Radmehr et al., 2024). DER are all kinds of teaching materials developed with modern information technology, presenting diverse content-rich, text, pictures, audio, video and other forms, the core of which lies in the sharing of high-quality educational resources by digital means (Akhmetshin et al., 2019).

As a product of the deep integration of information technology and education, the characteristics of DER have profoundly changed the traditional teaching mode. First of all, DER are interactive and dynamic. With the help of real-time discussion forums, collaboration tools and intelligent assessment systems, teachers and students can break through the time and space limitations to communicate instantly, while the addition of multimedia elements such as video and virtual reality makes abstract knowledge tangible and enhances students' immersion in learning (Siemens, 2013). Second, openness and sharing is one of the core advantages of DER. Through the Internet platform, high-quality courses and open-source teaching materials can be disseminated globally, effectively narrowing the education gap between regions. At the same time, the diversity of digital resources has also been fully realized, from e-books, microclasses to virtual experiments, rich forms to meet the needs of different learning scenarios. At the technical support level, digital education resources have demonstrated strong updatability and data-driven capability.

Digital education resources have made remarkable progress, but their high dependence on network infrastructure and digital devices may aggravate the “digital divide”. The imbalance of regional economic development is a serious challenge, and there are obvious gaps in the distribution of digital resources between urban and rural areas and between schools, and some teachers do not receive adequate technical support and professional guidance, and they face difficulties in using digital resources (Heine et al., 2023; Wang et al., 2023). Moreover, the issues of copyright protection and data privacy still need to be tackled by both technical means and policy norms (García et al., 2023; Cao et al., 2024; Zhao et al., 2024). Therefore, how to leverage the advantages of DER while avoiding their potential risks is an issue that needs to be continuously explored in the future digitization process of education.

This study systematically analyzes the application and potential value of digital resources in higher education using bibliometrics, SWOT analysis and the visualization tool VOS Viewer to reveal the research focus and development trend of digital resources in higher education. This study aims to (1) reveal the research focus and development trend of digital resources in higher education; (2) analyze in detail the advantages, disadvantages, opportunities and threats of the application of DER in higher education; (3) put forward targeted suggestions based on the results of the SWOT analysis.

This study discusses in depth the current status of the practice of DER in higher education and its potential value, enriches the theoretical system of DER in higher education, and also provides a solid theoretical foundation for subsequent research. Meanwhile, based on the results of SWOT analysis, practical suggestions are put forward, including strengthening the quality management of DER, improving the teacher training system, and optimizing the policy support environment. These suggestions provide scientific decision-making references for university administrators, educators and relevant decision-makers, and help to better utilize DER to realize the innovative development of higher education, which has important theoretical value and practical significance.

2. Literature review

The emergence and development of digital resources has changed the traditional teaching methods and become an integral part of higher education. With the advancement of technology, digital resources play a key role in innovating pedagogy, facilitating resource sharing and addressing sustainable development.

As the global level of technology continues to advance, digital resources are increasingly being used in modern education, especially in higher education. Since the outbreak of the Covid-19 pandemic, there has been a massive increase in research on online education, and digital resources have become an essential teaching tool for teachers (Tang, 2021). Some researchers have categorized digital educational resources to include online services, mobile applications, digital environments and interactive tools (Akhmetshin et al., 2019).

Digital technology has an important role in facilitating the sharing of resources in higher education (Xie, Zhang, 2024). Co-created digital resources in nursing education increase student engagement and knowledge retention by meeting specific pedagogical requirements (Laugaland et al., 2023). Similarly, digital collaborative writing platforms play an important role in facilitating active learning for multilingual students (Pennington et al., 2024). When using digital devices in the classroom, problems with asymmetric access can be effectively addressed through multimodal digital resources when they occur (Vänttinen, 2024).

3. Materials and methods

This study uses the visualization tool VOS Viewer to retrieve and analyze the relevant literature on digital educational resources and higher education in the past five years, and combines the SWOT analysis method to systematically analyze the application and potential value of digital resources in higher education, and to reveal the research focus and development trend of digital resources in higher education.

3.1. VOS viewer

This study searched the Web of Science core dataset for the last 5 years. The search terms are “digital educational resources” and “higher education”. Literature that meets the requirements is imported into VOS viewer software, and the year of publication, country and keywords are statistically analyzed, so as to analyze the research status and hotspots through visualization. After the literature was imported into VOS viewer software, the keyword threshold was set to 50 times, and the keywords that met the requirements were clustered and analyzed to generate a visual keyword co-occurrence network map to analyze the current research hotspots, trends and directions.

3.2. SWOT Analysis

SWOT analysis is a systematic strategic analysis tool that is commonly used by businesses, governments, non-profit organizations, and the education sector. This method helps to assess the strengths, weaknesses, external opportunities, and threats of an organization or project, and SWOT analysis is a systematic assessment framework that assists decision makers in planning reasonable and feasible strategic programs by integrating internal and external environmental factors. The theoretical basis of this approach comes from systems theory and management science, and its key element is the integration of qualitative and quantitative analysis, which provides a comprehensive understanding of the internal and external environments in which the organization operates, and based on this information, improvement plans can be developed.

In the field of higher education, SWOT analysis is more popular, it is applicable and flexible. SWOT analysis identifies the core issues and it lays the basis for improvement measures. As institutions of higher education embark on a new era of growth, so do possible threats to data security and intellectual property protection. SWOT analysis requires the intersection of four dimensions to form a complete strategy matrix. This matrix analysis methodology visualizes complex relationships, and it allows decision makers to analyze problems from multiple perspectives, avoiding the limitations of a single viewpoint.

Over time, the internal and external environments of an organization or project usually change, so the analysis needs to be updated regularly. In this study, we have compiled and analyzed the cutting-edge articles on the research on the application of DER in higher education from WOS in the past five years, and evaluated them from multiple perspectives by using SWOT analysis, so that the digital educational resources can better serve the innovation and development in the field of higher education.

4. Results

To further grasp the application of digital educational resources in higher education, this study uses VOS viewer and SWOT analysis. The results are as follows.

4.1. VOS viewer Result Analysis

Searching the Web of Science core dataset about digital resources and higher education published in the last five years, excluding duplicates and unqualified literature, and finally including 4388 documents in the analysis.

4.1.1. Trend and Annual Distribution of Published Literature

Figure 1 is the annual distribution chart of the number of publications published in the Web of Science core dataset about digital resources and higher education in the past five years, showing an increasing trend year by year.

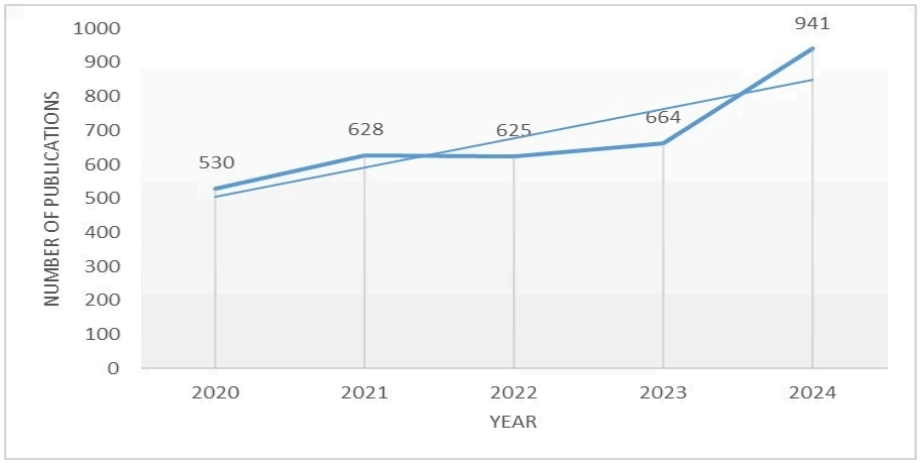

Fig. 1. Yearly distribution of literature on digital resources and higher education in the Web of Science core dataset (2020–2024)

4.1.2. Issuing Countries

As can be seen from Figures 2 and 3, the distribution of research on digital educational resources in the field of global higher education is characterized by significant geographical concentration. The United States, China, the United Kingdom and Spain are the countries that have published the most relevant literature, showing strong research capacity and discourse power in the field. Among them, the United States presents the strongest heat, highlighting its role as a major technology exporter and a pioneering country in education informatization. China follows closely behind, reflecting its comprehensive investment in policy promotion, platform construction and academic research in recent years. China and Russia are closely connected in the international cooperation network, especially China has formed denser cooperation clusters with India, Australia and other countries, reflecting its strategic expansion in the global layout of education digitization.

Meanwhile, Figure 4 shows that the research activities of China, India, Saudi Arabia and other countries will become more active after 2022, indicating the rapid growth of digital education resources construction in emerging countries in the “post epidemic era”, which indicates that Asian countries are still in the active development stage in this field. In contrast, research in Latin American and Southern European countries, such as Spain, Portugal and Brazil, has started relatively early, but the enthusiasm has declined, indicating that their research may have entered the stage of reflection and reconstruction. On the whole, the current research presents a pattern of “multi-center, multi-dimension and multi-country synergy”, which provides an international perspective and a comparative basis for the optimization of the practice of DER in higher education.

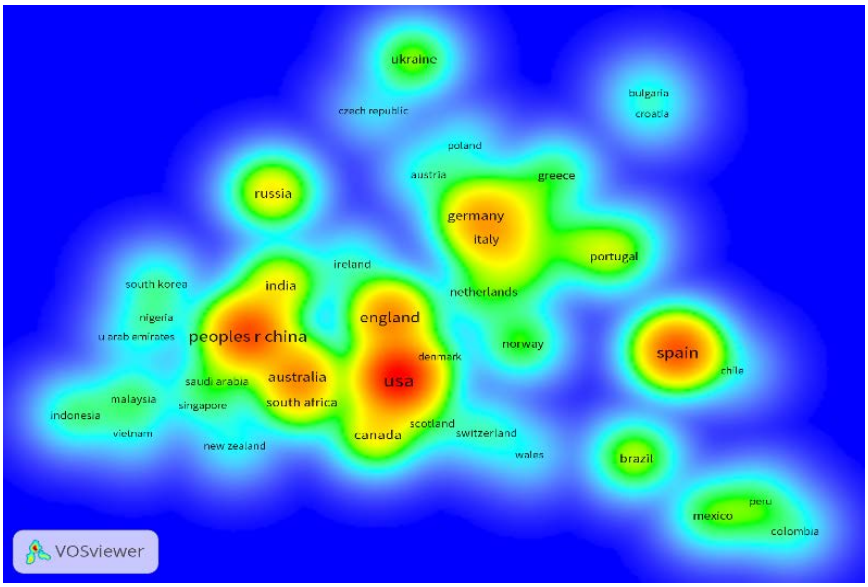

Fig. 2. Density Visualization of Issuing Countries

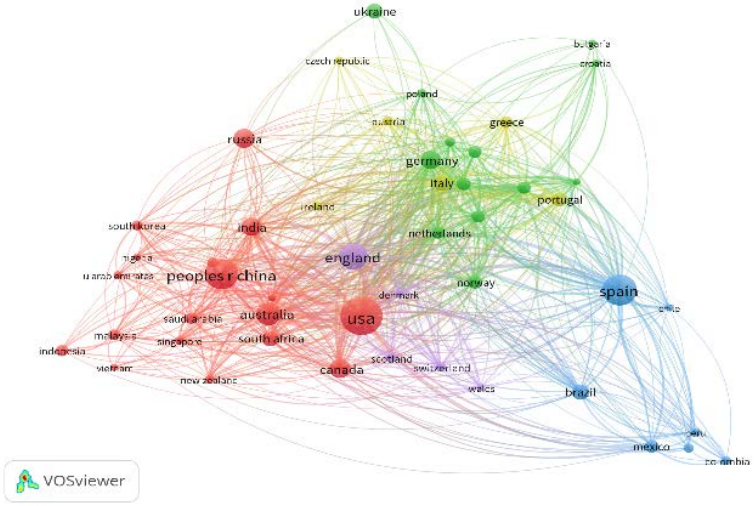

Fig. 3. Network Visualization of Issuing Countries

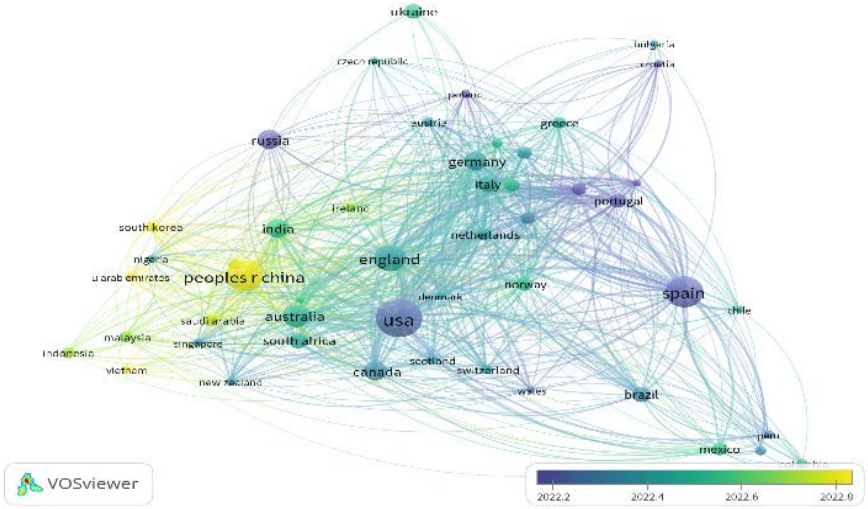

Fig. 4. Overlay Visualization of Issuing Countries

4.1.3. Keywords

In recent years, with the development of information technology and the influence of COVID-19 pandemic, the application of DER in higher education has gradually become an important direction of educational technology research. The visualization results show that “education”, “technology”, “students” and “higher education” are at the center of the research network, indicating that the academic community is particularly interested in the integration of digital technologies in education.

According to Figure 5, the research in the early 2022 is mainly focused on “online learning”, “covid-19” and “digital education” in the context of the epidemic. While over time, research will gradually shift to “artificial intelligence”, “digital literacy” and other topics. This suggests that, after the experience of emergency distance learning, educational research has entered a new phase oriented towards the long-term integration of digital resources and technologies.

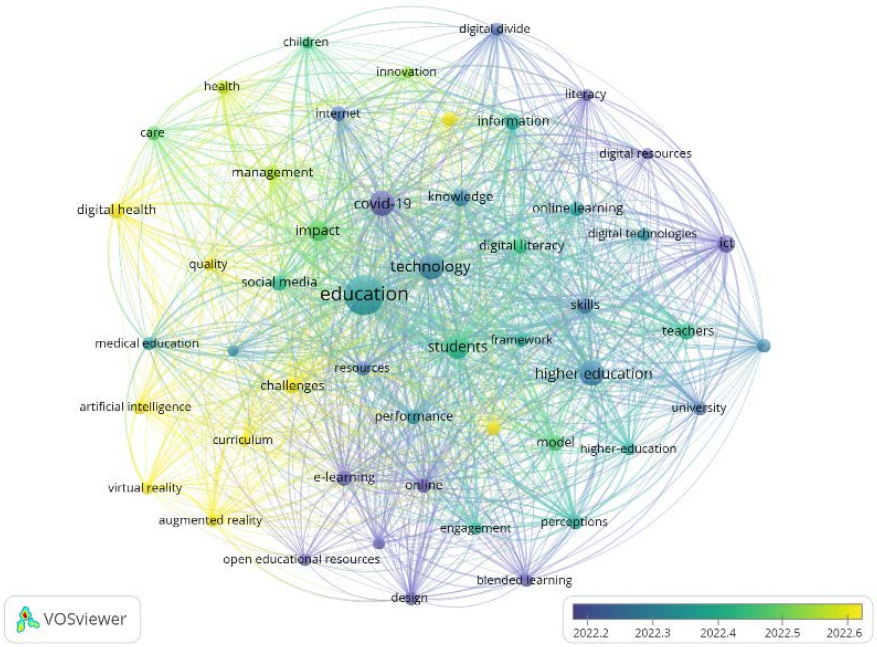

Fig. 5. Overlay Visualization of Keywords

Figure 6 reveals four major themes in digital education research: first, the red clusters are represented by “digital health”, “social media”, and “covid-19”, focus on social influences and educational environments; second, the green clusters are represented by “students”, “performance”, and “education environment”, focusing on the learning process and student behavior.; third, the blue cluster covers “ICT”, “teachers”, and “digital technologies”, pointing to the problem of adapting technology to teachers; fourth, the yellow cluster highlights “artificial intelligence”, “augmented reality”, representing new teaching tools and the expansion of specialized fields in higher education.

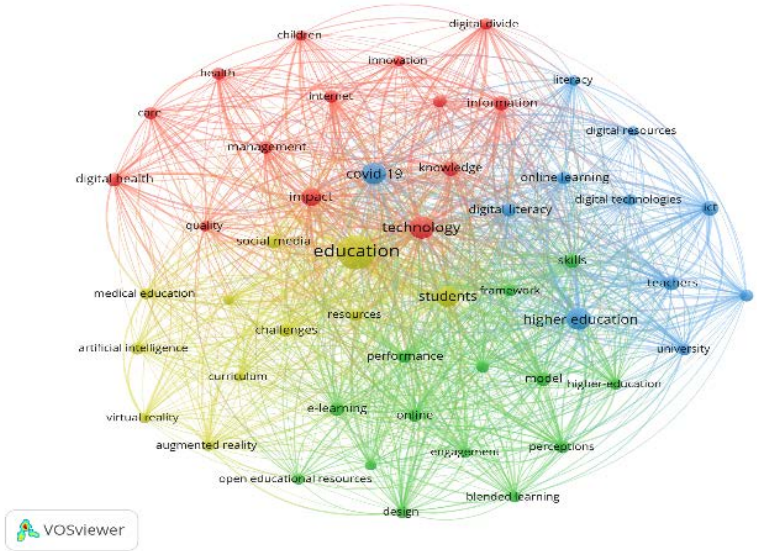

Fig. 6. Network Visualization of Keywords

The density map in Figure 7 further identifies the hot areas of research, i.e., the four core terms of “education”, “technology”, “students”, and “higher education” have the highest frequency of occurrence in the research, which is the central theme of the research on the application of digital education resources. Meanwhile, keywords such as “e-learning”, “digital literacy” and “management” also show a high density of occurrence, indicating that learner engagement, digital literacy, and digital education are the most important issues in the study, which indicate that

learner engagement and digital skill development have become hot research topics.

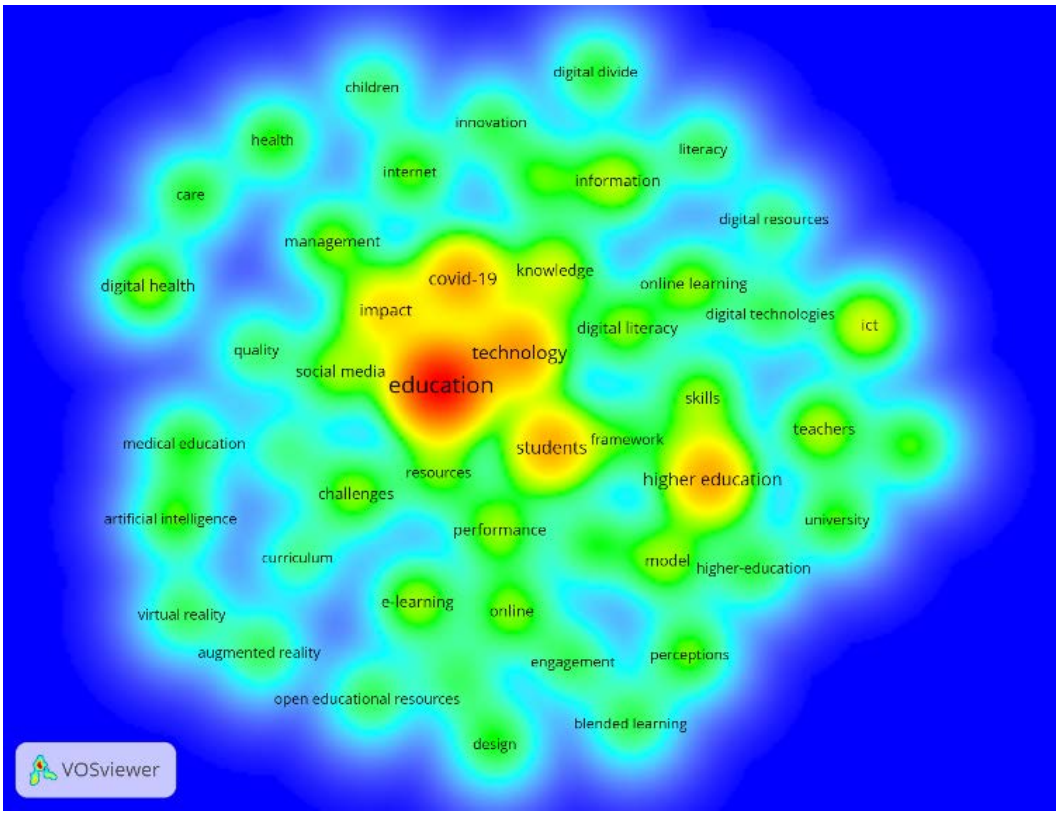

Fig. 7. Density Visualization of Keywords

In summary, the research on DER in higher education has formed a development pattern of interdisciplinary and cross-technology integration, with hotspots focusing on the online learning experience, educational technology innovation, and the improvement of teaching participation and assessment mechanisms.

3.1.4. Application of digital educational resources in higher education

With the rapid development of big data, artificial intelligence and other information technologies, DER are promoting the reform of higher education. In the higher education system, DER are not only limited to static resources such as electronic textbooks, multimedia courseware and online courses, but also include interactive simulation experiments, virtual laboratories, Open Educational Resources (OERs), and Massively Open Online Courses (MOOCs), which are dynamic and dynamic. These resources have enriched the content and form of teaching, and also made students' learning more diversified.

Digital educational resources are quite valuable in that they enhance teaching efficiency and the learning experience, and student engagement increases significantly (Pennington et al., 2024). Teachers use data analytics to keep track of students' progress and difficulties, and to better assist students with personalized instruction. DER have significant potential for innovation by expanding new ways of teaching and learning in higher education. DER are particularly suitable for highly practical disciplines such as medicine and engineering (Frøiland et al., 2023).

DER enable universities to respond more readily to the challenges of globalization, which has caused pressure of international competition for higher education, but also brought more opportunities for collaboration and exchange, and cross-regional platforms for sharing DER to promote international academic exchanges and cooperation.

DER have multiple application values in higher education. DER can improve teaching quality and learning effects, it promotes the fair distribution of educational resources, it promotes educational innovation, and it helps universities to maintain competitiveness in the wave of globalization, and it is of great significance to promote the sustainable development of higher education by deeply exploring the application value of DER (Rodríguez, Pulido-Montes, 2022).

4.2. SWOT Analysis

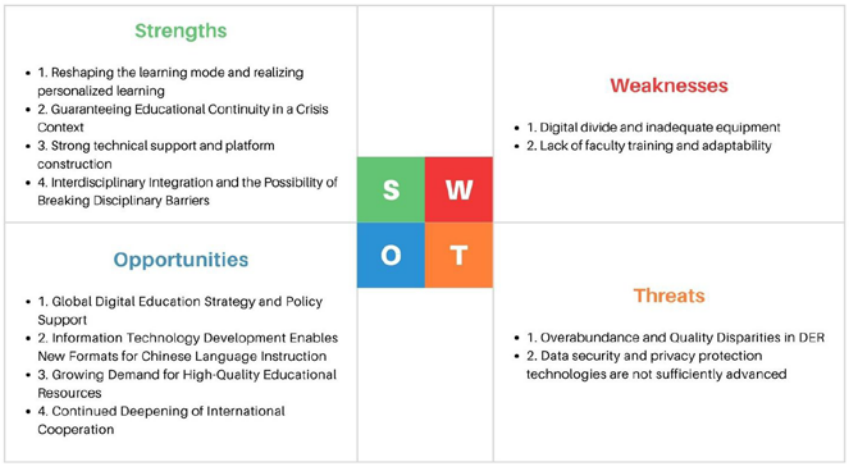

Fig. 8. The SWOT matrix

4.2.1. Advantages

(1) Reshaping the learning mode and realizing personalized learning

The most prominent advantage of DER lies in the profound reshaping of learning mode. It breaks through the limitations of traditional teaching in time and space, and provides learners with flexible and independent learning paths. In higher education, students often face problems such as heavy coursework and conflicting courses, while DER can provide learning resources accessible anytime and anywhere, so that students can arrange their learning progress according to their own pace and level of understanding, thus realizing personalized learning in the true sense of the word (Cook et al., 2024).

(2) Guaranteeing Educational Continuity in a Crisis Context

During the COVID-19 pandemic, the global higher education system was challenged like never before. In this context, DER demonstrated their critical role in crisis response (Rodríguez, Pulido-Montes, 2022; Mogas et al., 2023). In the case of school closure and suspension caused by the epidemic, DER ensured the continuity of teaching activities, and guaranteed the students' learning progress and the successful completion of teaching tasks. DER is not only a driving force for educational innovation, but also a core mechanism for coping with emergencies and guaranteeing the continuity of teaching and learning.

(3) Strong technical support and platform construction

The rapid development of information technology provides a technical foundation for the wide application of DER in higher education. From platform construction to content generation to user services, every aspect of DER is highly dependent on advanced information technology support. Cloud computing technology provides the DER platform with powerful elastic scalability and efficient storage space, so that teaching resources can be allocated on demand and run stably.

(4) Interdisciplinary Integration and the Possibility of Breaking Disciplinary Barriers

DER have the unique advantage of interdisciplinary integration. Traditional teaching is often restricted by the structure of the curriculum and the division of disciplines, and the integration and migration of knowledge is weak. The DER platform can integrate content from different fields to build a more open and three-dimensional knowledge system. Interdisciplinary collaboration and co-creation of digital resources can increase the relevance and effectiveness of digital resources (Laugaland et al., 2023; Barnes, Tour, 2023; Braßler, 2024). This type of pedagogical model not only broadens students' knowledge horizons, but also develops the cross-border thinking skills they will need to solve complex problems in their future work.

4.2.2. Disadvantages

(1) Digital divide and inadequate equipment.

Digital educational resources are widely used in higher education and it provides significant advantages and innovations. However, the challenges of digital divide and inadequate equipment still exist (Seleznev et al., 2022). The digital divide is reflected in the imbalance in the distribution of educational resources between urban and rural areas, as well as differences in IT penetration

rates. Students in rural areas often do not have stable internet access, while students in cities have easy access to online resources on the internet. The digital divide is equally significant in terms of hardware facilities, with problems such as interruptions and delays frequently occurring. Faculty and students' efficiency in using digital resources is compromised, and the use of infrastructure in some colleges and universities remains limited (Alenezi, 2023).

(2) Lack of faculty training and adaptability

The increasing popularity of DER has made the need for teacher training in the field of higher education more and more obvious, and some university teachers believe that they have encountered difficulties in the use of DER, especially in the production of multimedia courseware, the operation of online teaching platforms and data analysis. Therefore, HEIs need to take more specific measures to improve the effectiveness of teacher training (Seleznev et al., 2022). A flipped classroom training model can be implemented to integrate theoretical learning and practical operation. Or the practical skills of teachers can be enhanced through case studies and group discussions. At the same time, it is necessary to create a continuous tracking and coaching system, and organize regular experience sharing sessions, etc. Teacher training is not only limited to the scope of the technical level, the conceptual change is equally important.

4.2.3. Opportunities

The continued development of DER has been facilitated by a concerted global strategy to digitize higher education. Contingency programs during educational disruptions have contributed significantly to the development of flexible learning models and digital curriculum systems, and have provided an empirical basis for the diversification of future teaching and learning approaches (Mogas et al., 2023). The rapid development of information technology has led to the key position of DER in higher education, and the global demand for high-quality educational resources is growing rapidly, especially at the higher education level. Schools in remote and underdeveloped areas usually have difficulty in obtaining sufficient quality teaching materials and faculty, and the distribution of educational resources fails to be balanced. However, DER have the characteristics of convenience and flexibility, which can exactly improve this problem (Puiu et al., 2023).

4.2.4. Threats

At present, the most prominent threat facing the application of DER is the proliferation of resources and uneven quality. On the one hand, there is a lack of uniform standards for resource development and excessive differences between different platforms and courses; on the other hand, over-reliance on technology may make the teaching process lose its humanity and interactivity. In addition, data privacy and security issues are becoming increasingly serious. While heavily using platforms, applications and cloud services, colleges and universities are facing the potential risks of cyber-attacks and data leakage (Veletsianos, 2021).

Overall, the cyber environment is becoming more and more complex, and technological tools for data security and privacy protection need to be upgraded. Responding to these issues requires multi-sectoral collaboration in technology, management and law, data encryption can be used to enhance transmission security, data sharing protocols need to be optimized, the responsibilities of all parties need to be clarified, and strict privacy protection policies need to be formulated.

5. Discussion

Digital Educational Resources have become an important force in transforming the teaching and learning model of higher education, and their application has significant advantages in terms of flexibility, scalability, and policy promotion. However, its development still faces multiple challenges such as infrastructure, teacher training and data governance. Therefore, strengthening the integration of resources, improving the teacher training system, and establishing a diversified evaluation and guarantee mechanism are conducive to promoting the simultaneous improvement of educational equity and teaching quality.

(1) Strengthening Resource Integration and Optimizing Allocation

The rapid development of DER and the improvement of quality and efficiency have become important issues in higher education (Rodríguez, Pulido-Monte, 2022). Nowadays, the distribution of digital education resources in higher education is not very balanced, and the gap of resources between different schools in different regions is significant. Colleges and universities should build a unified DER sharing platform, which should integrate all kinds of high-quality educational resources, such as catechism, microclasses, virtual laboratories, etc., and realize efficient storage and rapid retrieval of resources with the help of cloud computing and big data technology (Puiu et al., 2023).

(2) Establishing a multi-level teacher training mechanism

Teachers are the core role of teaching and learning activities, and the level of teachers' informatization literacy and skills significantly affects the application effect of DER. Establishing a diversified teacher training mechanism has become the key to promoting the digital transformation of higher education (Puiu et al., 2023). Teachers in higher education have different levels and types, which require the development of differentiated training programs.

(3) Constructing a high-quality online course system

With the development of DER, building a high-quality online course system becomes the key to improve the quality of higher education teaching (Gumbi et al., 2024). High-quality course content needs to be scientific, systematic and innovative at the same time. The course content should be combined with the latest scientific research results and industry trends to maintain the cutting edge, and when designing the course content, pay attention to the hierarchy and progressivity, from basic knowledge to advanced applications, and gradually guide students to in-depth learning, so as to meet the needs of students at different stages of learning.

(4) Innovative Teaching Modes and Evaluation Methods

DER are commonly used in higher education, and innovative teaching models and evaluation methods have become the core of promoting the digital transformation of higher education (Seleznev et al., 2022). DER promote the change of teaching mode, and blended teaching is beginning to be popularized. This mode integrates online learning and offline classroom, making full use of the richness and flexibility of online resources, and enhancing the learning effect (Puiu et al., 2023).

In terms of evaluation methods, colleges and universities have begun to use more formative assessment and personalized assessment, which can more comprehensively assess students' comprehensive abilities. Formative assessment focuses on continuous observation during the learning process, and personalized assessment develops standards for each student that suit them and discovers each individual's potential more comprehensively.

(5) Optimizing the policy support environment

To improve teaching standards and learning efficiency, in addition to the practical actions that colleges and universities need to take to continue to deepen the reform of internal mechanisms, the government also needs to implement supportive policies (Rodríguez, Pulido-Montes, 2022). With the joint efforts of the whole society, the goal of digital transformation of higher education can be realized.

With the rapid development of information technology and the continuous updating of educational concepts, the strategic position of DER in higher education has become increasingly prominent. The field of higher education is undergoing an unprecedented technological change, and DER are an important part of this change, which has changed the traditional teaching methods and made education fairer and of higher quality.

Colleges and universities not only continue to introduce emerging technologies to optimize teaching tools and means, but also actively build interdisciplinary and cross-platform collaborative innovation mechanisms to promote the deep integration of teaching methods, curriculum design and resource allocation. This integrated development model helps to break the boundaries of traditional teaching and promote the evolution of the educational ecosystem in the direction of more intelligent, open and shared.

6. Conclusion

The sustainability of DER is a key issue. Although significant progress has been made in this area, challenges such as insufficient technical facilities and data privacy protection still exist, requiring the government, universities and the community to work together to make the application of DER in higher education evolve in a better direction.

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