

# Comparison of Virtual Learning Community Construction between China and the United States Based on KH Coder Text Data Mining

Yangsen Li <sup>1,\*</sup> and Li Ren <sup>2</sup>

<sup>1</sup> Department of Management, Sichuan University of Science & Engineering, Yibin, China

<sup>2</sup> School of Chemistry and Chem, Wuhan University of Technology, Wuhan, China

\* Corresponding author: Yangsen Li (Email: 1561679961@qq.com)

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**Abstract:** Virtual learning communities, as an innovative online education model, have gained significant attention worldwide. The virtual learning communities in the United States are characterized by advanced educational models, innovative technological applications, and rich practical experiences. Exploring and drawing lessons from the construction of virtual learning communities in the United States is of great value to China. This paper utilizes KH Coder as an analysis tool and conducts literature searches on the Web of Science for U.S. literature and on the CNKI database for Chinese literature. The analysis covers the period from 2019 to 2024, and includes frequency and network co-linearity analyses. The research findings indicate the following: First, Chinese online education research emphasizes the importance of technological application and innovation in the field of education. Second, Chinese online teaching research has certain limitations in terms of research scope. Third, there are certain issues in the dissemination of research findings in Chinese online teaching research. Based on the research results, the following adjustments should be made for Chinese virtual learning communities: First, the comparison of research literature between China and the United States shows that the development of virtual learning communities requires diverse collaborations. Second, the development of virtual learning communities requires continuous technological innovation. Third, the comparison of research literature between China and the United States reminds us that the development of virtual learning communities needs to focus on social interaction. Fourth, the development of virtual learning communities also requires teacher support and participation. Fifth, the development of virtual learning communities needs to encourage students' active participation and autonomous learning.

**Keywords:** Virtual Learning Community; Comparative Study; Text Data Mining; KH Coder; China-US Comparison.

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## 1. Research Background and Problem Statement

A virtual learning community, based on internet-based educational services, is a new model that explores innovative educational pathways in the era of Education 2.0 through the concept of virtual learning communities on the National Education Resources Public Service Platform[1]. It facilitates knowledge sharing, collaborative learning, and interactive communication among learners by integrating educational resources, learning tools, and social interaction features. Initially, virtual learning communities primarily existed in the form of simple online forums and email lists [2]. These platforms provided basic communication and resource sharing between students and educators but had limited functionality and interactivity. In recent years, virtual learning communities have increasingly emphasized personalized learning and intelligent support. By utilizing learning analytics, data mining, and artificial intelligence technologies, platforms can provide customized learning content, pathways, and support based on students' learning needs and characteristics, aiming to enhance learning outcomes and satisfaction. Massive open online courses (MOOCs) gained widespread attention and acceptance globally starting in 2012. Renowned MOOC platforms such as Coursera, edX, and Udacity were established, attracting a large number of students and educators to participate. This new online learning approach breaks the constraints of traditional education in terms of time and space, enabling students

worldwide to conveniently access high-quality educational resources.

As a global leader in internet technology, the United States has played a crucial role in driving the formation and development of online education. In the 1960s, the University of Illinois pioneered online education in the United States by using networked computers to deliver learning materials to students (China Online Education Industry Blue Book, 2015). John Sener (2010) proposed an important viewpoint in his role as the Special Projects Director at the Sloan Consortium, stating that nearly all students receiving higher education will experience some form of online education during their college careers, making the use of online technology for teaching and learning a daily, common, and indispensable educational experience[3]. Certificate programs on platforms like Coursera, nanodegree programs on Udacity, and micro-master's programs on edX are considered increasingly important in motivating users for continuous learning and skill enhancement. The global COVID-19 pandemic has had a significant impact on the education sector, prompting many schools and institutions to rapidly transition to virtual learning models. Particularly in the first two years before 2024, the pandemic had a significant influence on the digital transformation of education and the promotion of online learning. Both China and the United States have experienced large-scale remote learning practices, leading to increased attention and research on virtual learning communities. By conducting a comparative analysis of literature on virtual learning communities in China and the United States during

the past five years, researchers can gain insights into the commonalities, differences, and coping strategies of virtual learning communities in the context of the pandemic. This analysis can provide targeted recommendations and guidance for future education policies and practices.

However, research on the development of virtual learning communities in China has mainly focused on micro-level studies of knowledge and interaction, with relatively fewer macro-level comparative studies. Existing research in China (e.g., Li Haifeng et al., 2021; Li Xingbao et al., 2017; Zeng Yuan, 2021) shows several shortcomings regarding research on foreign virtual learning communities. Firstly, in macro-level research, there is a relative lack of application and development of relevant theoretical frameworks and methods for foreign virtual learning communities. Existing research may lack systematicity and consistency and fail to provide comprehensive theoretical explanations and comparable analyses. Secondly, macro-level research on foreign virtual learning communities in China often lacks a cross-cultural and cross-national comparative perspective. Virtual learning communities in different countries and regions may exhibit differences in cultural background, educational systems, social environments, and other aspects.

With the continuous development of digital technologies, the evolution of virtual learning communities is ongoing. Therefore, the author focuses on studying virtual learning communities in the United States, comparing the macro and micro-level characteristics of virtual learning community development between China and the United States, and finally proposing transformation strategies for the development of virtual learning communities in China through comparison and reference. By comparing the current status, operational models, and educational philosophies of virtual learning communities in China and the United States, China can draw on the successful experiences and innovative models of virtual learning communities in the United States in online education. This will help educational departments and relevant institutions in China to systematically absorb and apply international advanced experiences when formulating policies, developing strategies, and promoting educational reforms, ultimately improving the quality and effectiveness of education in China.

## **2. Research Design and Implementation**

### **2.1. Research Tools**

Citespace and CH Coder are two commonly used tools for literature analysis, and they have some differences in terms of functionality and application. Citespace is a text mining and visualization-based literature analysis tool primarily used to discover associations and research frontiers among publications. By analyzing information such as keywords, authors, and citation relationships, it generates knowledge maps and temporal-spatial maps to help users understand the evolution and trends in a research field. Citespace provides intuitive visualizations that effectively display the relationships among publications and research hotspots[4]. Developed by Japanese scholars, CH Coder[5] is a text data mining software that employs content analysis for literature analysis. It is primarily used for qualitative and quantitative analysis of themes, sentiments, and semantics in literature. CH Coder helps users identify keywords, phrases, and topics in literature, and analyze sentiment tendencies and semantic

associations. While CH Coder's visual representation is relatively simple, it offers rich text analysis capabilities, making it suitable for in-depth exploration of content characteristics in literature.

Furthermore, Citespace primarily focuses on statistical and network analysis methods in literature analysis. It reveals the relationships among publications by calculating indicators such as keyword co-occurrence frequency and citation relationships. It can generate visual knowledge maps and temporal-spatial maps to facilitate users' intuitive understanding of the structure and evolutionary trends in a research field. In comparison, CH Coder places more emphasis on the analysis and representation of text content. It utilizes natural language processing and machine learning techniques to identify keywords, phrases, and topics in literature, as well as perform sentiment analysis and semantic association analysis. Through these analyses, users can gain deeper insights into the topic distribution, sentiment tendencies, and semantic relationships in literature. This article chooses CH Coder primarily based on the following advantages. Firstly, CH Coder enables in-depth exploration of themes, sentiments, and semantic features in literature through text analysis methods, providing a more comprehensive perspective for research. Secondly, CH Coder offers rich text analysis capabilities and qualitative-quantitative analysis methods suitable for various types of literature research and application scenarios. Lastly, CH Coder has high scalability, allowing users to customize the analysis according to their specific needs and adjust the analysis models and parameter settings based on the actual situation.

In this study, the Web of Science<sup>TM</sup> Core Collection was used to search for literature related to virtual learning communities in the United States, while the Chinese National Knowledge Infrastructure (CNKI) database was used for Chinese language searches. Given the vast amount of literature and resources related to virtual learning communities, Citespace primarily employs network analysis methods such as keyword co-occurrence and citation relationships to reveal the associations among publications. In contrast, CH Coder utilizes natural language processing and machine learning techniques to delve into content characteristics in literature, including themes, sentiments, and semantics. This enables CH Coder to analyze and understand the literature information within virtual learning communities more comprehensively and provide deeper research perspectives.

### **2.2. Research Design**

In terms of data analysis methods, text data mining focuses more on the automatic processing and analysis of textual data, providing a deeper understanding of the text content by mining patterns and relationships within the text. On the other hand, hypothesis testing is more focused on collecting and analyzing empirical data to validate or infer the validity of research hypotheses. Text data mining is a process of extracting useful information and knowledge from large-scale textual data. It utilizes techniques such as natural language processing, machine learning, and statistics to process and analyze textual data, uncovering patterns, relationships, and trends hidden within the text. The goal of text data mining is to structure and quantify the text, extracting features, topics, sentiments, and other information. It is widely used in fields such as sentiment analysis, text classification, and topic

modeling, helping people better understand and utilize textual data. The research hypothesis in this study consists of the following two steps:

First, using KHCoder, a comparison of high-frequency vocabulary and topic co-occurrence relationships is conducted on the literature topics related to virtual learning communities collected from databases in both China and the United States. This step further expands the specific analysis methods and objectives. During data collection, specific literature databases from China and the United States are selected, and searches are conducted based on specific keywords or topics. At the same time, certain selection criteria are established, such as choosing a specific time range, literature types, research methods, etc., to ensure the selection of representative papers relevant to virtual learning communities. Before using KHCoder for analysis, data preprocessing is performed, such as removing duplicate papers and standardizing the format of the literature. Then, KHCoder is used to extract high-frequency vocabulary and topic keywords, and the co-occurrence relationships are compared to reveal the interconnections and importance among the topics.

Second, based on the results obtained from the first step, combined with specific literature cases, an in-depth analysis of the specific characteristics of research patterns in the American virtual learning community is conducted. Representative and diverse literature cases are selected for in-depth analysis. These cases may cover different fields, research methods, and topics to gain a comprehensive understanding of the characteristics of research in the American virtual learning community. Through analyzing the literature cases, a deeper understanding of the commonly used research methods and designs in the American virtual learning community is gained. The theoretical frameworks and models used in the literature cases are analyzed to understand the theoretical foundations and perspectives adopted by researchers in virtual learning community research, as well as the interpretation and insights provided by these theoretical frameworks and models.

The research literature data from the United States is obtained from the Web of Science (<https://www.webofscience.com>), while the research literature data from China is obtained from CNKI ([www.cnki.net](http://www.cnki.net)). The specific search criteria are shown in Table 1.

Table 1. Defining search parameters

|                 |                                                   |                                                                      |
|-----------------|---------------------------------------------------|----------------------------------------------------------------------|
| nation          | The US                                            | CHINA                                                                |
| Database        | Web of Science                                    | CNKI                                                                 |
| Key word        | Virtual Learning Community                        |                                                                      |
| Search period   | October 1, 2019, to March 1, 2024                 |                                                                      |
| search criteria | Enter paper search and conduct title-based search | Perform journal search, select core journals and CSSCI for retrieval |

After the search, a total of 689 articles related to the American virtual learning community and 490 articles related to the Chinese virtual learning community were found. These articles were loaded into Excel format documents for analysis using KH Coder. After preprocessing with KH Coder, the total number of words in the research literature of the American virtual learning community was 11,721, and for the Chinese literature, it was 5,874. Both datasets are rich in content and suitable for text data mining.

### 3. Organization of the Text

#### 3.1. Differences in Research on Virtual Learning Communities between China and the United States

After conducting high-frequency vocabulary analysis using KH Coder, significant differences in research themes on virtual learning communities between the United States and China were observed. As shown in Table 2, both the United States and China consider learning and education as core themes in virtual learning community research. This indicates that both countries are dedicated to exploring how to provide effective learning and educational experiences in virtual environments. Both the United States and China focus on online courses and instructional models within virtual learning communities. This suggests that both countries are researching how to design and optimize online courses to meet students' learning needs and provide high-quality teaching experiences. The research in both countries involves technological applications, including virtual reality, network systems, and learning platforms. This demonstrates that both countries recognize the crucial role of technology in virtual learning communities and aim to leverage technology to enhance the learning and teaching processes.

In terms of differences, the research in the United States seems to pay more attention to the impact of student health and the COVID-19 pandemic on virtual learning communities[6]. On the other hand, research topics in China have a stronger emphasis on the design and practices of learning platforms, as well as research at the university level. This reflects the divergent research focuses between the two countries. The research topics in the United States mention "Virtual Learning Community Education," highlighting the concept of community education. In contrast, the research topics in China do not explicitly mention community education. This may indicate that the United States places greater emphasis on the role and significance of virtual learning communities in community education.

Table 2. Word Frequency Comparison

| The US    |     | CHINA       |     |
|-----------|-----|-------------|-----|
| Virtual   | 193 | Learning    | 179 |
| learning  | 119 | Teaching    | 172 |
| Community | 94  | Platform    | 163 |
| Education | 79  | Research    | 142 |
| covid-19  | 72  | Online      | 100 |
| Pandemic  | 69  | Courses     | 75  |
| Student   | 66  | Mode        | 73  |
| Anhealth  | 62  | Design      | 66  |
| Reality   | 60  | Learning    | 62  |
| Virtual   | 53  | Education   | 60  |
| Review    | 51  | Practice    | 52  |
| System    | 50  | example     | 50  |
| Network   | 47  | Application | 45  |
| health    | 47  | University  | 38  |

Comparing the research themes between the United States and China using a topic keyword co-occurrence network can provide a more in-depth analysis, revealing commonalities and differences in their research, and providing guidance for further studies. The topic keyword co-occurrence network uncovers the underlying connections and importance of keywords by identifying their co-occurrence relationships within research topics.

From Figure 1, it can be observed that "virtual,"

"community," "learning," and "covid-19" are prominent keywords. In Chinese research on virtual learning communities, Figure 2 shows that the main keywords include "learning," "courses," "teaching," "practice," and other related content. In the research themes in the United States, as seen in Figure 1, "virtual learning community" stands out as a core keyword, co-occurring with keywords such as "learning," "teaching platforms," "online courses," "health," and "covid-19 pandemic." This indicates that research in the United States focuses on the development and operation of virtual learning communities, as well as their impact on learning, teaching, and student health. Particularly in the context of the COVID-19 pandemic, researchers are concerned about addressing the challenges posed by the pandemic to learning communities, ensuring student health and learning outcomes.

On the other hand, in the research themes in China, as revealed in Figure 2, the keyword "virtual learning community" co-occurs with keywords such as "learning", "education", "online courses", "university", and "practice". This indicates that research in China primarily focuses on the application and practice of virtual learning communities in learning, education, and university contexts. Researchers explore how to design and optimize virtual learning platforms to enhance learning outcomes and educational practices.

Different countries may have varying research topic choices influenced by their educational and societal needs. In the United States, the emphasis on student health and safety became crucial when swiftly transitioning to virtual learning during the COVID-19 pandemic. Governments and educational institutions actively paid attention and promoted research on the impact of the pandemic on virtual learning communities. In China, the development and practices of virtual learning communities are part of adapting to the demand for large-scale online learning, leading to a greater emphasis on the design and practical aspects of learning platforms in research topics.

Furthermore, the development and priorities in the field of educational research in each country may also contribute to differences in research themes. The United States has a rich research tradition and resources in educational sciences, social sciences, etc., with a long-standing focus on student health and educational policies. In contrast, China's research focus may be more concentrated on educational reforms, teaching methods, and technological applications. Therefore, Chinese research themes tend to prioritize practical and applied research.

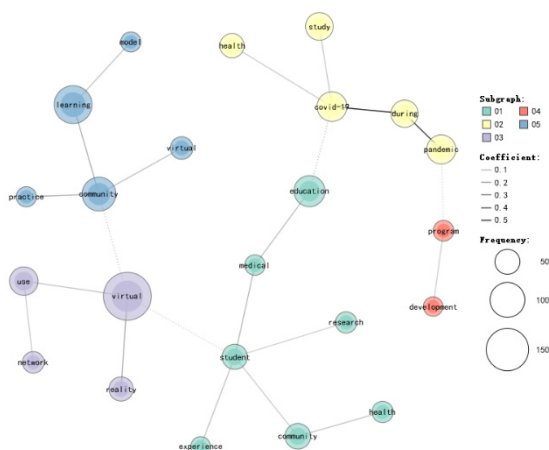


Fig 1. Word co-occurrence network diagram of the US

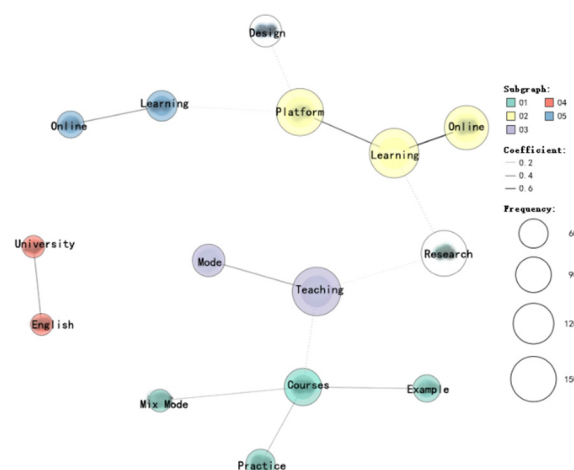


Fig 2. Word co-occurrence network diagram of China

### 3.2. Characteristics of Research on Virtual Learning Communities in the United States

First, online education research in the United States relies on a multidisciplinary approach and theoretical foundations. Many researchers draw on theories and methods from fields such as education, psychology, and computer science to comprehensively understand the effects and impacts of online education. This interdisciplinary approach allows researchers to explore factors such as learning processes, instructional strategies, and technological support in virtual learning environments, and analyze their effects on student learning outcomes and educational reform. In the context of online education research in the United States, education is an important disciplinary field that provides researchers with foundational knowledge about educational theories, instructional design, and learning assessment. The theories and research methods of education help researchers analyze the effectiveness of instructional goals, learner characteristics, and teaching strategies in online learning environments. Researchers may explore different instructional models and methods, such as personalized instruction, collaborative learning, and problem-based learning, to examine their applicability and effectiveness in online environments. They may also investigate assessment methods and feedback strategies in online learning to promote student learning and development. Through theoretical frameworks and research in education, researchers can provide recommendations for educational policies and practices related to online education. Psychology also plays a significant role in online education research in the United States. The theories and methods of psychology help researchers understand students' cognitive and affective processes and the impact of online learning environments on students' mental health and learning motivation. Researchers may study students' motivation, self-directed learning skills, and self-regulation abilities in online learning to reveal the relationship between learning motivation and learning outcomes in online learning environments. They may also focus on psychological factors such as attention management, learning anxiety, and social interaction and their influence on the online learning experience and learning outcomes. Through psychological research, researchers can provide recommendations for student support and mental health in online educational practices. Furthermore, computer science plays an important role in online education research in the United States. The

theoretical foundations and technical support of computer science enable researchers to develop and evaluate online learning platforms, learning management systems, and learning analytics tools. Researchers may study the design and functionality of virtual learning environments to enhance students' learning experiences and outcomes. They may also research learning analytics and data mining techniques to help educators understand students' learning behaviors and progress and provide personalized learning support and feedback. The research in computer science provides essential technical support for the development and optimization of online education platforms.

Second, online education research in the United States emphasizes empirical research and data-driven methodologies. Researchers widely adopt quantitative and qualitative research methods such as experimental studies, surveys, observations, and in-depth interviews to collect rich data. These data are used to validate hypotheses, evaluate instructional strategies, and assess learning outcomes[7]. The data-driven methodologies enable researchers to propose recommendations and improvement measures based on empirical evidence, promoting the development and optimization of online education. In online education research in the United States, empirical research methods are crucial. Empirical research is based on scientific principles and methods, collecting and analyzing data to verify hypotheses and draw conclusions. Quantitative research methods are widely used in online education research. Researchers compare the effects of different instructional strategies, learning tasks, or assessment methods on student learning outcomes and engagement by implementing controlled experiments, random assignment, and quantitative measurements. They use statistical analysis to test hypotheses and identify key factors in instructional design. This quantitative research approach provides replicable and comparable results, providing strong guidance for educational decision-makers. In addition to quantitative research methods, qualitative research methods also play an important role in online education research in the United States. Qualitative research methods primarily collect data through observations and in-depth interviews to understand students' experiences, perspectives, and attitudes. Researchers may observe the interaction processes in online classrooms, record student participation and communication styles. They may also conduct in-depth interviews with individual students or small groups to understand their perceptions and experiences in the online learning environment. The strengths of qualitative research methods lie in providing in-depth and detailed descriptions, helping researchers gain a deeper understanding of students' experiences and needs in online learning. The data-driven methodologies enable online education research in the United States to propose recommendations and improvement measures based on empirical evidence. By collecting a large amount of data, researchers can conduct in-depth analyses of various aspects of online education, including instructional strategies, learning tasks, assessment methods, as well as student learning outcomes and engagement. They can use data analysis to identify issues and improvement areas in instructional design and provide corresponding recommendations and guidance. For example, if a certain instructional strategy shows positive effects on student learning outcomes in data analysis, researchers may recommend educators to adopt that strategy in online classrooms. This data-driven approach contributes to

optimizing the quality and effectiveness of online education and provides scientific evidence for educational policymakers to formulate policies.

Third, online education research in the United States emphasizes the impact of instructional design and educational practices. Researchers focus on how to design effective online learning environments to facilitate student learning outcomes and active engagement. They study different instructional strategies, learning tasks, and assessment methods, and explore their effects on student learning motivation, cognitive development, and social interaction. This research orientation that emphasizes educational practices provides guidance for educators and decision-makers to improve the quality and effectiveness of online education. Instructional design is one of the core elements of online education, and research in online education in the United States aims to explore how to design effective online learning environments[8]. This includes studying different instructional strategies, learning tasks, and assessment methods. For example, researchers may explore how instructional strategies based on problem-solving and collaborative learning can be applied in online environments to stimulate students' active learning and critical thinking[9]. They may also research the use of multimedia materials, interactive simulations, and gamification elements to enhance the learning experience and interest. Additionally, assessing the effectiveness of online learning is also a critical issue, and researchers may study assessment tools and methods suitable for online teaching to accurately assess student learning outcomes and competency development. To explore the impact of instructional design, a variety of research methods are employed in online education research in the United States. Quantitative research methods, such as experimental designs and surveys, are used to collect a large amount of data to quantify the effects of instructional strategies and environments on student learning outcomes and engagement. At the same time, qualitative research methods, such as in-depth interviews and observations, are used to gain a deep understanding of students' experiences and perspectives in online learning. The comprehensive use of these research methods enables researchers to explore the impact of instructional design on online learning and provide strong evidence-based support. The practical outcomes of online education research in the United States have significant guidance for educators and decision-makers. By conducting in-depth research on the impact of different instructional design elements, researchers can provide practical recommendations and best practices to the education field. For example, they may propose effective implementation strategies for online group collaboration learning or recommend online teaching tools and resources suitable for specific subject areas. These outcomes can also be used by policymakers to formulate and improve online education policies to support the transformation and development of the education system.

## **4. Research Conclusion and Implications**

### **4.1. Research Conclusion**

According to the analysis of Chinese and American literature using KH Coder, the following conclusions can be drawn: First, online education research in China may emphasize the importance of technological applications and innovations in the field of education. Studies may find that

technology tools such as online learning platforms, virtual laboratories, and educational games can enrich teaching content and methods and enhance students' learning motivation and engagement. With the continuous development of information technology, online education is seen as a powerful educational approach that can overcome the limitations of time and space and provide students with broader learning opportunities. Therefore, online education research in China may focus on exploring how to better utilize technology tools to improve educational quality and effectiveness. Second, there may be certain limitations in the research scope of online teaching in China. The research may be overly focused on specific subjects or specific grade levels, neglecting teaching practices in other subjects and grade levels. This may be related to the characteristics of the Chinese education system, where there are clear divisions in curriculum settings and teaching requirements among different subjects and grade levels. However, a comprehensive online education research needs to address teaching practices in multiple subjects and grade levels to provide more comprehensive educational improvement recommendations. Additionally, online teaching research in China may be overly focused on the technological applications of online teaching, while neglecting research on teaching strategies, student engagement, and teacher roles. Although technology tools play an important role in online education, the design of teaching strategies and the role of teachers are still critical factors. Online teaching requires a comprehensive consideration of technology, teaching methods, and student needs to achieve effective learning outcomes. Therefore, online education research in China can further expand its research scope to focus on teaching strategies, student engagement, teacher roles, and other aspects to improve the quality and effectiveness of online teaching. Finally, there may be certain issues in the dissemination of research outcomes in online teaching research in China. Research outcomes may primarily exist in the form of academic papers and may not have widespread dissemination and application. In the academic community, publishing papers is the primary criterion for evaluating research outcomes, but this form of dissemination may have certain limitations. The outcomes of online education research should pay more attention to practical applications and actively explore ways to translate research findings into educational practices, promoting their dissemination and application through channels such as educational institutions, policymakers, and practitioners. This can increase the impact of research outcomes, promote the development and dissemination of online education.

In conclusion, through the analysis of Chinese and American literature using KH Coder, several conclusions can be drawn regarding online education research in China. Firstly, it emphasizes the importance of technological application and innovation. Secondly, there may be limitations in the research scope, focusing too much on specific subjects or grade levels and neglecting other subjects and grade levels. Additionally, there may be an overemphasis on the technological applications of online teaching, overlooking research on teaching strategies, student engagement, and teacher roles. Finally, there may be issues in the dissemination of research outcomes, with a primary focus on academic papers and limited dissemination and application.

## 4.2. Research Implications

First, the comparison of Chinese and American research literature suggests that the development of virtual learning communities requires diverse collaborations. Education experts, researchers, and technologists from different countries can engage in international cooperation to explore the best practices for virtual learning communities. This collaboration can involve cross-national research projects, sharing educational resources, and professional exchange activities. Through collaboration, educators from different countries can learn from and draw on each other's experiences, collectively address educational issues, and improve the quality and effectiveness of virtual learning communities. The comparison of Chinese and American research literature highlights the crucial role of diverse collaborations in the development of virtual learning communities[10]. For example, in the field of educational technology, both China and the United States possess rich experiences and technological resources. Collaborative projects between China and the United States can be initiated to jointly develop innovative virtual learning tools and platforms. This collaboration can facilitate technology exchange and the sharing of best practices, accelerating the development of virtual learning communities. Additionally, diverse collaborations can promote the sharing of educational resources. Different countries have unique educational resources and experiences, and through collaboration, resource complementarity and sharing can be achieved. Sharing educational resources can enrich the content of virtual learning communities and meet the diverse learning needs of students. For instance, Chinese and American educational institutions can collaborate to develop online courses, textbooks, and learning tools, enabling students to access high-quality educational resources across borders. In addition to resource sharing, diverse collaborations can also facilitate professional exchanges and knowledge co-construction. Education experts and researchers can utilize opportunities for cross-national cooperation to conduct seminars, academic conferences, and workshops to share research findings and experiences. This exchange can stimulate innovative thinking and contribute to the continuous development of virtual learning communities. In this process, cross-cultural perspectives and diverse viewpoints can bring new insights and understanding, promoting the progress of educational research. Secondly, the development of virtual learning communities requires continuous technological innovation. The comparison of Chinese and American research literature can help us understand the application and effects of different technologies in the field of education. In the future, it is important to encourage technological innovation and develop more intelligent and interactive virtual learning tools and platforms to provide richer learning experiences and support personalized learning. Technological innovation is one of the driving forces behind the development of virtual learning communities. Countries should increase investment in educational technology research and promote innovation in virtual learning tools and platforms. For example, new technologies such as artificial intelligence, augmented reality, and virtual reality can be applied to virtual learning communities to provide more intelligent and interactive learning experiences. Thirdly, the comparison of Chinese and American research literature reminds us that the development of virtual learning communities needs to emphasize social interaction[11].

Learning is not solely about acquiring knowledge but also involves communication and collaboration with others. Future virtual learning communities should provide rich social features to facilitate student interaction, collaboration, and co-construction of knowledge. Virtual learning communities should offer diverse social features, encouraging student interaction and collaboration. For example, online discussion boards, collaboration tools, and project platforms can facilitate student communication and collaboration, enabling them to co-construct knowledge and enhance learning outcomes. Fourthly, the development of virtual learning communities also requires the support and participation of teachers. Teachers play a crucial role in virtual learning communities by providing guidance, feedback, and motivation. Future developments should prioritize teacher training and support to help them adapt to virtual learning environments and fully leverage their professional knowledge and teaching abilities[12]. Teachers can continuously enhance their educational level and teaching abilities through online teaching training courses, sharing teaching resources, and professional exchange activities. Fifthly, the development of virtual learning communities requires encouraging active student participation and self-directed learning. Students should be seen as the protagonists of learning, and their voices and needs should be valued. Future developments should focus on providing opportunities for student participation, personalized customization of learning resources, and the collection and utilization of student feedback. Virtual learning communities can stimulate student learning interests and motivation, improve learning outcomes and satisfaction by introducing personalized learning paths, self-directed learning tasks, and learning analytics tools.

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## References

- [1] Zeng Yuan. Research on the Role of Ethical Norms in Virtual Learning Communities: A Case Study of the National Education Resources Public Service Platform Specialized Education Community [J]. China Digital Education, 2021, (07): 122-7.
- [2] PALLOFF R M, PRATT K. Building online learning communities: Effective strategies for the virtual classroom [M]. John Wiley & Sons, 2007.
- [3] SENER J. Why online education will attain full scale [J]. Journal of Asynchronous Learning Networks, 2010, 14(4): 3-16.
- [4] Ke Wentao. The Disenchantment of Tools: Application and Reflection of CiteSpace in Educational Research [J]. Chongqing Higher Education Research, 2019, 7(05): 117-28.
- [5] The official website of KHCoder is <http://khcoder.net> [J].
- [6] JEON H, SHIN H, SHON S, et al. Virtual Simulation Education Using Multiuser Virtual Environments and Standardized Patients for Child Healthcare in the Community Setting: A Multisite Pilot Study [J]. Clinical Simulation in Nursing, 2023, 83.
- [7] HEALY M G, TRAEGER L N, AXELSSON C G S, et al. NEJM Knowledge plus Question of the Week: A Novel Virtual Learning Community Effectively Utilizing an Online Discussion Forum [J]. Medical Teacher, 2019, 41(11): 1270-6.
- [8] HOFFMAN J L, ARGEROS G. Using Virtual Simulation to Teach Community Health Nursing Students About Public Health Nursing [J]. Journal of Community Health Nursing, 2021, 38(4): 244-52.
- [9] WANG J R. The comparison between architecture students' peer learning in informal situations within physical and virtual environments during the COVID-19 pandemic [J]. Indoor and Built Environment, 2023, 32(10): 2064-82.
- [10] Li Haifeng, Wang Wei. Why share knowledge? An exploration of the factors influencing knowledge sharing in virtual learning communities based on the systematic literature review method [J]. Chinese Distance Education, 2021, (11): 38-47+77.
- [11] Song Huiling, Shuai Chuanmin, Li Wenjing. Construction and Validation of a User Satisfaction Model for Virtual Learning Communities from the Perspective of Ecological Learning Theory [J]. China Distance Education [J]. Chinese Distance Education, 2019, (12): 68-77.
- [12] GIDDENS J, CURRY-LOURENCO K, MILES E, et al. Enhancing learning in an online doctoral course through a virtual community platform [J]. Journal of Professional Nursing, 2021, 37(1): 184-9.