Research on the Cultivation of Creative Ability of Students in Higher Education of Ethnic Areas with Outcome-based Education--- CiteSpace-based visualization and analysis

Qi Zeng, Mingfei Li*

Collage of Computer and Information, Qian Nan Normal University for Nationalities, Duyun, China

zengqi0063@163.com, *lmf624@foxmail.com

Abstract. Driven by the wave of scientific and technological revolution and the increasing integration of the global economy, innovation has become a new driving force for the sustainable development of national society and economy. The state has called for deepening the reform of innovation and entrepreneurship in higher education, and the cultivation of innovative talents has become the key path for China to realize the strategy of a strong innovative country, and colleges and universities have become the main position for the cultivation of innovative talents. This paper uses CiteSpace software to visualise and analyse the research on the cultivation of innovation ability of students in colleges and universities from 2013 to 2024. The results of the exercise show that the United States, China, Australia and the United Kingdom are in the leading position in this research field. The University of Queensland, Queensland University of Technology in Australia and East China Normal University in China ranked in the top three in terms of research. There are some collaborations between East China Normal University and other institutions, and other institutions need to improve communication and cooperation in future research. In terms of research hotspots, this paper found new research hotspots and trends, there are many researches in the theory of pedagogy, but the theoretical research based on the cultivation of innovation ability under OBE will be a new research hotspot in the future. Different from the traditional education concept, the OBE concept starts from the results and emphasizes student-centredness in the teaching process, which is an important way to improve the way of cultivating innovative talents in colleges and universities, to achieve the high-quality development of innovative talents, and to serve the needs of social practice.

Keywords: Creative; Higher Education; Outcome-based Education CiteSpace; Visual Analysis.

Y. Feng et al. (eds.), *Proceedings of the 4th International Conference on Internet, Education and Information Technology (IEIT 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 26,
https://doi.org/10.2991/978-94-6463-574-4_42

1 Introduction

In the context of the knowledge economy era, innovation ability has become a key indicator of a country's competitiveness, especially in a multi-ethnic country like China, promoting the development of higher education in ethnic areas is of great significance for achieving balanced regional development and maintaining national unity and social harmony. At present, with the accelerated development of globalization and informatization, the social requirements for college graduates are not only limited to the mastery of solid professional knowledge, but also attach more importance to their ability to solve practical problems and creative thinking[1]. As a key force in the transformation and upgrading of China's economy, the cultivation of creative ability of college students is particularly important, in which 'Outcome-Based education(OBE)' provides a new educational concept and practical path.

The traditional teacher-centred education model is no longer able to meet the needs of a fast-changing society, and OBE offers a new solution.OBE emphasizes the focus on student learning outcomes, and ensures that every student acquires the necessary knowledge and competencies to achieve the intended learning outcomes through the reverse design of the curriculum[2], the clarification of teaching and learning objectives, and the establishment of scientific assessment criteria. The learning outcomes of each student will be achieved. In the process, students' critical thinking, problem solving ability and creative practice ability are significantly enhanced[3].

So, what is the trend of current research publications on the development of innovative competences of students in local universities in ethnic areas in the context of results-oriented education? What are the research priorities? What kind of characteristics and shortcomings are presented? What are the future research trends in this area? These questions are the focus of this study, which uses CiteSpace to visualize and analyse the current status of research on the cultivation of creative ability of students in higher education and to provide suggestions for further research.

2 Research Methods and Tools

2.1 Data Sources

In this study, the core data collection of Web of Science databases (including SCI and SSCI) was used as the data source, and the search terms were "creative" and "higher education". The research direction is "Education Educational Research", the literature type is "Artistic", and the language is "English". The search period was from 2013 to 2024. 615 documents were selected as the sample for this study, excluding those that did not fit the theme.

2.2 Research Methods and Tools

This study mainly used CiteSpace software for the econometric analysis of the data. CiteSpace is a software that analyses domestic and international literature by visual-

izing it [4]. By analyzing the literature through this software, we can understand what the research history is and what the development trend is in the related fields. By visualizing the structure, patterns and distribution of scientific knowledge, it is possible to obtain the desired information more quickly[5].

Therefore, we used CiteSpace software to quantitatively and qualitatively analyze the 615 documents collected, and used bibliometrics and data visualization analysis methods to conduct an in-depth study of the original documents in terms of the year of publication, country distribution, institutional distribution, and keyword co-occurrence. The development of research on the creative ability of achievement oriented education for college students in the last decade was understood, and future hot research trends were explored based on scientific knowledge mapping.

3 Research Results and Analysis

3.1 Changes in Publication Volume

The data analysis of the screened 615 documents according to the number of annual publications can be obtained in Figure 1. The chart shows that between 2013 and 2024, OBE oriented cultivation of student creativity in higher education has received much attention from researchers. Among them, from 2013 to 2018, there was a continuous slow growth in the number of posts, with an increase of only 20. 2019 to 2023 showed a wavy growth trend, with more posts in 2019, 2021 and 2023. 2024 did not have a large total number of posts as only 4 months had passed, but the overall trend can still be seen to be upward.

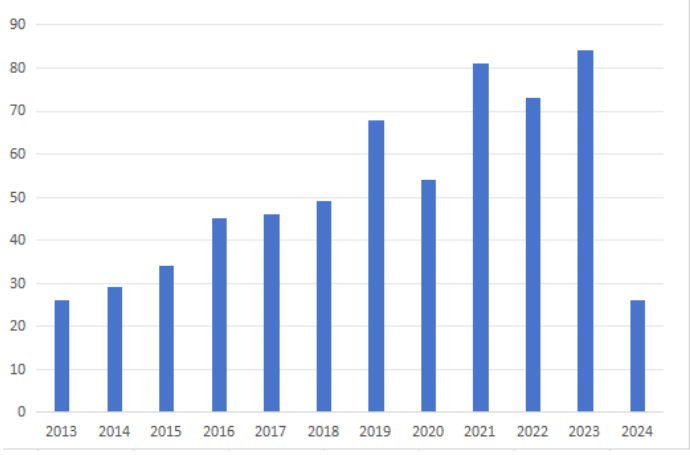

Fig. 1. Statistical distribution of annual number of publications

According to the background of the times, it can be seen that with the development of artificial intelligence technology, the requirements for talent training in future education have also changed. Students' creative ability is especially important, and education should cultivate creative talents for the artificial intelligence era[6], and guide students

to learn not only human-to-human cooperation but also human-machine collaboration[7] in their study and work in order to better adapt to the development of the future era. Therefore the cultivation of students' creative ability in higher education based on the OBE background has received extensive attention from the academic and research communities.

3.2 Country Distribution

We used CiteSpace software to visualize and analyze the countries of the615 papers collected, and we obtained Figure 2. As can be seen from the figure, a total of 68 countries have made research on the cultivation of creative ability among college students between 2013 and 2024, which is the majority of countries, and it is clear that the cultivation of creative ability among college students is worthy of in-depth research. In Table 1, we list the top ten countries and their number of publications. Among that we can find that during the period of 2013 to 2024, USA has had the most attention in this research with 86 publications, accounting for 13.9% of the total. It shows that USA is at the forefront of research in this field. The following countries are the China(85)，Australia(84), England(76), Chinese Taiwan(46), Spain(48), Canada(25), Turkey(19), South Korea(14), Israel(13), etc.It can be seen that research in this field requires a certain economic construction foundation and a clear creation-related policy, and with the support of the economy and policy, the creative ability of college students can be better cultivated[8]. Secondly, these countries attach great importance to higher education and creativity, especially China has been emphasizing the strategy of education and science and technology[9], so there are many relevant documents to support the cultivation of creativity for students in colleges and universities.

Table 1. Pubilshed number of top 10 countries

Number	Country	Published Number
1	USA	86
2	PEOPLES R CHINA	85
3	AUSTRALIA	84
4	ENGLAND	76
5	CHINESE TAIWAN	46
6	SPAIN	38
7	CANADA	25
8	TURKEY	19
9	SOUTH KOREA	14
10	ISRAEL	13

Through the visualization analysis, as in Figure 2, it can be seen The links between countries are relatively close. Led by China, the United States and Australia, there are close ties with other countries. This shows that in the era of knowledge economy, the development of creative abilities of students in higher education has received common attention worldwide, and this close cooperation will increase in the future.

Fig. 2. Country co-occurrence knowledge graph

3.3 Analysis of Research Institution

In order to study the source and provenance of these articles in more depth, we used CiteSpace to analyze the institutions that researched these articles, and Figure 3 shows the occurring knowledge graph of the institutions. From Figure 3we can see that there are many institutions that have researched the cultivation of creative ability among college students. Among them, Univ Queensland, Queensland Univ Technol, East China Normal Univ are leading the research. They are closely followed by Natl CHINESE TAIWAN Univ sci & Technol, Natl CHINESE TAIWAN Normal Univ, Griffith Univ, Univ sydney, Glasgow sch Art, Deakin Univ, Univ Hong Kong. We can see that in China most of the research is done by normal university while in other countries such as the USA and England, it is done by comprehensive universities.

Fig. 3. Institution co-occurrence knowledge graph

Although there are many research institutions, we can see that there is not much co-operation between institutions. For example, East China Normal Univ has some co-operation with other institutions, but there is little co-operation between other insti-

tutions. The research is about cultivating the innovation ability of college students, so there are more studies on this in colleges and universities. However, it should not be limited to the research in colleges and universities, but the enhancement of college students' innovation ability is an inevitable trend in the future development of education, which should attract the attention of the whole society, and it is suggested that the national education department organize more research in this field.

3.4 Analysis of Research Hotspots

Keywords are the emphasis and prominence of the core content of a paper, containing the main research point, research object, research method [10] and so on. Generally speaking, there must be some kind of correlation between keywords in the literature, and this correlation can be expressed by the frequency of co-occurrence. Therefore, by visualizing and analyzing the keywords through CiteSpace [11], we can learn the focus, hotspots and research trends of the research in the field of information technology applied to education.

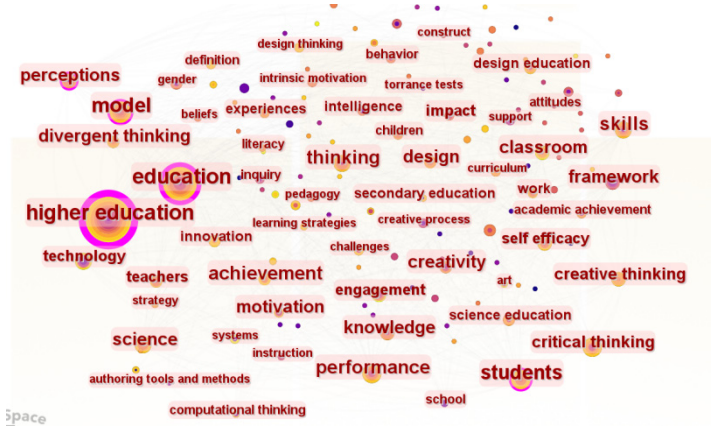

Fig. 4. Keyword co-occurrence knowledge graph

The keywords of 615documents can be seen by analyzing them through CiteSpace, with a total of 278nodes,1311connecting lines, and a network density of (Density)=0.034, which indicates that the centrality is strong(Figure 4). From the keywords with word frequency over 20(Table2, Table3), the top five keywords are information higher education (141), education (92), students (52), model (32), performance (29).

Combining the frequency and centrality of keyword appearances, the research hotspots of information technology in education can be categorized as follows:

1) Education: the main keywords involved are higher education, education, knowledge, classroom and so on. Under the backdrop of the new era, colleges and universities should constantly update their education concepts, clarify their goal orientation, establish and implement quality objectives based on social needs[12], and continuously optimize their talent training programmes and curriculum systems. Colleges and universities, as the supplier of talents and the main position of training, should take

the initiative to assume social responsibility, consciously change the concept of talent training, change the mode of talent training[13], OBE oriented to pay more attention to the students' learning methods, skills training, change the students' ideological concepts, enhance the interest in learning and exploring, and change from the passive 'supervised learning' to the active 'self-conscious learning', to strengthen the public practice of learning, to strengthen the public practice of learning[14]. To strengthen the construction of public practice teaching platform. We should strengthen the construction of public practice teaching platform. We should strengthen the practice teaching link, reform the practice teaching method, create a good environment for innovation and practice, realize the informatization of practice teaching[15], and let the students do what they learn, do what they learn, so as to continuously stimulate the innovation consciousness of the young students[16], improve the hands-on practical ability, and cultivate the innovation and entrepreneurship ability.

Table 2. High frequency keyword frequency statistics

number	keywords	frequency	number	keywords	frequency
1	higher education	141	11	skills	22
2	education	92	12	perceptions	20
3	students	52	13	knowledge	19
4	model	32	14	motivation	17
5	performance	29	15	critical thinking	16
6	thinking	28	16	technology	15
7	science	25	17	creativity	14
8	creative thinking	23	18	classroom	14
9	design	22	19	divergent thinking	13
10	achievement	22	20	engagement	13

2) Thinking: the main keywords involved are thinking, creative thinking, perceptions, critical thinking, divergent thinking and so on. The cultivation of college students' innovative ability needs to first help students broaden their learning horizons, increase the content of knowledge available to college students[17], help students understand the internal logic of innovative ability, and equip college students with the basic conditions to carry out innovative practice. Enriching innovative knowledge reserves will help students improve their ability to effectively use various types of knowledge[18], so that the knowledge content of applied and basic disciplines can become an important driving force to promote learning innovation, work innovation and practical innovation. Strengthening the ideological education and guidance for the cultivation of college students' innovation ability, helping college students to form a sense of innovation and development, and realizing the long-term promotion of the cultivation of college students' innovation ability[19]. Although some colleges and universities have built a systematic education and service system for the cultivation of college students' innova-

tion ability, some college students will not be able to maintain good professional qualities of learning innovation and practicing innovation once they are out of the existing education and learning environment[20]. Strengthening the ideological education and guidance for the cultivation of college students' innovative ability, rooting the sense of innovation, spirit of innovation and innovative thinking firmly in the minds of college students, and making innovative practice an effective strategy for college students to solve their learning problems, life problems and work problems[21].

3)Technology: The main keywords involved are science, design, skills, motivation, technology, etc. OBE emphasizes the competence-based approach, and education should provide students with the ability to adapt to future life. On the basis of innovative thinking, students should master the necessary innovative skills in order to turn their innovative spirit and consciousness into actual innovative behaviour[22]. Innovative skills are tangible and visible, including general innovative skills and professional basic innovative skills. Students have a strong sense of innovation and innovative spirit, but also to train the basic general innovation skills and professional foundation skills, to lay a solid foundation for innovative behaviour. Otherwise, how strong the innovative spirit and innovative consciousness is no source of water, no wood, can not be put into action.

Table 3. High frequency keyword centrality statistics

number	keywords	centrality	number	keywords	centrality
1	higher education	0.45	11	skills	0.08
2	education	0.32	12	perceptions	0.1
3	students	0.14	13	knowledge	0.05
4	model	0.1	14	motivation	0.08
5	performance	0.07	15	critical thinking	0.06
6	thinking	0.08	16	technology	0.02
7	science	0.06	17	creativity	0.03
8	creative thinking	0.03	18	classroom	0.02
9	design	0.04	19	divergent thinking	0.03
10	achievement	0.06	20	engagement	0.04

4 Conclusion

In this study, CiteSpace was used to visualize and analyse the relevant literature on the research on the cultivation of innovation ability of college students in the past ten years, and to sort out the research hotspots. Based on above data analysis results, the following conclusions are obtained:

1. From the aspect of the annual publication volume, the number of publications in this research in the last decade has shown a continuous growth trend. In 2012, the

Eighteenth National Congress of the Communist Party of China (CPC) explicitly stated that 'scientific and technological innovation is a strategic support for improving social productivity and comprehensive national strength, and must be placed at the centre of the overall situation of national development'. We must adhere to the road of independent innovation with Chinese characteristics and implement the innovation-driven development strategy'. In terms of strategic positioning, innovation is placed in an unprecedented position and rises to the level of national strategy.In 2019, with the continuous development of artificial intelligence technology[23], the requirements for the training of future talents have begun to change, and the education field has begun to pay attention to the cultivation of the innovation ability of students in colleges and universities. Therefore, the research literature on the cultivation of innovation ability of college students has been growing gradually so far in 2019. In the future, the research on the cultivation of innovation ability of college students will remain a continuously growing trend.

2. From the aspect of countries and institutions, We found that the United States, China, Australia and the United Kingdom have more research in this field and published a large number of papers. Among the tertiary institutions in each country, research on the development of innovation skills of tertiary students is dominated by the University of Queensland and Queensland University of Technology in Australia and the East China Normal University in China. As can be seen from the CiteSpace chart, there are more links between countries than between major institutions. In future research, in order to promote the cultivation and research of innovative talents in each country, the cooperation and exchange between institutions, and between institutions and enterprise organizations should be increased. The cultivation of innovative and entrepreneurial talents in colleges and universities is closely related to enterprises, so it is necessary to strengthen the cooperation between universities and enterprises to achieve the organic combination of talent, knowledge and capital, and effectively promote the organic connection between the talent chain and the industrial chain and innovation chain.

3. From the aspect of keywords, we divided the main keywords into three parts: Education aspect, Thinking aspect and Technology aspect. The educational aspect is that in the context of the era of intelligent technology development, colleges and universities, as the main position of talent cultivation, need to constantly update the concept of education and continuously optimize the talent cultivation programme and curriculum system. Taking OBE as the educational concept[24], it creates a good environment for the cultivation of innovation ability for students in colleges and universities, and stimulates students' innovation consciousness and ability. The thinking aspect refers to the fact that on the basis of imparting various kinds of knowledge and enriching students' innovative knowledge reserve, colleges and universities should let students form their own innovative consciousness and innovative spirit with the guidance of OBE[25], which emphasizes students' consciousness and autonomous behaviors that are internalized in their hearts and externalized in their actions, and these autonomous consciousness and thinking ability are tacit knowledge that cannot be easily expressed through words, graphics and other concrete expressions, and they are also an important force of innovation and change[26]. The technical aspect points out that education in colleges and universities needs to provide students with the ability to realize their innovative

consciousness, and the cultivation of practical ability is one of the essential elements of innovation and entrepreneurship activities.The learning outcome in the concept of OBE is the maximum ability that can be achieved after one stage of learning, and students can only apply the learning outcome of one stage to practice after mastering the corresponding technical skills[27], so that they can realize the scientific and technological achievements into outputs, and compare the expected goals with the actual outputs, which is the most important aspect of the cultivation process. actual outputs relative to each other, and make continuous corrections to what is not done well in the cultivation process and methods.

In summary, this paper uses CiteSpace software to visualize and analyse the research hotspots and trends in the cultivation of innovation ability of college students, and puts forward the research hotspots of OBE-oriented education concept and its application in the cultivation of innovation ability of college students. In the future research, I think the talent cultivation mode based on the OBE concept can provide new theoretical support and scientific guidance for the cultivation of innovative talents in colleges and universities in China, so we should pay more attention to the cultivation of college students' innovative ability and research, continue to update the educational concept and teaching environment, and cultivate students' innovative thinking and ability with OBE as the guidance.

Fund Project

1. Guizhou Province 2022 Undergraduate Teaching Content and Curriculum System Reform Project "Research on the" 1+3 "Training Model of Innovation and Entrepreneurship Talents Based on OBE Concept" (2022SJG011).

2.The first-class platform project for the 2021 school level education quality improvement project of Qiannan Normal University for Nationalities, titled "Computer Innovation and Entrepreneurship Incubation Platform - Dream+Co creation Space" (2021xjg015).

3. Research on talent cultivation mode based on the "Guizhou Province General Undergraduate Professional Evaluation Index System" - Taking the Internet of Things Engineering major as an example, No. 2022SJGO05.

References

1. Jing, L. I. "Creative Exploration of College Students' Mental Health Education." Journal of Shanxi Datong University(Natural Science Edition) (2015).
2. Gang, Ling, H. Wang, and X. Song. "Current Situation and Development of Outcome-Based Education in Computer Teaching." 2022 11th International Conference on Educational and Information Technology (ICEIT) (2022):36-39.
3. LIM, Cher Ping. "Outcome-based education in higher education institutions: A case study of an e-portfolio initiative." (2016).
4. Chen, Chaomei. CiteSpace: A Practical Guide for Mapping Scientific Literature. 2016.

5. Chen, Chaomei. "CiteSpace II: Detecting and Visualizing Emerging Trends." Journal of the American Society for Information Science & Technology 57.3(2006):359-377.
6. Yoon, Du Mim, and K. J. Kim. "Challenges and Opportunities in Game Artificial Intelligence Education Using Angry Birds." IEEE Access 3(2017):793-804.
7. Luckin, Rosemary, K. R. Koedinger, and J. E. Greer. "Artificial intelligence in education [electronic resource]: building technology rich learning contexts that work /." Frontiers in Artificial Intelligence & Applications (2007).
8. Keoy, Kay Hooi, et al. "An Investigation on the Impact of Technological Enablement on the Success of Entrepreneurial Adoption Among Higher Education Students: A Comparative Study." Journal of Information & Knowledge Management 22.01(2023).
9. Congbin, Duan Yide; Guo. "Research on the effect of higher education in blocking the intergenerational transmission of rural relative poverty." China Higher Education Research 38.13(2022):6-6.
10. Rocchesso, Davide, et al. "Keywords Sound Design, Auditory Display, Multimodal Interaction, Product Design, Interactive Arts and Music, Sound Perception and Cognition, Sound Modelling." (2022).
11. Xiaonan, Qin, L. U. Xiaoli, and W. U. Chunyou. "The knowledge mapping of domestic ecological security research: bibliometric analysis based on citespace." Acta Ecologica Sinica 34.13(2014).
12. Neely, Michelle E., et al. "Self-kindness when facing stress: The role of self-compassion, goal regulation, and support in college students' well-being." Motivation & Emotion 33.1(2009):88-97.
13. Mesa, Vilma. "Achievement Goal Orientations of Community College Mathematics Students and the Misalignment of Instructor Perceptions." Community College Review 40.1(2012):46.
14. Mccreary, Catherine, C. Millerperrin, and J. P. Trammell. "Past Sports Participation, Self-Efficacy, Goal Orientation, and Academic Achievement Among College Students." (2018).
15. Gen-Li, Tang, and W. Yan-Bo. "Study on the Cultivating Path of College Students' Innovation and Entrepreneurial Ability." Journal of Sichuan University of Science & Engineering(Social Sciences Edition) (2011).
16. Yu-Hong, Lu. "Reflections on the Education of College Students' Innovation and Entrepreneurship." Journal of Jinling Institute of Technology(Social Science) (2010).
17. Shi, Yin, et al. "Research of cultivating,managing and synthetical effect for college students' innovation projects depending on innovation base for college students." Experimental Technology and Management (2012).
18. Liu, Wenhua. "An evaluation method of college students'innovation and entrepreneurship ability based on AHP method." International Journal of Environment and Pollution (2022).
19. Meng, Fanchun, and R. He. "Analysis on the Approach of College Students'Innovation and Entre-preneurship Education under the New Media Environment." Review of Educational Theory (English) 5.3(2022):1-5.
20. "INTERGENERATIONAL HEALTH PROMOTION PROJECTS WITH COLLEGE STUDENTS." Innovation in Aging Supplement_1(2023):Supplement_1.
21. Chang, Yongzhi, and Y. Liu. "Assessment of College Entrepreneurship and Innovation Education Effect for Sci-Tech Service Industry." Discrete Dynamics in Nature and Society 2022(2022).
22. Riemenschneider, Cynthia K., L. L. Burney, and S. Bina. "The influence of organizational values on employee attitude and information security behavior: the mediating role of psychological capital." Information & computer sceurity (2023).

23. Cai, Weiqi. "Innovation and path of teacher literacy in basic education in the era of artificial intelligence." Region - Educational Research and Reviews 5.3(2023):55-57.
24. Midraj, Sadiq. "Outcome-Based Education (OBE)." American Cancer Society (2018).
25. Abdul Karim, Noor Alhuda, and Y. Y. Khoo. "OUTCOME-BASED EDUCATION: AN APPROACH FOR TEACHING AND LEARNING DEVELOPMENT." Journal of Research Policy & Practice of Teachers & Teacher Education (2013).
26. Tiwari, Abhya, et al. "Outcome-Based Education (OBE) Academic Planning-An Insight into All Round Development of an Engineer." 2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON) IEEE, 2018.
27. Tan, KatherineChan, Chong MeiSubramaniam, PathmawathyPing, Wong Li. "The effectiveness of outcome based education on the competencies of nursing students: A systematic review." Nurse education today 64(2018).