Iyer, S. et al. (Eds.) (2022). Proceedings of the 30th International Conference on Computers in Education. Asia Pacific Society for Computers in Education

Research Status and Hotspots of Pre-service Teachers' ICT in Education Competencies-Visualization Research Based on Citespace

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Abstract: Focusing on "pre-service teacher" and "ICT" as the keywords, this paper adopts Citspace to visualize the knowledge map, and uses the Web of Science as the database to analyze the publishing situation and research hotspots of pre-service teachers' ICT in education competencies from 2002 to 2022. Through keyword co-occurrence network analysis, the paper finds that: Nanyang Technological University has a lot of research achievements in teachers' ICT in education competencies, and the journal of Computer and Education is cited the most. Furthermore, keywords clustering analysis was carried out on the research hotspots, and 10 hotspot issues related to pre-service teachers' ICT in education competencies were obtained, which were roughly divided into teacher education, the application of ICT in education, and the hot theories of informatization teaching.

Keywords: Pre-service teacher, ICT in education competencies, cite space, hotspots

1. Research Background

In February 2022, the Ministry of Education's Department of Teachers' Work issued the "Key Points of the Work of the Department of Teachers' Work of the Ministry of Education in 2022", which clearly pointed out that it is necessary to promote artificial intelligence to boost the construction of the teaching team and further promote the information technology application ability improvement project 2.0. Improving the pre-service teachers' ICT in education competencies of the teaching staff is one of the important indicators to improve the core quality of the teaching staff. And the pre-service teachers are the main force of future teachers. The information awareness and the ICT in education competencies of pre-service teachers have an important influence on the development of education modernization. Under this background, Teacher Education Institutions (TEIs) should actively respond to the requirements, and fight for improving the comprehensive ability of pre-service teacher. (Liu, et al, 2019).

2.Data Collection and Data Analysis

The data of this study comes from the Web of Science. We typed in the keywords "pre-service teacher" and "ICT", selected the time slice as 1 year, and limited the publication time from 2002 to 2022. And then eliminated the less relevant papers, finally got 347 effectively retrieved papers. In order to reveal the research hotspots and development trends of the pre-service teachers' ICT in education competencies in recent years, we adopted the CiteSpace (6.1.R3) software to conduct a detailed map study (Hu & Chen (2014)). In this study, the visualization data in the Web of Science is organized and made into charts to sort out the textual structure, reference analysis, and change trends of the themes.

3. Research Results

Using the Web of Science as paper database, and then classify the papers that meet the requirements. We selected the "(TS= (pre-service teacher)) AND TS=(ICT)" as the search criteria and the time limit was from January 2002 to January 2022. An external analysis of the research on ICT in education competencies of pre-service teacher was conducted on institutional profiles, cited journals and hot issues.

3.1 Institutional Profile

An institution is the unit that authors rely on to publish papers, and the number of papers published by an institution is an important reference standard to measure the institution's scientific research capabilities. We selected the institution by node type and got the institution cooperation network diagram (Figure 1). Modularity is the clustering module value (Q value). It is generally believed that Q>0.3 means that the clustering structure is significant. The Q value in the analysis of the institution is 0.9567, indicating that the clustering structure is significant and convincing. The larger the annual ring in the knowledge graph, the more important the keyword, and the greater the intermediary centrality, the stronger the influence of the keyword (Chen,2017). As illustrated in Figure 1, Nanyang Technology University has the largest annual ring and the largest intermediary centrality. It shows that Nanyang Technology University has the greatest influence.

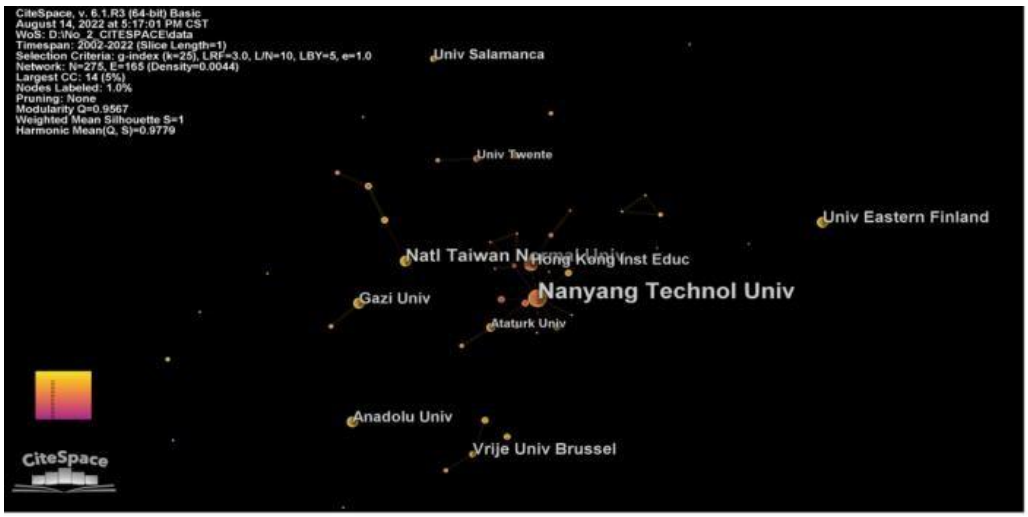

Figure 1. Institutional Cooperation Network Diagram

In order to have a clearer understanding of the specific number of papers published by each institution, we sorted out the number of papers published by each institution, and listed institutions that have published no less than 6 papers in the past 20 years (Table 1).

Table 1. *Institutions and Numbers of Published Papers*

Serial Number	Institution	Numbers of Paper
1	Nanyang Technological University	19
2	Taiwan Normal University	9
3	University of Eastern Finland	7
4	Free University of Brussels	7
5	Hong Kong Institute of Education	6
6	Gazi University	6
7	Anadolu University	6

As shown in Table 1, Nanyang Technological University has published the most papers on ICT in education competencies with 19 papers, followed by Taiwan Normal University with 9 papers. Among the top seven institutions, three are located in the Asia-Pacific region, and the total number of publications is 34, accounting for 56.6% of the total number of publications by the top seven. This shows that the Asia-Pacific region regards pre-service teacher informatization training as an important research field. Taking Singapore as an example: there have been 4 ICT-in-Education Masterplans since 1997 in Singapore. Four versions of ICT-in-Education Masterplan were implemented from 1997 to 2019. Currently, Singapore is conducting an Educational Technology (EdTech) Plan, which guides the development of a technology-enriched school environment for teaching and learning.

3.2 Cited Journals Analysis

Citespace was adopted to analyze the citations of the papers, and the journals to which the cited papers belonged were counted. Journals with more than 100 citations are listed in the table 2. It can be obtained from the table: the *journal of Computer and Education* was cited the most with 224 times, the *Journal of Computer Assisted Learning* was cited 127 times. This statistic provides readers with a list of journals, which have a high correlation with pre-service teachers' ICT in education competencies.

Table 2 *The counts of cited Journals*

Serial number	Cited Journals	Count
1	Computer and Education	224
2	Journal of Computer Assisted Learning	127
3	British Journal of Educational Technology	119
4	Australian Journal of Educational Technology	119
5	Teaching and Teacher Education	117
6	Computers in Human Behavior	106
7	Educational Technology Research and Development	103
8	Educational Technology and Society	102
9	Teachers College Record	101
10	Journals of Research on Technology in Education	100

3.3Analysis of Hot Issues

Co-word analysis technology is a text content analysis technology that explores the development of the discipline by analyzing the characteristic relationship of co-occurring words (Pan L & Jiang H, 2016). Keywords must appear in the core content of the paper, so the keywords of the paper are a trustworthy indicator. We adopted "pre-service teacher" and "ICT" as keywords, and perform keyword cluster analysis on the keywords, and finally got 10 clusters. The order of the cluster is from 0 to 9, the smaller the number, the more keywords contained in the cluster. Each cluster is composed of multiple closely related words.

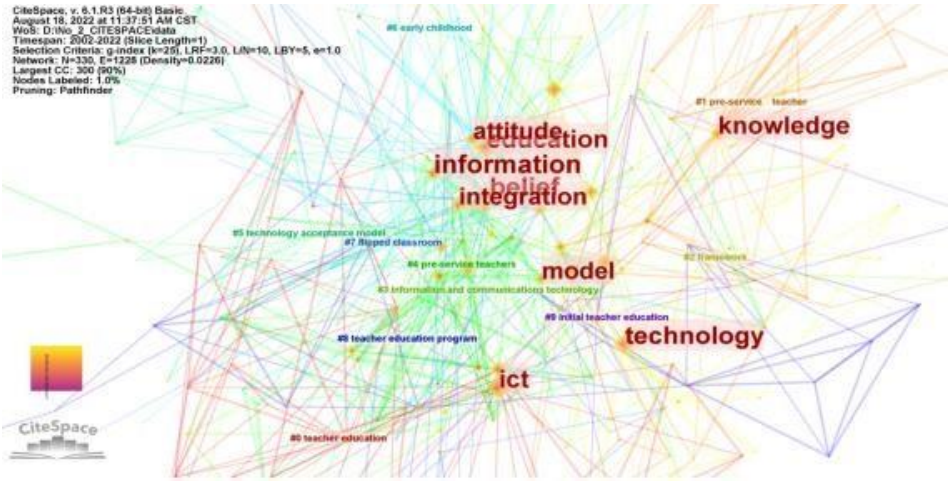

Figure 2. Keyword heat map

As can be seen from the figure, keywords related to pre-service teachers' ICT in education competencies include #0teacher education, #1pre-service teacher, #2framework, #3information and communications technology, #4pre-service teachers, #5technology acceptance model, #6early childhood, #7flipped classroom, #8teacher education program, #9inital teacher education.

According to the field of the keyword, we roughly divide the keywords into three categories: the “teacher education", "pre-service teacher(s)", "initial teacher education", "teacher education program" belong to teacher education, while the application of information technology in education includes "flipped classroom" "early childhood". What is more, the popular theories and professional terms include "information and communications technology", "framework" and "technology acceptance model". Therefore, the research hotspots in the past 20 years have focused on teacher education, the application of information technology and theoretical research.

4. Summary

Teachers in the ICT-mediated learning environments have to take on the more demanding role of a mediator and a knowledge broker: to provide guidance, strategic support, and assistance to help students at all levels to assume increasing responsibilities for their own learning. Inevitably, these questions have serious implication on how school teachers should be educated (Jonassen, et al., 2008; Kirschner & Selinger, 2003; Lock, 2007; UNESCO, 2008).

(1) The leaders of education institutions are supposed to hold a comprehensive vision. The ICT in education vision developed by TEIs may need to be reviewed as the needs of schools and society change with the advancement of ICT.In order to cope with the changes and advancements, the leaders of should actively take a series of measures from top to bottom: schools adjust their awareness and concepts, add more ICT elements, and adjust the teaching concepts of pre-service teacher trained to adapt to the school and society.

(2) An effective and robust pre-service teacher education program will prepare teachers with the necessary ICT and pedagogical competencies to integrate ICT for teaching, learning and administration in schools (Mims, Polly, Shepherd, & Inan, 2006). In the curriculum system for cultivating pre-service teacher, pre-service teacher not only learn subject knowledge and pedagogical knowledge, but also combine ICT with it, and integrate ICT into teaching.

(3) The authorities should issue documents to assist the implement of ICT infrastructure, resources and support strategies. Setting up technology infrastructure require consideration of available physical infrastructure. These devices must be allowed expansion and, as technology develops, be able to adapt accordingly. In addition, these ICT infrastructures must be equipped with software systems, management systems, etc.

Acknowledgements

This research is funded by the Chinese National Social Science Foundation "13th Five-Year Plan" 2019 Education West Project “the Path and Strategies of the Development of Pre-service Teachers’ ICT in Education Competencies in the New Era” (Grand No. XJA190285).

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