Current Research on Computer-Supported Collaborative Learning Based on Citespace Visual Analysis

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Abstract. Computer-supported collaborative learning(CSCL) refers to a basic cognitive process method using computer technology to establish collaborative learning environment and make teachers and students, students and students discuss, collaborate and communicate. This study uses CiteSpace, a visual tool for literature measurement, to sort out 903 web of science (WOS) literature. The main conclusions are as follows: The keyword combination indicates that cooperative learning, common management, computer science education, script, and social environment are hot topics. After 2018, machine learning, artificial intelligence, human-computer interaction, social network analysis, and task analysis have become hot topics in the forefront of CSCL research, showing a development trend of multi-collaboration, and attaching importance to the Internet, human-computer interaction, and personal-computer interaction.

Keywords: CSCL; Web of Science; Cite Space; Visual analysis

1 Introduction

Over the decades, advanced technologies have dramatically changed the way we live,and the development of modern information and communication technology has led to the emergence of many new computer applications[1]. The relationship between technology development and education is mutual[2].CSCL is the theory and practice that learners establish learning collaboration community and cultivate collaboration ability in the interaction process under the development background of computer technology, with the goal of improving learning performance[3].In the collaborative communication process, learners can learn from each other to explore, meaning construction, improve learners' collaborative learning skills, and ultimately promote the improvement of their cognitive level and thinking logic ability. Due to its personalized, CSCL is more and more popular[4].

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1.1 Collaborative Learning Ontology

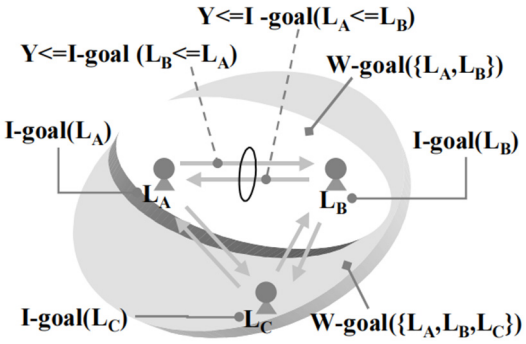

Fig. 1. Learning Goals in a Group

1.2

represents a diagram that illustrates the learning goals of a group with three learners, LA, LB, and LC. Each learner has their individual goals, denoted as i-goal, which they hope to achieve through the collaborative learning session. Learners LA and LB have an interactive goal, denoted as Y<=i-goal, where they interact with each other to achieve a common objective. This interactive goal is observed from both LA and LB's perspectives. Additionally, the article highlights w goals, which refer to the overall learning goal of the learning group, and w goal (LA, LB), which represents the learning goal of learners LA and LB[5].

2 Research design

2.1 Research tools

CiteSpace was used in our present research. CiteSpace uses nodes and lines to represent the relationship among keywords, authors and institutions, and visualized the research trends and trends in a field. It is often used in knowledge map generation and literature measurement analysis[6].This paper combines the knowledge map generated by CiteSpace6.2.R3 software with the measurement analysis of Excel software, and further explores the overall status, theme hot spots and development trend of CSCL through the methods of graphic rendering and data mining[7].

2.2 Data sources

Academic journals and international conference papers can be regarded as the main carrier of knowledge in the research field[8]. This study used Web of Science(WOS) databases and a total of 903 source papers focusing on CSCL were retrieved. Source articles included: author, title, source publication, abstract, and reference fields.

3 Research hot spots and trends

3.1 Research Hotspots

3.1.1 Keywords co-occurrence analysis

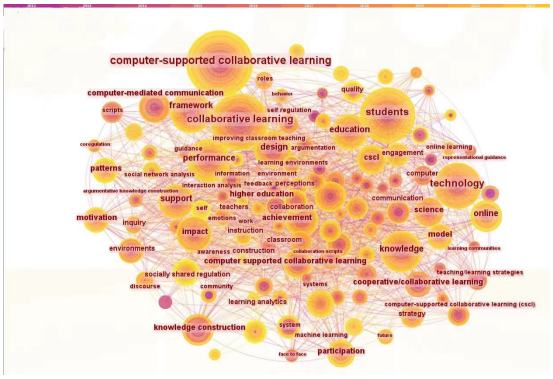

Fig. 2. Keyword co-occurrence analysis

Keyword co-occurrence refers to the co-occurrence of high-frequency keywords in the same research field. The sizes of nodes and circles in the figure reflect the frequency and center degree of the keyword. Using the keywords with CiteSpace6.2.R3 times greater than 20 times, we obtained a CSCL research keyword co-occurrence map with 389 nodes, 2812 connections and network density of 0.0373, as shown in Fig. 1. As shown in Fig 2, the nodes and connections are evenly distributed, and the network density of 0.0373 indicates that the keywords in the research field of garbage classification have a high degree of connection.

3.1.2 Keywords clustering analysis

Keywords clustering refers to a cluster formed by connecting keywords with similar topics in the research field. For the clustering analysis method of network structure, CiteSpace.6.2.R3 gives two indexes: the number of clustering modules (Q) and the clustering average contour value (S)[9]. In our study, Q=0.3301、S=0.685, showed **. Literature samples with significant clustering effect and reasonable clustering were grouped into eight categories:CSCL(#0),socially shared regulation (#1), Cooperative/Collaborative Learning (#2), computer architecture (#3)、computer supported collaborative learning (#4)、collaboration (#5)、I2 writing (#6)、multidisciplinary groups (#7).

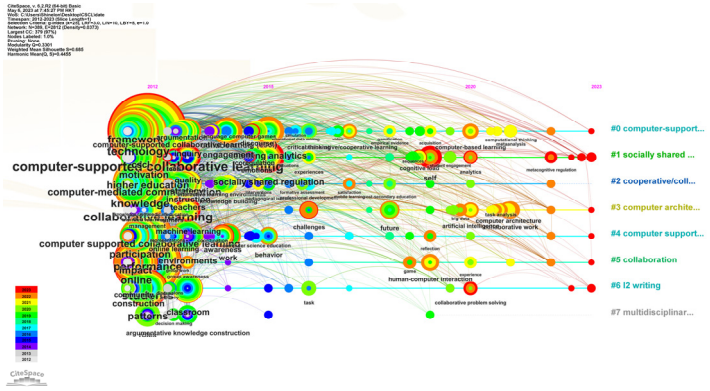

Fig. 3. CSCL keyword time collinear graph

In addition, the time span of each cluster evolution was presented using the CiteSpace6.2.3R line view function to form a keyword clustering time line atlas, as shown in **Fig. 3**.

3.2 Research trends

Top 20 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2012 - 2023
cooperative/collaborative learning	2012	3.17	2013	2014	
coregulation	2015	2.67	2015	2018	
computer science education	2015	2.64	2015	2017	
collaboration	2014	3.59	2016	2017	
collaboration scripts	2012	3.25	2016	2017	
community	2012	3.13	2016	2019	
environment	2012	2.78	2016	2017	
professional development	2016	2.74	2016	2017	
model	2012	2.64	2016	2017	
future	2018	3.6	2018	2020	
discourse	2015	2.77	2019	2021	
engagement	2014	2.74	2019	2023	
machine learning	2013	4.22	2020	2023	
computer-based learning	2020	3.3	2020	2023	
artificial intelligence	2020	3.3	2020	2023	
collaborative work	2021	5.13	2021	2023	
computer architecture	2021	4.62	2021	2023	
human-computer interaction	2019	3.23	2021	2023	
social network analysis	2012	3.17	2021	2023	
task analysis	2021	3.08	2021	2023	

Fig. 4. CSCL Keyword Emergence Chart

Emergence analysis refers to the exponential increase in the frequency of specific keywords, indicating that a potential topic has attracted or is attracting high attention within a specific period of time. Therefore, keyword emergence analysis is considered as a pointer to a highly active research field. According to the intensity and time of keyword emergence[10].In the study of CSCL, cooperative learning, common management, computer science education, script, and social environment before 2017 have relatively strong mutation intensity, as shown in **Fig. 4**.Since 2018, machine learning, artificial intelligence, human-computer interaction, social network analysis, and task analysis have become hot topics in CSCL research.

4 Conclusion

This study used CiteSpace, a visual tool for literature measurement, to sort out 903 WOS literature reports on garbage classification and treatment research by from 2012 to 2023. The conclusion is as follows: The keyword cluster structure is significant, Formed the CSCL, socially shared norms, Cooperative/Collaborative Learning, computer architecture, 8 theme clusters: Computer Supported Collaborative Learning, collaboration, I2 writing, and Multi Disciplinary Groups. In addition, with the development of computer network technology and distance online teaching under the epidemic situation[10], machine learning, artificial intelligence, human-computer interaction, social network analysis, and task analysis have become hot topics in the forefront of CSCL research since 2018. In the future research, we can conduct an in-depth comparative analysis of the Chinese and foreign literature in the field of CSCL to further promote the development of CSCL research in China.

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