

Visual Learning Analysis of Group Awareness Tools in Collaborative Learning

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Abstract

Blended learning environment integrates face-to-face teaching and online learning, improving teaching efficiency while also presenting challenges to teaching: the data from both online and offline learning cannot be effectively combined and applied to actual teaching. Group awareness tools(GAT) in collaborative learning can provide theoretical support for effective collaboration and can also be used as a visual learning analytics tool in teaching, providing a more scientific way to verify the actual effectiveness of teaching, enhance the ability and literacy of teachers and students in applying visual learning analytics.

Keywords

Collaborative learning, Group awareness, Learning analysis.

1. Introduction

In a blended learning environment, group perception makes collaboration more scientific and reliable, promotes communication and understanding among team members, contributes to the cognitive construction of team members at the knowledge level, and improves collaboration efficiency and collaborative task performance. Through visual analysis tools, this study studied the existing literature, summarized the existing visual analysis tools based on group perception theory under the condition of collaborative learning, and recommended two tools that may bring more convenient and reasonable cooperation in the future.

2. Theoretical Basis

2.1. Blended Learning Environment

There are many challenges in higher education: students cannot continue to focus on traditional face-to-face instruction, and there is less interaction between faculty and students or peers in online learning. These reduce students' willingness to ask questions and opportunities for in-depth discussion. Therefore, blended learning courses combining the advantages of traditional face-to-face learning and online learning are adopted. These courses promote social interaction through face-to-face, online collaborative learning and digitally enabled social networking. As a result, the extension from actual courses to online courses makes blended learning increasingly important.

Professor Li believes "Blended Learning is a popular term in the field of education, especially in the field of educational technology, after people reflect on e-Learning. Its main idea is to integrate the two learning modes of face-to-face teaching and Online learning to achieve a teaching method of reducing costs and improving benefits." [1] At present, there is no consensus on the design and implementation of blended learning model, and there is no uniform standard on the mode and proportion of mixing. From the perspective of ecology, in blended learning, individuals are at the center of micro-systems such as teachers, peers, technology, family and

curriculum. These elements interact with individuals and affect the change of learning experience.

2.2. Computer Supported Collaborative Learning(CSCL)

Collaborative learning is one of the core skill requirements of talents, and the job market also expects the recruitment of talents with a sense of teamwork and skills. To strengthen the construction of education informatization academic community, collaborative work is a key branch in the interpersonal field of deep learning literacy, teamwork, self-management and critical thinking constitute high-level abilities. It can be said that collaborative learning is an effective way to promote learning and plays a key role in the modernization of education.

Since the Johnson brothers proposed "collaborative learning", it has become a popular teaching mode and learning strategy after continuous research. The application of emerging technologies such as big data and artificial intelligence in the field of education has promoted the development of collaborative learning, and new research contents and methods have also emerged constantly. And explore more suitable to solve the problem of teaching practice ideas and research trends.

CSCL refers to the use of computer technology, especially multimedia and network technology, to assist and support collaborative learning. After 30 years of development, under the mutual shaping and driving of theory and technology, CSCL research has formed four research orientations, namely, basic theory, collaborative learning process, collaborative learning supporting technology and research methods. This paper also discusses the core issues such as how to understand the diversity of theoretical basis and how to build its fusion relationship, how to recognize and organize the collaborative learning process, how to design and use technology to promote collaborative learning, and how to understand and build the research method system.[2] Collaborative learning has become a kind of learning mode, which has been widely used in the traditional class teaching and information technology learning environment. A new generation of researchers is beginning to seek to identify the hidden results of positive collaboration. It focuses on the process of collaboration and interaction among members, and tries to understand the internal mechanism of effective collaboration through in-depth analysis of the collaborative learning process.

2.3. Group Awareness Theory

Group awareness refers to learners' understanding of various aspects of the collaborative group or partner's information, such as the current position of the collaborative partner, the activities they participate in, the knowledge level, interest preference and feeling state, etc., to help the team coordinate and complete the common task. Unlike classroom instructional design, collaborative learning is difficult for instructional designers to presuppose specific learning processes and generally control the whole learning process.[3] Before the occurrence of collaborative learning, people actually did not know what cognitive and social conflicts would be perceived by teachers and students in the process of collaboration, what interactive behaviors would occur, and what the path of collaborative learning would be. Therefore, the design scheme of collaborative learning has little binding effect on the collaborative process, and the promotion of collaborative process depends on the monitoring and regulation between individuals. It needs to be based on the awareness of the members of the group.

2.4. Visualization of CSCL with Group Awareness Tool

Group awareness tools can be divided into three types: cognitive group awareness tools, behavioral group awareness tools and social group awareness tools.[4] Cognitive awareness mainly refers to the information related to learning tasks or learning topics, such as the learning content being studied by peers or the degree of mastery of a certain knowledge point, which can be visually represented through knowledge graphs. Some scholars have embedded group

awareness tools that can increase social cognitive conflicts to promote the change of learning results and learning attitudes. Behavioral group awareness tools refers to the awareness of the behavioral information of learners' activities in the collaborative learning environment, such as what content learners or peers are learning, what opinions they have published, how often they participate in collaboration, and how long they have been learning on average. Specific representations include bar charts, bar charts, radar charts, etc., whose essence is the quantification of collaborative behaviors. Social group awareness tools mainly provide social behavior patterns of group members or peers, such as group influence, emotional state, learning style, etc., which can be represented by radar map or labeling of learners.

3. Research Design

3.1. Method

In this study, CiteSpace developed by Professor Chen[5] was used as an analysis tool. Analyze China's collaborative learning research groups through the cooperative knowledge map of research institutions; Keyword co-occurrence network analysis collaborative learning research hotspot; High emergence keywords and time series graphs analysis the research trend of collaborative learning.

The brief steps for analyzing collaborative learning research by using CiteSpace includes: data format transformation; time area is set from 1995 to 2024, and the time span is 1 year. The clipped connection mode and visual presentation mode are the default.

3.2. Data Source

In this study, with the theme of "collaborative learning" in the CNKI journal database, the sources are from core journals and CSSCI. 1306 relevant literatures are retrieved, and 1198 valid literatures are finally obtained, excluding conferences, reports, interviews. Finally, 1198 literatures are taken as research objects.

3.3. Visualizing with CiteSpace

3.3.1. Keywords map

In CiteSpace, the number of keyword co-occurrence is set to more than 10, and the keyword graph in Figure1 is obtained, from which the correlation among collaborative learning, learning science, and learning analysis can be known. The evolution of learning interaction from face-to-face interaction to interaction in a technical environment has brought many challenges for the CSCL field to move forward. The computer environment increases the cognitive load of learners, leading to the decline of learners' social initiative; Learners have limited channels of information exchange, rarely refer to the contributions of others, and it is difficult to establish well-founded arguments: students cannot form a common learning goal and work hard for it, and it is easy to reach a consensus quickly and superficially. Learning analysis is committed to exploring the nature of education with data, becoming an important force to promote the digital transformation of education, and an important basis for designing precision teaching intervention and improving learning effectiveness. The analysis of multi-agent interaction characteristics, role maintenance, transformation and structural evolution, can provide basis for the elaboration of specific intervention content and form.

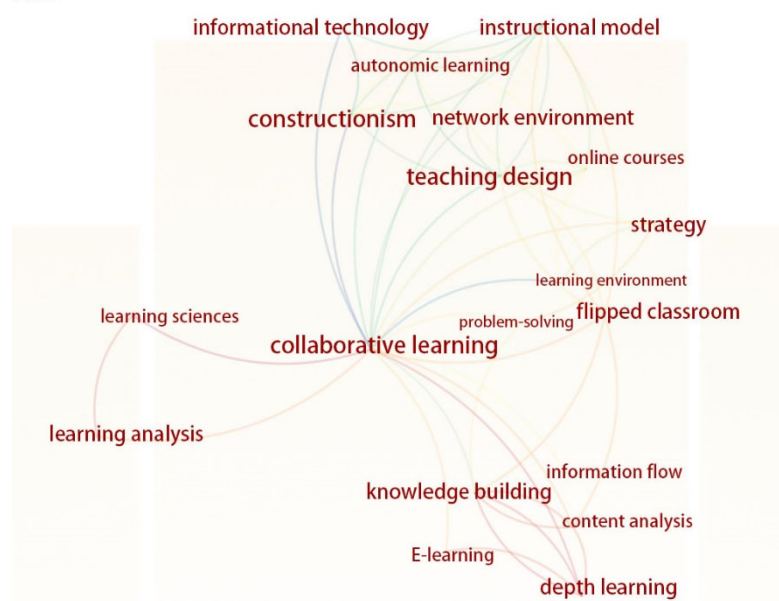


Figure 1. Keywords map

3.3.2. Cluster map of keywords

Cluster diagram is a spectrum diagram of cluster results drawn according to the similarity between cluster objects, which can clearly show the grouping of data points. The keyword clustering map in this study is shown in Figure2. Keywords clustered include collaborative learning, information technology, instructional design, distance education, knowledge construction, learning analysis, interactive analysis, network education, and learning resources.

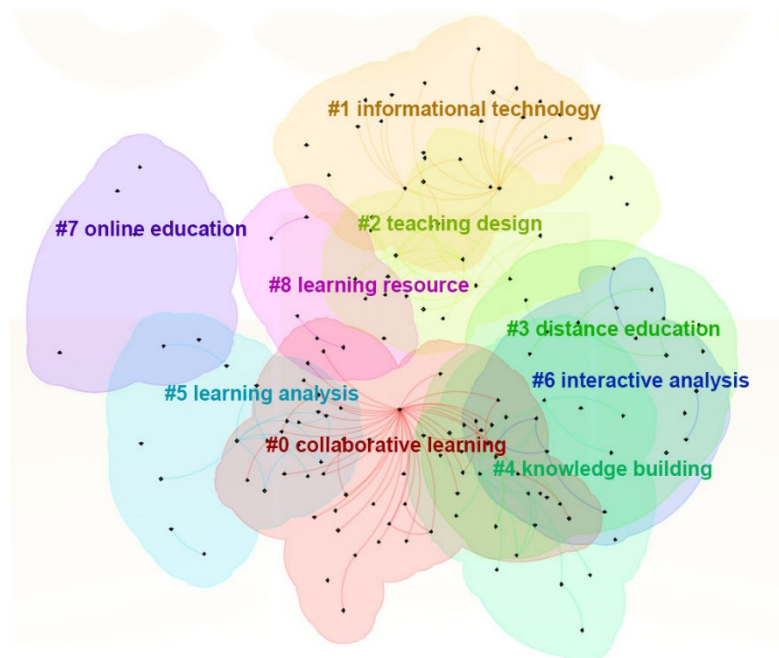


Figure 2. Cluster map of keywords

3.3.3. Keywords timeline map

The timeline map arranges the keywords appearing in the literature in the order of their time sequence, which can clearly show the evolution process of the research topic and the heat and correlation of keywords at different time periods. The timeline map of this study is shown in

Figure3, according to which the research on collaborative learning can be divided into three stages. The first stage is the stage of exploring the theoretical basis, focusing on the construction of learning resources and learning environments. The second stage is the stage of focusing on methods, based on the theoretical basis of constructivism, focusing on the methods of knowledge construction, and collaborative scripts began to be widely studied until today. Collaborative scripts are still a hot topic in the field of collaborative learning. Some scholars have proved that collaborative scripts can produce more positive learning outcomes than unscripted collaborative practice, whether in general fields focused on ability development or specific fields related to knowledge.[6]The third stage is the stage of focusing on efficiency, with learning analytics, group awareness, and artificial intelligence being the representative directions. For example, the research hotspots in the direction of learning analytics include: learning effort, cognitive effort, learning strategies, self-regulation, and learning evaluation. From these research hot topics, we can see that learning analytics technologies have participated in the entire process of collaborative learning, from the proposal of learning strategies to evaluation, from the analysis of effort to intervention and regulation, scientifically improving the efficiency of collaboration.

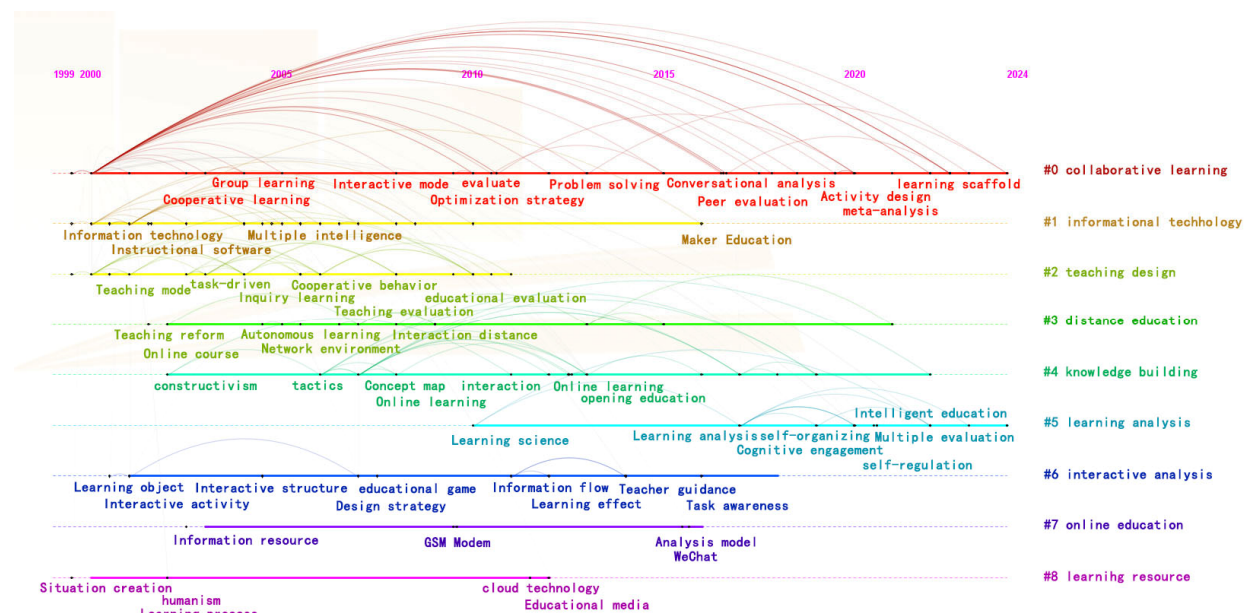


Figure 3. Cluster map of keywords

4. Results

Visual learning analysis is an emerging research field formed by the intersection of learning analysis and visual analysis. It refers to the interactive data visualization that uses computational tools and methods to understand educational phenomena. It emphasizes that the advantages of automatic analysis and visualization of computers can support human reasoning and decision-making process, and help to understand complex learning phenomena and solve complex learning problems. Visual learning analysis has a dual meaning: on the one hand, refers to learning the tools of analysis technology and design products; on the other hand, it also represents a process method of learning analysis, emphasizing the interactive data exploration process of man-machine collaboration.

4.1. Common Methods

According to different purposes of learning analysis and diverse data types, different data characteristics, data representation and presentation methods are also different. The common

ways of visualizing data representation in learning analysis include histogram, scatter diagram, Sankey diagram, heat map, tree diagram, time series diagram, network diagram, etc.

4.2. Learning Dashboard

Learning analysis dashboard is a technology that visualizes learning trajectories and helps teachers, learners and other stakeholders to deeply explore and understand the learning process, providing reliable evidence for implementing interventions and optimizing learning. In collaborative learning, the main goal of teachers is to help learners realize meaning construction instead of transferring knowledge content, which indicates that the role of teachers is no longer the role of knowledge imparts in traditional classroom teaching. Instead, teachers should not only support and promote the knowledge construction process of learners, but also participate in the construction process as learning members.

4.3. Knowledge Graph

Knowledge graph is a semantic network that represents the relationships between entities, aiming to formalize the description of things and their relationships in the real world. Basic form mainly including "entity-relationship-entity" and "concept-attribute-attribute value" two forms. Construction is the ultimate goal of the whole learning process, and the meaning to be constructed refers to the nature and laws of things and the internal relations between things. The long-term storage form of such understanding in the brain is "schema", that is, the cognitive structure of what is currently learned. Based on the group awareness theory, the knowledge level and cognitive structure of cooperative groups and peers can be visualized through knowledge graph in the process of collaborative learning, thus assisting in meaning construction.

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