The construction of process model of collaborative knowledge construction based on special topic in the network environment

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Abstract: With the rapid development of computer technology, human society is entering the era of knowledge society and information technology, so education is facing great challenges. The concept and practice of education need to be innovated, the knowledge construction in learning needs to be strengthened, and the focus of teaching should be shifted from "activity centered" to "thought centered". The goal of collaborative knowledge construction is to form valuable public knowledge for learning groups, rather than simply improving the contents of learning individuals' minds. It focuses on the construction and improvement of group knowledge. Through literature research, the form of topic based on Wiki network environment may be helpful for collaborative knowledge construction, so this paper studies the topic based collaborative knowledge construction in the network environment.

1. Introduction

Before exploring the mode of collaborative knowledge construction based on special topics in the network environment, we need to explore the process model of collaborative knowledge construction based on special topics in the network environment, which is a systematic description of the basic elements and their relationships in the mode. The process model in this study is based on the problem-based collaborative knowledge construction model of the network classroom proposed by Dr. Xie youru, combined with the characteristics of the network environment, the special learning process model and the collaborative knowledge construction process model, through the analysis of the process elements of the collaborative knowledge construction based on the special subject in the network environment, and from the perspective of the system, find out the different elements The paper uses ISM to build the analogy model of the process of collaborative knowledge construction, and then preliminarily constructs the model of collaborative knowledge construction based on special topics in the network environment.

2. Topic based learning process in the network environment

A project-based learning activity is often composed of several steps, such as "determining a project, making a plan, exploring a project, creating a work, exchanging results, and evaluating and reflecting". Project-based learning has been carried out for many years, and has been proved to be an effective learning method in practice. Under the network environment, with the help of the advantages of the network, especially Wiki in this study, [1]it provides good support for PBL in various stages.

2.1. Specialized learning content

In the network environment, topic based learning is carried out in the form of topic. Topics contain interdisciplinary knowledge, which not only emphasizes the horizontal expansion of knowledge, but also emphasizes the vertical extension of knowledge. Wiki sites generally have a unified, clear and firm focus. Wiki site content must have a high degree of relevance to the topic, which any writer and participant should strictly follow. Wiki Collaboration is also to expand and improve the same topic, and then constitute the knowledge structure system or knowledge base of

the system.

2.2. Collaborative learning

Under the network environment, the construction process of collaborative knowledge based on special topics is the process of students' division of labor, cooperation, consultation and communication to jointly construct community knowledge, and collaborative activities are the most important link of learning activities. Because every member can modify and maintain the page, it requires the members to have a spirit of cooperation. At the same time, in order to ensure the effectiveness of record updating, it also requires members to have a high moral spirit, which just meets the needs of new talents in the new century. In this way, members can expand and co create on a certain topic. Wiki knowledge is the result of collective work of the community. Members can browse and improve the page while achieving knowledge growth and sharing.

2.3. Sharing of learning results

Under the network environment, the result of collaborative knowledge construction based on special topics is the crystallization of team negotiation wisdom. The knowledge system constructed belongs to public knowledge and shares with each other. Wiki allows everyone to modify the page information on the website, so that everyone can participate, CO create and share knowledge. [2]At the same time, there is a set of technical and operational specifications (such as page locking and version control) to ensure the correctness of the website. Some major pages can lock content with lock-in technology, while retaining the version of each page change. It not only adheres to the principle of open participation for the public, but also tries to reduce the risk brought by many participants.

2.4 Feature extraction of collaborative knowledge construction in the network environment

Through the analysis of learning elements, knowledge construction process elements and collaborative learning elements based on special topics in the network environment, this paper finds out the interrelations among various elements from the perspective of system, and constructs the analogy model of collaborative knowledge construction process by means of ISM. There is no consensus on the elements of project-based learning. [3] By comparing the views of blunenfeld and others on the elements of project-based learning, this paper holds that project-based learning consists of four basic elements, namely, learning project, investigation activities and project works, cooperation mode and information technology tools. Chinese scholar analyzed the process of knowledge construction of learning forum from the perspective of macro and intelligent development, including nine elements: questioning, explanation / clarification, conflict, support, defense, evaluation, knowledge construction, synthesis and reflection. [4]In this study, the author uses Stahl's point of view for reference, combines the learning elements based on the topic, the basic elements of collaborative learning, and the characteristics of collaborative knowledge construction based on the topic in the network environment to deduce the components of collaborative knowledge construction process. As shown in Table 1.

Table1. Derivation of components

Element extraction basis		**Constituent elements**
Analysis of learning elements based on special topics	● Learning topics ● Investigation activities and special works ● Cooperation mode ● Information technology	Based on the comprehensive consideration of project-based learning elements, basic elements of collaborative learning and knowledge building process elements, it is determined that the basic elements of Project-based Collaborative Knowledge Building

Analysis on the elements of collaborative knowledge construction process	● Brain storm ● Speech expression ● Response ● Organization ● Analysis of ● Summary	Process in the network environment include: ● Learning individual ● Cooperation group organization ● Special topics of collaborative activities ● Brainstorming (personal understanding of the topic) ● Sharing cognition (sharing ideas, ideas, resources, etc.) ● Group consensus building (group consensus is formed by integrating different views and ideas through organizational analysis) ● Generation of intelligent products (special works and group achievements) ● Personal reflection (comment on their own behaviors and group achievements, and propose areas to be improved) ● Team process (consider which members' behaviors are helpful and which are not; decide which behaviors can be continued and which behaviors should be changed) ● Collaborative activity environment (wiki website, network resources, learning tools, etc.)
Analysis of elements of cooperative learning	● Active interdependence ● Face to face promotional interaction ● Individual and group responsibilities ● Interpersonal and group skills ● Team process	

2.5. Analysis of the relationship between the components – ISM analysis

2.5.1. Establish element relation table

According to the analysis, the basic elements of topic based collaborative knowledge construction process in the network environment include: learning individual (S1), collaborative group organization (S2), collaborative activity topic (S3), brainstorming (S4), shared cognition (S5), group building consensus (S6), generating intelligent products (S7), personal reflection (S8), group process (S9), collaborative activity environment (S10). We compare each element (SI) with other elements respectively. If there is a relationship, it is indicated in the element relationship table with the symbol "○", as shown in Table 2 element relationship

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
S1		○								○
S2			○	○		○				
S3										
S4						○				
S5						○				
S6							○			
S7			○			○				
S8							○			
S9				○		○		○		
S10			○							

2.5.2. Establish adjacency matrix

According to the above element relation table, the adjacency matrix A is established:

$$A = \begin{array}{c|cccccccccc} & S1 & S2 & S3 & S4 & S5 & S6 & S7 & S8 & S9 & S10 \\ S1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ S2 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ S3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ S4 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ S5 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ S6 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ S7 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ S8 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ S9 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ S10 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{array}$$

2.5.3. Perform matrix operation to find the reachable matrix

$(A+I)^4 = (A+I)^3 = M$

$$A+I = \begin{array}{c|cccccccccc} & S1 & S2 & S3 & S4 & S5 & S6 & S7 & S8 & S9 & S10 \\ S1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ S2 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ S3 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ S4 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ S5 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ S6 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ S7 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ S8 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ S9 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\ S10 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{array}$$

$$(A+I)^4 = \begin{array}{c|cccccccccc} & S1 & S2 & S3 & S4 & S5 & S6 & S7 & S8 & S9 & S10 \\ S1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ S2 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ S3 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ S4 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ S5 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ S6 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ S7 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ S8 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\ S9 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\ S10 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{array} = (A+I)^3 = M$$

It should be noted that

I represents a matrix, and the diagonal element of the matrix is 1, the other elements are 0;

M stands for reachable matrix. When the condition of (a + I) K + 1 = (a + I) k is satisfied, M is called reachable matrix.

2.5.4 Decomposition of reachable matrix

Before decomposing the reachable matrix, the reachable set and the antecedent set of the reachable matrix must be analyzed.Define the reachable set R (SI): R (SI) is the set of column elements corresponding to element Si in the reachable matrix, which represents the element Si reaches.Define the antecedent set Q (SI): Q (SI) is the set of row elements corresponding to the element Si column in the reachable matrix, which contains the matrix element 1. Intersection a = R (SI) ∩ Q (SI)In order to decompose the reachable matrix, we first list the reachable set and its intersection on the table, as shown in Table 3:

Table 3. Reachable set, antecedent set and their intersection table

i	R（Si）	Q（Si）	R(Si)∩Q(Si)
1	1,2,6,10	1,9	1
2	2,3,4,6	1,2,6,8	2,6
3	3,5,6,7	2,3,4,7,10	3,7
4	4,6	2,4,9	4
5	5,6	3,5,6	5,6
6	2,5,6,7	1,2,3,4,5,6,7,8,9,10	2,5,6,7
7	3,6,7	3,6,7,8,10	3,6,7
8	6,7,8	8,9,10	8
9	1,4,6,8,9	9,10	9
10	3,6,7,8,10	1,2,10	10

The method of hierarchical decomposition is to extract hierarchy according to R (SI) ∩ Q (SI) = R (SI). It can be seen from the above table that S5, S6 and S7 meet this condition, which means that this element is the top level of the system, that is, the ultimate goal of the system. Then extract all the elements of 5, 6 and 7 in Table 4 to get table 5.

Table 4. Results after extracting elements 5, 6 and 7

i	R（Si）	Q（Si）	R（Si）∩Q（Si）
1	1,2,10	1,9	1
2	2,3,4	1,2,8	2
3	3	2,3,4,10	3
4	4	2,4,9	4
8	8	8,9,10	8
9	1,4,8,9	9,10	9
10	3,8,10	1,2,10	10

Similarly, if you look at table 5, you can see that S3, S4, and S8 meet the conditions and take them as the second layer of the system. Then extract all the elements about 3, 4 and 8 in the table and get table 5.

Table 5. Results after extracting elements 3, 4 and 8

i	R（Si）	Q（Si）	R（Si）∩Q（Si）
1	1,2,10	1,9	1
2	2	1,2	2
9	1,9	9,10	9
10	10	1,2,10	10

Similarly, observing table 6, it can be found that S2 and S10 meet the conditions and take them as the third layer of the system. Then extract the elements of Table 2 and table 10, and get table 6.

Table 6. Results after extracting elements 2 and 10

i	R（Si）	Q（Si）	R（Si）∩Q（Si）
1	1	1,9	1
9	1,9	9	9

Similarly, looking at table 7, it can be found that S1 meets the conditions and takes it as the fourth layer of the system. Then extract all the elements related to 1 in the table and get Table 7.

Table 7. Results after extracting element 1

i	R（Si）	Q（Si）	R(Si)∩Q(Si)
9	9	9	9

Similarly, from table 8, we can see that S9 satisfies the condition, that is, the lowest layer of S system. It is the most fundamental cause of system motion. The relationship of each layer of the system can be shown in Figure 1.

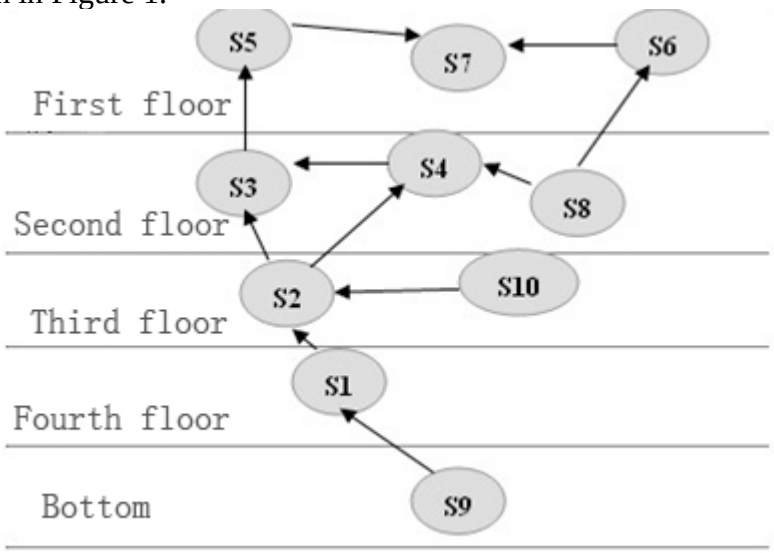

Fig. 1. Diagram of relationship between layers

The topic of collaborative activities is the basis of the process of collaborative knowledge construction based on the topic. According to the teaching objectives and learning contents of this unit or learning module, as well as the actual life experience of the students, the teachers put forward learning topics. [5] The cooperation group can combine freely according to the task signature, and the teacher provides supervision and adjustment.

3. Conclusion

Each group will improve the group's plan according to the teacher's evaluation and the students' opinions and suggestions, and submit the final plan on Wiki. At the same time, teachers organize all groups to reflect on the whole process of collaborative learning, what they learned, what they learned, what skills they practiced, and what they lack in terms of, so that students can write their own learning experience on Wiki, which is more conducive to the whole process of reflection. Finally, the teacher locks the group page to form the group's final intelligent product.

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