Creating a Knowledge Development Model for Blog-Based Learning

Tien-Chi Huang

***Abstract*—Online learning has become a popular approach in school because of easier access to the Internet. As one of Web 2.0 applications, blogs have emerged and stress information sharing and user-centered design. Although blogging is a popular technology adopted in educational settings, it has limitations in representing information in blog entries efficiently and structurally. The learning and Internet-surfing process should emphasize cognition abilities since the large quantity of information students encounter requires better organizing, analyzing, and application ability. This study develops a knowledge development model based on revision of Bloom's Cognitive Taxonomy, in which the teacher guides students to construct an individual knowledge structure by reading, writing, tagging, and classifying blog entries. To achieve this goal, this work devises a blog platform and uses an ISO standard, a topic maps technique, to depict knowledge structure.**

***Index Terms*—Blog, topic maps, knowledge development, Bloom's taxonomy.**

I. Introduction

The Internet is currently applied in a wide range of e-Learning settings, and various innovative web-based learning systems have been developed over the last few years. Numerous information technologies have emerged to support this type of educational environment, by facilitating communication and collaboration among online learners. Blogs, wikis, Facebook, and microblogs are all technologies in educational contexts that have appeared in previous studies [1]-[4]. In the last five years, the world has witnessed a dramatic increase in the number of publications on blog usage within the context of education [5]-[10].

Although comprehensive blog usage has received considerable attention in previous studies, the literature related to issues of blog usage in knowledge development domains are still critically lacking. This study develops a knowledge development model in which instructors guide students to develop a knowledge structure at an individual level through reading, writing, tagging, and classifying blog entries.

II. Related Works

A. Blogs in educational contexts

A weblog (blog) is a web-based technology that allows people to quickly share their thoughts and comments with the entire web population. Persons who are not necessarily familiar with web design codes (HTML, CSS) are able to successfully post an article with multimedia materials. This advantage has increased recent attention to pedagogical roles of blogs in the e-learning literature. Compared with other popular social software applications (wikis, online forums, Facebook, and microblogs), blogs can be more applied more broadly, allowing simplified web pages, links, and resource collections. Many teachers have demonstrated a willingness to adopt blogs as teaching tools [8]. Particularly in the context of higher education, numerous studies have revealed the role of blogs in various academic disciplines, such as cooperative learning [7], teacher education [9], pharmacology [11], and language learning [12].

However, previous studies have provided little information of the means by which blogs can help students structure their own knowledge. The present study addresses this research gap by aligning the role of blogs with educational objectives in the cognition domain.

B. Topic Maps

Topic Maps (TM) is an emerging semantic web technology, published by the International Standards Organization (ISO) since 1999, and used to represent knowledge structure and improve the ease of finding information on the web [13]. TM is based on a formal model associated with formal semantics, interchange syntax, and graphical notation and has also been defined using XML syntax (aka XML Topic Maps, XTM) since 2000. Due to the flexibility of the XML format, TM is easily exchanged among topic map builders.

Core concepts, topics, associations, and occurrences (TAO), are essential in constructing topic maps associated with domain knowledge. Topics represent subjects that are typically real world concepts; associations depict general relationships between topics abstractly or specifically; and occurrences typically refer to information resources representing relationships with one or more subjects.

Fig. illustrates a fundamental TAO model and the relationships among three core elements, as an example of citizenship education used in this study.

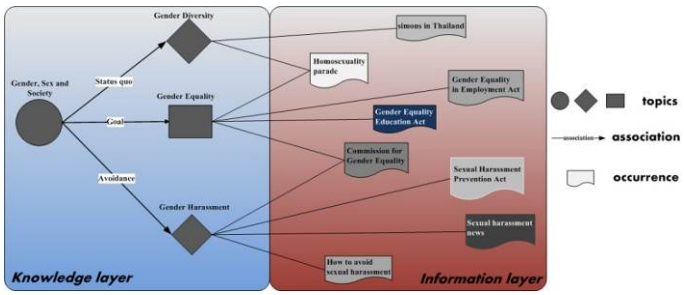

Fig. 1. An example of a TAO model

TM has found numerous applications for assisting in an e-learning context [14][15]. By developing TM in a

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knowledge-centered learning environment, students could develop many types of thinking and learning, such as problem-solving, reflective learning, and the development of concepts related to comprehension [16]. In this study, the instructor predefines topics representing key concepts in the "Citizenship" subject, in which associations represent abstract or specific relationships among predefined topics, and occurrences are blog entries written and read by students (also see
Fig.).

C. Revision of Bloom's Taxonomy in the cognition domain

Since Bloom et al. [17] first proposed the taxonomy of educational objectives in the cognition domain, the system has been widely used in academia. However, after years of applying this system, researchers have shown the need for its revision to help teachers understand and implement a standards-based curriculum [18]. This issue was addressed in a revised edition published in 2001 [19]. In the revision, educational objectives were classified into two dimensions: knowledge and cognitive processes. A two-dimensional table of taxonomy may be produced by combing these two dimensions, as shown in TABLE I [20].

TABLE I. TWO-DIMENSIONAL TAXONOMY TABLE IN THE COGNITION DOMAIN

Dimension of Cognitive Processes	Dimension of Knowledge			
	Factual knowledge	Conceptual Knowledge	Procedural Knowledge	Metacognitive Knowledge
Remember				
Understand				
Apply				
Analyze				
Evaluate				
Create				

Because the six levels of cognitive processes are based on constructivist learning, they are typically used to describe the cognitive activities associated with knowledge development. The present study adopted these six cognitive activities to explain how students structure knowledge.

III. THE KNOWLEDGE DEVELOPMENT PROCESS

A. Knowledge development model

The knowledge development model represented in this study establishes a framework describing how teachers and topic maps guide learners through the process of knowledge development. Using this model, the authors propose a theoretical and methodological lens for analyzing, integrating, and designing knowledge development units. The devised model comprises two types of development processes: extrinsic and intrinsic (figure 2). Extrinsic development represents knowledge implemented through the creation of topic maps, while intrinsic development comprises six levels: remember, understand, apply, analyze, evaluate, and create, defined in a revision of Bloom's taxonomy of educational objectives. Although the two types of development processes are described, they are not separate processes and are operated in a single knowledge development process. Topic maps visualize the knowledge structure to students (extrinsic development); however, before establishing a knowledge structure, they must internalize what they learn in preceding activities. The entire internalization process is called intrinsic knowledge development (the inner ring), in which teachers educate students to engage in learning. The learning activities explain each level of the intrinsic development process in greater detail.

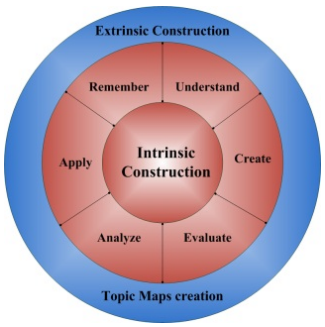

Fig. 2. Knowledge development model

B. Building the Topic Map structure

As previously mentioned, Topic Map creation is regarded as student's extrinsic knowledge development and is an essential and crucial step in the model. However, the ISO standard does not define how a topic map is created and maintained. This task is left completely to the user and the application. This study creates the topic map structure by experts in a certain subject domain, and the occurrences of topic maps are filled by blog entries posted by students.

According to "White Paper, The Topic Map Handbook," there are six main tasks to building a topic map [21]. We followed these tasks and asked experts to build topic maps for the subject of "Citizenship and Society" systematically.

1) Define the application domain

The present study defines "Citizenship and Society," a social science curriculum in senior high school, as the application domain. The citizenship subject comprises four main subjects including psychology, politics, law, and economics. Because it is a social science subject rather than a literary subject, it is characterized by methodology and a knowledge structure, and, being a social science, real events and real people are the subject's features. In a topic map, topics and associations construct a knowledge structure by presenting concepts and their relations, while occurrences indicate real events, objects, and things to help students transfer learning.

2) Define the functional requirements

In this study, topic map plays the role of an instructional/learning tool built into the developed blog system. Therefore, the main users are citizenship teachers and students.

Each student has his/her own topic map space to present topics and associations set by the instructor, and occurrences filled up with blog entries posted by students. The topic map iTM means that every individual student has his/her own topic map.

3) Define the schema

The "2006 National Curriculum Outline for Senior High School," issued by the Ministry of Education in Taiwan, scheduled the crucial knowledge sphere, concepts, and issues in every subject domain, in the form of a chapter or textbook captions. This study presents those concepts and issues of "citizenship and society" using the topic map. For instance,

"Prime Minister" and "Monarch" are two major concepts in the "cabinet system", and these three concepts are topics in a topic map. Associations present the relations between topics. In the above case, the association between "Monarch" and "Prime Minister" is "to nominate."

4) Select tools and implement application

The blog is used to implement the application. As mentioned in the literature, the blog is an efficient teaching/learning tool for combing multiple online resources. To enforce its function in presenting structural information, this study developed a blogging system to aggregate student learning portfolios including text, images, and video contents. These contents are regarded as occurrences in topic maps, and each student has his/her own topic map.

5) Populate the topic map

As in the above step, student posts are occurrences in topic maps. Before a post is published, every student is asked to classify it into a certain category that is actually the topic defined in a topic map. Although misclassification may occur and cannot be checked by the system automatically, students still can use a review to understand their error and reclassify the posts. The curriculum expert who defines the topic maps should also adjust the structure of topic maps based on class instruction. A topic map can be populated automatically by students, and manually by the topic map designer.

6) Maintain the topic map and its application

To keep the application running and the topic map up-to-date, students are asked to read and write blog entries in line with current events and news. As previously mentioned, the structure of a topic map is maintained by the curriculum expert who defines the topic map schema.

C. Learning activity design

According to Piaget's cognitive development theory, senior high school students are in the formal-operational stage, in which developing abstract thinking is the primary task. The subject of citizenship comprises four main subjects, including sociology, politics, law, and economics. To master these subjects in the social sciences, students must exert multiple cognitive abilities: abilities such as memorizing, understanding, applying, analyzing, evaluating, and creating. This study adopted a revision of Bloom's *Taxonomy of Learning Domains* and topic maps into the teaching process to enable students to structure knowledge themselves.

1) Motivation

News and current events are considered very important in "Citizenship and Society," because news comprises events that actually occur in society. To read and understand news and to determine its value promotes concern about society, which has considerable significance for developing citizen virtue and social responsibility in students.

To arouse student motivation toward this learning activity, the teachers first posts a blog entry about current events associated with the specific course.

2) Learning activity-1: remember and understand

During this stage, the teacher points out key concepts in the news and elaborates the connections between these concepts and the current course, whereupon students are asked to recall and memorize the concepts involved. To determine their comprehension of these concepts, students are required to compare and interpret them in a newly posted blog entry. This activity involves comparing the processes of differentiating between two or more similar concepts, whereas interpreting is the ability of students to define things in their own words.

Recalled concepts are regarded as keywords associated with specific topics. At the end of this stage, students are asked to categorize blog entries as main and secondary topics within a topic map to comprehend the knowledge structure related to the current course using cognitive abilities they have been developing. In this stage, producing a topic map achieves the extrinsic development of knowledge, while in the recall and comprehension processes, students conduct the primary steps of intrinsic development.

3) Learning activity-2: Apply, Analyze, and Create

Referring to the news, students are then required to: (1) search for information related to current keywords; (2) record web links; (3) reorganize information in a reasonable manner; and (4) edit and post a blog entry about the information by expressing a particular point of view, prejudice, or intention related to that information.

In this intrinsic process of development, students must apply learning content to new patterns through creating new blog entries using their analysis skills. To internalize extrinsic development (knowledge structure), students must recognize and select an appropriate "topic" from the predefined key concepts for the article. In this manner, entries become occurrences in the topic map.

4) Learning activity-3: evaluation

According to a given set of standards, students evaluate the blog entries of their peers, by writing comments and scoring the entries. Specifically, the evaluation activity comprises two sub-activities: checking and analyzing. When evaluating the blog entries of others, students must identify fallacies in categorization and viewpoint and learn to judge the value of the articles, including the appropriateness of text, the logic behind arguments, whether the content is on-point, and whether it is expressed in a concise manner.

The above-mentioned learning activities can be categorized into a two-dimensional taxonomy table, shown in Table II. This method helps to clearly describe each learning activity, which belongs to a specific cognitive behavior and knowledge type. Meanwhile, it also allows observation of the knowledge creation context, which helps a teacher guide students to develop integrated knowledge structures and information about applicability.

IV. System Demonstration

Figure 3 illustrates the developed blogging system applied to the subject of citizenship education.

Students post their learning content and interact with one another using comments. Multimedia content (images, photos, videos) is allowed for inclusion in a post. When students edit a post, they can use the text-decoration function (bold, italic, colors, sizes, and fonts) to point out what they need to emphasize.

Students can also construct their own knowledge structure using the "iTM" function representing *individual Topic Maps*, shown in figure 4.

Fig. 3. Developed blog platform

The individual topic map includes four sections, the main topic section, the topic structure section, the occurrence list section, and the visualized topic maps section. As previously mentioned, four main topics presented in the main topic section are included in the subject of "Citizenship and Society," politics, economics, psychology, and law. The topic structure section uses a tree structure to present the topics in a selected main topic (politics is given in Fig. 4). Content in the topic structure section correspondingly changes when a different main topic is selected. The occurrences in each topic in the topic structure section are presented in the occurrence list section, and those occurrences are blog entries classified into two types of occurrences, read and written blog entries. When a blog article is read by a student for over 20 seconds, the system automatically flags this article as a read entry for him/her. Similarly, the system flags an entry as a written entry when a student posts an article on his/her own blog. Finally, a graphical topic map is presented in the visualized topic map section. Students can easily view the topic map presented in a topic-centric way. By clicking other topics, they can change the topic map display to understand the relations between two topics.

The iTM results represent the knowledge structure retained by students. Students construct an understanding of the main topic with subtopics by finding and associating blog entries distributed on different blogs with their own knowledge structure. Using individual topic maps enables students to observe the nature of knowledge and the processes by which it is constructed and to recall and review which topics have been developed, the relationships between main topics and subtopics that have been identified, and which occurrences are associated with them. Several studies have shown that helping students to see the potential implications of what they are learning is an effective means to enhance knowledge transfer [22].

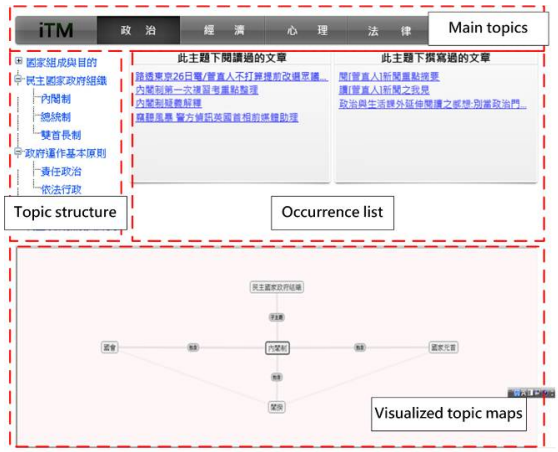

Fig. 4. Individual topic map

TABLE II. CLASSIFICATION IN A TAXONOMY TABLE OF INTRINSIC KNOWLEDGE DEVELOPMENT LEARNING ACTIVITIES IN THE CITIZENSHIP SUBJECT

Dimension of Cognitive Processes	Dimension of Knowledge			
	Factual knowledge	Conceptual Knowledge	Procedural Knowledge	Metacognitive Knowledge
Remember	● recall and memorize those concepts of current course			
Understand		● compare, interpret those concepts in a newly posed blog entry in their own blog ● categorize the keywords into "Topic" in the topic maps		
Apply			● search information relative to the current keywords	
Analyze			● reorganize the information in a reasonable way ● debunk the point of view, prejudice, or intention in current information	
Evaluate				● evaluate classmates' blog entries according to the formal criteria
Create	● post a blog entry about the information to debunk the point of view, prejudice, or intention in that information			

TABLE III EXPERIMENT 1 RESULTS

				iTM group	non-iTM group	t-test	Df
Experiment 1	Extrinsic KD	Pre-test	Mean	30.93	31.02	t = 0.344	58
			SD	8.14	10.99	p = 0.732	
		Post-test	Mean	39.73	35.06	t = 2.041	58
			SD	7.29	9.91	p = 0.046*	

TABLE IV EXPERIMENT 2 RESULTS

	1. memorize	2. interpret	3. compare	4. categorize	5. reorganize	6. evaluate	7. creating	Total mean
Mean	9.37	8.55	8.68	8.95	8.06	7.37	6.82	8.25
SD	0.82	1.68	1.30	1.25	1.60	1.71	1.39	
Passed at the first time	30/30	29/30	30/30	30/30	29/30	28/30	26/30	28.85
Retry and passed		1/1			1/1	2/2	4/4	

TABLE V . INTRINSIC KNOWLEDGE DEVELOPMENT EVALUATION INSTRUMENT

Evaluation Indicators	Finished (0-10)	Need to retry (<5)	Comments
This student can **recall and memorize (tell)** at least five concepts of current course.	☐_____	☐_____	
This student can **interpret** those concepts properly in a newly posed blog entry in their own blog.	☐_____	☐_____	
This student can **compare** those concepts properly in a newly posed blog entry.	☐_____	☐_____	
This student can **categorize** the keywords into "Topic" correctly in the topic maps.	☐_____	☐_____	
This student can find and **reorganize** information relative to a given topic.	☐_____	☐_____	
This student can **evaluate** classmates' blog entries according to the formal criteria in a reasonable way.	☐_____	☐_____	
This student can debunk the point of view, prejudice, or intention from the given topic by **posting/creating** a new blog entry.	☐_____	☐_____	

V. EXPERIMENT

An experiment was conducted to evaluate the blogging system with individual topic maps to examine whether individual topic maps improve student knowledge development. The experiment examined (1) whether the iTM improves student knowledge development, and (2) whether the students can gain those cognitive abilities proposed by Bloom through participating in online-leaning activities in this blogging system.

A. Participants

Thirty participants were recruited from a senior high school in Taichung, Taiwan. All participants were second-year students having over two years of blog use experiences. They had no previous experience in using topic map learning before this experiment.

B. Design

Participants were informed that the proposed system was designed to improve their online-learning experience. Two experiments were designed according to research goals.

Experiment 1: This experiment conducted a true experimental design. Students were randomly divided into two groups, referred to hereafter as the iTM group and the non-iTM group. Both groups attended class and used the blogging system to post blog entries as their homework; however, only the iTM group could see and use the iTM function on their blogs. In other words, two groups received the same course at school, and used the same blog interface, except for the iTM function.

To evaluate the effects of iTM, "extrinsic knowledge development evaluation" was carried on in both groups. In this evaluation, the instructor posted ten entries on the teacher blog, and each entry mentioned one news article. The participants were required to find the topic terms in each article and respond by submitting a secret comment (others could not see it, except for the instructor). The set of correct answers was announced and the score was given to participants by the instructors. The higher the score, the better the extrinsic knowledge development of participants is.

Experiment 2: This experiment examined whether the students gained cognitive abilities. All participants received the same online blogging curriculum, and experienced the same blog learning activities designed according to Bloom's revised taxonomy of cognitive abilities (see Table 2). The blog-based learning activities lasted for one month, and aimed to help participants achieve intrinsic knowledge

development. To evaluate the intrinsic knowledge of participants, this study developed an evaluation instrument based on Bloom's taxonomy named "intrinsic knowledge development evaluation."

To fill the evaluation table, instructors had to review, check, and score all participant works (blog entries) according to the corresponding indicators. The evaluation standard required participants to gain at least five grades (0-10 grade) at each indicator to pass it. A participant was asked to repeat a specific activity again if he/she failed the corresponding indicator. To give beneficial feedback to participants, instructors could write comments according to the performance of each participant on each indicator.

VI. Results and Discussion

Table III and Table IV show the results of the two experiments, respectively.

A. Extrinsic knowledge development

In experiment 1, separate *t-test* was carried out to test the effect of the topic map assisted learning, and to estimate the prior knowledge of two groups. The mean of two groups' pretests were close, and the independent sample *t-test* shows that they were not significantly different (t =0.344, p = 0.073) as expected, due to they were divided randomly into to two groups. Significant group difference was found on two groups' post-test (t =2.041, p = 0.046 < 0.05).

The results show that iTM effectively increases student retention to find topics. The participants completed topic finding tasks more quickly via the blogging system with iTM assistance than via the blogging system alone. From the results, we can deduce that the iTM using graphical topic maps and a hierarchical tree-like structure strengthens student cognitive abilities, leading to a cognitive relationship creation between topics and current events. Findings of topic tasks demonstrate that the iTM group students have a better ability to link main topics (i.e. important concepts) to their learning portfolio (i.e. blog entries), indicating that the iTM group students have learned to investigate and analyze numerous online information using the built in knowledge structure.

B. Intrinsic knowledge development

In experiment 2, a criteria-referenced evaluation was conducted to examine whether the participants passed each indicator in TABLE V. Results showed that every mean of indicators is higher than 5 (see TABLE VI), and the overall mean of all the indicators were 8.25. The average number of people passed the indicator is about 28 persons.

The results show that the mean scores of intrinsic knowledge development indicators did not significantly differ between the two groups. This result implies that blog-based learning activities indeed help students retain their cognitive abilities proposed by Bloom. Blog-based learning activities provide a greater opportunity to connect between schooling and current events. Particularly in citizenship education, these cognitive abilities demonstrate the ultimate purpose of school-based learning: transfer from school to everyday environments. An analysis of everyday current news provides opportunities to students to rethink what they have learned in this subject and align citizenship education with the requirements of everyday environments. Helping students develop intrinsic knowledge using blogs is a good way to facilitate their learning, while also encouraging flexibility.

VII. Conclusions

Blog-based learning must address the nature of learning activities and the means to make those activities pedagogical. To deal with the above issues, this study established a knowledge development model on a blog platform. Experiment results show that this model enables students to build their own knowledge structure for blog entries, and to read, write, and categorize those entries in a consistent structure. The iTM enables students to observe the nature of the knowledge they develop and the processes involved in its development.

This study argues that blogs can prompt student cognitive abilities in an educational setting, while topic maps alone with an online curriculum can enhance the development of an extrinsic knowledge structure in students.

Our future study will explore whether the knowledge structures students develop are well organized and whether they help students transfer their knowledge to other units in the same subject. Meanwhile, issues of transferring knowledge appear to be important for accelerating learning both within and outside of schools. We must also explore whether the proposed knowledge development model is well applied in other subjects.

Appendix

TABLE V shows the intrinsic knowledge-development evaluation instrument. This instrument is composed of seven "cognitive ability indicators" and corresponding instructor checks and comments. Instructors can conduct this evaluation after participants finish all activities.

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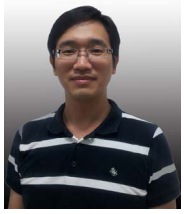

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