A  B  S  T  R  A  C  T

With the advent of Web 2.0 technology, message transmission has become increasingly convenient, and the rising amount of information has become gradually diverse. A question must be asked of this trend, on whether informal learning resources can be integrated into formal learning knowledge. This study attempts to integrate educational blog articles and use the wealth of information inherent in the development of a blogging system with knowledge navigation for both formal and informal learning in civic education. The system, Topic Maps (TM) technology was implemented to represent informal learning content in a formal curriculum structure. To develop a framework adapted to formal and informal learning contexts, this study proposes a seamless model for teachers and system developers to represent informal learning content that adheres to the formal knowledge structure. Analytical results indicate that students approved the effectiveness of combining the blogging system and individual Topic Maps (iTMs) function. In other words, the system derived from the design framework helps students learn citizenship courses in an innovative manner. The outcome further supports the proposed seamless model in providing an appropriate viewpoint for integrating formal and informal learning.

K  E  Y  W  O  R  D  S
Blog, Topic maps, Knowledge navigation, Civic education, Formal learning, Informal learning

I  N  T  R  O  D  U  C  T  I  O  N

Civic education in formal education comprises four wide-ranging fields, namely, politics, law, economics, and psychology/sociology, fields of knowledge that are crucial to becoming an ideal citizen. However, exam-oriented education in Taiwan limited civic education to textbook teaching in secondary education. Although textbooks used in formal curricula are valuable resources, solely focusing on written text without establishing a connection to real-life situations decreases the relevance of information in students’ lives. Therefore, this study proposes the online medium as an information source to eliminate the disadvantages of using formal learning content in teaching and learning civic education (Du & Wagner, 2007).

Although web-based learning has been widely used for several years, teachers were regarded as the primary source of learning materials (Huang et al., 2009). Since the advent of Web 2.0 solutions in 2004, numerous user-centric information platforms and applications in the form of blogs, Wikipedia, and YouTube have expanded widely. Among these resources, blogs are the most appropriate educational medium because of their low threshold, ease of use, and incorporation of various resources including multimedia, individualization, and socialization characteristics (Kim, 2008). Blogs have proven to be an adequate teaching platform for students in higher education (Kang, Bonk, & Kim, 2011; Huang, Huang, & Yu, 2011). Their informal interactive nature encourages students to direct attention to specific aspects, reflect on certain concepts and ideas, and eventually receive feedback (Bransford, Brown, & Cocking, 1999). The main advantage in using educational blogs is that they can be an ideal interface not only for delivering formal learning content, but also for reporting informal life experiences, news, and information worldwide (Huang, 2011; Lin & Kao, 2010). However, because of the information and knowledge scattered over numerous blogs, learners can experience difficulty integrating and absorbing self-collected learning materials without a systematic approach. Thus, a certain level of systematization is required to ensure learning effectiveness. In other words, educational blogs should integrate navigation functions to represent information in a systematic manner, to optimize efficiency. Therefore, this study develops an educational blogging platform equipped with a knowledge navigation function to animate civic education between students and teachers inside and outside the classroom.

We used an ISO standard named “Topic Maps” to structure the knowledge representation of the “Citizenship and Society” course and to link the corresponding blog entries as supplementary learning resources. The design of the
knowledge structure follows the Newly Revised High School Curriculum Guidelines (99 Guidelines) issued by the Ministry of Education in Taiwan, and schedules the crucial knowledge sphere, concepts, and issues in every subject domain in the form of a chapter or textbook captions.

Background

Civic education and Informal learning

A free society must ultimately depend on its citizens, and the approach for infusing people with necessary qualities is through education (Branson, 1998). Civic education is a primary and important component in developing holistic education. The goal of civic education is to cultivate positive values and attitudes in students, to discharge their responsibilities with the necessary knowledge and skills. To cultivate a citizen, an objective of civic education is to link learned knowledge with daily life experiences. However, civic education in secondary education in Taiwan is often limited to classroom teaching because students are often unable to experience the usefulness of acquired knowledge in their daily lives. This subject should deserve more than a passing notice. Whereas considerable attention has focused previously on research issues related to the development of civic education curricula in schools, literature on the development of informal civic education has emerged slowly and has been more scattered. In light of these concerns, an approach to bridging classroom teaching and daily life experience is necessary.

Past studies have identified five primary characteristics of informal learning. (1) outside educational establishments (Sung, et al., 2008, 2010); (2) originates accidentally and sporadically, in association with certain occasions, from changing practical requirements (Schugurensky, 2000; Sung, et al., 2010); (3) related to situation management and fitness for life (Clough et al., 2008; Janssen, Berlanga, & Koper, 2011); (4) experienced directly in its "natural" function of everyday life (Gu, Gu, & Laffey, 2011); and (5) spontaneous (Janssen, Berlanga, & Koper, 2011). These characteristics form the basis for this study to identify a research niche for developing informal civic education, and the inspiration to adopt an innovative technology to achieve it. Blogs, a Web-based technology, have been often adopted to disseminate useful information in educational contexts, particularly in informal learning contexts (Park, Heo, & Lee, 2011). Hence, this study uses blogging technology in an attempt to combine class teaching with informal civic education.

Blog roles in educational contexts

A weblog (blog) is a Web 2.0 technology that allows people to share their thoughts and comments quickly with the entire online population. People unfamiliar with Web design codes (HTML, CSS) are successfully able to post an article with multimedia materials. This advantage has recently gained the attention of e-learning literature to pedagogical roles. The literature is filled with discussions surrounding the pedagogical usage of blogs, which can be categorized roughly into two types of roles: formal learning usage and informal learning usage (Guazzaroni et al., 2010). Blogging opens possibilities for representing formal or informal learning content in an informal learning context, and blogs often bridge formal and informal learning. Formal learning content includes structured and organized content ordered by date or curricula categories, whereas informal learning content typically involves learning experiences in daily life. Blogging creates new possibilities for self-expression and social interaction with peers. Writing blogs not only relieves emotional stress and stimulates self-expression and reflective thinking skills (Xie, Ke & Sharma, 2008), but also enables networking and sharing of resources and ideas in a professional learning community (Farmer, 2004). Reading blogs also facilitates self-reflection (Brescia & Miller, 2006) and enhances community membership and participation (Baumer, Sueyoshi, & Tomlinson, 2011). Blogging plays a synthesized role in providing numerous opportunities for self-reflection and peer interaction.

A blog is also suitable for managing an online learning portfolio because of its permalink and reverse chronological order features. The permalink is a URL that indicates a specific blog entry to enable bloggers to maintain their learning processes as a longer-lasting URL for reference (Treese, 2004). These permalinks can be archived by date or categories named by bloggers to provide an enhanced approach to represent the learning portfolio. Users can easily review his or her learning experience represented by blog entries displayed in reverse chronological order. The learning experience typically includes generating personal learning goals, planning how to tackle a problem,
implementing the means for tackling a problem, evaluating whether learning goals have been met, and replanning based on this evaluation.

Although blogging opens possibilities for representing formal or informal learning content in an informal learning context in literature, attention has been minimal in how to fully integrate informal learning content with the formal curriculum structure on blogs. Therefore, this study develops a blogging system for supporting both formal and informal learning in an informal learning setting. Accordingly, new approaches should be devised on how to acquire knowledge and skill, and how to efficiently deploy learning resources that are constantly updated with the current knowledge economy (Guazzaroni et al., 2010). However, the rapid increase of blog resources and modality types has led to a great accumulation of information (Huang, Huang, & Cheng, 2008, 2009). Another important issue is the development of an approach for extracting knowledge from the massive unorganized information resources online.

**Topic Maps and knowledge navigation**

This study used the information navigation system to address these issues by constructing information. Although this type of navigation system solves the issues, most existing systems have shown that information matching and keywords lead to incomplete outcomes and lack expansibility in knowledge representation.

Therefore, this study proposes the latest concept in this domain, “knowledge navigation,” to overcome the incomplete issue. Based on semantic Web technology, knowledge navigation connects customers and resources more effectively by presenting information resources for users within a specific knowledge structure (scope) and providing a search service. This method accounts for both the resource view and the knowledge view in providing users with more diverse, qualitative, and complete information.

This study used Topic Maps (TM), known as the “GPS of the information universe,” which is an ISO standard, to build a blogging system with knowledge navigation. Formulated in XML-syntax, TM possesses interchangeable features that allow it to describe the relatedness between concepts and even link it to online information resources easily (Pepper, 2010). Three primary elements defined in TM, topic, association, and occurrence are also adapted to knowledge system development (Rath, 2003). Therefore, in online education settings, TM is an appropriate method for instructors to demonstrate subject knowledge and connect it to massive online resources in an organized manner. Assisted by TM, users and students can experience information navigation more efficiently. XML Topic Maps (XTM) have become a mainstream of knowledge navigation and are applied in many fields (Stefan & Ludwig, 2002; Petra & Helmut, 2005).

Zhai, Wand, and Lv (2008) applied XTM to develop an urban traffic information portal for knowledge navigation. By using topic map query language, users can retrieve related information on urban services, such as hotels, banks, and hospitals. Wu and Wang proposed a method to build a TM-based knowledge navigation model for explicit knowledge navigation. The results showed that TMs offer an appropriate approach to visualize explicit knowledge and to enhance our understanding of knowledge navigation for the customer services domain of mobile communication corporations in China. Likewise, Kemény, Erdős, and Vánca (2008) successfully used topic maps to enable usability and accessibility of knowledge resources of a research community to members of the group.

This literature review shows the application of knowledge navigation in various domains. However, empirical studies on TMs for knowledge navigation in schools remain relatively limited. Current educational blogs are not typically customized for educational purposes for user interface and function features (Kim, 2008). Previous empirical studies have not emphasized the usage and sharing of knowledge values in blog entries. To develop a blog-based knowledge navigation system (BKNS) for creating a new role of blog usage in schooling, this study uses TMs as a tool for representing knowledge guided by the proposed framework and conducts an empirical study to determine the extent to which the blogging system can construct and navigate knowledge.

**The proposed framework**

The BKNS provides a personalized service to individual students based on their learning portfolios. This section details the system architecture, user roles, components, and TM designs.
System architecture and user roles

Figure 1 shows the BKNS architecture, and the numerals indicate the system operation procedure. User roles include the teacher and the students. In the BKNS, the teacher is responsible for designing the TM framework, and the students are responsible for posting and reading blog entries as occurrences in TMs. The system comprises three repositories: the blog knowledge base, the topic association repository, and the TM repository. Several operations are conducted during the learning progress. First, the teacher creates the TM framework (Step 1). During the topic association creation process, the teacher might refer to the types of course materials, such as textbooks, multimedia resources, online resources, and academic papers. The topic association schema is the backbone of TMs, which defines topics in a certain course and associations between topics, stored in the topic association repository. Second, a blog knowledge base stores all posts published by the teacher and students. Finally, the TM repository maintains all topic map files (XTM format).

Students have no limits to access limits the blog entries posted in the BKNS, but only registered students can publish blog entries in their respective blogs and obtain an individual knowledge navigation service. After students log into the BKNS, the blog-authoring module offers a What You See Is What You Get (WYSIWYG) editing environment for publishing blog entries (Step 2). This module allows students to view information similar to the result while creating the posting. After the registered learner publishes his/her own post, or reads posts published by others, an e-portfolio detection agent records a blog entry status (Step 3). Blog entries read or written by students are considered occurrence links in the students’ own TMs, and a topic mapping agent embeds these links (occurrence syntax) into the existing TM (Step 4). Therefore, all students have their own TMs to represent the individual knowledge structure. These TMs are generated by the TM-generating module and stored in the TM repository (Step 5). Finally, a TM is parsed by the TM parsing and representing module, and is represented graphically in radial form for individual knowledge navigation (Steps 6 and 7).

![Figure 1. The system architecture of BNKS](image-url)
System components

Blog authoring module

This module provides an interface for users to post a blog entry. The basic elements in a post such as title, category, date, tags, and post body are editable by using this module. This module uses a WYSIWYG editor for easy embedding of images, videos, text decorations, and hyperlinks in a post, which infers that the editor has the ability to directly manipulate post layout without having to type or remember names of layout commands (HTML codes). This function also enables users to emphasize certain aspects of a blog entry by using text decorations such as underline, bold, italics, and colors.

Figure 2. The blog authoring module

E-portfolio detection agent

This agent records each post that the teacher and students write and read. When a user reads a post over 20 seconds, the agent determines whether the user has studied the post and marks the post as “a read post” in a specific category. When the learner posts a blog entry, the agent marks this entry as “a written post” and records its author information into the system.

Topic mapping agent

The topic mapping agent is responsible for linking posts to corresponding topics. This agent embeds the XTM codes into the TM file when a user posts a blog entry in the blog knowledge base.

Topic map-generating module

The TM-generating module generates XTM files for each user. Because every BKNS user can have his/her own written/read posts, the TMs (XTM files) generated by this module are individualized and unique. After the TM designer (the instructor in this study) builds the schema of a TM, this module organizes all XTM codes and generates
the first XTM file. When a user registers an account and posts blog entries, this module automatically generates an independent XTM file for each user.

**Topic map parsing and representation module**

The topic map parsing and representation module is responsible for parsing each XTM file and representing it graphically. The following figures show two examples of graphical TMs, which are centered by the political concepts of “Polity and Form of Government” and “Democratic Theory.” Each node in the figure can add extra information such as colors, an introduction, and other links related to this topic. The functionality of these graphics is similar to that of the Belvedere system, designed to teach science-related subjects to high school students unfamiliar with the science domain and to recognize abstract relationships in scientific theories (Suthers et al., 1995). Instead of using reason with students, this module imparts in-depth knowledge of what they have read and written. According to the theory of human mental ability, people can process and remember visual information quickly (Gordin & Pea, 1995). Therefore, visual representations of information and knowledge should aid people in learning.

![Figure 3a. Topic map example centered with "Polity and Form of government" topic](image1)

![Figure 3b. Topic map example centered with "Democratic theory" topic](image2)

**Topic map design**

Before users can use the BKNS, the TM designer must build the TM schema, which is the backbone of the TM and is designed according to the subject concepts. The standard process of achieving TM design and implementation is outlined in the following steps:

- **Step 1: Define the application domain**
  This study defines "Citizenship and Society," a social science curriculum in senior high school, as the application domain. This course in senior high school encompasses the four main subjects of psychology/society, politics, law, and economics. Because it is a social science field instead of a literary field, it is characterized by methodology and a knowledge structure, and as a social science, real events and real people comprise the subject's features. In a TM, topics and associations construct a knowledge structure by presenting concepts and their relations, whereas occurrences indicate real events, objects, and items (linkable blog entries) to help students transfer learning.

- **Step 2: Define the functional requirements**
  In this study, the TM plays the role of an instructional/learning tool integrated into the developed blog system. Therefore, the main users are citizenship teachers and students. All students have their respective TM space to
present topics and associations set by the instructor and occurrences filled with blog entries posted by students. Therefore, every student has his or her own TM through the designed individual topic map function.

- **Step3: Define the schema**
  Issued by the Ministry of Education in Taiwan, the Newly Revised High School Curriculum Guidelines (99 Guidelines) delineated the crucial knowledge sphere, concepts, and issues in every subject domain in the form of a chapter or textbook captions. This study presents these concepts and issues of "Citizenship and Society" by using the TM. For instance, "Prime Minister" and "Monarch" are two major concepts in the "cabinet system," and these three concepts (Prime Minister, Monarch, and cabinet system) are topics in a TM. Associations present the relations between topics. For this case, the association between "Monarch" and "Prime Minister" is "to nominate."

- **Step4: Select tools and implement application**
  The blog is used to implement the application. As mentioned in the literature, blogs are 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 content. These contents are considered occurrences in TMs.

- **Step5: Populate the topic map**
  As in the previous step, student posts are occurrences in TMs. Before a post is published, every student is asked to classify it into a specific category of the topic defined in a TM. Although misclassification may occur and cannot be checked by the system automatically, students can still use a review function to understand their errors for post reclassification. The curriculum expert who defines the TMs should also adjust the TM structure based on class instruction. A TM can be populated automatically by students and manually by the TM designer.

- **Step6: Maintain the topic map and its application**
  To keep the application running and the TM updated, students are asked to read and write blog entries in line with current events and news. As mentioned, the structure of a TM is maintained by the curriculum expert who defines the TM schema.

![Figure 4. The developed blogging system](image)
System demonstration

Figure 4 shows the developed blogging system applied to the subject of citizenship education. Students can post their learning content and interact with one another by posting comments. As shown in the figure, multimedia content (images, photos, videos) can be included in a post. When students edit a post, they can use the text-decoration function (bold, italics, colors, size, and fonts) to draw attention to parts requiring emphasis. In order to strengthen individual and adaptive learning (Wang, Wang, Huang, 2008), students can also construct their own knowledge structure using the “iTM” function representing individual Topic Maps, as shown in Figure 5.

![Image of individual knowledge representation using topic map technology](image)

Figure 5. Individual knowledge representation using topic map technology

The individual TM includes four sections: the main topic section, the topic structure section, the occurrence list section, and the visualized TM section. As mentioned, four main topics in the subject of “Citizenship and Society” (politics, economics, psychology, and law) are presented in the main topic section. The topic structure section uses a tree structure to present the topics in a selected main topic (politics is shown in Figure 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 these occurrences are blog entries classified into two types of occurrences: read and written blog entries. As stated in the function of the e-portfolio detection agent, when a blog article is read by a student for over 20 seconds, it flags this article as a read entry for him/her. Similarly, the agent flags an entry as a written entry when a student posts an article on his/her own blog. Finally, a graphical TM is presented in the visualized TM section by TM parsing and the representation module. Students can easily view the TM presented in a topic-centric manner. By clicking other topics, they can change the TM display to understand the relations between two topics. In addition, every topic provides additional information (e.g., topic introductions and hyperlinks to outside resources), which can be provided in advance by the TM designer.

Methods

Experimental design

A three-stage experimental design was chosen to examine the effectiveness of the proposed framework. The participants were 48 second-grade students recruited from a senior high school in Taiwan. All participants received the same three-stage treatment explained below.

- 0/0 stage (teaching in the classroom without the aid of the BKNS)
- 0/1 stage (teaching with a blogging system)
- 1/1 stage (teaching with the BKNS).
Measures

Formal learning tests

To investigate learning efficiency facilitated by the blogging system and iTM, students were required to undergo three tests at various points during the semester. After completing a five-week course of Citizenship and Society (the 0/0 stage), students were administered the first test. After the first test, the students completed another five-week course (the 0/1 stage) before taking the second test. Finally, after the second test, the students completed another five-week course (the 1/1 stage) and took the third test. All the tests were paper-and-pencil tests with multiple-choice questions. Because the scope of the tests varied according to the course content, student scores (of four classes in the same grade) were standardized to determine whether the relative position among students varied at different stages. By using the following formula, student scores for the three tests were standardized to obtain measures of relative position of each student (i.e., the z score).

\[
    z = \frac{X - \mu}{\sigma}
\]

where X is a raw score to be standardized; \( \mu \) is the mean of the population (entire eleventh grade, 248 students); and \( \sigma \) is the standard deviation of the population.

Questionnaire: Effectiveness of the blogging system and iTM function

To examine student attitudes toward the knowledge navigation system, we developed a questionnaire containing 10 items. To measure student responses, we administered a questionnaire employing a 5-point Likert scale, ranging from 5 (strongly agree) to 1 (strongly disagree). The questionnaire focused on student attitudes toward the blogging system and iTM function. We verified that the questionnaire was valid and reliable because the two investigated factors explained 68.08% of the overall variance. For the validity, the coefficients \( \alpha \) for the internal consistency of the two factors was .85 and .83, respectively. After the time course of the blogging system and iTM, the questionnaire was administered to students after the second test and before the third test.

Results

Formal learning tests

The mean standardized scores and mean raw scores of the students for the three tests are shown in Table 1. For the mean raw scores, the results show that the mean raw score was lower for the second test, which was conducted after the students completed the course using the blogging system. By observing students’ standardized scores to determine their relative position, we found that the mean standardized score increased after the students completed the course with the iTM function.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Mean</th>
<th>Z score mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/0</td>
<td>81.2</td>
<td>69.24</td>
</tr>
<tr>
<td>0/1</td>
<td>79.8</td>
<td>69.79</td>
</tr>
<tr>
<td>1/1</td>
<td>84.1</td>
<td>72.94</td>
</tr>
</tbody>
</table>

Effectiveness of the blog and iTM

For student attitudes toward the blogging system, the mean rating of the students at the 1-1 stage was higher than that at the 0-1 stage, as shown in Table 2. By considering the results of the unstructured interviews, we found that students changed their attitudes toward the blogging system after experiencing the blogging system with the iTM function. Therefore, we infer that the students generally had a more positive attitude toward the iTM function than toward the blogging system alone.
Table 2. Students’ responses to the blogging system and iTM function

<table>
<thead>
<tr>
<th>Stage</th>
<th>Toward the blogging system</th>
<th>Toward iTM function</th>
<th>Toward the blogging system with iTM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
</tr>
<tr>
<td>0/1</td>
<td>3.24</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>1/1</td>
<td>3.59</td>
<td>1.14</td>
<td>4.32</td>
</tr>
</tbody>
</table>

\[ t = 3.06^* \]

*p < .005

Correlation analysis

Correlation analyses of students’ raw scores for the three tests and their attitudes were performed. As shown in Table 3, students’ raw scores were immediately positively correlated with their attitudes toward the blogging system (r = 0.51 for the second test; r = 0.52 for the third test) and significantly positively correlated with the iTM function (r = 0.75).

Table 3. Correlation analysis between achievements and effectiveness

<table>
<thead>
<tr>
<th>Prior achievements</th>
<th>Blogging system effectiveness</th>
<th>iTM function effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First test (0/0 stage)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Second test (0/1 stage)</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>Third test (1/1 stage)</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.75</td>
</tr>
</tbody>
</table>

For the correlation between students’ prior achievements and their attitudes, we found that students’ prior achievements were negatively correlated with their attitudes toward the blogging system (r = -0.73) and the iTM function (r = -0.68), indicating that the prior achievements of students was negatively correlated more positive attitudes toward the blogging system and the iTM function.

For the rating distribution, the standard deviation was close to 1, indicating a substantial variation among students. Therefore, this study categorized the students into groups to identify the cause of the variation. The students were first categorized by gender. However, no significant difference was found between male and female students.

Subsequently, the students were categorized into “prior-high” and “prior-low” groups based on their prior achievements. Students with scores for the previous semester in the top 50% were categorized into the “prior-high” group, and the remaining students were categorized into the “prior-low” group. By comparing the two groups, we found that the students in the “prior-low” group had a more positive attitude toward the effectiveness of the blogging system, compared to that of the students in the “prior-high” group. The same pattern was found for the two groups on student attitudes toward the iTM function.

Table 4. Group analysis at 1-1 stage

<table>
<thead>
<tr>
<th></th>
<th>Blogging system effectiveness</th>
<th>iTM effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>(a)</td>
<td>Male</td>
<td>3.42</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>3.63</td>
</tr>
<tr>
<td>(b)</td>
<td>Prior high</td>
<td>2.63</td>
</tr>
<tr>
<td></td>
<td>Prior low</td>
<td>4.56</td>
</tr>
</tbody>
</table>

Discussion

Creating a seamless context for formal and informal learning

The objective of this study was to investigate the efficiency of formal learning through an informal interface, such as a blog. Because the paper-and-pencil tests were developed based on a formal curriculum, this study evaluated the efficiency of formal education by using results from the three paper-and-pencil tests. By calculating the mean
standardized scores for analysis and comparison, we found that students’ standardized scores improved as the experiment progressed. For example, by using the blogging system and the iTM function, the students’ relative positions improved, compared to the earlier stage.

Further analysis of the correlation between student attitudes toward the blogging system and formal learning revealed that, when students had limited experience with the educational blogging system, an intermediate positive correlation emerged between their test scores and their attitudes toward the effectiveness of the blogging system. During the informal unstructured interviews, the students reported the degree to which they enjoyed informal learning using the blogging system. In addition, because the blogging system provided diverse course-related but extracurricular information related to daily life, the students could explore this information in relation to the courses or by sharing their life experiences.

However, this study has three limitations. First, it is the first to attempt using a blogging system to assist formal learning; thus, the ideal method for enhancing formal learning by using a blogging system has yet to be determined. Second, including extracurricular knowledge in addition to the knowledge presented in classes increased the knowledge that students were required to learn. Third, the learning environment was informal; thus, if the students logged into the blogging system from home, some may have been unable to relate information on the blog with the formal courses. Consequently, although the blogging system enabled the presentation of formal teaching materials in an informal environment, assistance from other tools is still required to fully integrate formal and informal learning.

To address the poor organization of the blogging system, which hinders its ability to enhance formal learning effectively, this study implemented the iTM function in the blogging system. By investigating the correlation between the iTM function and formal learning, we found that student attitudes toward the effectiveness of iTM were significantly and positively correlated to their test scores ($r = 0.75$). This pattern indicated that, with the assistance of a blogging system and iTM, students can effectively integrate formal and informal learning in an informal setting.

The influence of other factors on the seamless model

To understand whether other factors influence the seamless model, we further considered the gender and prior achievement categories. To investigate the influence of gender, students were divided into boys and girls. To investigate the influence of prior achievements, the students were divided into a prior-high and prior-low group, according to their prior achievements.

The analytical results showed that data variations can be attributed to whether a student’s prior achievements were high or low. In other words, lower prior achievements of a student indicated more positive attitudes toward the blogging system and the iTM function. Related literature suggested that, in addition to family background (Chang, 2009), students’ low motivation or interest to learn formal content they consider “boring” or “irrelevant to real life” is another significant factor in their low achievements, irrespective of whether they learned in class or over the Internet (Tsai, 1989; Bernard et al., 2004). Unstructured interviews with students in the prior-low group were conducted. The results revealed that students in the prior-low group had the following characteristics: preferring to learn through various teaching methods, performing poorly during conventional paper-and-pencil tests, and preferring to learn knowledge related to real life instead of abstract knowledge. Alternatively, students excelling at in-class activities showed less interest in additional learning activities and tools, to the extent that they even found these activities and tools unhelpful.

Therefore, we developed a new blogging system by creating a novel learning environment that differs from the conventional class setting. Through the blogging system, students can easily receive or share various teaching materials and multimedia features and browse the Internet. This blogging system provides an informal setting and materials for students with low prior achievements to incorporate formal content with real-life knowledge learned through informal learning and explore their interests in a subject. However, for students with high prior achievements, sharing their life experiences on the blogging system provided no significant benefit to the learning achievements they had already done well in, instead adding additional learning time they did not require.

Furthermore, the developed system supplemented the blogging system with the iTM function to address the poor organization of the blogging system. The iTM function can dynamically present the connection between the topics of
formal learning and informal learning. The supplementation not only provided students with a novel learning experience, but also enabled students with high prior achievements to combine formal content, Internet resources, and blog entries by using the iTM function.

Therefore, to help students effectively combine the formal and informal learning of the Citizenship and Society unit, this study proposed a seamless model, as shown below, to provide teachers and system developers with a new perspective. For the seamless model, students in the high achievement group can use informal learning to facilitate the learning efficiency of formal learning. The iTM function was employed as an assistance tool of innovative technology for these students. Conversely, for students with low achievements, they can learn through informal and innovative methods (e.g., a blogging system) to enhance their interests in formal content and further encourage them to incorporate informal content in the structure of formal knowledge, to create a seamless learning environment (CEDEFOP, 2008).

![Seamless model for incorporating formal and informal learning by learners in civic education](image)

**Figure 6.** Seamless model for incorporating formal and informal learning by learners in civic education

**Conclusion**

For this study we developed a guide system of blogging embedded with TM technology. The blogging system was employed as an informal learning interface for learners to share their life experiences and news (Woodward & Nanlohy, 2004). In addition, teachers could supplement formal learning with related material. Furthermore, the iTM function was incorporated to enable the formal content and structure to be presented in an organized manner, by using a TM and integrating Internet resources and blog entries. Empirical evidence has shown that the proposed BKNS can facilitate students’ formal learning, provide students with novel experiences of innovative technology applications, and enable students to learn through unique practical experiences.

In addition, this study proposed the seamless model for teachers and system designers to fully bridge formal and informal learning. By using this model, we also identified further areas of concern for combining formal and informal learning. For example, would an informal learning style be expanded to other types such as different social platforms, lighter devices, and collaborative learning? Future studies could test the teaching of other subjects with the seamless model. This will be helpful in attaining a greater understanding of designing curricula and learning activities for easier integration of formal and informal learning.

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