Cooperative Weblog Learning in Higher Education: Its Facilitating Effects on Social Interaction, Time Lag, and Cognitive Load

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ABSTRACT

This paper examines the effects of using weblog technologies to support cooperative learning in higher education. The study focused on the effects of features embedded in weblogs on social interactions, time lags, and cognitive loads. A quasi-experimental control-group research design was adopted. The participants were 115 undergraduates who were randomly divided into two groups. Students in the comparison group engaged in Jigsaw learning activities in the classroom, while the experimental group used a weblogging system during parts of the cooperative processes. Two findings were found. (1) Weblogs with Jigsaw cooperative learning activities, promoted better social interactions than those found in the comparison group. (2) RSS feeds and keyword searches made important contributions to cooperative learning, more than had been previously identified in the literature. These two components were found to alleviate cognitive overload and the consequences of time lag. Consequently, this study provides new insights into the role of weblogging in higher education.

Keywords

Cooperative learning, weblog, social interaction, blended learning

Introduction

The Internet is now being broadly applied in e-Learning settings and in recent years new web-based learning systems have been developed. These systems constitute a trend in technology-enhanced education (Khalifa & Lam, 2002; Chen et al., 2005) and many studies have focused on web-based features for computer supported cooperative learning (CSCL) environments (Neo, 2005; Piccinini & Scollo, 2006).

Despite previous studies in the benefits of using web-based technology in educational settings, some questions remain unanswered. (1) Web-based learning scenarios may lead to time lags, the contextual structure of exchanged messages might be impaired by asynchronous communications. This raises questions about the consistency of message quality and the effectiveness of communications in asynchronous scenarios. (2) Web-based learning creates social situations outside the parameters of face-to-face interactions. This suggests that social interactions should be supported by suitable didactical arrangements and instructional measures (Swan et al., 2000). (3) Cognitive overload in web-based learning seems likely. When learners have to use complex technology, process large quantities of information (e.g. multimedia form via various channels), and simultaneously communicate with others (Van Bruggen et al., 2002), their attention is often divided. The question is the extent to which this impairs learning.

Weblogs in educational settings

A weblog (i.e. blog) is a web-based technology that has been around for many years; the number of bloggers making informed contributions to a multitude of specific topics continues to grow rapidly. To compare with other social software applications (e.g. online forums, wikis), blogs have a broader application and allow simple web pages, links and resource collections (Fessakis et al., 2008). The automatic chronological archiving function of blog entries is regarded as a support to find needed information efficiently (Beldarrain, 2006). RSS delivery, sense of ownership, and entries and comments archives are attributes a blog contributes to overcome the limitations of current computer-mediated communication (CMC) systems (Kim, 2008). Kim mentioned that a blog communicates differently to traditional CMC tools (e.g. message board or listserve) because it utilizes a permalink, blog users leave comments simpler and more effectively when compared to the traditional CMC applications. Since blogs are so easy to use,
they are increasingly being viewed as viable educational resources and applications (Chen & Bonk, 2008; Wang et al., 2008; Huang et al., 2009).

However, if blogs are to be effective in educational settings, mechanisms are necessary to overcome information overflow and time lag which were rarely mentioned in the past blog-related studies. One such mechanism is the use of RSS (Really Simple Syndication or Rich Site Summary) feeds; RSS is a family of web feed formats that are used to publish frequently updated content. In an e-learning environment, RSS feeds might be used to update the content of auxiliary materials created from blog-based entries (Huang et al., 2008). Studies have mentioned the potential of RSS feeds to filter and track the ever-growing number of online resources (Karrer, 2007); however, no studies have investigated the effects of RSS feeds on learning materials in real classroom settings. Therefore, this study applies RSS feeds to blog entries and seeks to determine how and to what extent they can help students remain aware of the ever-expanding supplementary materials.

In addition to above two issues in communications, there is also the potential for social interaction problems in blog-based learning settings. Makri & Kynigos (2007) indicated that the forms of social interaction in blog-based learning settings are very different with ones in a classroom. They concluded that the blog-based learning needs to be supported by appropriate pedagogical strategies. Hence, to facilitate social interactions in blog-based learning settings, suitable didactic arrangements should be created. Cooperative learning is frequently used to facilitate interactions in real classroom settings; nevertheless, face-to-face interactions can be undermined by such social factors as atmosphere, shyness, peer pressure, and time constraints. This study seeks to investigate whether these limitations can be mitigated by using a blog-assisted cooperative learning environment. Additionally, it is the fact that the formal curriculums in Taiwan educational settings are very difficult to be completely taught on the Internet due to lots of causes that should be considered (e.g. equipment, class size, lack of online synchronous teaching system etc.). Hence, the goal of the current study is to investigate whether blended learning with Web 2.0 technology can deal with some problems met in the classroom learning. Specifically, the Jigsaw cooperative learning strategy is combined with weblogging in an attempt to create a suitable and interactive learning setting.

The Jigsaw cooperative learning strategy

The Jigsaw model is a cooperative learning technique initially proposed by Aronson & Patnoe (1997). Its benefits include enhanced student attitudes, performance, and attendance, reduced test-taking anxiety, and more active participation in learning (Lai & Wu, 2006). However, little research has been done on applications of Jigsaw cooperative methods outside of classroom settings (Huang, Huang, & Hsieh, 2008), and consequently, little is known about the possible benefits of incorporating the Jigsaw model into a blog-assisted learning context. Since Jigsaw cooperative learning emphasizes the ability to work independently in a group, every piece students made need to be presented by each student independently. With this concern, blog technology provides a suitable environment for demonstrating their works. Meanwhile, every learning track (e.g. entries, comments, and trackbacks) would be kept in blog sites for further evaluations. To investigate this issue, we implemented the Jigsaw model using blog technology and examined teacher and student attitudes toward the blended approach. For the concerns, we sought to determine how comfortable members of the same group felt about comments posted on the blogs by their peers. Traditionally, the Jigsaw cooperative learning is usually solely conducted in primary and secondary education for developing cooperative learning in classroom. However, in higher education environment, we have more expectation of creating a blended learning setting to not only educate learners face to face communication skills but also teach them how to use technology to reduce the learning burden efficiently.

The cognitive load issue in web-based learning settings

One issue that has attracted much attention in web-based learning settings is the danger of cognitive overload due to exposure to a surfeit of online resources over a short time. There is a well-known consequence of high cognitive loads: the redundancy effect (Chandler & Sweller, 1991). The effect occurs when separate parts of the material repeat the same piece of information, thereby making it more difficult to learn. To alleviate this effect, material should be presented in an integrated and unitary manner.
In this study, we argue that the tagging function, collocating the keyword search function, could alleviate cognitive overloads that may be associated with a huge number of educational blog entries. A tag can be regarded as a label “stuck” to the blog article. By using tags, authors can conveniently attach semantic keywords to each blog article, and this, in turn, may shape the way readers search through related articles and help them filter out redundant information.

Three main research questions

We developed a weblogging system with the above-mentioned features and expected to answer the following three questions.
1. To what extent can RSS feeds help mitigate the effects of time lags in delivery (information lag) when the RSS feeds are applied to supplementary materials?
2. To what extent can a cooperatively structured blog using the Jigsaw method foster better social interactions than a classroom environment that uses the same cooperative model? In particular, do the levels of perceived peer and time pressure differ between these two situations?
3. To what extent can the keyword search function, combined with the blog tag feature, alleviate cognitive overloads as perceived by participants?

Methods

Setting

The study was carried out in the fall semester of 2006 in the Department of Engineering Science at one large university in Taiwan. Two classes of sophomores (N=115) enrolled in a course titled ‘Data Structure’ participated in the study. The course was a three-hour weekly course.

Research design

A quasi-experimental comparison-group research design was adopted for the study. Two classes were randomly assigned as either an experimental or a comparison group. The experimental group consisted of 57 students who learned using the blog-assisted Jigsaw method; of these, 79% (N=45) were male and 21% (N=12) were female. The comparison group consisted of 58 students who learned using the Jigsaw method in a classroom; of these, 81% (N=47) were male and 19% (N=11) were female. To evaluate the impact of the blog-assisted Jigsaw method, qualitative and quantitative data analyses were carried out via questionnaires.

Jigsaw learning activities

This section introduces the six Jigsaw learning activities given to both groups. As shown in Fig. 1, step 1 and step 4 are face to face instruction and discussion conducted in the classrooms. Both groups go through these two steps. The only difference being the venue or medium in which Jigsaw group meetings and work feedback were provided (Figure 1, step 5 and step 6). In the experimental group knowledge was shared by blog-based supplementary materials delivery and discussion spaces were offered via the weblogging system. The latter allowed students to review or discuss each other’s work online. In contrast, the comparison group performed these activities in the classroom setting.
Step 1: Receive lessons

The component, although not usually mentioned in Jigsaw activities, was intentionally included to ensure that students have a sound foundation in the basic concepts of a topic by receiving lessons from instructors at the beginning of the course.

Step 2: Topic assignment

The instructor divided each lesson into several topics or exercises. These were randomly assigned to the students in the Jigsaw groups. For example, if the lesson unit is ‘Trees’, the topics might encompass “Representation of Trees”, “Binary Tree Representations”, “Binary Tree Traversal and Tree Searches”, and the exercises might be “Write a function that reads in a tree represented as a list and creates its internal representation using nodes with three fields: tag, data, and link”, or “What is the maximum number of nodes in a _k_ -ary tree of height _h_? Prove your answer.”

Step 3: Individual study

After the large-class instructional session was given by the instructor, students studied individually using such resources as the course textbook, notes, reference books, and online resources. During this period, they were advised to take notes to record their own learning or the steps they used to solve problem exercises. Students were asked to familiarize themselves with all the tasks needed to complete the assigned exercises.

Step 4: Expert group meeting

Expert groups were formed in this phase by having one student from each Jigsaw group cooperate with students from other groups assigned to the same topics or exercises. In order to construct ‘expert knowledge’, all expert students shared their notes and knowledge acquired during the previous phase, and then they refined their work on the basis of input received during this cooperation phase. This phase lasted for approximately fifty minutes and was conducted in the classroom for both the comparison and experimental groups.
**Step 5: Jigsaw group meeting**

When the expert students returned to their Jigsaw groups, the process of knowledge sharing proceeded. The purposes of this phase are to train expert students to present their work and to give students opportunities to extend their knowledge by replying to and clarifying questions from group members. Also, this phase gives group members an opportunity to query or comment on the expert student’s work. In this phase, the experimental group utilized a weblogging system to present and comment on work, while the comparison group presented work in the classroom using traditional pen and paper methods. To complete this phase, the comparison groups spent one fifty-minute section in the classroom, while the experimental group was required to carry out this phase on the blogging system for a suggested total time of fifty minutes.

**Step 6: Feedback of work**

For each Jigsaw group, both the TA and the instructor used blogs to identify some of the strengths and weaknesses of each piece by providing feedback and suggesting improvements to student work. However, the TA and instructor provided comments on paper to the classroom group; these were delivered in class about one week later.

**Asynchronous Jigsaw group meetings on the blogging system**

Meetings on the weblogging system are asynchronous discussions, which can free participants from the time and space constraints placed upon a traditional Jigsaw method held in a classroom. Blogging encourages participation from those not used to speaking up and criticizing in public. Group members can in turn review, comment, and raise questions for further clarification whenever they want. The weblogging system developed to facilitate the cooperative activities of the experimental group contained several functions, including the following.

**Keyword search and tag functions to assist learning**

The degree to which the materials are organized directly influences the amount of information that students can take in, store, and recall (Tan et al., 2003). From this perspective the benefits of a search function are obvious. Students can use the keyword search function to find relevant blog entries. The search results should display information similar to the searched concept, thereby organizing the available materials efficiently and directing attention to the desired topics. Additionally, the search engine is able to grub topic-related blog entries using tags added by expert students when they post their work. The tag feature with the keyword search function is responsible for helping to alleviate cognitive overload caused by looking for related information that shifts through all blog entries.

**Cooperative blog-based supplementary materials using the RSS mechanism**

At the end of the whole Jigsaw activity the TA reformatted and edited high-quality posts to serve as supplementary materials. The reformatting process including figure redrawing, typesetting, and error correction, enabled students to study effectively with peer-generated supplementary materials. By using the RSS subscription, students can easily and instantly access latest information on their topic of study, rather than being informed of changes by the material designer (the TA in this study). Therefore, we expect the time-lag problem of information acquisition to be solved by the RSS mechanism. Figure 2 shows an example of using blog-based supplementary materials in a web-based setting. In this study, participants used a free RSS reader (e.g. Google reader) to recognize these subscription feeds and manage them easily and efficiently.
Figure 2. An example of using supplementary materials

Measures

Two questionnaires were used in the study.
- Questionnaire 1 was used to examine any differential perceptions toward social interactions during the Jigsaw learning activities between two groups (Table 1). Students were requested to provide explanation for their answers. The results of items 5 to 8 are expected to answer the second research question.
- Questionnaire 2 was distributed only to the blog-assisted group. It examined perceptions of the RSS mechanism (the first item) that is used to investigate the first research question, blog-based supplementary materials (items 2-4), the keyword search function (items 5 and 6), and the blog tag feature (the last item). It also asked students if and how these functions helped them obtain related materials and alleviate cognitive overloading, which is expected to answer the third research question (items 5-7). The data were collected via half open-ended questions after each of the seven statements (Table 2).

Responses to both questionnaires were scored using a Likert-type scale: strongly agree (5 points), agree (4 points), neutral (3 points), disagree (2 points), strongly disagree (1 point).

Quantitative responses to questionnaire 1 were analyzed using an independent $t$-test, while quantitative responses to questionnaire 2 were analyzed using a one group $t$-test on each statement. The constant comparative method suggested by Lincoln & Guba (1985) was employed as the data analysis method for coding responses to the open-ended questions in the questionnaires.

Table 1. Questionnaire 1: Students’ responses to the Jigsaw learning activities and social interaction

<table>
<thead>
<tr>
<th>Question</th>
<th>Group</th>
<th>SA &amp; A</th>
<th>Neutral</th>
<th>D&amp;SD</th>
<th>Mean</th>
<th>$t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cooperative</td>
<td>42% (24)</td>
<td>38% (22)</td>
<td>20% (11)</td>
<td>3.18</td>
<td>2.622**</td>
</tr>
<tr>
<td></td>
<td>learning</td>
<td>Blog-assisted</td>
<td>Classroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>helps me learn</td>
<td>31% (18)</td>
<td>40% (23)</td>
<td>29% (17)</td>
<td>3.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>more.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>The expert</td>
<td>73% (42)</td>
<td>24% (14)</td>
<td>3% (1)</td>
<td>3.70</td>
<td>0.704</td>
</tr>
<tr>
<td></td>
<td>group meeting</td>
<td>Blog-assisted</td>
<td>Classroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>helps me to</td>
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<td></td>
<td>fill knowledge</td>
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<tr>
<td></td>
<td>gaps left by</td>
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</tbody>
</table>

Two blog-based works
independent study.

3. The Jigsaw group meeting made me show my work to group members effectively.

<table>
<thead>
<tr>
<th>Question</th>
<th>SA &amp; A (%)</th>
<th>Neutral (%)</th>
<th>D&amp;SD (%)</th>
<th>Mean</th>
<th>t (vs. Neutral)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. With the help of the RSS mechanism, supplementary materials were obtained quickly and used easily.</td>
<td>92(52)</td>
<td>8(5)</td>
<td>0</td>
<td>4.47</td>
<td>16.921**</td>
</tr>
<tr>
<td>2. The supplementary materials truly helped me study the course.</td>
<td>83(47)</td>
<td>10(6)</td>
<td>7(4)</td>
<td>4.05</td>
<td>8.881**</td>
</tr>
<tr>
<td>3. The supplementary materials can help me organise the new knowledge.</td>
<td>85(48)</td>
<td>12(7)</td>
<td>3(2)</td>
<td>4.16</td>
<td>11.289**</td>
</tr>
<tr>
<td>4. I like to exploit supplementary materials in my studies.</td>
<td>75(42)</td>
<td>12(7)</td>
<td>13(8)</td>
<td>3.88</td>
<td>5.835**</td>
</tr>
<tr>
<td>5. The keyword search function provided in the blog system helped me quickly locate needed information.</td>
<td>85(48)</td>
<td>10(6)</td>
<td>5(3)</td>
<td>4.00</td>
<td>9.416**</td>
</tr>
<tr>
<td>6. The keyword search function provided in the blog system helped me effectively locate needed information.</td>
<td>78(44)</td>
<td>12(7)</td>
<td>10(6)</td>
<td>3.84</td>
<td>6.625**</td>
</tr>
<tr>
<td>7. With tag feature, the keyword search helped me sift through information without feeling overwhelmed by the large quantity of blog entries.</td>
<td>23(13)</td>
<td>60(34)</td>
<td>17(10)</td>
<td>3.04</td>
<td>0.322</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01

Results

Attitudes towards social interaction during Jigsaw learning activities

Responses from the experimental group to questions concerning their impressions of the Jigsaw learning activities were all more positive than those from the comparison group (Table 1). T-tests on each item found only two items to not be significant. Item 1 assessed overall attitudes toward the cooperative learning activities. It was found to be statistically significant at .01 level (Question 1, t(1,113) = 2.622, p < 0.01). In the half open-ended response area, students in the classroom said that they “felt anxious, nervous, and under a great deal of pressure” to express their opinions to group members in face-to-face situations. In contrast, the majority of experimental group students thought that asynchronous cooperative learning gave them more time to think and organise the information they had received, and it gave them a greater sense of ownership over their newly expanded knowledge base.
The results of t-tests on item 3 found that the effectiveness of the Jigsaw group meeting for presenting work was statistically significant (Question 3, \(t(1,113) = 2.832, p < 0.01\)). Only some students in the blog-assisted group expressed negative views about presenting their work during the Jigsaw group meeting, while nearly 20% of students in the classroom group disagreed with this point (4% vs. 19%).

**Perceptions of social interaction in the weblogging cooperative learning environment**

Analyses on items 4 to 7 were performed to investigate differences between the groups regarding social interaction, including peer and time pressure, when presenting and commenting on work. The results showed a significant difference in the reactions of the two groups (Question 4, \(t(1,113) = 5.602, p<0.01\)). Of the students in the experimental group, 47% agreed and strongly agreed that they did not feel pressure from their peers when sharing their work. However, 59% of comparison group students felt pressure from their peers. Analysis of the data from the open-ended question points to two themes regarding this effect: First, the online learning environment creates a virtual space, which enables students to concentrate on posting their work. Students in the online learning environment were less likely to be “disturbed or distracted” by instant responses from peers. Second, the online learning environment reduced the number of situations where students needed to respond on the spot; this also alleviated anxiety.

Results from the t-test indicated a significant difference between the experimental group and the comparison group with regards to time pressure when presenting their work (Question 5, \(t(1,113) = 4.945, p < 0.01\)). Up to 45 students (79%) in the experimental group did not feel time pressure when presenting work. The main reason identified by descriptive responses was that the online learning environment allowed students to set their own pace. Twenty-two students mentioned that they "didn't have to implement it at any particular time", so they can “work in separate order” to set their own pace and schedule. Moreover, one student indicated that she could "take her time examining and revising the work". In contrast, four comparison group students mentioned in their written responses that “due to the limitation of class time”, they may "take up time allocated for other group members", which resulted in time pressure when presenting their work. With regard to item 6 (commenting on my groupmates’ work does not generate peer pressure), the difference between the groups was found to be significant (\(t(1,113) = 2.578, p < 0.05\)). Experimental group students indicated significantly less peer pressure than the comparison group when evaluating their groupmates’ work. The main reason was that the online learning environment did not require students to face the group members; therefore, when evaluating group members’ work, the influence exerted by the presence or judgement of others was lowered. For example, “comment is a very sensitive issue. Not seeing the person I am commenting on makes me less likely to be influenced by others’ presence or judgment”; “because I do not need to worry about others’ presence or judgement, I can express my thoughts without reservation”. In the comparison group, 70% of students did not agree with this statement. Two main reasons were deduced from student explanations. One was that, when evaluating others’ work in the classroom, some were afraid of “awkward” feelings resulting from “on the spot commenting behaviour”. For example, some students indicated that

- **When commenting in front of everyone, I will worry about other people’s feeling and only dare to express positive points.**

Meanwhile, there were students who worried about showing lack of ability when commenting. Concerns may include showing lack of professional knowledge or lack of questioning and commenting abilities. Some responses include these:

- **When confronting public speaking or situation where you need to speak spontaneously, I do not know what to say.**

Finally, no statistical significance was found regarding item 7 (time pressure while presenting work, \(t(1,113) = 0.658, p = 0.638\)). Most students in both groups did not feel time pressure while commenting about work (\(M_{exp} = 4.37; M_{comparison} = 4.26\)). Twenty-eight students in the two groups remarked that "the content of each comment is not long", so they "didn't feel time pressure while commenting". On the other hand, the fact that students in the experimental group did not perceive any time pressure is consistent with their responses to item 5. Eighteen students mentioned that they were able to “view member's work in greater details before commenting” and “didn't have to comment immediately but separately at different times”, so they “sensed no time pressure while commenting”.

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Although the quantitative data did not reveal a difference between the two groups, some variation can be seen in the written responses. No students in the experimental group indicated that they perceived time pressure while commenting, but all students who chose to strongly disagree in the comparison group indicated that "immediate commenting" results in a great deal of time pressure. In other words, an asynchronous learning environment enables individuals to prepare for commenting. For experimental students, they experienced not only online group meeting process in level 5 but also the classroom meeting process in level 4. Although we didn’t require students to express their perceptions for both learning situations, the unofficial interview shows that students did agree the online instruction and discussion process brought less time and peer pressure to them.

**Responses to the blog-based supplementary materials with RSS delivery**

The purpose of the second questionnaire was to examine the blog-assisted group’s perceptions of the blog-based supplementary materials, keyword search, and tag function of the developed system. A $t$-test was conducted to compare the difference between responses (agree or disagree or neutral) to each of the nine variables in Table 2.

Four items were used to assess attitudes toward the RSS feed and supplementary materials. More than 90% of the students gave a positive response to use of the RSS feed as an aid in obtaining supplementary materials in a fast manner (Question 1, $t(1,56) = 16.921$, $p < 0.01$). Most students (83%) agreed that the supplementary materials helped them study Data Structure (Question 2, $t(1,56) = 8.881$, $p < 0.01$) and 85% of them thought that supplementary materials helped them organize new knowledge (Question 3, $t(1,56) = 11.289$, $p < 0.01$). A small proportion (13%) of the group did not like using the supplementary materials in their learning (Question 4).

**Perceptions of the keyword search and tag functions**

Most students responded that the keyword search function helped them quickly and efficiently get the information that they required (Question 5, 85%, $t(56) = 9.416$, $p < 0.01$) (Question 6, 78%, $t(56) = 6.625$, $p < 0.01$). Students indicated that the keyword search function helped them find relevant information in a large database in an effective and efficient way. One student responded, “Without reading every single article, necessary information can be found within short period of time.” Some students said they used the keyword search function to “find learning resources for their studies,” and that by helping them to find the work of their peers in their own and other groups, it helped them in “extending, reviewing and organizing learning content”.

It is noteworthy that, although most students acknowledged the keyword’s usefulness, some individuals disagreed with it. As clearly stated in the responses, an individual’s ability to search using keywords can affect the search results. One student indicated, “I am not good at using keywords. I often need to try many times, and sometimes there are no matching results.”

Regarding the tag function, only 23% of students agreed that it helped to sort large amounts of information (Question 7, $t(1,56) = 0.322$, $p > 0.05$). Reasons that students shared included

- *I have a habit of using tags, and maybe because I am familiar with picking keywords this decreases the time I spend on searching.*

It is surprising that up to 60% students chose neutral. From responses like “not understanding the tag feature” and “not being in the habit of using the tag feature”, we can extrapolate that these are the main reasons.

**Discussion**

The aim of this study was to examine the effects of incorporating a weblogging system into a higher education course so as to allow students to cooperate with their peers in an asynchronous cooperative learning environment. We first examined the RSS mechanism as applied to supplemental materials to alleviate the time lag issue. The results (the first item of questionnaire 2) suggest that an RSS feed not only helps supplementary materials be quickly delivered to students, but it also helps make those materials easy to access. Hence, we conclude that the RSS mechanism can reduce the time lag when delivering supplementary materials. This ensures consistency in the
delivered information and should lead to learning efficiency in an asynchronous learning environment. Put differently, without the RSS subscription, students may access less of the available supplementary materials and access supplementary materials less efficiently, which could cause learning gaps. Therefore, according to this research, the RSS subscription mechanism can help ensure the integrity of supplementary materials.

The results of items 2-4 in questionnaire 2 indicated that students were willing to exploit the supplementary materials when studying and that the content of those materials indeed assisted their learning. The topics and exercises assigned to students were required readings. Supplementary materials elaborated on these readings and exercises and presented them in a structured way.

Although the RSS mechanism was used to syndicate supplementary materials, the benefits of the RSS mechanism are not limited to speed of delivery. Subscription to RSS feeds enables students to choose the materials they want to see. RSS technology is a pull technology rather than push technology; that is, content is not forced on students. Students can quickly scan titles and read materials of interest via the RSS mechanism. Hence, active selection may trigger intrinsic interest, which could allow them to learn more (Tobias, 1994). This kind of application clearly needs further exploration.

As for the second research question, items 5-8 in questionnaire 1 were designed to investigate whether the effects of social factors, like peer pressure and time constraints, could be alleviated by using a blog-assisted cooperative learning environment. The results indicated that students used blogs to express their opinions and suggestions more freely when commenting on others’ work; in comparison, students in the classroom group tended to take into consideration group atmosphere, time limitations, and the perspectives of others. As revealed, not needing to be physically present to face their group-mates direct reactions, it helped experimental group students alleviate uneasy feelings, emotional burdens or tensions that may occur as a result of the evaluative comments they made about their classmates’ performance on the work during works feedback session. This data substantiated the findings of media effects that mediated communication differed significantly from face-to-face interaction (Jessup & Tansik, 1991; Williams, 1977). Specifically, nonverbal cues, such as gestures and facial expressions, which may have many indicative functions to point to the dynamic psychological state of the individual, are easily emitted in face-to-face situations to the effect of regulating individual psychological states and behaviors (Williams, 1977).

These results may be explained by considering the influence of collectivism, which is prevalent in Oriental societies. Collectivism stresses human interdependence and the importance of a collective. Students in Oriental countries are usually influenced by collectivism, so they may feel a great deal of peer pressure when they are asked to criticize their peers’ work or when they are to be criticized openly (Brown et al., 2007; Shea & Yeh, 2008). Peer pressure, as shown in the study, seemed be partially eliminated. According to the above statements, we can conclude that, when participating in the same cooperative learning model, students with the support of an asynchronous learning environment perceived better social interactions than those in the classroom group.

The third research question was designed to investigate whether the keyword search and tag functions in the blogging system helped alleviate cognitive overload. Items 5-7 in questionnaire 2 were devised to answer this question. The results indicated that the keyword search function was regarded as a filtering technique, used to filter out repetitive information, which consequently minimized the redundancy effect. Since the materials found by a search were limited to those relevant to the search terms, students were able to filter out any redundant parts of the search result so that they could avoid studying similar content. These findings are consistent with findings reported in previous studies (Cao et al., 2004, Sutherland & Schneider, 2008). Our results, however, should be treated cautiously because the results seem not to support the effects of the tag feature. According to student responses, most students lack the ability to use tags and are unfamiliar with many of the potential associated with tag (e.g. multiple tags can defined, users can define their own tags by themselves), hence, this obviously becomes a null curriculum (what missing from the curriculum) (Eisner, 1985) in this study. The potential utility of tags in weblog learning settings clearly needs further exploration.

**Limitations of the study**

We need to admit that much remains to be done, then, but we anticipate that the work will generate important findings in the fields of blended learning environments. We have not shown the academic performance of the subject
matter between both groups because we argued that a grade on an examination paper cannot answer any one of three research questions. In this sense, the difference of actual performance between two groups is not our main concern.

In addition, the time student took on online posting is very difficult to control. Firstly, the time they spent on learning depends on their learning motivation. Secondly, for an educator, we hope that learners can make as much effort in school work as possible. Therefore, both groups were requested for the least time limitation (fifty minutes) they should spend to access to the weblog or report in public. The experiment design may not be ideal due to the partial time control. The different session arrangement may lead to different results in terms of the time pressure. Since the official class time frame was regulated as three successive sessions per week, this experiment design and time frame was limited to the higher education regulations about the class arrangement. Therefore, the results, particularly on the time pressure issue, may be limited to generalize to other type of class session arrangement.

Conclusions

This paper described a study undertaken in a Taiwan university that explored student perceptions of a weblogging learning system developed to support Jigsaw cooperative learning. Blog posts were further processed as supplementary materials to assist students in learning the course ‘Data Structure’.

Results indicated that students in the Jigsaw cooperative learning group that used the weblogging system exploited the benefits offered by the blog. The use of blogs encouraged students to strengthen their own skills with regards to easily sharing course key points and to fully express their thoughts in such an environment with less peer and time pressures. In addition, the other components built into the weblogging system, such as the keyword search function, decreased cognitive overload. Therefore, the main conclusions of this study are two: (1) Weblogs can be combined with Jigsaw cooperative learning activities to form a better social interaction model than the classroom cooperative learning model. This may be particularly true for students in Oriental countries. (2) The components built into the weblogging system, specifically the RSS mechanism and keyword search function, have a much wider role to play in cooperative learning than has been previously articulated in the literature. In particular, this study has indicated that these functions can alleviate cognitive overload and the time lag of information delivery.

This study shows that cooperative learning among students need not be restricted to the classroom, as might be implied by traditional applications of the method. In fact, limitations imposed by the physical space can be overcome through the use of an online social system, such as a weblogging system. Additionally, since the Jigsaw learning method was conducted in a typical manner, the implementation of this process should be practical in other course domains and for students at other levels.

To achieve effective learning in this kind of online cooperative setting, some basic skills need to be taught and developed. First, students need the ability to construct a precise keyword search query. Further, the system should provide some mechanisms to help learners to refine search results. Second, although the tag feature was expected to enhance student abilities to extract keywords informally and personally, and then improve the precision of their keyword search, the results of this study did not support this expectation. This is most likely due to inability to use this function. Therefore, students should be taught in how to apply the tagging function to organize materials and revisit self-made work. In view of the above-mentioned null curriculums, we suggest that educators ought to take them into consideration when developing online learning systems and teaching strategies.

In addition, the results suggest that use of the RSS mechanism in blog-assisted learning may be a productive topic for future research. We are hopeful that more applications and more detailed results may differentiate these views from one another in the near future. Finally, research and development in this area will be continued with the goal of refining the practicality and appropriateness of the weblogging learning environment so that it meets all expectations for supporting and enhancing student learning using a cooperative learning model.

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