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A Case Study on Exploring Students' Intellectual Interactions in A Network-enhanced Classroom Setting[1]

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Abstract

It is widely recognized that the Internet offers tremendous potential for education at all levels. This article describes a case study examining how an Internet communication program, EdPsy Web, which was used to support a pre-service teacher training course changed the quality of social and intellectual interactions relative to those found in a traditional classroom setting. Using a post-course survey, on-line data and electronic message analysis, we sought to answer the following questions: (a) Did a network-enhanced classroom setting motivate students to interact and share knowledge? and (b) Did distinctive intellectual interactions occur in network-enhanced classroom settings? The survey showed that students saw the value of and demonstrated positive attitudes toward network learning after using EdPsy Web to facilitate discourses. When assignments were delivered in an electronic form, students were motivated to see and compare what other students had accomplished, and thus were more aware of what they had achieved. The time and place-independent nature of this network learning environment provided opportunities for collaboration and knowledge sharing among users. The analysis of electronic discourse explicitly demonstrated the multi-threaded nature of electronic message interactions. In general, the network-enhanced classroom setting offered an alternative pattern of interaction that differed from the traditional face-to-face setting in some ways, but not all.

Key Words: Internet, collaborative learning, computer network

There has been dynamic growth in the utilization of Internet communications in higher education, including the use of e-mail, electronic conferencing and distance learning programs. Researchers have indicated that the utilization of communication technology in education impacts the reformation of traditional classroom practices in at least four major ways including: (a) It expands the amount of information available to teachers and students; (b) it promotes collaboration and communication between individuals, and within and among classes on a network; (c) it promotes interdisciplinary approaches to science and knowledge integration; and (d) it expands the boundaries of the classroom (Roberts, Blakeslee, Brown &, Lenk, 1990).

Computer-mediated communication functions differently than traditional face-to-face communication. In addition to the capability of managing a large amount of information and expanding the boundaries of classroom activities, this new medium has its own rules or patterns for managing the temporal, spatial, and social aspects of interactions (Beals, 1992; Harasim, 1990; Kiesler, Siegel, & Mcquire, 1984). It allows for asynchronous interactions, requiring users to write messages and store them in the computer memory for other users to read. Asynchronicity expands user control over the time of interaction, thereby increasing the time available to read or re-read a message before carefully formulating a proper response. The result is a more fruitful and thoughtful discussion of interrelated topics. The record of dialogue interactions can be a rich source of ideas for knowledge-building activities. Furthermore, the place-independent feature of the communication-based learn-

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ing environment allows for social and intellectual interaction outside the traditional classroom setting. Networks are available to link persons in different locations for the purpose of communication. Compared with traditional face-to-face communication, asynchronous network communication operates in the absence of social context cues, such as facial expressions, eye contact, and verbal intonation. Because of the lack of social context cues, participants must express themselves clearly and understandably. Research has indicated that in computer mediated communication (CMC) environments, participants usually write more complete sentences to express their ideas which contrasts with traditional face-to-face speech communication where fragmented sentences appear frequently and where participants heavily rely on context cues to communicate (Jehng, 1997; Kern, 1995). Transcripts of network conversations provide an explicit record of interactions which users can employ to interpret and trace the progress of intellectual interactions. Finally, a communication-based learning environment tends to minimize differences in social status as well as physical characteristics, thereby providing a more egalitarian context for social interactions. This may lead to more open and spontaneous participation.

Due to the powerful capabilities for information management and unique communcative style, the communication-based learning environment may have different influences on student learning and motivation. The research project discussed in this article includes a case study that was used in a college-level pre-service teacher training course to examine the intellectual interactions and learning potential of an Internet-enhanced classroom setting. The purpose of this case study was to provide a clear picture of how a network-enhanced learning environment can facilitate learning and what challenges are faced by educational researchers and technologists using this kind of learning environment.

I. Collaborative Learning and Distributed Intelligence in the Classroom Setting

In recent studies on human cognition, researchers viewed learners as agents in distributed cognitive systems which included physical objects, symbolic representations, people in social relationships, and physical surroundings, each of which played a part in the accomplishment of cognitive activities (Oshima, Scardamalia, & Briter, 1996; Pea, 1993; Perkins, 1993; Resnick, Levine, & Teasley, 1991). This view of human cognition implied that learning no longer was an individual enterprise, but rather was a joint effort made by learners and their surrounding environment.

Theoretically, the classroom could be regarded as a distributed system where students, teachers, symbols and artifacts interact. Classroom discourse provides a collective zone of proximal development that supports student learning. The zone of proximal development is the region of activity in which learners can achieve with aid from a supportive context, which includes but is not limited to people (Vygotsky, 1978). The concept defines the distance between the current competence levels of independent performance and the competence levels that can be achieved through collaboration with more capable people or more germane artifacts. The zone of proximal development embodies a concept of readiness to learn and emphasizes the upper level of competence, and these upper level boundaries are constantly changing along with each learner's increasing independent competence at successive levels (Brown, Ash, Rutherford, Nakagawa, Gordon, & Campione, 1993).

The notion of distributed cognition brings an emphasis on group interaction or collaborative learning in order to reform current educational practices in the classroom. Educational researchers have argued that collaborative learning has at least four major benefits with regard to students' cognitive development and achievement (Johnson & Johnson, 1990; Webb, 1982) including: (a) Students are forced to confront their ideas and to express their own ideas explicitly; (b) students are forced to coordinate their actions during collaboration and provide mutual guidance and support which serve as scaffolding in order to help one another accomplish learning tasks that might otherwise be too difficult for individual learners; (c) students not only get immediate and meaningful feedback from their collaborators, but their explanations also become more sophisticated and substantial as they become more proficient; and (d) students learn to self-monitor and self-regulate their behaviors more precisely as they interact with their collaborative partners. Higher levels of thinking and learning become possible in the peer group setting.

II. Facilitating Collective Knowledge Building in Network-enhanced Learning Environments

Researchers in the field of educational communication recognize that tools offered by CMC not only increase learners' access to information, but also facilitate knowledge- building activities. Recently, several researchers have begun to address issues and challenges regarding student learning using communication technologies. Researchers delving into Internet-enhanced learning environments have shown that the utilization of communication tools in teaching may influence student learning regarding science (Hsi & Hoadley, 1997; Linn & Songer, 1991; Songer, 1996). A communication-based learning environment provides an opportunity for students to get access to real-time resources and firsthand information. Students also have greater opportunities to participate in dialogue with peers both near and far. The flux of personal experiences, scientific information and expert knowledge diffused throughout the learning environment has the potential to help students develop a rich explanatory base for learning and application of knowledge. Studies have shown that students in network learning environments demonstrated significantly greater understanding of scientific concepts (Songer, 1996), greater motivation to interact and share ideas with other students (Ruberg, Moore, & Taylor, 1996), and more thoughtful and self-regulated learning behaviors (Scardamalia & Bereiter, 1991) than students in traditional classroom setting.

Communication technology offers a new environment for social and intellectual interactions and allows greater access to collective knowledge-building. For example, computer networks can augment the possibility of active participation beyond what can occur in face-to-face settings (Harasim, 1987). Time-independent and place-independent participation enables each person to access learning activities at times and places most convenient to them or most opportune for the task, thereby facilitating increased participation. Computer networks can help build a more cohesive learning community in which collaborative knowledge construction is encouraged. Studies have indicated that communication technology can facilitate thinking and help shape thought (Brown, Rutherford, Nakagawa, Gordon, & Campione, 1993; Scardamalia & Breiter, 1991). Communication tools have demonstrated potential as means of sustaining and expanding zones of proximal development, freeing teachers from the burden of being the sole source of knowledge and allowing the learning community to extend beyond the classroom.

Although applying communication technology to facilitate intellectual interactions has promise, it is imperative to know the factors that affect students' learning and attitudes in communication-based learning environments. Previous CAL research has indicated that gender and prior computer knowledge and experience can be crucial factors associated with students' attitudes towards using the technology (Ash & Cummins, 1985; Chen, 1986; Levin & Gordon, 1989; Shashaani, 1994). Often, male students and experienced users tended to have more positive attitudes toward using the learning technology and gained more from it. Male students usually had more access to computers and had more male computer-user role models for them to emulate. Male students therefore tended to have more positive attitudes towards using computers for learning. Computer attitudes and the amount of computer use had reciprocal correlations. Students who knew more about computers, used computers more, and had more access to home computers were more interested in computers and had more confidence in working with them (Wu & Morgan, 1989). It would be interesting to know whether what was found in the CAL research was also true in a communication-based learning environment.

Educational researchers have claimed that communication technology could be a powerful program for collaborative interactions and for building communities of learners. Few researchers, however, have demonstrated how the mechanism underlying the process of collaborative interaction provided opportunities to facilitate learning, or how participants were motivated to learn in a computer network environment. Based on the view that collaborative interactions in communication-based learning were essential for students to develop understanding and obtain experience, our research was used to answer two questions: (a) Would a network-enhanced classroom setting actually motivate students to interact and share knowledge? and (b) Did distinctive intellectual interactions occur in a network-enhanced classroom setting? Answers to these two problems could help us not only understand how a communication-based learning environment facilitates group interaction and collective knowledge building, but also help us develop an effective learning environment.

1. Methods

The study was conducted in an instructional setting in which college students interacted and discussed educational psychology issues using an Internet program which was developed to assist and facilitate teacher-student and student-student interactions. The reason for choosing a social science course was that cases in social science are more poorly-structured and multifaceted in nature. These cases permitted a comprehensive investigation of how students interact, and present and share ideas with their partners in a network-enhanced learning environment. The study lasted one semester during the spring of 1997.

Three evaluation methodologies including, a survey, on-line data and message flow analysis, were used to investigate social and intellectual interactions and to assess the educational value of this network-enhanced learning environment (Levin, Kim, & Riel, 1990; Mason, 1992).

A. Participating Subjects

Fifty-eight full-time students registered at National Central University, located in Chung-li, Taiwan participated in this study. The students were enrolled in an educational psychology course designed as one of the prerequisites for pre-service teachers. In the Taiwanese educational system, college students must be at least sophomores to qualify to enroll in a teacher training program. The 58 participants were from different departments. There were 22 male and 36 female students in this subject pool. Since the students came from different departments and studied at different educational levels, the subject pool was considered to be representative of college students enrolled in pre-service teacher training programs in Taiwan.

B. The Network-enhanced Learning Environment

An Internet communication program called EdPsy Web was developed and used in this study. The study was conducted in a natural instructional setting. The role and purpose of this communication program was to enhance, not to replace, existing classroom instructional activities, and transform them into more effective ones. Ten functions were provided by EdPsy Web to assist the teacher in managing instructional activities (Fig.1).

C. Participant information

Students could access information about their teacher by clicking the “Know your Teacher” button. Information regarding the teacher's educational background, research activities, and publications were available for the students’ reference. The program also allowed students to access fellow students’ personal information, such as nicknames, blood types, birth dates, astrological signs, preferred movie stars, hobbies, etc., by using the “Know your Classmates” button. These two buttons helped the teacher as well as the students get acquainted with each other and thus motivated them to interact with each other.

D. Instructional Activities

The program provided various functions to assist the teacher to moderate instructional activities. An on-line course syllabus was available for students to consult at any time using the "Course Syllabus" button. Students could find out what would be taught in upcoming classroom sessions. The system also provided an on-line case study function using the “On-line Case Study” button. Using this button, students could post ideas and peruse other students’ opinions regarding particular cases or issues. All written assignments could be delivered to and evaluated by the teacher electronically by means of the “Assignments” button. Students could use this function to see the teacher’s evaluative comments as well as other students’ works. The “Exchange Idea” button allowed students to exchange ideas with each other regarding the course. The "Reference" button provided lists of reference materials relevant to the course content, such as books, journals, technical reports, and brief introductions to preeminent educational psychologists.

E. Instructional Administration

Activities regarding the course were announced and accessed through the “Announcements” button. Students checked their grades by clicking the “Check your Performance” button. Finally, students sent their suggestions to the teacher regarding the course through the “Your suggestions” button.

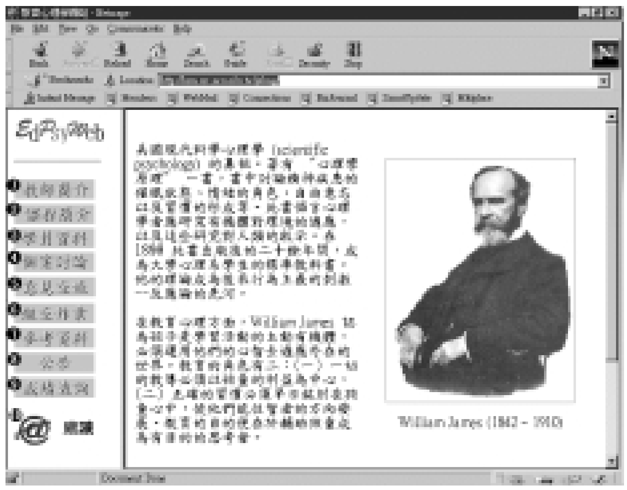

Fig. 1. The EdPsy Web network learning environment.

Note. Labels of the 10 buttons: (1) "Know your Teacher", (2) "Course Syllabus", (3) "Know your Classmates", (4) "On-line Discussion", (5) "Exchange Ideas", (6) "Assignments", (7) "Reference", (8) "Announcement", (9) "Check your Performance", (10) "Your Suggestions".

2. Procedure

In order to implement the network community successfully, the teacher managed a reliable computer network for student access and also designed well-specified tasks for the students to accomplish (Riel & Levin, 1985). The teacher presented the course contents orally to the students in the classroom. At the beginning of the semester, the teacher spent one week teaching students how to familiarize themselves with the EdPsy Web network learning environment. Students were required to enter their personal information into the system to enable them to become better acquainted. All written assignments were transmitted to the teacher electronically.

After the mid-term examination, the teacher assigned on-line case study activities. The selected cases contained important issues relevant to the course content. Cases were posted electronically. Students also posted their ideas and discussed solutions to the cases with their classmates using this Internet program. During on-line case study activities, students were allowed to collect information from different sources. Two on-line case study activities were arranged and each one lasted two weeks. The teacher provided detailed explanations of the solutions in the classroom at the end of each on-line case study activity.

The two on-line case study activities were conducted in different formats commonly employed in traditional face-to-face classroom settings. In the first case study activity, students were required to state their opinions individually. This case queried whether speed reading could really help students study and acquire knowledge. Students used what they had learned from this educational psychology course in order to explain why they thought that speed reading did or did not assist learning. In the second case study activity, students were asked to study in a group. Six groups were formed, and each was required to formulate opinions before posting them on EdPsy Web. This case queried whether an objective evaluation system could be developed to measure what students learned in a poorly-structured domain, such as history, geography or civics. During these two on-line case study activities, the teacher did not take any action to moderate or intervene in student discussions.

3. Data Source

A post-course questionnaire was developed to assess student attitudes toward this network-enhanced learning environment. The questionnaire contained 21 statements with a five-point Likert scale in which 1 indicated strong disagreement, 3 neutral and 5 strong agreement. Sample statements are listed in the Appendix. The questionnaire also included an open-ended question that sought to solicit students' specific opinions about EdPsy Web. The questionnaire also required them to provide personal information, such as gender and prior Internet experience. All the students completed the questionnaire anonymously. Fifteen senior students who needed to participate in graduation exams dropped out of the second study activity and did not complete the questionnaire.

All students' on-line behaviors were recorded using EdPsy Web, including the time and frequency with which they logged into the system. Students' written assignments, ideas and opinions expressed during the two on-line case study activities were all collected using the system.

4. Analysis and Results

In response to the two research questions addressed above, our data analysis focused on four specific issues connected with emergent learning in the EdPsy Web network learning environment including: (a) Did students have positive attitudes toward learning within this network learning environment? (b) Were students of different genders have different motivations for using the Internet communication program due to their prior Internet experience? (c) Did students demonstrate particular learning behaviors using the Internet communication program during the on-line case study activities? and (d) Did on-line case study activities affect their understanding of specific issues related to educational psychology? We outlined our results in the following section and discussed four specific issues.

III. Student Attitudes and the Motivational Differences

Statistical analyses of the students' responses on the post-course questionnaire showed that the mean scores of all 21 statements were above 3, with the lowest score of 3.10 and the highest score of 4.40, indicating that in many circumstances, students had positive attitudes toward learning using EdPsy Web. The students' opinions and suggestions regarding EdPsy Web were summarized as follows:

1. Valuable statements made by preeminent educational psychologists were included in EdPsy Web to motivate students and provide them with insights into certain trends in educational and learning philosophy.

2. The most recent academic activities relevant to

this educational psychology course were presented using the program, for example, lectures, conferences, and research projects. The students were interested in knowing about recent happenings in educational psychology research and relevant academic activities.

3. The on-line case study activities were motivating and should be increased so that students could have more opportunities to share their ideas and knowledge with each other. Most of the students preferred that the on-line case study activities be conducted on an individual rather than a group basis.

4. On-line case study activities should be open to the public so that more ideas could be solicited and added to the database. The students were motivated to listen and absorb opinions based on different perspectives, thereby expanding their own knowledge base.

5. It was convenient to deliver assignments electronically. It was of great educational value for students to see, compare, and share with each other their work using the EdPsy Web.

A 2×2 ANOVA analysis of the students' responses on the questionnaire was done using two demographic variables: gender and prior Internet experience. Results indicated that the two variables significantly determined the students' attitudes toward EdPsy Web. Students who were frequent Internet users (at least 3 hours a week) tended to be more motivated and to have more positive attitudes toward learning with EdPsy Web than did infrequent Internet users (less than 3 hours a week), $F = 5.49$, $p < .05$. Male students tended to have more positive attitudes than female students, $F = 8.24$, $p < .05$. There was an interaction effect between the gender and the prior Internet experience variables, $F = 7.60$, $p < .05$. Female students who were frequent Internet users tended to have more positive attitudes than the female students who were not frequent users. There was, however, no significant difference in attitude between male students who were frequent Internet users and those who were infrequent users. Table 1 summarizes the results.

Table 1. Students' Attitudes Toward Learning with EdPsy as a Function of Their Gender and Internet Experience

		Gender	
		Male students	Female students
Internet Experience	More than 3 hrs per week	86. 09* (9.83)	94.00 (3.61)
	Less than 3 hrs per week	85. 63 (11.72)	80.69 (11.68)

Note. Mean scores with standard deviation in parenthesis.

IV. Student on-line learning behaviors

Analysis of student login data can help reveal online learning behaviors. Overall, the 58 students logged onto EdPsy Web more than 950 times during 10-week study. Three hundred and ninety-eight logins were clustered during the two on-line case study activities. Ninety-three messages were posted during these two on-line activities, of which 80 individual messages were for the first activity (average 1.38 per person) and 13 group messages for the second (average 2.17 per group). For the first activity, all the students in the class posted messages. This was different from the traditional classroom setting in which not every student is willing to or has the opportunity to speak up or express an idea. According to the data, the time when students logged onto the program ranged from as early as 6:15 a.m. to as late as 3:44 a.m.. This indicates that students were motivated to use the system at any time during the day.

V. Effects of on-line case study activities

In order to explore how the on-line case study activities affected student learning, transcripts of all the written messages were analyzed, and an attempt was made to draw up a typology of electronic messages on the basis of the educational values they displayed. Only transcripts of written messages for the first on-line case study activity were analyzed because these messages were written by individuals and were more suitable for investigating the intellectual interactions than were those formed by groups in the second activity. Some of the specific educational questions addressed during the analysis were:

(a) Do messages draw on the subjects' own experience?
(b) Do messages refer to the course material?
(c) Do messages refer to relevant materials outside the course?
(d) Do messages reveal any pattern of interaction?

The time-independent feature of communication technology allows asynchronous exchange of ideas. The students did not have to respond to any messages immediately. This gave the students time to draw ideas from different sources other than the textbook, such as personal learning experience, lectures, newspaper articles, Internet resources and other relevant materials. The analysis of the transcripts reveals the independence and initiative displayed by the students in searching out different sources of information they could use to develop their ideas for the on-line case study. For example, one male student wrote a message drawn from his personal learning experience concerning speed reading:

> "... I received speed reading training while I was preparing for the national entrance exam during senior high school. I really feel that speed reading training helps me read faster, but it may decrease comprehension. I also feel that I learned a lot about study skills from the training. Although the speed reading skill can be acquired within a short period of time, you still need to keep practicing in order to maintain those skills. In my experience, a speed reading training course teaches different reading skills, such as skimming through control of eye movements, reading without subvocalizing, range reading, meta guiding with photographic memory, mind mapping, etc."[2]

Some of the students wrote messages to express their ideas based on knowledge they obtained from the textbook. Some of them used information they had learned in order to defend speed reading and explained how it really facilitated quick learning of text material. Others doubted the educational value of speed reading. For example, a student drew a theory about human memory to explain why speed reading can not facilitate deep learning and information processing:

> "...In 1972, Craik and Lockhart proposed the theory of levels of processing where information can be processed in human memory at either the syntactic level or the semantic level. Processing information at the syntactic level becomes superficial processing. It is difficult to keep information that is processed at the syntactic level in their memory for a longer period of time for later retrieval. Speed reading training only teaches students how to draw quick attention to learning materials, but does not allow time for deep information processing. Therefore, speed reading does not help individuals to retain information in their memory for long periods of time..."

In addition to personal experience and textbook theories, several students obtained information from the Internet and from materials outside the course, respectively. The following excerpts indicated that students drew information from two alternative sources to add to the discussion. The first source was from the Internet:

> "... Many people believe that speed reading is simply skimming or scanning materials and that reading material slowly is the best way to subsume printed information. Such assumptions are incorrect. Skimming may be appropriate for reading new material. Surprisingly, the more quickly you read, the better you can remember what you read. But it is important to comprehend what you read. One efficient way to read material is mind-mapping, a multi-dimensional mnemonic, where you make use of the structure of paragraphs and their placement in the text to improve your reading efficiency, but do not use each word. For example, you just make up a memory word for the main theme of each paragraph and relate them to one another. Reading paragraph by paragraph easily helps you understand. Reading materials word for word does not help comprehension... Resources: http://www.study.com.tw/txt3.htm...."

The second source was other relevant reading material:

> "I did not know much about speed reading until I read the book "Marvelous Speed Reading Techniques," written by Elice Ai. There is still controversy as to whether speed reading can enhance learning. Speed reading mainly requires readers to concentrate as much as they can while reading. This skill emphasizes direct contact between the eyes and the brain, not the mouth. Therefore, speed reading can increase reading efficiency and enable readers to read materials several times within a short period of time. Sometimes, overlearning can be achieved through speed reading, which can help students memorize information for tests to be held the next day...."

Analysis of transcripts also revealed that there were no particular persons who dominated or took the lead during discussion, and all the students posted at least one message.

Another interesting finding in the first case study activity was discerned during message flow analysis in which the number of messages per day was plotted against the duration of the activity (Levin et al, 1990). As Figure 2 shows, the number of messages issued and the number of student logins per day significantly correlated, $r = 81$, $p \leq .000$. That is, the more the students logged onto the system, the more messages were issued by them. The number of logins per day, however, was not equal to the number of students who logged onto the system. Some students might log into the system more than once in a day. Similarly, the number of messages issued per day also was not equal to the number of students who posted the message. Some students posted more than one message per day. Table 2 provides detailed information concerning the number of logins and messages issued per day against the number of students who logged onto the system or issued messages. Interestingly, the number of student logins and messages jumped dramatically each Tuesday, which was when the class met. For example, while there were 15 messages and 43 student logins on the first Tuesday, there were fewer than 10 messages and fewer than 20 student logins on any other day during the first week. Except for Tuesday, there were no significant differences in the number of messages or student logins between weekdays and weekends. A similar pattern was found in the second week of on-line activity. Obviously, the ebb and flow of messages and student logins corresponded to the ebb and flow of school activity. Therefore, the general level of activity of the network learning environment was very similar to that of the face-to-face environment (Levin, Kim, & Riel, 1990).

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[2]All excerpts are translated from Chinese.

Table 2. Number of Logins vs. Number of Students Who Logged In and Number of Messages vs. Number of Students Who Issued Messages Per Day in the First Case Study Activity

Date	5/7 (Mon)	5/8 (Tue)	5/9 (Wed)	5/10 (Thur)	5/11 (Fri)	5/12 (Sat)	5/13 (Sun)
No. of logins per day (No. of students who logged in)	20(20)	10(9)	11(10)	5(5)	3(2)	8(4)	43(35)
No. of messages per day (No. of students who issued messages)	5 (5)	2(2)	3(2)	1(1)	2(2)	6(5)	15(15)
Date	5/14 (Mon)	5/15 (Tue)	5/16 (Wed)	5/17 (Thur)	5/18 (Fri)	5/19 (Sat)	5/20 (Sun)
No. of logins per day (No. of students who logged in)	32(34)	20(17)	16(13)	15(12)	12(12)	26(22)	27(20)
No. of messages per day (No. of students who issued messages)	5(5)	6(4)	5(4)	5(5)	4(4)	7(7)	14(10)

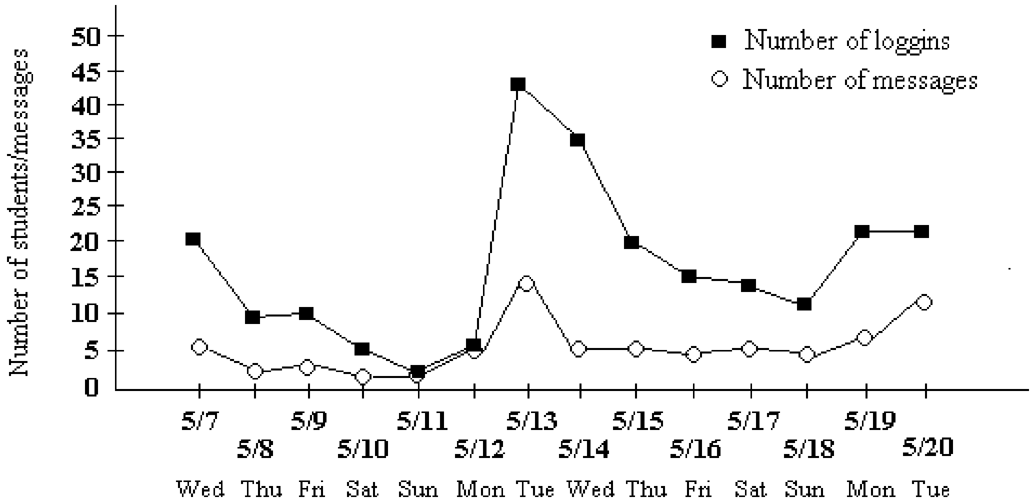

Fig. 2. Number of logins/messages in the first case study activity.

Analysis of transcripts also revealed that not all the students introduced new ideas about speed reading; some of them developed, elaborated or synthesized on what students had introduced previous messages. Researchers investigating on-line learning found that at least three types of roles could be identified when tracing specific themes discussants wove their way through messages: idea introducer, idea developer, idea synthesizer (Vallee, Johansen, Randolph, & Hasting, 1974). Based on this idea, an analysis of the most important role that each message plays was made for the first on-line activity. As Fig. 3 shows, in the initial stage of the activity, students' messages dealt mainly with idea introduction and development. Some of the students' messages introduced speed reading, such as the theoretical assumptions underlying speed reading, different kinds of speed reading approaches, or examples of successful learning experiences. Other students then drew certain psychological theories from textbooks to support or dispute previously initiated ideas. As more new ideas were introduced, more students began to add information to elaborate upon earlier ideas during the middle stages of the activity. Almost 60% were considered as idea developers from day 4 to day 12. The tendency toward idea synthesizer became more apparent near the end of the activity. After reading previously developed ideas, some of the students attempted to synthesize what they had read and arrived at their own understanding and conclusions. Nodes, with different color patterns in Fig.3 represents messages. Messages sharing the same content are connected. The transition from idea introduction to idea development and idea synthesis is explicitly shown in Fig. 3.

The chart in Fig. 3 shows that messages sharing the same main ideas were clustered around each day, and clusters containing messages with the same main ideas were linked with lines across the duration of case study activity. A main idea was elaborated upon into more specific ideas that later became main ideas. For example, students at first might think from the perspective of forgetting or comprehension perspectives

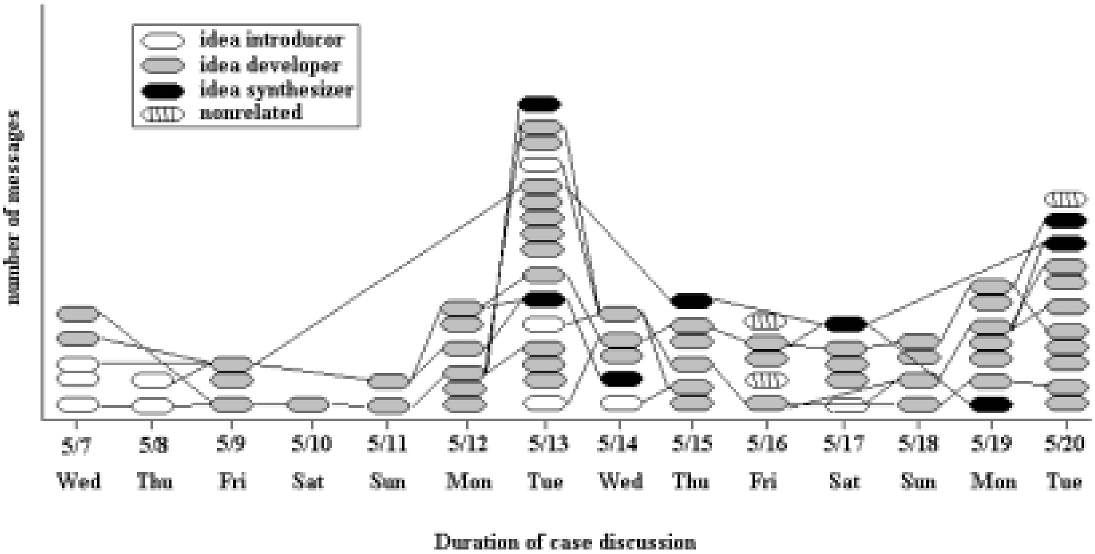

Fig. 3. The multi-threaded characteristics of electronic message flow in the first case study activity.

to dispute the educational value of speed reading. More elaborate ideas may then be developed by adopting either memory decay or different information processing theories to defend the forgetting perspective. The map clearly reflects how on-line intellectual interactions were formed. It also demonstrated the multi-threaded nature of electronic message interactions, and the fact that different ideas were pursued in parallel (Quinn, Mehan, Levin, & Black, 1983). Interestingly, the multi-threaded nature became more apparent during the later stages of the case study activities when the senders of the messages progressed into idea developer or synthesizers.

3. Discussion and Conclusion

The findings of this case study revealed that students had a positive attitude toward network learning after they used the Internet communication program, EdPsy Web, to assist learning, social interactions, group problem solving, assignment delivery, and knowledge sharing. According to results of the post-course survey, the students were highly motivated to use any system that would allow them to send their assignments electronically, to read their teacher's evaluative comments, and to compare other students' works in electronic form. In most traditional classroom settings, students usually submit assignments to their teachers physically and receive feedback from them without having an opportunity to understand what they had accomplished in comparison with other students. In the EdPsy Web, however, students had the opportunity to see and compare their work with that of other students. This provided an opportunity for students to be more aware of their learning progress, leading to a more effective knowledge acquisition process.

The results of this study support the hypothesis that two variables, gender and prior Internet experience, significantly correlated with students' attitudes toward the Internet communication program. These findings are consistent with those of previous studies on students' attitudes toward computer-assisted learning environments (Arch & Cummins, 1985; Levin & Gordon, 1989; Shashaani, 1994). Since boys are exposed to computers at an earlier age and more often than girls (Shashaani, 1994), they have more opportunities to use the Internet, and are therefore more apt to take advantage of this kind of tool. With less time exposure to the Internet, most female students in this study were not familiar with the functions afforded by this program. Most female students did not fully appreciate it, nor did they take advantage of it. This may have a bearing on the differences in the male and female students' attitudes toward the program. The positive attitudes that students had towards the Internet program may be attributed to the novelty effect. It has been argued that the novelty effect might be significant during the first two or three weeks, but it will gradually disappear when students become more familiar with the environment.

Analysis of the on-line case study activities revealed that the students took full advantage of the communication program to generate and express their ideas. In traditional classroom settings, students who like to show off may dominate the entire discussion while others who are shy about expressing themselves may just sit and listen without taking advantage of opportunities to share their ideas with their classmates. Traditional classroom discussions only allow ideas to be presented within a fifty-minute time frame. The network-enhanced learning environment provided more time and opportunities for students to generate and express their ideas. According to the results of our survey, the students preferred that the on-line case study activities be held on an individual basis rather than as a group. This may indicate that the students were motivated to use the program to express their own thoughts, and that they learned by using it individually. For the first on-line case study activity, the data explicitly showed that there was no group leader who dominated and took the lead during the on-line learning activity, and that all the students posted messages. Evidently, the network learning environment provided a more egalitarian climate for social and intellectual interaction.

This research focused on using communication technology to improve intellectual interactions and knowledge sharing opportunity in a traditional classroom setting. Although the results of this study indicated that the introduction of communication technology into traditional classroom instruction might improve students' intellectual interaction, the conclusions may not be so encouraging. Since this research was based on one case study, it may be that the findings of this research can not be generalized to other instructional situations. Much more similar research needs to be done to explore and add to our understanding of the potential applications of communication technology in reforming conventional approaches to schooling. It is important to find out whether collaborative learning using communication programs in different domains cause different forms of intellectual interactions which result in different learning outcomes. Future research should focus on the development of communication programs with more intelligent interfaces to help moderate and facilitate social and intellectual interactions. As for teachers, it will be challenging for them to devise and master effective instructional approaches using modern communication technology in order to improve their teaching abilities and increase interactions with their students.

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Appendix

Samples statements in the post-course questionnaire.

1. I feel engrossed in learning with EdPsy Web.
2. I am willing to use similar tool in other course.
3. Inspecting other students' works in the network can be helpful.
4. The on-line problem solving activities motivates us to learn.
5. It is convenient to deliver assignments electronically.

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檢視網路支援學習環境中學習者智能互動的歷程 ── 一個個案研究

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摘　要

眾所週知，網際網路的發展已賦予傳統教學活動無限的發展潛能。這篇研究報告主要是描述一項探索性質的個案研究，以瞭解在網際網路支援學習環境中，學生的社會互動與知識分享的過程。此研究主要是檢視一個網際網路教學工具 "EdPsy Web" 如何支援學習者參與學習一個師資培育的課程，並在其間協助強化師生間的互動。這個研究根據問卷調查、線上資料及電子訊息分析等方法探討以下兩個問題：(a) 網際網路輔助教學活動如何能激勵學生互動與分享觀點與知識？(b) 學生是否在此環境中呈現出有別於傳統教室學習的行為？問卷調查的結果得知多數學生可以體會並持正面的態度肯定網際網路輔助教學的價值。學生偏好以電子檔的型式繳交作業，同時可以在線上流覽老師對作業所給予的評語，並比較同學間的作品，藉以檢視個人的學習狀況。由於網際網路輔助教學活動不受時間與空間的限制，可以提供合作思考與知識分享的機會。自學生在線上進行個案研討的電子訊息中，分析顯示線上資訊以多線 (multiple threads) 的型式呈現，可以容許相關的課題與不同的觀點同時出現，藉以激發學生多元思考的能力。而線上資料的分析結果也發現學生的部份行為與傳統教室的學習行為無異。要言之，網際網路輔助教學活動在學習者智能互動方面，展現出不同的教學風格。