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Computer conferencing: can it significantly improve distance adult students' learning outcomes and student interactivity?

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Abstract

The study aimed at identifying the effectiveness of computer conferencing and integrated media when being applied to distance education in Thailand. Both quantitative and qualitative methods were employed. The subjects of the study were 92 Thai distance adult students who enrolled in a secondary education subject (Quality of Life Improvement) in the second semester of Academic Year 1999. On a random basis, they were divided into three groups. Students in the first group studied by using traditional material and engaging in face-to-face group discussions. Those in the second group also studied by using the traditional method but they had word- processing access for their homework and assignments. Students in the other group studied by using the same material and participating in online group discussions during a period of a 10-week experiment. Research instruments including an academic achievement test, an attitude scale, a questionnaire, computer mediated communication (CMC) records of contributions, teachers' comments, student self-reports and focused group interviews, were used to collect data. It was found that students in all three groups improved their scores upon the post-test measures of academic achievement. Those who participated in online group discussions also had a more positive attitude towards computer and information technology. The integrated technologies significantly supported student interactivity and collaborative learning.

Keywords

Student-led electronic discussion, Computer conferencing, Student learning outcomes, Student academic achievement, Student attitude towards computer and information technology, Student interactivity, Collaborative learning

1. Introduction

Technology has become increasingly interactive and distributed such that learners in the new millennium are able to participate in incredibly complex networks of information and resources. New learning technologies can provide enhanced communication and interaction to support learning. These include: 1) communications technologies such as video conferencing, electronic mail, computer conferencing and 2) technologies that provide access to information such as the Internet and the World Wide Web (O'Rourke 1999, p.100). Each technology has different characteristics - strengths and limitations - that make it more

or less appropriate for a given learning need (Chute et al 1999, p.25). When applying these technologies to distance education or flexible learning, distance educators and administrators therefore need to make a reasonable decision about which particular technology or mix of technologies, support their grounded educational context and available information technology facilities.

Computer Mediated Communication (CMC) applications have advantages on student learning while they study on-campus and off-campus. The applications provide opportunities for students to increase interaction and collaboration with their peers. Computer conferencing is a significant application that is being utilized to support student-to-student communication in teaching and leaning settings. It not only supports social interaction among students, but also it helps students to learn newly created knowledge or new understanding as a result of the conference interaction.

The study has been undertaken within a non-formal education program in the educational context of Thailand. An integration of multi-media and computer conferencing has been utilized in adult student learning processes. The main purpose of the study was to study adult student learning outcomes in terms of student academic achievement, student attitude toward computer and information technology and student interactivity.

2. An Overview of the Educational Context in Thailand

2.1 Education in Thailand

According to the National Education Act B.E.2542 (Office of the National Education Commission 1999), the structure of education in Thailand covers three types of education: formal education, non-formal education and informal education. *Formal education*, divided into two levels: basic education and higher education, is mainly provided for students in educational institutes. *Non-formal education* is provided for those missing an opportunity to enroll in formal education. These students can enroll in primary, lower secondary or upper secondary education level as distance education students. Most of them continue their higher education level in tertiary education in colleges and universities after they finish their upper secondary education. Distance education students can obtain knowledge from a variety of learning sources. In addition, there are some vocational and technical short-term training courses offered in non-formal education provision for adult students. Non-formal education is similar to adult education provided in Open Access College and Adult Re-entry College in Australia. *Informal education* is provided to enable students and general people to learn something by themselves according to their interests, potentialities, readiness and opportunities available from persons, society, environment, media or other sources of knowledge.

Educational technologies have been applied to education in this country for such a long time. Broadcasting media, for example, have been developed for government and general use, especially for commercial use and entertainment since 1930. The utilization of television broadcasts for education started in 1964 when the government launched an instructional television project to broadcast television programs to primary schools in Bangkok. The expansion of education opportunity of the government has led to the establishment of the Center for Distance Education by Satellite in 1994 (The Ministry of Education 1999). Computer technologies have also been used in education since 1979 when the Ministry of Education established the Ministry of Education Network (MOENet). In formal education, especially in primary and secondary schools, owing to the educational reform 1995-2007, the Ministry of Education has provided some funding to support these computing facilities. In most private schools where they are self-funded, computer technologies are widely applied to teaching and learning. The progress of computer

technology for education is rapidly increasing in higher education due to the government policy of expanding opportunities for higher education to the provinces through the use of information technologies. Owing to the limited budgets provided by the government, computer facilities are still in great demand. In some local learning centers under the supervision of Non-formal Education Department, these facilities are supported by local authorities

In Thailand, education media utilized in distance education generally comprise main media (printed materials) and supporting media including audio and video cassettes, radio and television programs. At present, the integration of education media and computing facilities including computer networks is also increasingly utilized in Thai educational context both in formal and non-formal education. Web-based instruction is also increasingly applied to support traditional media. Besides traditional learning materials, in formal education especially in upper secondary education level and in higher education both in public and private universities and colleges, online resources are tremendously developed in order that students can enhance their learning experiences.

2.2 Innovative projects in Thailand

In order to achieve the major goal of expansion of compulsory education to all Thai people from 6 years to 9 years and to provide quality basic education to all Thai people for at least 12 years according to the New Constitution 1997 of Thailand, some innovative projects have been established. *Satellite Distance Education Project* in cooperation with the ThaiCOM foundation and the Ministry of Education was initiated to provide television broadcasts through the ThaiCOM satellite in 1994 (Yamsaka 1998). The main objectives of the project are to provide educational opportunities to all target groups, to develop the effectiveness of distance education provision and to strengthen the quality of distance education programs. From the 5-year follow-up evaluation of the project (1994 -1999), it was found that the project implementation successfully achieved the major objectives although some administrative aspects needed to be concerned and improved. The project is now being implemented and some public and private organizations get involved both in television program production and also in the development of the project management.

Lighthouse Project, another innovative project, was initiated by Non-formal Education Department (1999) in cooperation with Massachusetts Institute of Technology (MIT), run by Professor Seymour Papert of America. The project, applying computer technology and the Internet to distance student learning, was aimed to improve teaching and learning process of learners in such a way that they have their own thoughts. A pilot project was first launched in 1997 in Chiengrai Province in the north of Thailand. In collaboration with the Northern Regional Non-Formal Education Centre on professional training programs, the project has been expanded to Lumpang Province in 1999. All non-formal education instructors participating in the project, attended Micro Worlds/Lego-Logo and Electronic Magazines Training Computer Programs. Then, the non-formal education facilitators organized classrooms for distance education and vocational non-formal education student training programs. These initiated each student to proceed the project s/he was interested in. Besides, it also enabled learners to use creative thinking, problem-solving skills, and assisted learners to accomplish his or her project properly. At the same time, learners had an opportunity to practice learning and provided assistance for each other in the peer learning. In 1999 this project was tried out as a village project at Nongbote Community Learning Centre in Nang-Rong, Burirum Province in the northeast of Thailand. At present, the project implementation has been expanded to many schools and institutes in different departments throughout the country.

Moreover, Non-formal Education Department established the *Electronic Library Project* in non-formal education centers throughout the country. The department has increasingly developed a number of online subjects and resources for distance education students and general people. They can access to the online resources from electronic libraries where computer networking is fully equipped. They can also access to these online resources from homes and workplaces. These online materials are self-study programs that the students and the interested people can choose to learn whatever subjects or topics they like at their own time and at their own pace. Throughout the country, electronic libraries have been increasingly developed and equipped with electronic media of different programs of study and different areas of interest. Electronic learning materials and computer technologies including Internet access have been provided to all target groups of people who seek information for their quality of life improvement.

3. Review of Literature

The literature review mainly focuses on important studies which are relevant to the research study. It includes five main topics as follows:

- approaches to learning and student interaction at the individual level;
- student interaction at the group level;
- collaborative learning;
- adult student characteristics;
- students'attitude toward computer and information technology.

3.1 Approaches to learning and student interaction at the individual level.

When discussing student approaches to learning, the study mainly focused on three types of approaches to leaning as categorized by Biggs & Moore (1993). These three types are surface, deep and achieving approaches. The surface approach is generally associated with negative factors such as poor performance, ill-structured learning, dropout, and poor academic self-concept. The deep approach, on the other hand, is associated with positive factors; namely, an academic approach focused on personally valued subjects, qualitatively rich learning and a good academic self-concept. The achieving approach is also positive academically, but it is more externally driven by the need to excel. An approach to learning reflects the interaction between a student's current motivation and the teaching context. The approach can then impact on student motivation.

Interaction has already been identified as an important ingredient in student learning. identifies three types of interaction: learner - content, learner - learner, and learner-instructor. Learner-content interaction explains the learner's involvement with the content as they construct their knowledge by building on the information given. Learner-learner interaction is either a one to one exchange or is communication with a small or large group. Learner-instructor interaction is the communication between the learner and the instructor for the purpose of explaining, elaborating, scaffolding and providing feedback.

Another view on interactivity is provided by and who discuss interaction in terms of a pedagogical technique based on the four communication paradigms. One-alone communication refers to engagement with the learning resources, which may include online databases, learning activities, and web resources. One-one communication is between two people accommodated by email or one-one chats. One-many communication is supported through discussion lists, bulletin boards online chats and symposiums. Many-many communications can be organized within computer conferencing systems and can include debates, role plays, brainstorming as a few examples.

Some studies have concentrated in describing student critical thinking and student reasoning skills by the use of Computer Supported Co-operative Learning (CSCL) technologies. These studies have aimed at analyzing student text contributions within student-content interaction by applying Garrison's theory of critical thinking and Henri's theory of critical reasoning skills (Kitchen & McDougall 1998; Marttunen 1998; Newman et al 1997). Garrison's critical thinking stages (Garrison 1992) can be compared with Henri's critical reasoning skills (Henri 1992) in Table 1.

Table 1: A Comparison of Garrison's Critical Thinking Stages and Henri's Critical

Reasoning Skills

Garrison's Critical Thinking Stages	Henri's Critical Reasoning Skills
1. Problem identification *a triggering event arouses interest in a problem*	1. Elementary clarification *observing or studying a problem, identifying its elements, observing their linkages*
2. Problem definition *define problem boundaries, ends and means*	2. In-depth clarification *analyzing a problem to understand its underlying values, beliefs and assumptions*
3. Problem exploration *ability to see to heart of problem based on deep understanding of situation*	3. Inference *admitting or proposing an idea based on links to admittedly true propositions*
4. Problem applicability *evaluation of alternative solutions and new ideas*	4. Judgement *making decisions, evaluations and criticisms*
5. Problem integration *acting upon understanding to validate knowledge*	5. Strategies *for application of solution following on choice or decision*

Garrison' s Critical Thinking Stages and Henri's critical reasoning skills can be applied to surface and in-depth learning processes. The first stage can be applied to surface approach and stages 2 to 5 can be applied to deep-achieving approach. Some stages can be integrated and briefly, there are two main processes of cognitive skills. These are surface and in-depth or deep-achieving processes.

3.2 Student interaction at the group level

have provided a strong theoretical basis for cooperative learning as outlined in cognitive developmental, behavioral and social interdependence theories. Most of this theoretical basis has been derived from face to face studies, but such theories are finding support in computer-mediated environments. An understanding of the theory of social interdependence

provides insight into the behaviors that occur through computer conferencing. They cited a number of studies in which collaborative learning has been shown to yield high levels of achievement and also has demonstrated other positive outcomes such as 'greater interpersonal relationships' and 'improved psychological health'.

Based on the constructivist learning environment, students participating in a computer-mediated conferencing are interacting with other students to produce new knowledge. They also arrive at new understandings of meaning. Levin et al (1990) proposed a constructivist model of CMC interaction. Within the proposed model, each participant responds to a statement, a question or a problem by contributing to the whole group his/her information, understandings, personal experiences and referenced data. Some dissonance or disagreements may occur and then, the negotiation is needed in order to propose a preliminary conclusion or restate a tentative statement. After that, testing and modification of proposed conclusion with references need to be done before they come to the agreement statement and newly constructed knowledge.

Gunawardena et al (1997) studied the five categories of the content analysis of the transcripts suggested by Henri (1992) and pointed out some weaknesses within the 5 dimensions. They identified only 3 dimensions: interactive dimension, the content indicating the application of cognitive skills and the content showing metacognitive skills. From these 3 dimensions, they attempted to find out appropriate interaction analysis/content analysis to assist in examining the negotiation of meaning and co-construction of knowledge in collaborative learning environments. In addition to Henri's theory, based on the constructivist model of CMC interaction proposed by Levin et al (1990), the new interaction analysis model was developed and proposed. The interaction analysis model is outlined in 5 phases as follows: 1) sharing / comparing of information; 2) discovery and exploration of dissonance or inconsistency among ideas, concepts or statements; 3) negotiation of meaning/co-construction of knowledge; 4) testing and modification of proposed synthesis or co-construction; and 5) agreement statement(s) /applications of newly-constructed meaning (Gunawardena 1997).

Johnson & Johnson (1996) identified numerous behaviors in their own research and also in other research studies which they referred to as 'Interaction Patterns'. These patterns are categorised as follows: 1) giving and receiving help and assistance; 2) exchanging resources and information; 3) giving and receiving feedback; 4) challenging each other's reasoning; 5) advocating increased efforts to achieve; 6) mutually influencing each other's reasoning and behavior; 7) engaging in the interpersonal and small group skills; and 8) processing group members effectiveness.

Group learning is a good way of encouraging social interaction and has often been used to promote deep learning. Students learn best by interacting with others, rather than in working in isolation. Through group work students are motivated and encouraged to remain focused on the task. The resultant interactivity leads to knowledge building which requires "articulation, expression or representation of what is learned" (Jonassen et al 1999).

3.3 Collaborative learning

Collaborative learning is a kind of learning style by which an individual can learn with partners for the common purpose. In the process, learner can share work, information, experience and have social interaction. Collaborative can be used to increase interaction in adult distance learning. Collaboration and cooperation are different. Pugach and Johnson (1995) emphasize that collaboration is more than just sharing ideas. Collaboration grows out of trust between professionals. It cannot be constructed artificially. Cooperation is defined as acting together, in a coordinated way at work, leisure, or in social relationships, in the pursuit

of shared goals, the enjoyment of the joint activity, or simply furthering the relationship. Collaborative learning has basically been valued for its benefits. It can prepare learners for the workplace and it can help individuals to work and live well.

Collaborative learning groups can be a valuable teaching tool in countering the isolation felt by distance education students. In collaborative learning, participants share ideas and elaborate on new material. The outcomes in terms of more self-directed and deeper learning appear to depend on the extent of students' willingness to get involved, to share ideas with other students, and to take responsibility for their own learning.

Collaborative learning can be applied to CMC environments, especially in the distance learning which learners lack the interaction between instructors and learners and among learners. Stacey (1998), in her study, investigated the experiences of the students over two semesters of their MBA course, focusing particularly on their use of group communication through the electronic system. The use of CMC has been researched as it was used in small group electronic conferencing as a means of facilitating the groups' social construction of knowledge. It was found that the group processes and tasks in the researched course could facilitate the social construction of knowledge within the groups. Their process of collaborative learning was achieved through a range of collaborative behaviors and through a model of the attributes of collaborative learning which emerged from the analysis of the data gathered from the students participating in the study. The attributes of the social construction of knowledge which emerged through collaborative learning via CMC were: 1) sharing the diverse perspectives of the group members; 2) clarification of ideas via group communication; 3) feedback to a learner's ideas from other group members; 4) seeking group solutions for problems; 5) practicing the new language of the knowledge community in discussion with other group members before using this language in the whole group or in the new knowledge community; 6) the power of group discussion either mediated by communication media or by direct contact; and 7) group sharing of resources.

In summary, the research suggests that CMC technologies, which are used to support collaboration, discursive interaction and the building of relationships, can provide the scaffolding that guides, supports and develops the construction of knowledge leading to quality learning outcomes.

3.4 Adult student characteristics

Distance students are different in various factors such as age, gender, family responsibility, employment base, and purposes of enrolling in courses, previous skills and experiences in some particular areas or topics. In order to help them to make the most of their distance learning experiences, it is important that distance educators consider student factors and characteristics. A research report studied students' demographic characteristics: age, gender, personal income and socioeconomic status in relation to student satisfaction with interactive telecourses (Biner et al. 1996). Results showed that among the demographic variables, gender reliably predicted student satisfaction with the management of telecourses. Male students were more satisfied than females with those aspects of the courses. But age, personal income and socioeconomic status were not related to this satisfaction. Further analysis needs to be done in order to explain why male students are more satisfied than females. There may be some other factors such as attitude toward computers and technologies, and previous experiences in the related area.

In the teaching-learning process, student characteristics may include conceptions of learning, developmental factors, social factors, abilities, expectations of success and failure and preferred approach to learning (Biggs & Moore 1993), but for the distance learners, some other characteristics are quite important in pursuing education at a distance. A

research study has explored student characteristics, in using CMC technology, such as gender, academic self-concept, parental education, skill and experience with technology, communication apprehension and social influence. The factors found necessary in using CMC technology successfully were experience with computer, social influence with respect to CMC tools and communication apprehension (Fishman 1997).

A survey of expert opinion about distance education research in developing countries found that little research information was available on the following: learners characteristics, development of students' study skill, expert learning systems and professional development of distance education. It also suggested that research efforts should be concentrated in some specific areas, including learner characteristics (Jegede 1993).

3.5 Students' attitudes toward computer and information technology

Students' attitudes appear to be very important to students' academic achievement. Although some research reports investigated the relationship between students' attitudes and their academic achievement, no strong significant relationship has been found. However, more recent studies have shown that a relationship between students' attitudes and academic achievement does exist. Ma (1997) in a study on 'Reciprocal Relationships Between Attitude Toward Mathematics and Achievement in Mathematics', in which data were used from high school seniors from the Dominican Republic who completed mathematics achievement tests and a questionnaire on mathematics attitudes, found that reciprocal relationships existed, and suggested that the reciprocal nature between attitude and achievement could substantially modify their causal relationship. Likewise, Freedman (1997) in a study that investigated the use of a hands-on laboratory progress for improving student attitudes toward science and increasing student achievement levels in science knowledge, indicated that students who had laboratory instruction scored higher in achievement and showed a positive correlation between attitude and achievement. The literature, therefore, suggests that there is a relationship between student attitude and academic achievement, even though these are in the same area of specialty.

Concerning attitudes toward computers and information technologies, a number of research reports investigated student attitudes toward computers and information technologies by using various types of attitude scales. Some research reports were concerned with the development of some attitude scales, mainly looking at their reliability and validity. Popovich et al. (1987) developed the Attitude Toward Computer Usage Scale (ATCUS), using a sample of undergraduate students to measure an individual's attitude toward computer usage. Popovich et al., using factor analysis, identified four major components of computer attitudes: positive reactions to computers, negative reactions to computers, reactions to computer-related mechanisms and computer and the education of children. Brown, Brown and Baack (1988) further tested ATCUS using senior citizens to determine if the same factors were present for the senior age group. The results were very similar; however, the factors loadings were more consistent than the original study.

Some research reports investigated attitude toward computers and information technologies at different dimensions and different levels of education. Westbrook (1997) in a study on 'Changes in Students'Attitude Toward Graduate Business Instruction via Interactive Television', in which data were used from graduate business students during the first term of a two-year degree program taught via a fully interactive telecommunications systems, found that students attitudes changed between the time they began classes and completed their first term. Likewise, Knezek and Christensen (1997) in a study on 'Changes in Teacher Attitudes During Six-Week Technology Training Sessions', found that teachers who completed the technology training viewed as positive outcomes of the training session a reduction in anxiety and an increase in prestige associated with using computers. These

research reports imply that attitudes can be changed within a period of time if effective materials and methods are properly implemented.

4. Method

4.1 Participants

The study focused on adult distance education students. The participants were 92 distance adult students who enrolled in a secondary education subject (Quality of Life Improvement) in the second semester of Academic Year 1999 at a learning center in Petchburi Non-formal Education Center, Petchburi Province in the central part of Thailand. Most of them were mainly mature-aged students and they had jobs and family commitments.

4.2 Procedures

The study employed both quantitative and qualitative methods. A quasi-experimental research design using control and experimental groups with pre-test/post-test designwas implemented. The research procedures included three main stages: the pilot study, the experiment and the follow-up study. On a random basis, students were divided into three groups; of which, 38 student were in Group 1 known as Control Group 1, 26 students were in Group 2 known as Control Group 2 and 28 students were in Group 3 known as the Experimental Group. During the experiment period of 10 weeks, Students in Group 1 studied by using traditional material and engaging in face-to-face group discussions. Those in Group 2 also studied by using the traditional method but they had word- processing access for their homework and assignments. Students in Group 3 studied by using the same material and participating in online group discussions. The experiment covered 10 main topics during a period of a 10 weeks.

Data were gathered from three sources: students, teachers and administrators. Research instruments included an academic achievement test, an attitude scale, a questionnaire, computer mediated communication (CMC) records of contributions from Group 3 students known as student discourses within online discussions, teachers comments, student self-reports and focused group interviews.

The questionnaire was used at the beginning of the study to collect general information about student characteristics and the student approaches to learning modified from Learning Process Questionnaire (LPQ) (Biggs 1987). The academic achievement test and the attitude scale were used at the beginning and at the end of the 10-week period of the experiment as pre-test and post-test measurements to collect data regarding student academic achievement and student attitude toward computer and information technology. The academic achievement test, developed by Department of Non-formal Education, covered the contents of 10 main topics. The attitude scale (ATCUS) was first developed by Popovich et al (1987), furthered tested by Brown, Brown and Baack (1988) and modified by the researcher. In a factor analysis of ATCUS carried out in previous work (to be published), it was found that there were two major factors. These two factors were Factor 1 known as "Positive feelings and reactions to computer", and Factor 2 known as "Negative feelings and reactions to computer". These two factors were treated separately in further data analysis.

Teacher comments, Student self-report and focused group interviews with students, teachers and the administrators who got involved in the study were used during and at the end of the study to collect data regarding student interaction and collaboration, and student support from teachers and administrators and also IT facilitated within the learning centre. The student discourses were archived from student CMC records of contributions for the discourse analysis by using an instrument developed by the researcher. The instrument

based on grounded theories included behaviour analysis at individual level and interactive behaviour analysis at the group level as shown in Table 2.

Table 2: Cognitive Skill Development and Interactive Analysis Model

Behavior analysis at individual level:

I1 Elementary clarification

I1-a Observing/studying a problem

I1-b Identifying its elements

I1-c Observing/studying their linkages

I2 In-depth clarification

I2-a Analyzing a problem

I2-b Identifying assumptions

I2-c Establishing referential criteria

I2-d Seeking out specialized information

I3 Synthesis and application

I3-a Drawing primary conclusions

I3-b Proposing an idea based on links and relevant information

I3-c Value judgment on relevant solutions

I3-d Making final decisions and deciding on the action(s) to be taken

Interactive Behavior analysis at group level:

G1 Sharing/comparing/contributing of information, encouragement, help and feedback

G1-a Asking and answering questions to clarify details of statements

G1-b Sharing and exchanging knowledge, resources and information

G1-c Challenging others to engage in group discussion, giving help and feedback

G2 Inconsistency of ideas, concepts or statements

G2-a Identifying and stating areas of disagreement

G2-b Asking and answering questions to clarify the source and extend of disagreement

G2-c Restating the participant's position and advancing arguments or considerations supported by references

G3 Negotiation of meaning/co-construction of knowledge

G3-a Negotiating or clarifying the meaning of terms and areas of disagreement

G3-b Proposing new statements embodying compromise and co-construction

G3-c Integrating or accommodating metaphors or analogies

G4 Testing and modification of proposed synthesis or co-construction of knowledge

G4-a Testing against personal experiences

G4-b Testing against existing knowledge and information

G4-c Testing against formal data collected

G5 Agreement statement(s) and application of newly constructed knowledge

G5-a Summarization of agreement(s)

G5-b Application of new knowledge

G5-c Metacognitive statements illustrated by all participants as a result of the conference interaction

5. Results and discussions

5.1 Student Characteristics

The general information regarding student characteristics were as follows: 1) 54 percent of the students were male and 56 percent of them were between 18 and 25 years old. 2) 46 percent of the students had an income of 3,000-5,000 Thai baht per month (approximately 24 baht = AUD$1.00) and 38 percent of them had more than 3 years of work experience. 3) 68 percent of the students had no computing experience. 4) 43 percent of the students who

enrolled in this course wanted to gain some more knowledge and learning experiences, of whom, 39 percent wanted to further their higher studies after they completed this course.

The students varied in their approaches to learning as shown in Table 3. It was found that 56% of male students had deep approaches to learning while 64% of female students had achieving approaches in Group 1. For those in Group 2, 57% of male students had deep approaches to learning while 67% of female students had achieving approaches. In Group 3, 67% of male students had deep approaches to learning while 62% of female students had achieving approaches. Overall, Most of the male students had deep approaches while most female students had achieving approaches. Thai students tended to have the combined approaches to learning, that is, the deep-achieving approaches to learning.

Table 3: Student Approaches to Learning: Surface, Deep, Achieving

Group		Male		Total		Female		Total
	Surface	Deep	Achieving		Surface	Deep	Achieving	
Group1	3 (19%)	9 (56%)	4 (25%)	16 (100%)	1 (4%)	7 (32%)	14 (64%)	22 (100%)
Group2	0 (0%)	8 (57%)	6 (43%)	14 (100%)	0 (0%)	4 (33%)	8 (67%)	12 (100%)
Group3	1 (6%)	10 (67%)	4 (27%)	15 (100%)	0 (0%)	5 (38%)	8 (62%)	13 (100%)

5.2 Student academic achievement

By using an academic achievement test of 60 items as pre-test and post-test measurements with students in these 3 groups, the results of student academic achievement were shown in Table 4.

Table 4: Student Academic Achievement

Group	N	Mean (Pre-test)	S.D. (Pre-test)	Mean (Post-test)	S.D. (Post-test)
Control G.1	38	21.47	4.48	32.39	10.65
Control G.2	26	22.81	4.03	27.81	6.49

Exp. Group	28	25.79	4.76	35.36	9.00
Total	92	23.16	4.77	32.00	9.50

The post-test means were higher than the pre-test means for all 3 groups when treated separately. That was to say, students in these three groups had higher academic achievement after the 10-week period of the research experimentation. When comparing means of these three groups, it was found that the pre-test means of these 3 groups were significantly different. It was also found that the post-test means of these three groups were significantly different. When using Analysis of Covariance (ANCOVA) to adjust pre-test means (initial means) and to compare post-test means. It was found that the post-test means of Group 1 and Group 2 were significantly different, the post-test means of Group 2 and Experimental Group were also significantly different but those of Group 1 and Experimental Group were not significantly different.

When comparing arithmetic means between groups by using A 2 x 3 repeated measures ANOVA, the analysis revealed a significant effect for time ($F(1,89) = 82.6$, $p < .001$). However, the group by time interaction was significant ($F(2,89) = 3.6$, $p = .03$). Simple main effects indicated that the increase within the second group was less than the increase within the other two groups, which did not significantly differ from each other.

5.3 Student attitude toward computer and information technology

By using the Attitude Toward Computer Usage Scale (ATCUS) as pre-test and post-test measurements, the results of student attitude toward computer and information technology of the 3 groups of students were shown in Table 5 and Table 6.

Table 5: Student Attitude toward Computer and Information Technology

Factor 1 "Positive feelings and reactions to computer"

Group	Pre-test		Post-test	
	Mean	S.D.	Mean	S.D.
Group 1	28.92	5.77	31.11	3.83
Group 2	30.12	3.58	29.50	5.52
Group 3	31.50	4.00	33.11	4.18

When comparing the pre-test and post-test measurements for Factor 1, it was found that students in Group 1 and Group 3 had more positive feelings and reactions to computer at the post-test measurement while the students in Group 2 had less positive feelings and reactions to computer. It may be concluded that those in Group 2 had a lot of assignments and homework using Word processing and this overloaded tasks negatively affected their attitude toward computer.

When comparing pre-test means of these 3 groups. It was found that the pre-test means were insignificantly different at the beginning of the experiment. After the 10-week period of the experiment, it was found that the post test means of these 3 groups were significantly different.

Table 6: Student Attitude toward Computer and Information Technology

Factor 2 "Negative feelings and reactions to computer"

Group	Pre-test		Post-test	
	Mean	S.D.	Mean	S.D.
Group 1	26.16	5.12	27.53	6.26
Group 2	26.00	5.29	25.27	5.24
Group 3	22.82	5.77	20.89	6.14

When comparing the pre-test and post-test measurements for Factor 2, it was found that students in Group 1 had more negative feelings and reactions to computer at the post-test measurement while the students in Group 2 and Group 3 had less negative feelings and reactions to computer. It may be concluded that those in Group 2 and Group 3 had opportunities to use computers for preparing their assignments and homework and for engaging in online discussions respectively and they could realize the benefits of computers for their tasks.

When comparing the pre-test means of these 3 groups, it was found that the pre-test means were significantly different at the beginning of the experiment. After the 10-week period of the experiment, it was found that the post-test means of these 3 groups were still significantly different.

At the first stage of the experiment, the students had difficulties using computers but after the researcher had conducted some computer and information technology training sessions, the students in Group 2 were able to use computers for their assignments more effectively. For those in the experimental group, they also had more positive feelings and reactions to computer in their post-test measures since computers provide them with opportunities for them to interact with their peers at different times.

From data supported by student self-report and interviews with focused groups of students, it was found that most students regarded computers as their useful tools. Computers supported their individualized learning and group learning. In small group work, particularly in electronic discussion, the experimental group students had enough time to plan their own tasks, to search for relevant information and to participate in group discussion. They also had opportunities to exchange resources and information, to share knowledge with others, and to give and receive help, assistance and feedback among their peers. Computers made them more enthusiastic to learn something and to work in small groups.

5.4 Student collaborative learning

From teacher comments and student interviews, it was found that working in small groups, both in face-to-face group discussions and electronic discussions, had greatly helped students in individualized and group learning. It also helped them to work with the others more collaboratively. Most students agreed that group work was more beneficial to distance students who mostly spent their time studying at homes or at their workplaces by themselves. This was because they had opportunities to exchange knowledge and personal experiences. They also had opportunities to plan, implement and evaluate their group tasks with their peers. Acting as potential leaders and followers in small groups was another beneficial point of group work.

5.5 Student learning outcomes and student interactivity

From student discourse analysis by using the instrument developed by the researcher as mentioned in Table 2, a random selection of two discussion topics were chosen for discourse analysis. The results of the analysis were shown in Table 7 and Table 8.

5.5.1 Student learning outcomes

Regarding the first discussion topic as shown in Table 7, students tended to have interaction with the content at the in-depth level. Their contributions were mostly in proposing an idea based on links and relevant information (I3-b per Table 2, frequency 23.40%) and observing/studying a problem (I1-a, frequency 17.02%). When looking at male and female students, it was found that their contributions were similar. Both male and female students' contributions were in proposing an idea based on links and relevant information (I3-b, frequency 21.95% and 24.53% respectively) and observing/studying a problem (I1-a, frequency 17.07% and 16.98% respectively).

5.5.2 Student interaction and collaborative learning

Most of the students engaged in group discussion by challenging others to engage in groups discussion, giving help and feedback (G1-c, per Table 2, frequency 6.38%), and restating the participant's position and advancing arguments or considerations supported by references (G2-c, frequency 6.38%). Male students mostly engaged in group discussion by restating the participant's position and advancing arguments or considerations supported by references (G2-c, frequency 9.75%) while female students mostly did it by challenging others to engage in groups discussion, giving help and feedback (G1-c, frequency 7.55%). It is evident that most students were involved in interaction and collaboration, although not at the higher levels of engagement.

Table 7: Analysis of responses - Student interaction at individual and group levels

Discussion topic: "Problems of natural water and how to conserve it"

Coding	Students(21)					
	Male(11)		Female(10)		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage

I1-a	7	17.07	9	16.98	16	17.02
I1-b	5	12.19	5	9.43	10	10.64
I1-c	1	2.44	4	7.55	5	5.32
I2-a	3	7.32	6	11.32	9	9.57
I2-b	0	0	0	0	0	0
I2-c	0	0	0	0	0	0
I2-d	0	0	0	0	0	0
I3-a	0	0	1	1.89	1	1.06
I3-b	9	21.95	13	24.53	22	23.40
I3-c	2	4.88	5	9.43	7	7.45
I3-d	3	7.32	1	1.89	4	4.26
G1-a	0	0	0	0	0	0
G1-b	3	7.32	1	1.89	4	4.26
G1-c	2	4.88	4	7.55	6	6.38
G2-a	2	4.88	2	3.77	4	4.26
G2-b	0	0	0	0	0	0
G2-c	4	9.75	2	3.77	6	6.38
G3-a	0	0	0	0	0	0
G3-b	0	0	0	0	0	0
G3-c	0	0	0	0	0	0
G4-a	0	0	0	0	0	0
G4-b	0	0	0	0	0	0
G4-c	0	0	0	0	0	0
G5-a	0	0	0	0	0	0
G5-b	0	0	0	0	0	0

G5-c	0	0	0	0	0	0
Total	**41**	**100**	**53**	**100**	**94**	**100**

5.5.3 Student learning outcomes

Regarding the second discussion topic as shown in Table 8, students tended to have interaction with the content at the in-depth level. Their contributions were mostly in making final decision and deciding on the action(s) to be taken (I-3d per Table 2, frequency 26.92%) and analyzing a problem (I2-a, frequency 17.95%). When looking at male and female students, it was found that their contributions were similar. Both male and female students' contributions were in making final decision and deciding on the action(s) to be taken (I-3d, frequency 22.86% and 30.23% respectively), and analyzing a problem (I2-a, frequency 17.14% and 18.60% respectively).

5.5.4 Student interaction and collaborative learning

Most of the students engaged in group discussion by asking and answering questions to clarify the source and extend of disagreement (G2-b per Table 2, frequency 6.41%) and restate the participant's position and advancing argument or considerations supported by references (G2-c, frequency 5.13%). Male students mostly engaged in group discussion by asking and answering questions to clarify the source and extend of disagreement (G2-b, frequency 8.57%) while female students mostly did it by asking and answering questions to clarify the source and extend of disagreement, and restate the participant's position and advancing argument or considerations supported by references (G2-c, frequency 4.66% and 4.66% respectively). It is evident that a few of male students were involved in higher level by testing against existing knowledge and information (G4-b, frequency 2.86%) and a few of female students were involved in it by integrating or accommodating metaphors or analogies (G3-c, frequency 2.32%).

Table 8: Analysis of responses - Student interaction at individual and group levels

Discussion topic: "What are the damages caused by the destruction of Thai

heritage sites? What's your idea to preserve Thai heritage sites?"

Coding	**Students (21)**					
	Male(11)		**Female(10)**		**Total**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
I1-a	2	5.71	2	4.66	4	5.13
I1-b	1	2.86	0	0	1	1.28
I1-c	4	11.43	1	2.32	5	6.41

I2-a	6	17.14	8	18.60	14	17.95
I2-b	0	0	0	0	0	0
I2-c	0	0	0	0	0	0
I2-d	3	8.57	4	9.30	7	8.98
I3-a	1	2.86	0	0	1	1.28
I3-b	0	0	1	2.32	1	1.28
I3-c	4	11.43	9	20.93	13	16.67
I3-d	8	22.86	13	30.23	21	26.92
G1-a	0	0	0	0	0	0
G1-b	0	0	0	0	0	0
G1-c	0	0	0	0	0	0
G2-a	0	0	0	0	0	0
G2-b	3	8.57	2	4.66	5	6.41
G2-c	2	5.71	2	4.66	4	5.13
G3-a	0	0	0	0	0	0
G3-b	0	0	0	0	0	0
G3-c	0	0	1	2.32	1	1.28
G4-a	0	0	0	0	0	0
G4-b	1	2.86	0	0	1	1.28
G4-c	0	0	0	0	0	0
G5-a	0	0	0	0	0	0
G5-b	0	0	0	0	0	0
G5-c	0	0	0	0	0	0
Total	**35**	**100**	**43**	**100**	**78**	**100**

In regards with student approach to learning, most of the students had deep and achieving approaches to learning. They tended to contribute to their group by applying their deeper approaches to learning. In other word, they participated in their group discussions by contributing more critical- reasoning texts. When looking at student contributions in these two discussion topics, most of the students, both male and female, improved a lot in their cognitive skills and the interaction with their peers. They responded to the contents (regarded as student-content interaction or student interaction at the individual level) with in-depth levels of cognitive skills.

As mentioned earlier, most students were mainly mature-aged students. Most of them had jobs and family commitments. Such experiences with family and workplace helped them to engage in the deeper levels.

At the group level, few students participated in online discussions at the higher levels of engagement. Not many of them did it at the highest level of engagement. That was to say, most students did not engage in group discussion at higher levels in some particular aspects such as negotiation of meaning/co-construction of knowledge, testing and modification of proposed synthesis or co-construction of knowledge, and agreement statement(s) and application of newly constructed knowledge.

Since most distance education students spent most of the time studying by themselves at homes and/or at workplaces, they did not have many opportunities to exchange their opinions and learning resources with their peers and their teacher, both face-to-face and online. They therefore lacked effective skills in engaging in group discussions.

From focused group interviews, some students did not have enough time to attend tutorial sessions, to participate in small group work and to engage in online discussions. Consequently, they could not accomplish their intended group work. A few of them could not complete all the learning tasks suggested in the subject guidelines because they had their personal limitations regarding their jobs and families.

It is of some concern that most of the students did not participate in group discussions at the higher level of engagement at the group level. Student-led groups may lack experience in scaffolding, guiding and constructing their knowledge. Teacher/facilitator intervention may provide the encouragement, direction and guidance needed to attain the higher levels of reasoning and critical thinking in interaction and collaboration.

6. Conclusion and further analysis

At this stage, it is evident that computer conferencing had a significant effect on distance adult students' learning outcomes in terms of student academic achievement, student attitude toward computer and information technology and student interactivity. Students in these three groups improved their scores upon the post-test measures of academic achievement, especially those in the Experimental Group. The Students in Group 1 and the Experimental Group had more positive feelings and reactions to computer at the post-test measures but those in Group 2 had less positive feelings and reactions to computer. Those who participated in online discussions had more positive attitude toward computer and information technologies. Regarding student interaction and collaborative learning, it revealed an effectiveness of computer conferencing when being applied with other integrated media. The students in the Experiment Group improved their critical reasoning skills and they participated in group discussions at higher levels of engagement. However, some of them did not participated effectively in group discussions because of their personal limitations. A teacher or facilitator should provide encouragement, guidance and guidance in

order to help them to achieve the higher levels of critical reasoning skills in interaction and collaborative learning.

The results above are part of a broader study, further data analysis, both quantitative and qualitative, will be carried out. This will include student academic achievement, student attitude toward computer and information technology, and student collaboration and interaction in group work according to student characteristics, their approaches to learning both at the individual and the group levels. The analysis of relationships between student academic achievement and attitude toward computer, approaches to learning and student academic achievement, approaches to learning and CMC records of contributions, and CMC records of contributions and student academic achievement will also be carried out.

What is needed is a broad model for optimizing the application of information technology in distance education in Thailand. Such a model should address the structural levels of the Thai education systems. It will include considerations regarding educational administration and management at the top level where major policies are made, at middle level in local areas where information technologies are facilitated and implemented, and also at the bottom level or at the classroom settings where actual teaching- learning processes take place.

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