Students' Overall Learning Satisfaction about Networked Cooperative Learning with Portfolio Assessment System

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Abstract: This study examined the students' overall learning satisfaction about cooperative learning activities and networked cooperative learning with portfolio assessment system, an instructional method that emphasizes idea expressing via writing and oral presentation, accumulated dialogues through inquiries between peers, critical thinking via peer assessment, and knowledge construction via doing a practical assignment. In this study, a post questionnaire used to measure students' overall learning satisfaction. Thirty-six juniors enrolled in a course Introduction to Computer Science and were assigned to twelve teams. Each team was assigned to design a combined Intranet and Internet computer network for a fictitious company. In the last, quantitative results indicated that students' overall learning satisfaction is high and 86% students willing to join the learning activities that similar to this study in the future.

Key-Words: Cooperative learning, Portfolio assessment, Team composition, Team forming, Peer assessment

1 Introduction

Portfolio assessment can demonstrate and make clear the learning processes of a particular learner [1]. Portfolio assessment can enhance a learner's critical thinking and motivation to learn; therefore, it a good way of alternative assessment evaluate college students [2]. In the past, the portfolio-assessment almost focused on the outcome of individual. However, the combination of portfolio-assessment and cooperative learning under a networked system has seldom been explored. For example, Chang [3] designed a web-based learning portfolio system that provides some functions for a student to submit his (or her) assignment, collect his (or her) assignment, evaluate other students' assignments, and browse other students' assignments. Chang did not consider the functions for cooperative learning.

Research of cooperative learning claims the students learn better when they learn together [4-5]. Cooper and Mueck [6] have defined the cooperative learning as a structured and systematic instructional strategy in which teams work together toward a common goal. The learning activities of cooperative learning should include negotiating a common goal with team members, keeping up the responsibilities for their team members' learning as well as their own, assigning complementary roles and tasks to individuals within each group, and cultivating social skills for effective cooperative learning [7-8]. Springer, Stanne, and Donovan [8] have claimed that the learning activities of cooperative learning need more authentic assessment of higher-order thinking and problem solving. Therefore, the combination of portfolio-assessment and cooperative learning should be done to enhance each other and to form a brand new cooperative learning with portfolio-assessment. In such a learning environment, a student should cooperate with his (or her) team members and each team should do their best to enrich their portfolios to compete with other teams. All the while, this study regards the cooperative learning as the most important part of cooperative learning with portfolio-assessment. Furthermore, the cooperative learning with portfolio assessment could be easily applied in classroom activities and online learning activities.

Johnson and Johnson [9] said that there is a natural partnership between technology and cooperation. The use of cooperative learning with computers tends to increase cooperative behavior

and attitudes toward cooperative learning [10-13]. Therefore, this study would measure students' learning satisfaction at first. The learning satisfaction was divided into four categories in this study: satisfied with cooperative learning, satisfied with the task, satisfied with system use, and satisfied with outcome.

Cooperative learning with portfolio-assessment can be implemented as a networked system. In this study, the learning system composed of three distinct functions: the first sub-system focused on the management of portfolios (e.g., students can collect, search, and make selections from and reflect on themselves assignment and team's assignment), this function was extended from networked portfolio system [1], the second sub-system focused on peer-assessment and self-assessment (extended from networked peer assessment system; [14], and with the third sub-system focused on facilitating cooperative learning (e.g., the function of team composition for teacher to use and the discussion forum for team members).

2 Pertinent Literature

2.1 Portfolio and Networked Portfolio

Paulson, Paulson, and Mayer [15] said that a portfolio is a purposeful collection of a student's work that tells the story of a student's progression of achievement, and a collection of items that reveal different aspects of an individual's growth and development over time. Shores and Cathy [16] have divided the portfolio into three types: 1) Private portfolio□It is one you probably already keep (e.g., photographs of some academic activities). 2) Learning Portfolio: It will encourage richer reflection and communication within your program, and is the most fun and the most rewarding to implement. 3) Pass-along Portfolio: Condensed vision of the first two.

Russell and Butcher [17] have analyzed the use of portfolios in educational technology courses, and have concluded its advantages. For example, it is more interesting for students to learn, portfolios allow each student to determine what they want to learn and how they demonstrate their knowledge and skills, portfolios include a lot of information and artifacts, and portfolios provide a method for students and instructors to do outcome assessment and for students to reflect on their assignment and abilities. They [17] have also indicated the limitations of portfolios. For example, portfolios requires more time from the students and the instructors than other evaluation approaches, the benefits of portfolios are not appreciated and understood by some students and lack of research evidence in value of portfolios.

In a previous study [1], they have implemented a networked portfolio system, composed of two distinct functions that one focusing on peer-assessment with the other focusing on portfolio-assessment. Functions designed to facilitate peer-assessment include on-line submission of assignment, on-line marking and the ability to view suggestions from peers. At the end of a semester, the function of portfolio-assessment allows students to select their best assignment. However, the functions for cooperative learning under networked portfolio system have not been considered.

Some examples of networked portfolio system common in the academic world are listed in Table 1 with comparisons in different perspectives. The famous characteristics of these systems [3, 18-20] are the allowance of interaction between learners and their instructors, navigational tools, assessment, and so on.

Table 1. Several networked systems (adapted from [20]).

Features of system	[18]	[3]	[19]	[20]	This study
Password and user name security	O	O	O	O	O
Desktop based file management for uploading to server	O	O	O	O	O
Automated glossary tool	O	X	X	X	X
Search tool for online documents	O	X	X	X	O
Functionalities for cooperative learning	X	X	X	X	O
SCORM compliant	O	X	X	X	X

Table 1: Part two.

Features of Instructor-Learner facilities	[18]	[3]	[19]	[20]	This study
Instructor can assign specific course material to individual or group of learners	O	O	O	O	O
Multiple choice self test tutorial questions (automatic marking)	O	X	X	X	X
Learner access and progress data available	O	O	O	O	O

Table 1: Part three.

Features of Telecomm.	[18]	[3]	[19]	[20]	This study
Course electronic mail	O	O	O	O	O
Course bulletin board	O	O	O	O	O
Team bulletin board	X	X	X	X	O
Course chat facility	O	X	X	X	X

2.2 Cooperative Learning and Team Composition

Cooperative learning can be divided into four types: formal cooperative learning, informal cooperative learning, cooperative base groups, and academic controversy [9]. In formal cooperative learning, the student work together from one class period to several weeks to reach each team's shared learning goals and accomplish assigned tasks [21-22]. The teacher may transform any course requirement into cooperative learning activity. In informal cooperative learning, the student are assigned into some particular teams and each team works together to complete a shared learning goal from a short period of time to one class period [22-23]. In cooperative base groups [22-23], the student work together in heterogeneous groups with stable membership and in a long term. Each member in a base group needs to give the support, help, encouragement, assistance, and make academic progress. In academic controversy [24], the teacher organize some academic controversies by choosing an important issue, assigning students to groups of four, dividing the group into two pairs, assigning one pair the pro position and the other pair a con position. Then each pair takes one side and prepares the best case for their position. After a period of time, each pair presents their viewpoints to the opposing pair. After the presentation and discussion, the pairs reverse roles and develop an understanding of both perspectives.

Many studies of cooperative learning conducted with diverse subject areas and a wide range of tasks provide evidence that cooperative learning is an effective learning and teaching approach [21]. Previous studies showed that cooperative learning benefits students in terms of achievement, motivation, critical thinking, metacognitive thought, job satisfaction, and social skills [9, 21]. Previous studies also pointed out some important factors that may affect the effectiveness of cooperative learning, including positive interdependence, individual and group accountability, promotive interaction, appropriate use of social skill, resources, and group processing [7, 9, 25-26]. In sum, there is a solid stepping-stone for teachers to apply cooperative learning in the in classroom activities and online learning activities.

However, it's hard for the teacher to manage cooperative learning activities [9]. For example, the team composition is composed of two important decisions. First, teachers need to consider students' characteristics: there are race, gender, ability, and many psychological features. Second, teachers also must consider the type of grouping is either heterogeneous or homogeneous. Some studies showed that students in heterogeneous ability groups tend to learn more than students in homogeneous ability groups [27-28]. The academic discussion and peer interaction in heterogeneous groups promote the development of more effective reasoning strategies [26, 29-30]. Hooper and Hannafin [31] found that low-ability students' interaction was 30% more when placed in heterogeneous pairs and the student in heterogeneous pairs achieved and cooperated significantly more than the student in homogeneous pairs. The last problem is that teachers who are willing to use ability variable for heterogeneous grouping and then they must deal with major

computation requirements. Therefore, this study implemented a team composition program [32] for this task.

3 Research Methodology

3.1 Aims of this Study

This study examines the students' overall learning satisfaction about networked cooperative learning with portfolio assessment system. Specific research aims are listed below.

1. Are most students satisfied with cooperative learning under NetCoP?
2. Are most students satisfied with the task under NetCoP?
3. Are most students satisfied with system use under NetCoP?
4. Are most students satisfied with outcome under NetCoP?

This study is also interested in students' willingness to join learning activities via NetCoP in the near future and so forth and discovers more qualitative feedback from students via open-ended questions.

3.2 System Design

This study presents a web-based system, Networked Cooperative Learning with Portfolio Assessment System (hereinafter referred to as NetCoP, revised from a previous study [33]), that coordinates student learning in a manner similar to researchers, scientists and practitioners that have learned from doing. Author has utilized the Windows 2000 server to be the operating system, Internet information system 5.0 to be the web server, and SQL server 7.0 to be the database management system. Author has implemented the functions of NetCoP by using server-side programs to retrieve and store database information. These server-side programs were coded with ASP (active server pages). Students can turn in their assignment directly through this online system. Because the assignment is in the same format as a HTML (hypertext markup language) file, the assignment can be stored directly into the file system to be read by the reviewers through the web browser.

System administrator of all classes can create a new class through the administration program. Once the class is created, the system establishes a new directory using the ID (e.g., course1) assigned to this class. The pre-defined programs are generated as well. Meanwhile, the new directory is attached with some programs (referred to figure 1). Doing so makes each class independent in that it has its own directory. The teacher of this course can manage the students' learning activities through the administration program, news program, and team composition program. Class management includes student's enrollment information, assignments, assessment, and team composition. The enrolled students can turn in their assignment, modify their assignment afterwards, receive and give grades, receive and give suggestions, and view assignment of other students. When a student has turned in his (or her) assignment, this assignment will be assigned a random number by the system together with a directory established. This assignment is therefore stored in the directory. In doing so, each assignment can be recorded distinctly before and after each round of modification.

3.3 Participants and Course Content

Participants were thirty-six juniors enrolled in an introductory computer science class, which is Introduction to Computer Science, at a technical university in northern Taiwan. The thirty-six students were divided into twelve groups of three individuals each using team composition program with ability variable. All teams were given a whole-semester cooperative design assignment. The course covered seven topics during eighteen weeks, i.e., Basic concepts of computers, Digital representation, Boolean expressions, Operating systems, Application software (e.g., Word, PowerPoint, and Excel), Introduction to the Internet, WWW, Web-sites, and Web-pages, and Designing web-pages.

3.4 Measurements

The perceived satisfactory was measured by a questionnaire containing twenty-five questions about the students' perception on cooperative learning, the task, system use, and outcome in networked cooperative learning with portfolio-assessment as well as students' willingness to join learning activities via NetCoP in the near future. Students were asked to rate their satisfactory on a four-point Likert scale, ranging from 1 = strongly disagree to 4 = strongly agree. A typical statement about the satisfaction with cooperative learning is "I satisfied with the team members dispatched via team composition program." "I think the discussion forum program is ease to use" is a statement about satisfaction with system use. "This task interested

me to do more work than other courses' requirement" is a statement about satisfaction with the task. A statement about satisfaction with outcome is "I should use my team's network design in my workplace." An open-ended question is attached to each statement to elicit free opinion or modification suggestions for NetCoP and cooperative learning activities.

3.5 Group Task

Participants were asked to design a combined Intranet and Internet computer network for a fictitious company. Each team was given a company floor map and some computer network security considerations. The teams should discuss the assignment, invent a solution cooperatively, and write down the cooperative process as they made design decisions on hardware and software requirements. The assignment had to clearly identify the responsibility and outcome of each student in this group task.

3.6 Procedures

The students were instructed to do the following procedures(adapted from [33]):

- Instructor demonstrates the educational objectives of cooperative learning, portfolio-assessment, peer-assessment, and self-assessment in the beginning and uses some real samples from previous semester to prepare students for later activities (This step done in the first of this semester and lasts about 3 hours).
- Instructor coaches a part of teaching materials covered in this semester (Each topic was scheduled about 1~2 weeks).
- Instructor assigned three students (referred to [34]) into a team through the simulated annealing K team-forming algorithm for heterogeneous grouping [32] and the entrance examination score as the input of above algorithm. The students were asked to become acquainted with each other and seat themselves together during class time.
- Students and the instructor collaboratively discuss the assignment and the criteria to make corrections via NetCoP and face-to-face (This step lasts about a week). The instructor discusses the criteria to mark an assignment with students in classroom teaching. Students still can discuss this assignment with the instructor informally via NetCoP after classroom teaching. The criteria for this assignment are creativity, feasibility and correctness. The range of rating is divided into ten categories from extremely excellent (10) to extremely poor (1).
- Instructor gave students one or two hours of class time per week for group work. To emphasize the need for personal accountability and cooperation, group members took turns organizing their assignment, recording their cooperative process, and correcting some possible mistakes in team members' work. Students should submit their work in group discussion forum in class and continue their discussion after class.
- The assignment and documents about cooperative process as they made any specific design decisions on hardware and software requirements completed by the teams is uploaded to the system. Teams have completed the assignment by themselves. Teams were instructed to complete the work and submit it to NetCoP within a week; otherwise they receive no credit on this assignment.
- The system randomly assigns reviewers (each reviewer grades three to four assignments). The procedure is automatically done by system after all of the teams have uploaded their own assignments to NetCoP. In this study, three other teams' assignments were assigned to each reviewer according to past experiences [14].
- Reviewers grade and comment on themselves' and peers' assignments (This period lasts about a week). Students can assess each assignment in a day to alleviate their loading.
- The system notifies the students of their grades and comments. NetCoP instructs automatically each student to browse the results of peer-assessment and self-assessment via e-mail after the review process.
- Based on the comments on each team's performance, their must make corrections or modifications (This period lasts about a week).
- The above steps are repeated one more time, twice or not all (researchers can select times of repetition based on their needs). In this study, teams were requested to re-submit their assignment again. Each team must present their assignment orally in the front of other teams and instructor after this assessment procedure.

4 Research Findings

Participants that responded positively to answers 3 and 4 on the questionnaire were categorized as "satisfied" students and all others were categorized as "unsatisfied" students.

4.1 Analysis of Satisfaction with Cooperative Learning under NetCoP

- I satisfied with the team members dispatched via team composition program: The result showed that 86% of students were satisfied.
- I satisfied with the team members' contribution to assignment: The result showed that 89% of students were satisfied.
- I satisfied with the team members' attitudes toward finishing assignment: The result showed that 94% of students were satisfied.
- I satisfied with the team members' feedback and assistance: The result showed that 92% of students were satisfied.
- I learn a lot of interpersonal and small group skills in this course: The result showed that 94% of students agreed to this question.

4.2 Analysis of Satisfaction with the Task under NetCoP

- This task interested me to do more work than other courses' requirement: The result showed that 83% of students agreed to this question.
- This task is meaningful to me: The result showed that 92% of students were satisfied.
- I satisfied with the load of this assignment: The result showed that 86% of students were satisfied.
- I can follow my team's schedule: The result showed that 83% of students agreed to this question.
- I have more control over my own work than traditional assignment: The result showed that 92% of students agreed to this question.

4.3 Analysis of Satisfaction with System Use under NetCoP

- I satisfied with NetCoP in sum: The result showed that 89% of students were satisfied.
- I think the submission of assignment is ease to use: The result showed that 86% of students agreed to this question.
- I satisfied with the user interface of presenting an assignment on the browser: The result showed that 92% of students were satisfied.
- I think the assignment assessment is ease to use: The result showed that 86% of students agreed to this question.
- I satisfied with the user interface of presenting reviewers' evaluation on the browser: The result showed that 89% of students were satisfied.
- I think the portfolio management is ease to use: The result that 86% of students agreed to this question.
- I think the portfolio management is useful: The result showed that 89% of students agreed to this question.
- I think the discussion forum program is ease to use: The result showed that 89% of students agreed with this question.
- I think the discussion forum is useful: The result showed that 89% of students agreed to this question.
- I satisfied with the user interface of presenting course information on the browser: The result showed that 94% of students were satisfied.

4.4 Analysis of Satisfaction with the Outcome under NetCoP

- I should use my team's network design in my workplace: The result showed that 86% of students agreed to this question.
- I am proud of the completed assignment: The result showed that 94% of students agreed to this question.
- I won the team members' respect during this learning activity: The result showed that 97% of students agreed to this question.
- I am more confident than before: The result showed that 94% of students agreed to this question.
- I satisfied with the outcome of my team: The result showed that 94% of students were satisfied.

4.5 Analysis of Willingness to Join Similar Learning Activities

I am willing to join learning activities via NetCoP in the near future: The result showed that 86% of students do willing to join learning activities via NetCoP in the near future. Feedback from structured interview indicated that majorities of student regarded the learning activities as effective and benefited from networked cooperative learning with portfolio assessment.

5 Conclusions and Implications

This study examined the students' overall learning satisfaction about NetCoP and cooperative learning activities. First, students satisfied with cooperative learning under NetCoP. Most students satisfied with the team members' attitudes toward finishing assignment (94%), the team members' feedback and assistance (92%), the team members' contribution to assignment (89%), and the team members dispatched via team composition program (86%). Many students (94%) also said that they learn a lot of interpersonal and small group skills in this course.

Second, students satisfied with the task under NetCoP. Many students agreed that they have more control over their own work than traditional assignment (92%), this task is meaningful to them (92%), this task interested them to do more work than other courses' requirement (83%), and they can follow their team's schedule (83%). Many students (86%) also satisfied with the load of this assignment.

Third, students satisfied with NetCoP in sum (89%). The shortage of our system, as pointed out by some students, was that speed of uploading and downloading is too slow. Speed of uploading and downloading is related to the outdated network devices. One way to improve this problem is to upgrade those outdated network devices in the near future, or indicate the response times of the download next to the hyperlink to make the response time more predictable [33, 35]. Many students also satisfied with the user interface of presenting an assignment on the browser (92%), agreed to the usefulness of portfolio management (89%), satisfied with the user interface of presenting reviewers' evaluation on the browser (89%), agreed to ease of use in submitting an assignment (86%), agreed to ease of use in assessing peers' assignment (86%) and so forth.

Fourth, students satisfied with the outcome under NetCoP. Many students agreed that they won the team members' respect during this learning activity (97%), they are proud of the completed assignment (94%), they are more confident than before (94%), and they should use their own team's network design in their workplace (86%). Many students (94%) also satisfied with the outcome of their own team.

Fifth, there are 86% of students do willing to join learning activities via NetCoP in the near future. The shortages of learning activities under NetCoP, as pointed out by another 14% of students, were as follows: 1) more peer pressures than other courses. 2) The learning procedures are time consuming. 3) Some other teams tended to give extremely low scores to our assignment. 4) Suggestions from other teams are useless for our assignment. Some of these shortages, pointed out by students, may be advantages for instructors. Students have revised their own assignment actively due to they have more peer pressures than other courses. Of course, the learning activities and team-forming algorithm should be revised to increase the satisfactory of students. In sum, the findings of this investigation generally support prior studies that argued for the importance of cooperative learning and social interaction in increasing learner satisfaction [10, 12, 36-37].

Although this study applies heterogeneous ability team composition, the team composition program can be revised to assist with other team composition needs [38]. In some cases, instructors have to compose teams with various homogeneous or heterogeneous characteristics. Therefore, an efficient team composition program may reduce instructors' teaching load in the cooperative learning process. In the future, Researchers should continue to design some suitable programs to help instructors assign various types of teams and continue to evaluate the students' satisfaction with cooperative learning activities.

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