Engaging Students in Group-based Co-operative Learning- A Malaysian Perspective

Mai Neo
Senior Lecturer, Faculty of Creative Multimedia
Multimedia University, Malaysia, 21, Jalan USJ 5/3
47610 UEP Subang Jaya, Selangor, Malaysia
Tel/Fax: +6-03-56357817
kneo@pc.jaring.my

ABSTRACT

In recent years, the information and communication technology (ICT) has created a significant impact on the methods of communicating information and knowledge to the learners and, consequently, innovative teaching techniques have evolved to change the way teachers teach and students learn.

In this paper, the focus is on a study which was conducted on a group-based cooperative learning class to determine its impact on student learning and the reactions of these learners towards this instructional methodology. The students in the course were given a web-based multimedia-mediated cooperative learning project to complete. Students worked in groups and used multimedia and web technologies to construct their projects. As such, a technology-supported cooperative learning framework was established. A survey was conducted to ascertain the reactions of the students towards this mode of teaching and learning.

Results of the study showed that in group-based learning, students learned by cooperating and interacting with each other and participated actively in their own learning process. Students also learned to cultivate teamwork, communication, management and interpersonal skills. Furthermore, by incorporating a multimedia project into the cooperative learning structure, a viable and effective strategy was created to enhance student learning.

Keywords

Cooperative learning, Group-based learning, Web-based education, Multimedia learning, Project-based learning

Introduction: Computer-backed learning

In recent years, the ICT and, in particular, the multimedia technology, has increasingly altered the landscape in the Malaysian educational field particularly in higher education. It is affecting the communication strategies in the education environment and influencing the way educators teach and students learn. The changing landscape in the Malaysian education arena is as a result of educational reforms that have been happening in the United States in the past two decades (Lambert and McCombs, 1998).

These reforms called for a focus on student-centred learning, rather than on teaching and pedagogy, curriculum and instruction. They sought to challenge the fundamental assumptions about student learning, where learning is now defined as "the ability to retain, synthesize, and apply conceptually complex information in meaningful ways" (Lambert & McCombs, 1998). The availability of technology and multimedia enables these reforms to be effectively carried out because in designing multimedia applications, new insights into the learning process of the designer can be discerned, as the learner is forced to represent information and knowledge in new and innovative ways (Agnew,Kellerman & Meyer, 1996). More recently, there was a calling for an awareness of the need to improve student achievements and a restructuring calling for education to look at the learner, and create learner-centred opportunities in the classroom (Lambert & McCombs, 1998).

In light of this, the Malaysian Government is echoing this learner-centred learning initiative and has thereby called for using multimedia materials for student development, self-assessment and self-directed learning (Mohaiadin, 2000; Chee, 2000) as well as e-learning methods in the universities (Kamsah, Mokhtar, Ahmad & Yaacob, 2000; Ismail, 2001). Mat (2000) proposed that Malaysian educationists be proactive to incorporating technology into the teaching and learning environment. In such an environment, students will experience new challenges in technology and must be versatile to them.

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Group-based co-operative learning – the pedagogical perspective

In the traditional classroom of higher institutions of learning, students are generally regarded as passive learners and receipients of the educational content. Assessments of student learning are generally based on their individual work such as quizzes, examinations and tests. Each student competes with his/her peers to obtain the highest score that can be achieved individually. There is very little interaction among the students and they rarely have any opportunity to work together as a team and cooperate in their learning process. Thus, in this method of teaching and learning, educational content is teacher-directed and learning is individualistic. In this context, the content is delivered to the learners by the teacher and the students rely mainly on the teacher, the knowledge expert, for their knowledge and information.

The cooperative learning model, however, is an instructional method in which students are grouped in small learning teams and work in cooperation with each other to solve a common problem or to perform a task presented by the teacher (Johnson & Johnson, 1986; Johnson, Johnson & Smith, 1991; Slavin, 1983). Students work and cooperate among themselves, helping each other to achieve the group goal, and receive a group performance score. Students learn content through group activities where they interact with each other, exchange information and knowledge, and work as a team to achieve the learning goals. This learning mode is student-centred and encourages students to cooperate and collaborate with each other in achieving their learning outcomes. It also encourages students to foster interpersonal competencies such as *"oral communication; active listening; group leadership; the ability to examine assumptions; and the ability to tolerate ambiguities. All of these skills are highly valued in employment"* (Tribe, 1994).

Research has shown that using group and project-based activities are ways to effectively provide students with a more active approach to learning (Guzkowska & Kent, 1994; Berge, Collins & Dougherty, 2000; Hung & Wong, 2000; Bennet, Harper & Hedberg, 2001), and therefore these are important elements to explore and study. Research has also indicated that since employers often seek out graduates who have acquired teamwork skills alongside technical competence, group work has been integrated into the curriculum (Bennet, et. al, 2001; Markkanen & Ponta, 2001; Nelson, 1999).

Gregory and Thorley (1994) posit that group-based learning has two aims. The first is the contributions made through task skills, and the second focuses on process skills. They defined process skills as skills derived from assessing *"the whole area of the individual's response to the group and the group dynamics as well as the way in which the group goes about completing the task and its participants interact in so doing"*. They stated that in such group-based learning activities, students may learn something about the group dynamics and the way in which groups work, they may learn about themselves and their own personal skills, and they may learn something about the particular subject matter. Thus group-based learning is *"a method of learning which is both flexible and effective in cognitive, skill and affective learning domains,"* i.e., students learn to think, do and develop feelings towards their tasks.

In learning group skills, the environment must be seen as either relevant to the curriculum, or meeting the student's perceived needs in some way (Brown, Collins & Duguid, 1989; Herrington, Oliver, Herrington & Sparrow, 2000). One example of instilling group learning motivation is to give students the opportunity to acquire team skills via small exercises and culminating in a large self-managed team project. Such exercises can begin with students working in small sub-groups of about 4-6 and then followed by a second phase of two or more sub-groups with different initial solutions attempt to come to an agreement. This exercise will invariably generate conversation and relationship-building among the students in the group and encouraging them to work well collectively (Robson, 1994).

The theoretical framework for this group-based cooperative learning environment is embedded in the social constructivist learning structure. In this learning mode, students learn by interacting socially with their peers and teacher to achieve their learning goals. The constructivist approach to learning encourages students to cooperate and collaborate with each other as a team to seek knowledge and information in order to solve a problem or achieve a common learning outcome on their own while the teacher acts as a guide, supporting them in their learning process. This co-operative method of learning can be used as an alternative to the traditional learning mode as it effectively promotes active student learning and encourages learning of team skills. The best argument for cooperative learning is that it increases cognitive achievement, motivates students in their learning, increases academic performance and help develop social competence and skills that are required in the community and the world of work at large. Johnson & Johnson (1989), in their compilation of results from over 500 research studies came to the conclusion that cooperative learning was an effective teaching strategy. Johnson & Johnson (1994) also indicated that cooperative learning approaches led to (a) higher academic achievement

than competitive or individual approaches, (b) better interpersonal relationships among students, and (c) more positive attitudes toward subject studied and the overall classroom experience (Johnson & Johnson, 1994).

In the context of this study, the co-operative learning experience involved the use of multimedia authoring tools, Internet communication tools such as e-mail, chatrooms, discussion boards, instant messaging services, and web-based authoring tools. The web-based authoring tools would enable teachers and students to create multimedia-oriented applications that were interactive and could be deployed on the web, while communication tools on the Internet such as Yahoo Messenger or MSN Messenger would allow for two-way communication activities between the teacher and students. These types of technologies would enable groups to work better, especially when they faced difficulties in scheduling meetings and discussions on a face-to-face basis. Multimedia authoring tools would enable groups to work together as a team to complete their projects, as they could brainstorm and apply their creative thinking skills to making their information multimedia-oriented and in using these complex multimedia and web authoring tools. These tools would thus provide the groups with hands-on experience of using leading industry tools to develop multimedia applications.

The class structure

In this study, a cooperative learning lesson was conducted among the students in the Courseware class in the Faculty of Creative Multimedia (FCM), in the Multimedia University, Malaysia. This Courseware class was a 3rd year course in which students would study about the learning theories and their proponents. To facilitate this group-based cooperative learning environment, it was conducted in 3 stages.

Stage 1: Small groups research paper

In the Research Paper stage, students had to research and collect information on a chosen Learning Theorist. The class was first divided into 3 main groups, the Behaviourist, Constructivist and Cognitive Groups. Each of these groups consisted of 30 randomly assigned students, with the exception of the Cognitive groups, which had 20. Then each Learning Theory Group were further divided into sub-groups (with sub-group leaders, SGLs) consisting of 5 members (4 for the Cognitive group) of their own choosing, and to choose a Theorist from their Learning Theory Group to write a research paper on. There were 2 sub-groups to one Theorist. The groups were given 3 weeks to submit their reports.

Stage 2: Sub-groups website development

After turning in their research papers, all sub-groups in one learning theory group had to come up with an overall Learning Theory website, with the goal to educate and inform other learners about the different Learning Theories. Their website would be educational, interactive, multimedia-oriented, and delivered on the Web. They also had to use all the information from the research papers written by their subgroups to be used for content for the website. The final website would then be presented by their Learning Theory Group Leader (LGL), whom they chose, from their Learning Group. They were given 6 weeks to complete the task.

After turning in their respective research papers, the sub-groups then had to create an overall website for their Learning Theory. Here, similar sub-groups had to combine with each other (to make a new group of 10) and to filter out similar information as well as compile a more comprehensive report of their Theorist. Each Learning Group also had elected one Overall Learning Theory Group Leader (OGL), who was in charge of organising all the sub-groups. Each Learning Group had to decide on the interface of the website, the information to display in the webpages (according to the objectives of the class), and the overall design of the site. They also had to turn in a progress reports. At the end of the project, each Learning Theory Group had to present the website to the class, and display its webpages, interactive features, as well as their development of the website. The Learning Theory Group Leaders were chosen to perform this task.

Stage 3: Class homepage

In the final stage, the 3 Learning Theory Group Leaders combined all 3 Theory websites into one overall Learning Theories website which was uploaded onto the web server and made accessible to all students. Figure 1 illustrates the instructional design of the class.
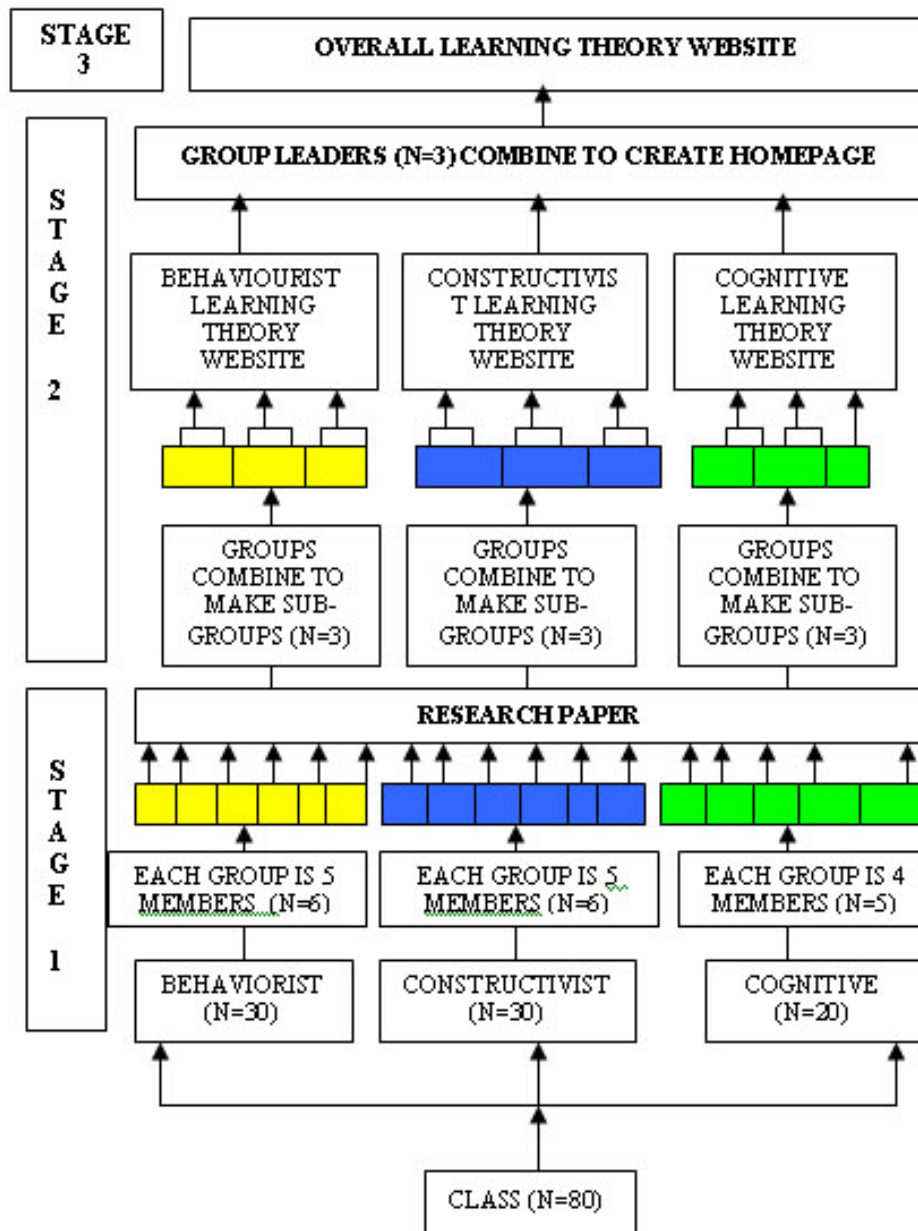
Figure 1. The cooperative instructional design of the class

The student learning process

In this learning environment, students were very much responsible for their own learning process. Many of the decisions were made by members of each group based on meetings, brainstorming sessions and group discussions. From these discussions, they chose their group members and Group Leaders. Once they had established their membership, students then proceeded to the website project ideation stage, where they would brainstorm on their project ideas via meetings, and discussed possible solutions to the website creation. This included the filtering, organising and acquisition of information, and the division of tasks among members of the group, both at the sub-group and the final website development levels.

Group collaboration occurred throughout the planning and executing of this project, and in various stages. There were small group collaborations during the research paper phase, graduating to sub-group collaboration during the development of the individual Learning Theories website, and finally, between Learning Theory groups and the Overall Learning Theory Leader to collaborate for the Learning Theory Homepage. During these collaborative learning phases, students relied on group consensus and Group Leader direction to make their

decisions. These decisions included deciding on the interfaces of the websites, the media content for display, the interactivity, and the overall consistency of design.

The groups would then proceed to author their website and develop their content for presentation. Here they would then utilise the web authoring technology, such as Macromedia Dreamweaver and Flash to create their interactive multimedia website. They were also allowed to use any third-party software application to further help them with their development, which included using Adobe Photoshop and Image Ready for editing images. Finally, once the websites and homepage were developed, the groups presented their respective websites to the class and showcased their development process for discussion and reflection.

This learning process is schematically presented in Figure 2. The softwares that were used to create the final website took advantage of the students' existing skills in developing multimedia applications. The groups also met once a week for lectures to provide them with fundamental information about the class and for consultation with the lecturer in order to discuss their ideas and concepts.
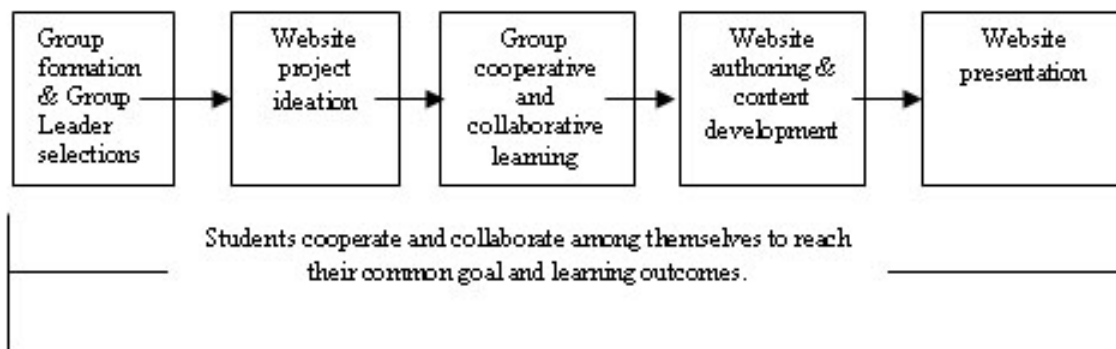

Figure 2. The student learning framework

In this learning environment, students constructed new knowledge through their active social interactions with their peers (Vygotsky, 1978). They built on their prior knowledge through the exchange of ideas among their team members, and collaborated with each other to complete their project. Students engaged in discussions, brainstormed their ideas, produced multiple perspectives to solving their project, and became creative in their project presentation in order to reach their common goal. Technology, especially web-authoring tools, became an enabler in this learning environment, as it provided students with the tools to be creative with their ideas and presentation. Web communication technologies were also used to help the collaborative learning process of these groups. Many of the students used Yahoo! Messenger, an instant messaging service, to communicate with their team members and leaders, when scheduling face-to-face meeting became problematic.

Student learning assessments

Formative assessments were made throughout the 9 weeks to measure students' learning processes. There were 2 types of learning outcomes that were looked for in this study: students' product learning outcomes and their process learning outcomes. For product learning outcomes, students were evaluated on the product of their projects. In this case, the product outcomes were the research papers, the websites and the corresponding learning theory webpages, which were assessed on the interactivity, links and navigation, design and interface, clarity of content, depth of content presentation, and their ability to write about the Learning Theory and its corresponding theorists. Here, students had to demonstrate their competency in completing the assigned tasks, which were the research papers (at the Stage 1 level) and the website (Stage 2 & Stage 3 levels). Figure 3 illustrates the learning product outcomes of students from the study (Stages 2 & 3).

Process outcomes, on the other hand, involved assessing how students responded to this cooperative group-based learning project, and were taken from their group progress reports, project survey and open-ended questions. In particular, they needed to demonstrate skills in teamwork and leadership, communication, project and group management, decision-making and presentation. Since each phase of the project was accompanied by a group progress report and member journal, these group journals and progress reports were examined, and groups were required to give a presentation at the end of the project completion date. The groups' journals revealed several

activities that took place in the course of the project. Firstly, owing to their busy schedules and problems in meeting up for group discussions, many of the groups in both studies used the class times, and also the Web, to conduct their group meetings. In particular, all 3 Learning Theory Groups used emails to disseminate information among members and Yahoo! Messenger to conduct chats. Figure 4 the Cognitive Learning Theory Group's Yahoo discussion board.
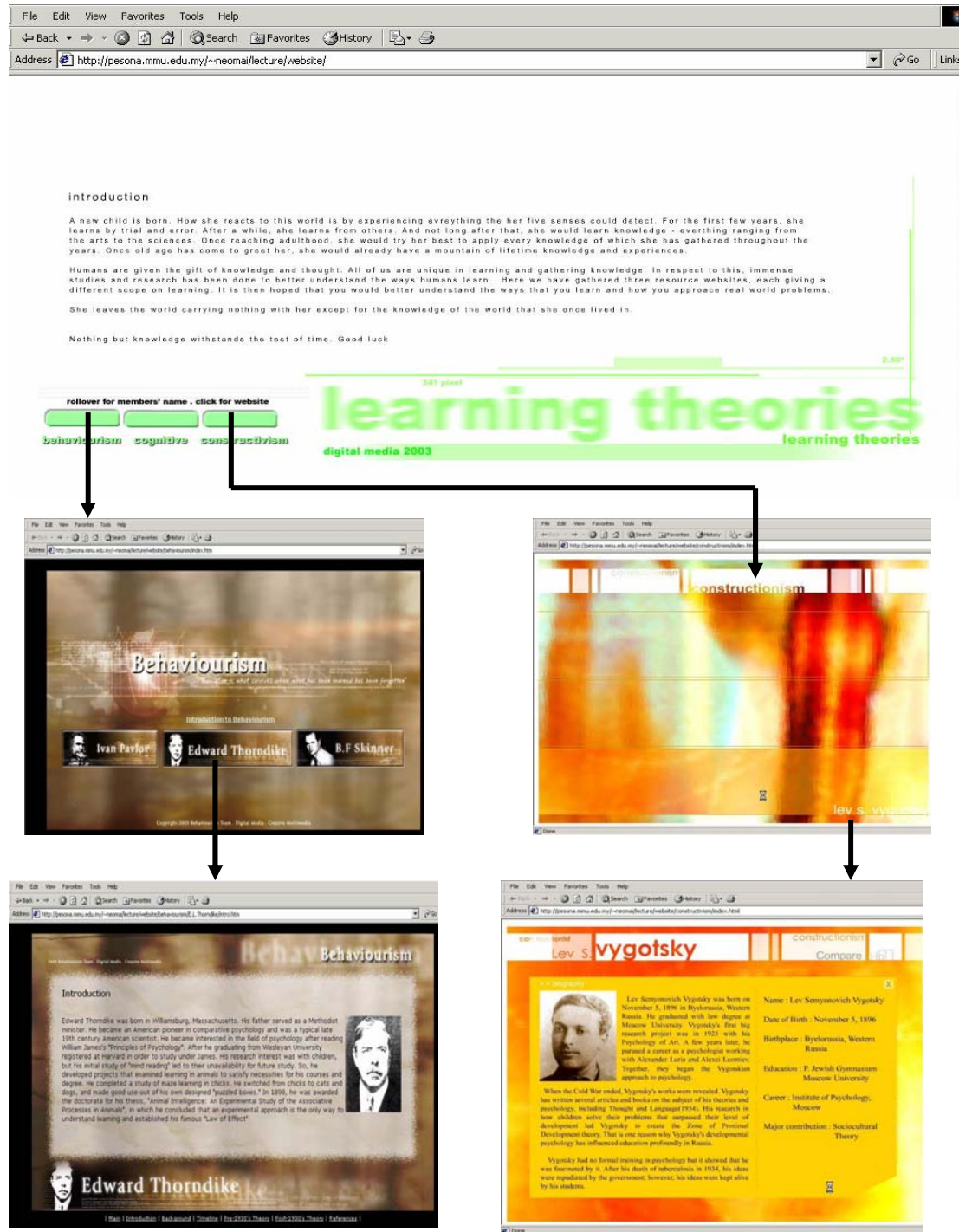

Figure 3. The website and corresponding webpages for groups

Figure 4. One group's Yahoo! Groups Discussion Board

The survey results

The students were given a 13-item survey at the end of their task to assess their attitudes towards doing the project and working in their respective teams during the respective phases. The reliability of the survey, using the Cronbach alpha coefficient, was 0.8230, indicating satisfactory levels of internal consistency. The survey was measured on a 5-point Likert scale, with 1 = Strongly Disagree (SDA), 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly Agree. Table 1 illustrates the means and percentage responses of the students on the various survey items. Figure 5 displays the means in bar graphs.

Table 1. Means (m) and percentage responses (p) on survey

| SURVEY ITEMS	Mean (m)	% (p)
1. We were able to achieve our group goals	3.77	69.6
2. Our group leader was very effective	3.75	63.3
3. I enjoyed collaborating with team members	3.82	70.9
4. I was able to contribute well to the project	3.78	73.4
5. The collaboration enhanced my learning of the topic	3.89	77.2
6. My group members contributed well to the project	3.97	81.0
7. The collaboration was a challenge but I enjoyed it	3.71	70.9
8. My group was able to work together effectively	3.81	68.4
9. We were able to solve our problems as a group	3.85	77.2
10. I found the collaboration very motivating	3.62	57.0
11. My group communicated well with each other	3.76	70.9
12. I learn more from the collaboration than on my own	3.65	53.2
13. My group taught me some things I would not have learnt on my own	3.57	57.0
	N = 79	
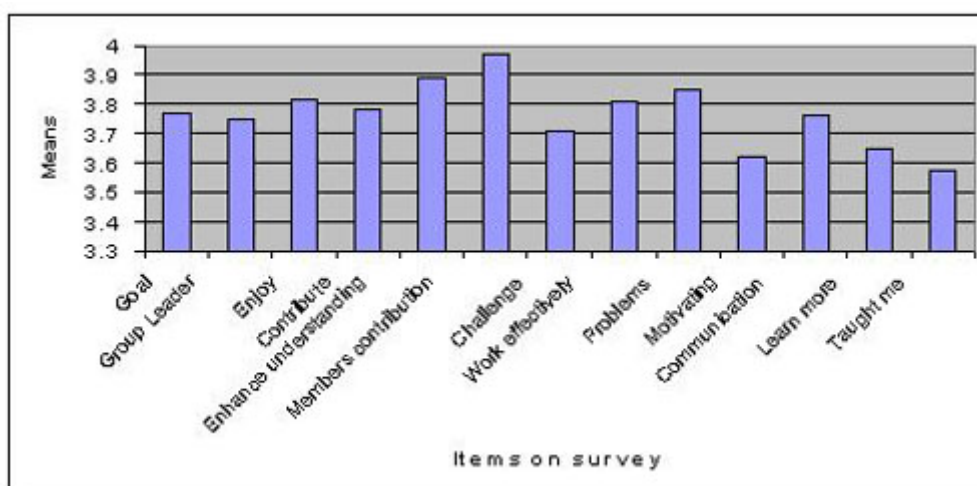
Figure 5. Bar charts of survey means

As shown in Table 1, the majority of the class reported favorable attitudes and perceptions in the surveys. Therefore, within this cooperative learning environment, several cooperative constructs (and skills) can be assessed.

1. Teamwork and communication skills

➢ Items 4, 6, 8, 9 and 11 in the survey were used to measure students' teamwork, leadership and communication skills. This would encompass how well the students worked together as a group, and solved their group problems. This study reported high means on these items.
➢ 73.4% of students reported that they contributed well to the project (Item 4, m=3.78).
➢ These groups also reported that their group members contributed well to the project, Item 6, (m=3.97, p=81%).
➢ In terms of being able to work together well and effectively, Item 8, groups reported a mean of 3.81 (p=68.4).
➢ Embedded in this construct of teamwork is the ability to also solve group problems, Item 9. Here 77.2% of students reported a mean of 3.85, indicating that the ability to solve problems was high.
➢ Groups also reported a fairly high mean for communication skills, Item 11, within the group. 70.9% of students reported a mean of 3.76, indicating that communication among their group was good.

2. Project management

➢ Project management skills were measured by items 1 and 2 in the survey, which were items that asked students about their ability to complete their group tasks, and the role played by their group leader. Again the means reported here were quite very high.
➢ 69.6% of students reported a mean of 3.77 on the ability to achieve their group goals (Item 1), indicating that the project management skills of this group was high.
➢ In terms of the effectiveness of the group leader, Item 2, 63.3% of students reporting a mean of 3.75.

3. Ability to perform

➢ Items 5, 12 and 13 sought to measure students' ability to perform within the cooperative setting (see Table 1). Both items looked at how much students learnt from the project and whether they felt that they gained more skills from their group than on their own.
➢ In terms on enhancing their learning, Item 5, 77.2% of students reported a mean of 3.89, indicating that more students found that their learning process was enhanced by the project.
➢ 53.2% of students reported that they did learn more from the group than if they were to do the task on their own (Item 12, m=3.65).

> Over half of the class felt that their groups did teach them some things which they would not have learnt on their own (Item 13, m=3.57, p=57%).

4. Personal attitudes

> The survey also tried to gauge students' personal attitudes toward the group project, in terms of their personal enjoyment and motivation. Items 3, 7 and 10, sought to measure this construct.
> Students reported high means for Item 3, (m=3.82, p=70.9%), indicating that they enjoyed collaborating with their team members.
> Students also found the project rather challenging but enjoyed doing it (Item 7), with 70.9% students in reporting a mean of 3.71.
> 57% of students found the project to be motivating, Item 10 (m=3.62).

The instructional relationship

Since this class was one where students were encouraged to cooperate and collaborate among their own peers, the role of the teacher was less involved, especially where the group's dynamics were concerned. Since many of these students have been classmates for many years, the initial period needed to get to know each other was not necessary, and students were able to get organised fairly quickly. The role of the teacher in this learning environment, however, changed from being involved in the groups' decision-making process to becoming an external consultant, helping them to understand the content and materials for their websites, and guiding them in their website development process. Many of the decisions made in the project depended heavily on the cooperation and collaborations among students in these groups and the ability for them to work together to complete their shared goal.

The instructional relationship between the teacher, teacher and technology is illustrated in Figure 6. As can be seen from the diagram, the role of the teacher was one that was somewhat "hands-off", in terms of being involved in the group's dynamics. In particular, the teacher moved from being the sole expert in the class to an external consultant in the learning environment. Since the students in these cooperative learning environments were autonomous from the teacher, they were solely responsible for the negotiations and the learning outcomes of the group. The teacher became the "guide on the side", providing consultations when needed and not playing a highly active role in the group's management process.

However, the teacher played an important role in the structure of the class and the tasks assigned. The teacher was also responsible for monitoring the group's progress via their work-in-progress reports and evaluating the groups formatively. The teacher also supported the student's knowledge skills by providing a theoretical foundation to enable them to have a basic understanding of the course. Although the class and the learning environment contained prescribed tasks and requirements by the teacher, the attainment and path to achieving and implementing the plan rested solely on the groups. They played a significantly active role in their learning process, from the decision of the group leader, to the website design, to the documentation of the reports. This is in line with the constructivist learning approach, where students play active roles in their learning process.

The technology in this environment acted as both a communicative as well as a learning platform for the students and the teacher. The teacher used the technology for creating technology-based instruction for the class lectures, and utilised the Web technologies to keep in touch with the students and modifying class content as necessary. In this learning environment, the teacher used the Web as a server to house the students' website, and made it accessible to them so that they could all study from it.

Results showed that technology played a very big part in the students' learning process. Students used web software and third-party helper tools such as Macromedia Flash and Adobe Image Ready to help them create their websites. Students also used the Web technologies to help them overcome communication problems such as the inability to schedule and conduct physical meetings, updating members on new information, sharing ideas, conducting asynchronous discussions, and posting queries. Yahoo! Messenger (for real-time chats) and Yahoo! Groups (for group discussions) were the popular web communication tools used, second to emails.

In the process, it was observed that students had to learn how to compromise and cooperate with each other in order to reach their common goal. As such, they had to build and foster their teamwork and cooperative spirit. As with cooperative learning groups, interdependency was an important element in their learning process, as

students relied on each other to successfully complete their project. It was also observed that there was a lot of interaction between the teacher and the students, and between students and students, which resulted in the establishment of a learning community where the members cooperated and contributed towards a common goal. These observations are further supported by the survey data (see Table 1), where cooperation, collaboration and teamwork items were favorably assessed.
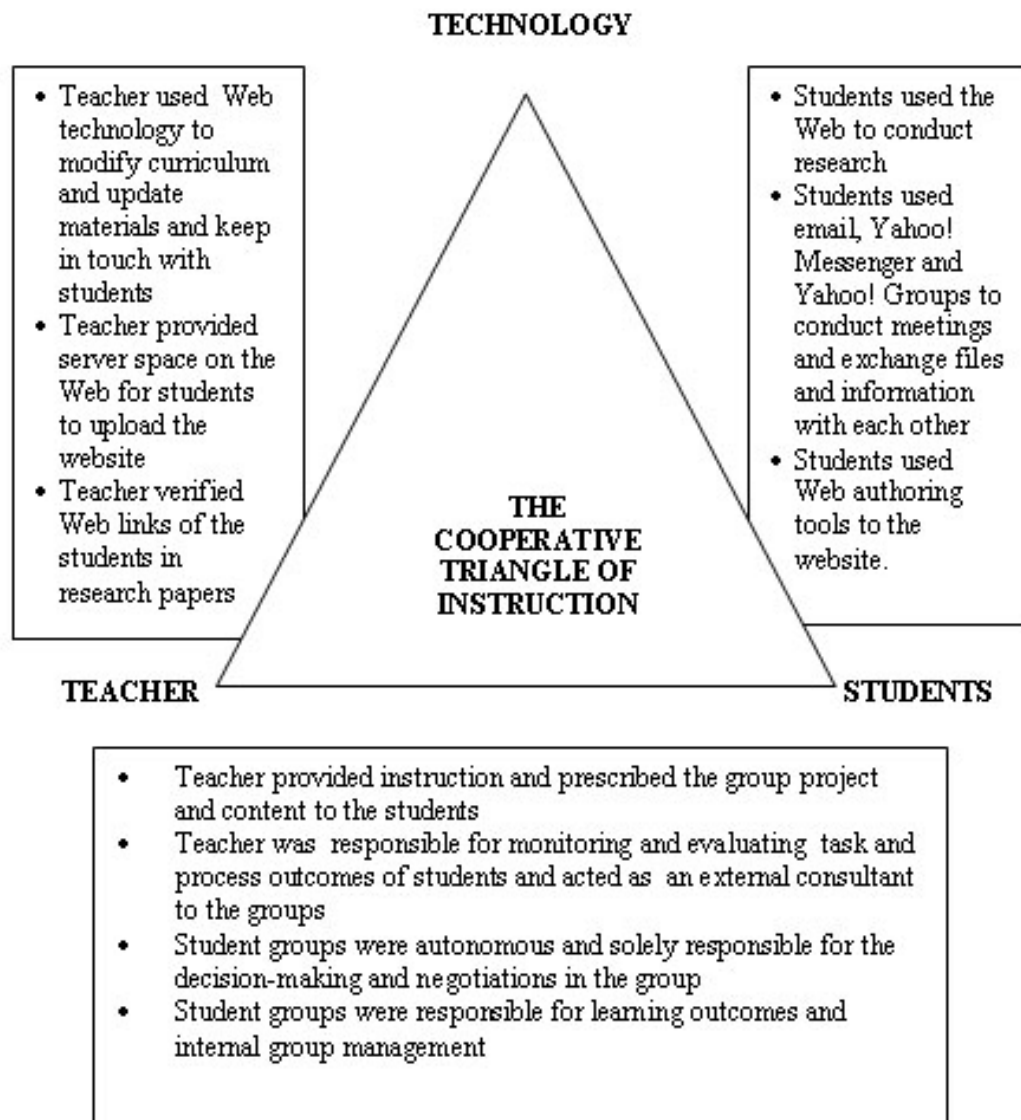

Figure 6. The instructional relationship in the cooperative learning environment

The technology-backed group-based cooperative learning framework

The resulting model for this learning environment is one that encompasses the salient traits and attributes of the cooperative learning environment developed for this research study. Figure 7 shows the traditional learning model and the technology-supported group-based cooperative learning framework.

As Figure 7 shows, at the heart of this environment is the development of a group-based learning setting, where students worked together in teams to achieve a common, shared, goal. Surrounding this group-based learning setting is the understanding and interrelationships between the teacher, students and technology. As mentioned in the preceding section, the instructional relationship between the three major components of this learning environment, the teacher, students and technology, is integral to the effectiveness of this environment. Here, students are the active and engaged participants of their own learning process, with the teacher serving as an

external consultant and manager, and technology being the enabler for students to access, develop and communicate with each other, and for the teacher to have an innovative method of teaching in the classroom. In the traditional learning model, however, the teacher is active in lecturing only while the students listen and take down notes. There is very limited interaction between the teacher and students. This mode of learning is mainly regarded as passive.

The combination of the group-based learning setting and the understanding of the instructional relationship between the teacher, students and technology results in the successful creation of a technology-supported cooperative learning framework where students learn by interacting with each other, work together as a team, actively participate in their learning process, and experience several key learning outcomes such as cooperation, teamwork, group management, communication and interpersonal skills, which are important for their future careers. This mode of learning uses technology to create a learning environment to provide learners with a richer context and promote cooperation in learning among the students.
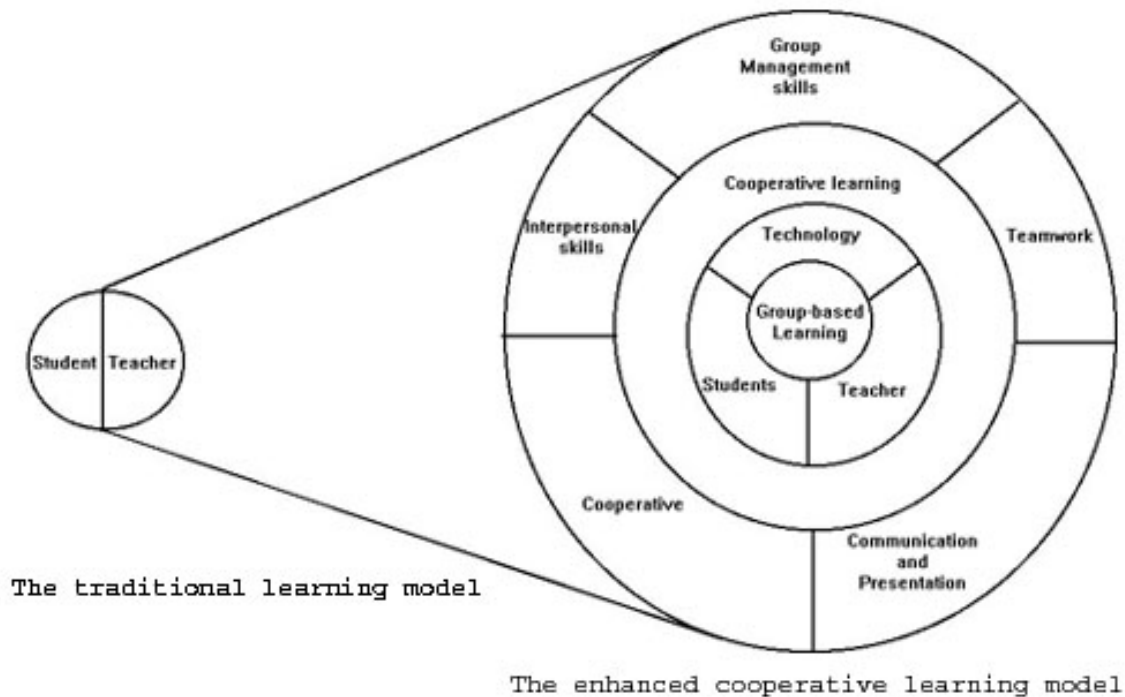

Figure 7. The traditional and technology-backed cooperative learning framework

Discussion

In this cooperative learning experience in the classroom, it can be seen that the group-based learning environment provides learners with an active learning process whereby students learn by interacting and cooperating with each other and with the teacher, and by using technology to create the content. The technologies that are applied in this cooperative learning environment include multimedia technology, web authoring tools, and Internet communication tools such as email, chatrooms, instant messaging (via Yahoo Messenger or MSN Messenger) and discussion boards services. Multimedia and web authoring tools allowed students to exercise their creative thinking skills to apply various media elements to their information and content, as well as interactive features to make the application appealing and dynamic. Internet communication tools allowed for both asynchronous and synchronous two-way communication activities to be conducted between the teacher and students, and among the students themselves. Students can leave email messages for the teacher to answer before their next class, and conduct virtual meetings with their group members at night from their own homes, and during times when members are unable to meet. These technologies expedite their development process and allow them to make more efficient use of their time as a group.

In this learning mode, students participated and were engaged actively in their learning process, constructing knowledge and determining their own learning path while building the multimedia website. The learning process is constructive, interactive and cooperative rather than individualistic, competitive and passive as in the traditional learning process. The results obtained in this learning experience showed that, besides promoting cooperation and interaction in the learning process, this learning experience also inculcates into the learners

teamwork, communication and presentation, interpersonal and group management skills. The instructional relationship between the teacher, students and technology is a fairly complex one, but it provides the teacher with a more flexible and innovative teaching approach, and the students with a richer learning environment whereby students can learn to become independent, autonomous and self-directed learners. This experience also shows that technology played a supportive role in the learning process which focusses mainly on student learning. They used technology to create their own website, constructing their own knowledge using the multimedia technology and determining their own learning path and goals in their project and many other group activities. In the cooperative learning model, a group learning activity is dependent on the socially structured exchange of information between learners. The learning framework shown above in Figure 7 provides a concise illustration of the enhanced and technology-supported cooperative learning approach.

As seen from this study, the advantages of group-based learning are (a) group learning emphasises cooperation among students rather than competition as in the traditional method, (b) it provides opportunities for learner-centred activities in the learning process, (c) it provides expertise and skills that cannot be obtained in an individual learning setting and (d) it provides solutions to complex tasks that cannot be done by the individual alone. In contrast, group-based learning has its limitations, such as group management tasks are difficult and require patience on the part of the teacher and students, and teamwork is vital to the successful implementation of group-based-learning.

Conclusion

The cooperative learning structure has received an encouraging and positive reaction from the students as shown by the students' work, the motivating response to their learning process and their enthusiasm in using multimedia technology to create their projects. The permeation of multimedia technology into the educational arena has created an important impact on Malaysian educationists and teachers in tertiary level as well as enabling students to use technology in the classroom to create a technology-supported learning environment such as the cooperative learning mode in this paper.

This cooperative learning environment also displayed many characteristics of the learner-centred instruction, even though some parts of the learning process and content were prescribed by the teacher. As students worked together in groups, they shared information and came to each other's aid. They were a team whose players worked together to achieve group goals successfully. They used multimedia technology to create their own website, constructed their own knowledge and determined their own learning path and goals in their project. Students learnt the content by interacting with their peers and teacher, while the teacher acted as a facilitator of learning guiding the students in their learning process.

In this context, the cooperative learning structure, the instructional relationship between the teacher, students and technology, and the technology-supported cooperative learning framework provided a viable and constructive guide and support in this area of learning. Also, the approach in learning was geared towards the social constructivist learning perspective. Hence, this teaching and learning method can be regarded as a highly credible alternative to traditional learning methods.

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