Chapter 2 – Collaborative Learning

This chapter explores the field of collaborative learning, which serves as the domain for this research. It discusses the theoretical aspects (i.e. definition, benefits and drawbacks) and various types of collaborative learning techniques. This chapter also presents Computer Supported Collaborative Learning (CSCL) and its applications for supporting primary and secondary schools education. It further narrows down the scope by focusing on CSCL in the Malaysian schools. Finally, the chapter introduces the WebCL (Web-Based Collaborative Learning System) project, its workshop evaluation and a proposed module namely G-Jigsaw.

2.1 Collaborative Learning Definition

Collaborative learning is an umbrella term for a variety of educational approaches involving joint intellectual efforts by students, or students and teachers together (Smith and MacGregor, 1992). To collaborate means to work together, which implies a concept of shared goals and an explicit intention of "add value" – to create something new or different through a deliberate and structured collaborative process, as opposed to simply exchanging information or passing on instructions (Kaye, 1994). Concisely, the term collaborative learning is an idea of small, interdependence groups of students working together as a team to achieve a common learning goal.

Collaborative learning emphasizes on collaborative efforts among students in their group along with the teacher's guidance. It is a process whereby each member contributes personal experience, information, perspectives, insight, skills and attitudes with the intent of improving learning accomplishments of others. The group's collective learning ultimately becomes possessed by each individual (Klemm, 1994). In most collaborative learning situations students work in small groups, mutually searching for understanding, meanings or solutions while the teachers provide guides for their students. Students are accountable for one another's learning as well as their own. Thus the success of one student helps other students to be successful (Gokhale, 1995).

Besides, Panitz (1997b) views collaborative learning as a personal philosophy rather than just a classroom technique. Collaborative learning suggests a way of communicating with people that respects and highlights individual group members' abilities and contribution in all collaborative learning situations. As a result, there is a sharing of authority and acceptance of responsibility among group members for the group actions. Additionally, Zhao and his colleagues (2001) further supplements collaborative learning where knowledge is not something that is delivered to students, but rather emerges from active dialogues among those who seek understand and apply concepts and techniques (Zhao et. al., 2001). Hence, collaborative learning can be exciting for students because they are actively engaged in a discussion rather than passively attaining information.

2.2 Benefits of Collaborative Learning

Proponents of collaborative learning insist that tremendous benefits are found with collaborative learning. There is a list of 59 benefits of collaborative learning that had been identified by Ted Panitz (1997a). This chapter reviews and extracts only the important advantages that are related to this research.

Collaborative learning can help students to develop higher level of thinking skills

(Webb, 1982). In collaborative learning environment, students working together engaged actively in the learning process rather than just passively listening to information presented by their teacher. Throughout the learning process, students formulate ideas, discuss them, receive immediate feedback as well as respond to questions or comments. Therefore, students are able to develop their leadership, oral communication and social interaction skills. These will lead students to a higher self-esteem.

Besides, collaborative learning fosters team building and team approach to solve problems while maintaining individual accountability (Cooper et. al. 1990; Johnson et. al. 1984). One of the key element of collaborative learning is group forming. Students engaged in collaborative learning will gain benefits from the group building and group processing techniques via various collaborative learning activities (e.g. group project). Activities such as group tests or group quizzes that require individual answers but the results are evaluated by groups help to promote individual accountability. Hence, these types of activities maintain a strong element of accountability by each group member.

In addition, collaborative learning will be able to simulate critical thinking and assists students to clarify their ideas (Gokhale, 1995). During the students' discussion and debate activities, they will be able to formulate ideas, except other group members' ideas as well as discuss, criticize and debate these ideas. As a result, these activities are able to enhance students' critical thinking skills. Furthermore, students will be able to accept and understand their own culture and other group members' cultures. Thus, students are able to view situation from different perspectives that will lead them to diversity of understanding and promote multiple perspectives.

Another important advantage of collaborative learning is that it allows more challenging tasks to be carried out without making the working load unreasonable (Felder, 1997; cited from Panitz, 1997a). This is accomplished by creating each group members independency such as in Jigsaw procedure where each student is responsible towards his/her group members and for the group success. This approach results in group members pooling their knowledge and resources. Thus, it is feasible to carry out more challenging and advance activities which are not possible to be carried out individually. Therefore, larger projects become attainable by dividing the project into smaller groups.

2.3 Limitations of Collaborative Learning

Even though the above benefits of collaborative learning are established, however there are still some drawbacks in collaborative learning. Laister and Koubek (2001) pointed out some disadvantages of collaborative learning as listed below:

i. Many teachers feel that they are loosing control over the learning process and that therefore their effectiveness and their contribution to the learning process are being diminished.

ii. There are difficulties in evaluating collaborative learning students with traditional individual teaching criteria.

iii. There are pressure on shy students and those who find it difficult to get along in groups in general.

2.4 Collaborative Learning Techniques

Over the years, many different types of collaborative learning techniques have been developed to carry out student collaborative learning activities in class. This section briefly overviews some major collaborative learning techniques. The descriptions of various collaborative learning techniques in the following sections are adapted from (Knight and Bohlmeyer, 1990; cited from Bell, 1996) and (Zhao and Akahori, 2001).

2.4.1 Circles of Learning (Learning Together)

Learning Together is a technique originally developed by Johnson and Johnson (1975). Based on this technique, a group of students pursuing a definite goal will share their ideas and learning materials. Then the groups are rewarded according to their level of performance. A new version, which is developed under the name "Circles of Learning" (Johnson et. al., 1984), comprises eighteen steps that can be easily be adapted to fit a particular subject or topic.

2.4.2 Student Teams-Achievement Division (STAD)

STAD is a technique developed by Slavin that involves group competition and rewards (Slavin, 1980). In STAD, students are assigned to four-member learning groups heterogeneously by ability, gender and ethnicity. The teacher presents a lesson and the student work together within their group to master the lesson given. Then, all the students are required to take quizzes individually. The group score is accumulated from individual student score that meet or exceed their own earlier performances. The groups that successfully achieve certain criteria may earn certificates or other rewards. The groups have to be of equal strength for this technique to be truly effective.

2.4.3 Teams-Games-Tournaments (TGT)

According to DeVries and Slavin (1978) TGT uses tournaments in which students of comparable ability compete with each other. Unlike STAD, this technique replaces the quizzes with weekly tournaments (academic games). In TGT, students play the games at three-person "tournament tables". The winners for each round compete with the runner up and the loser. Points collected during each tournament will contribute to the group score.

2.4.4 Team-Assisted Individualization or Team-Accelerated Instruction (TAI)

TAI is also developed by Slavin. It is a technique that shares with STAD and TGT technique that uses four-member mixed ability learning groups and certificates for high-performing groups (Slavin, 1985). However, the individualization part of TAI makes it differ from STAD and TGT. In TAI, students work on their individual units according to their level of ability. Group members then check each others' work against the answer sheet and help each with any problem before resorting to the teacher.

2.4.5 Group Investigation (GI)

GI is a highly structured technique advocated by Sharan and colleagues (Sharan et. al., 1984). In GI, students work in small groups using cooperative inquiry, group discussion and cooperative planning and projects. It comprises six successive stages with high degree of student involvement. Students are engaged in choosing a general topic and sub-topics, involve in the investigation planning and its implementation as well as the analysis and the evaluation on information they gathered. Then, the results of their research are presented to the whole class to be evaluated.

2.4.8 Jigsaw Classroom

Aronson and his colleagues developed Jigsaw Classroom technique in 1978 (Aronson et. al., 1978). In this technique, each member in each group is assigned to a particular task, problem or topic. Then, members from all the different groups whom are pursuing the same task meet to research and/or discuss their responsible task. Finally, they return to their original group to share the results of their discussions.

2.5 Computer Supported Collaborative Learning (CSCL)

Barbara Wasson (1998) defines CSCL as an emerging paradigm for research in educational technology that focuses on the use of information and communication technology (ICT) as a mediation tool within collaborative methods of learning. Its main characteristic is that the role of technology consists of giving assistance to the human elements of the educational process (teacher and student) in order to enable collaborative learning processes.

CSCL focuses on how collaborative learning supported by technology can enhance peer interaction and work in groups as well as how collaboration and technology facilitate sharing and distributing of knowledge and expertise among community members (Lipponen, 2001). Furthermore, CSCL is based on the promise that computer supported systems can support and facilitate group process and group dynamics in ways that are not achievable by face-to-face. However, they are not designed to replace face-to-face communication.

CSCL examines the design, adoption and use of groupware for learning purpose. Groupware is a technology designed to facilitate the work of groups. It may be used to communicate, cooperate, solve problems, compete or negotiate (Brinck, 1998).

2.5.1 CSCL Applications

CSCL applications are applications that have been developed for specific purpose of supporting group learning (Crawley, 1997b). Although studies have been carried out on how colleges and universities students learn together through the CSCL applications, for instances CLARE – Collaborative Learning and Research Environment (Wan, 1994), CaMILE – a Collaborative and Multimedia Interactive Learning Environment (Guzdial, 1997), CoMentor (Gibbs, et. al., 1998) and TheU (Contact Consortium, 1998), little attention has been paid to how CSCL applications can support children's collaborative learning (Crawley, 1997b; Cockburn and Greenberg, 1998). As a result, only a few CSCL applications are intended for primary and secondary school children. The following section reviews four CSCL applications that support children's collaborative learning. The applications include Belvedere (Suthers, 1998), CoVis (Edelson, et. al., 1995), CSILE (Scardamalia & Bereiter, 1993; 1994) and TurboTurtle (Cockburn and Greenberg, 1998).

Belvedere (Suthers, 1998)

The Belvedere project aims to develop educational technology and associated student activities in science. The activities introduce students (from 12 to 15 years old) to the give-and-take process of theory formation and revision. It provides a graphical computer environment that can be displayed on networked computer. Belvedere is designed to support problem-based collaborative learning scenarios using evidence and concept maps. Students use it to construct and reflect their ideas through "inquiry diagrams". They work together to state and compare alternative theories and arguments about them, and change them in response to new evidence or criticism. Through the Belvedere, students learn critical inquiry skills that they can apply in science and everyday life.

Belvedere Inquiry Diagrams are designed to help students express graphically how ideas are connected. These ideas can come from scientific articles or from their own knowledge, experiments and research. Belvedere assists students to keep track on their and other students' ideas by allowing students to map a problem out graphically. It also helps the students to figure out whether there is more information required to strengthen or complete an idea. The visual depiction of ideas and relationships help students to experience the abstract ideas.

Belvedere comprises two significant software tools namely Collaborative Inquiry Tools and programs that coach students. The Collaborative Inquiry Tools include a Collaborative Inquiry Database, which stores various kinds of information relevant to students' projects, including a record of each group's on-line discussion or debate, reference materials with author for each project, suggested experiments and individual notes; Inquiry Diagrams, which uses shapes for different types of statements and link different kinds of relationships between these statements and Textual Displays for students to summarize their work and writing reports. In addition, programs that coach students are used to coach student contributions, point out relevant information and identify problematic argument. Besides, Belvedere supports multiple views of students' evidence models: they can view their model as a graph, matrix or hierarchy. Each view supports students' learning in different ways.

CoVis – Collaborative Visualization (Edelson, et. al., 1995)

The CoVis Project is vision to reform and improve science education through the use of moderate and wideband computer networks. Therefore, it is able to establish distributed learning and teaching communities through software to support collaboration and communication, Internet direct to the classroom, scientific visualization and inquiry tools, video or audio conferencing with screen sharing as well as professional development for teachers (Gomez and Pea, 1996). It serves as a test-bed that explores issues of scaling, diversity and sustainability as they relate to the use of networking technologies that enable high school students to work in collaboration with remote students, teachers, and scientists.

In CoVis project, students (K-12) study science through inquiry-based activities. Utilizing the scientific visualization software, which specifically modified to be appropriate in a learning environment, students have access to the same research tools and data sets used by leading-edge scientists in the field. "Collaborative Visualization" thus refers to development of scientific understanding, which is mediated by scientific visualization tools in a collaborative context.

CoVis provides students with a range of collaboration and communication tools. These include: desktop video teleconferencing; shared software environments for remote, real-time collaboration; access to the Internet resources; a multimedia scientist's "notebook"; and scientific visualization software. In addition to deploy new technology, the CoVis project team works closely with teachers at participating schools to develop new curriculum and pedagogical approaches that take advantage of the project-enhanced science learning.

CSILE – Computer Supported Intentional Learning Environments (Scardamalia & Bereiter, 1993; 1994)

CSILE is an educational knowledge media system for Studies in Education that focus in intentional learning. It is designed to support students in purposeful, intentional, and collaborative learning in a local network environment. CSILE emphasizes on building a classroom culture supportive of active knowledge construction that can extend individual intentional learning to the group level. Its purpose is to make students (fifth or sixth grade) think and reflect their thought process that provoke question asking and answering in a public forum.

Students can select different communication modes (text, video, audio, animation) to generate "nodes." These nodes contain ideas or information that is related to topics they study. Nodes are available for others to comment on, lead to dialogues and an accumulation of knowledge. CSILE promotes student cognitions through "thinking type" prompts that direct individuals to define personal learning goals, reflect on personal knowledge gaps, construct theories and so on. Such facilities were developed to help students practice and hopefully master some of the higher-level cognitive operations that are typically associated with autonomous thinkers and learners.

In a CSILE classroom, each computer workstation is connected to a multimedia database that contains the ongoing research of the class. All "notes" (the files used in CSILE) are placed in a common area, where they are viewable by all. Students connect their notes to other students' notes through facilities provided. This enables student to share information, answer each other questions and provide advice more easily in CSILE's on-line environment. The strength of this approach is that it objectifies the knowledge of the classroom and makes the advancement of that knowledge a social activity. All questions, theories, ideas, information and discoveries are preserved in the database for the analysis of the entire class.

TurboTurtle – (Cockburn and Greenberg, 1998)

TurboTurtle is a dynamic multi-user microworld or computer simulations of restricted environment and it's used for the exploration of Newtonian physics. It promotes discovery and exploratory learning by enabling students (from 7 to 17 years old) to experiment with concepts such as gravity, friction, force, velocity and so on, and see how values change affect the objects moving within the simulation. TurboTurtle's design rationale includes concepts such as equal opportunity controls, simulation timing, concrete versus abstract controls, recoverability and how strictly views should be shared between students. It attempts to make extensive use of sound, color, and animation to capture the interest of young students. It also develops user interfaces that producing an educational environment, which is both engaging and easy to use.

TurboTurtle is a truly collaborative microworld, where students have their own displays, their own mouse, and an ability to do anything at any time. With TurboTurtle, students can alter the attributes of the simulation environment, such as gravity, friction, and presence or absence of walls. Students explore the microworld by manipulating a variety of parameters, and learn concepts by studying the behaviors and interactions that occur. As a free-form microworld, students can manipulate TurboTurtle as they wish. However, teachers can modify TurboTurtle to display a prescriptive set of tasks containing questions, lines of investigation, and hints of things to try. Teachers can also add structure to the group's activities by setting the simulation environment to an interesting state, which includes a set of problems and questions. This allows teachers to scaffold the student's passage through TurboTurtle's educational domain.

TurboTurtle has evolved into a groupware system where several students, each on their own computer, can simultaneous control the micro world and gesture around the shared display. The efforts involved to make it as a groupware system is trivial, primarily because it was built with a groupware toolkit called GroupKit. This toolkit uses its remote procedure call facility to tell all processes to execute an action at all sites. As a result, TurboTurtle gained its extensive facilities for group-awareness, such as telepointers and WYSIWIS (What-You-See-Is-What-I-See) display. It also has the ability to update the latecomers, ensuring that their view of the micro world is same as their fellow students.

Table 2-1 summarizes the CSCL applications discussed above.

Table 2-1 CSCL Applications that support Children's Collaborative Learning

CSCL Application	Educational Objectives	Software/Tools	Classroom Activities	Stage/Year
Belvedere	To help students to learn critical inquiry skills using evidence and concept maps	Collaborative Inquiry Tools (i.e. Collaborative Inquiry Database, Inquiry Diagrams and Text Displays) for creating Inquiry Diagrams. Guided Programs for accessing on-line materials	In a classroom, students construct and reflect their ideas through "inquiry diagrams". They work together to state and compare alternative theories and arguments about them and change them in response to new evidence or criticism	12-15 years old students
CoVis	To help student to develop scientific understanding mediated by scientific visualization tools in a	Desktop video teleconferencing Shared software environments for remote, real-time collaboration Internet access to the resources	In CoVis project, students study science through inquiry-based activities. Utilizing the customized scientific	K-12 students

	collaborative context	Multimedia scientist's "notebook" Scientific visualization software	visualization software, students have access to the same research tools and data sets used by the scientists in the field	
CSILE	To make students think and reflect their thought process in a public forum	A tool for generating "nodes" in different communication modes (i.e. text, video, audio, animation) A multimedia database that contains the class ongoing research A common repository for storing and accessing CSILE's "notes"	In a CSILE classroom, students can select different communication modes to generate "nodes." These nodes are an accumulation of knowledge and are available for others to comment on and leading to dialogue. Students share information, answer each other questions, and provide advice more easily in CSILE's on-line environment.	Fifth/sixth-grade students
TurboTurtle	To promote discovery and exploratory learning through microworld (restricted computer simulation)	Utilizing many features of GroupKit, TurboTurtle enables students to alter the attributes of the simulation environment, allows teachers to modify turbo turtle's displays and add structure to the group's activities	With TurboTurtle, students experiment the micro world with concepts such as gravity, friction, force and velocity by manipulating a variety of parameters to learn those concepts by studying the behaviors and interactions that occur	7-17 years old students

2.6 CSCL in Malaysian Schools

In Malaysia, a new innovation of schools was introduced in 1996 called the Smart School (Smart School Project Team, 1997. pg 6). Then in 1999, 90 schools were picked to pilot the Malaysian Smart School project. The Smart School project is one of the seven flagship applications that are part of Malaysian Multimedia Super Corridor (MSC). The Malaysian Smart School is defined as a 'learning institution that has been systematically reinvented in terms of teaching-learning practices and school administration in order to prepare children for the Information Age' (Smart School Project Team, 1997. pg 20). The idea of Smart School is dedicated to the task of regaining excellence in Malaysian education. It restructures Malaysian education by changing the teaching and learning environments in schools.

Under the Malaysian Smart School initiative, collaborative learning is selected as one of the key teaching and learning practice. It is stated clearly in the conceptual blueprint that tools which facilitate group work within the class and across the class are one of the key requirements (Smart School Project Team, 1997. pg 102). Even though the empirical research has revealed many of the promises and benefits of collaborative learning (refer section 2.2), however managing and carrying out these collaborative learning activities without the support of computer technology are not going to be an easy (Enerson et. al., 1997; Salim et. al., 2001). In this sense, CSCL applications play significant roles in supporting student's collaborative learning activities.

As of countless research through the Internet and a workshop with a group of primary school teachers for duration of three weeks, it is indicated that no CSCL applications are being developed in Malaysia. In addition, investigations carried out by Kasirun and Salim (2001) also highlighted the lack of CSCL applications for schools in Malaysia.

Currently, only a few education portals that provide limited collaborative features such as email, chat and discussion databases are available. Basically, teachers and students use email or chat tool to communicate with each other. Discussion databases are used to share information on a particular topic. Some examples of such education web portals include CikguNet (Rahman, 2000), Malaysian SchoolNet (Tajul-Arus, 2000) and TIGETWeb Project (Osman, 2000).

CikguNet is Malaysia's first education portal developed by the MIMOS (Malaysian Institute of Microelectronic Systems) that aims to support and prepares educators for the e-learning environment. It creates a major repository for teaching and learning resources. Teachers in Malaysia can share their ideas and teaching experiences in a particular subject via threaded discussion, email and chat. Tools for content development are provided. Students can also use these tools to ask questions or seek advices on problems they faced in their studies.

The Malaysian SchoolNet is a Ministry of Education's (MOE) project that utilizes the Internet technology as a medium for Malaysian schools educational activities. It enables students, teachers and administrators to communicate, share information and access the Internet information for knowledge gathering, skills upgrading and at the same time contribute to Malaysia's k-economy development.

TIGERWeb (Terengganu Intelligent Gateway to Educational Resources) is one of the projects undertaken by Terengganu State Education Department (TSED) under the MOE to pilot-test an interim project aimed in preparing normal and traditional schools to migrate to the smart school learning environment. This project is piloted by TSED in collaboration with Terengganu State Education Resource Center. TIGERWeb connects all school in Terengganu to a central site and it serves as an education portal that allows access, retrieval and sharing information.

Beside these educational web portals, there are also some CD-based educational applications used in Malaysia for teaching and learning purposes. This type of applications provides limited interaction throughout the learning process.

On the other hand, although there are commercial applications that provide full ranges of collaborative features (e.g. WebCT (WebCT, 2001) and LearningSpace (IBM Lotus Team, 2000)) to support student collaboration, nevertheless, they are not solely designed specifically to support group learning. These applications tend to focus on the delivery of learning materials utilizing various communication tools rather than the types of collaborative learning activities. For example, these applications support the messaging, calendaring, document generation as well as workflow management through both synchronous and asynchronous communication tools.

Due to these reasons, there are needs to develop collaborative learning applications to facilitate the collaborative teaching and learning. As a result, the Faculty of Computer Science and Information Technology in collaboration with the Faculty of Education, University of Malaya is researching and developing a system that will fulfill such needs under the WebCL project (Salim, 2001). WebCL, or Web-based Collaborative Learning System, is a project lead by Associate Professor Dr. Siti Salwa Salim that aims to identify, design and develop a wide range of collaborative learning modules, each of which can be used to facilitate teachers in the preparation of collaborative learning activities, the execution of activities by students and the monitoring of the activities while students are collaborating in accomplishing the learning goals. This project is supported by the provision of Intensification of Research in Priority Areas (IRPA) research grant 04-02-03-0704.

WebCL project began with reviews on collaborative learning literatures and existing technology-mediated collaborative learning tools. The main focuses of this review are: the collaborative learning and processes; the activities and features incorporated in the tools; the interface adopted by the tools; as well as the problems and inadequacies of existing technology.

Based on the review compiled, the first version of WebCL was developed. This version of WebCL comprised of six modules namely Group Discussion, Group Project, Group Presentation, Group Quiz, Group Debate and Group Study. These collaborative modules were founded based on the work proposed by theorist of group learning and processes such as Johnson et. al. (1984), Aronson et. al. (1978), and Slavin (1980). These modules are then formatively evaluated by a group of primary school teachers in a workshop.

2.7 WebCL Workshop

In the July of year 2000, a workshop was conducted at the University of Malaya with three major objectives: to brainstorm the collaborative learning activities carried out in primary schools and the problems faced, to formatively evaluate the first version of WebCL modules and to propose possible modules to support primary school students' collaborative learning activities. Section 2.7.1 to 2.7.3 discusses these in more detail.

A group of ten primary school teachers participated in the workshop for the duration of three weeks as part of their professional attachment. This group of teachers is equipped with some computer and programming skills on educational technology and they are well trained in Instructional Design.

2.7.1 The Workshop's Brainstorming Sessions

Throughout the workshop, several discussions were conducted with the teachers in order to gain a clearer understanding on the current primary schools practices and collaborative learning involvement. Feedback from these teachers indicated the following aspects:

- Collaborative learning is not new among Malaysian primary school teachers.
- Teachers have conducted various group activities at their own school to promote student collaboration.
- Collaborative learning activities are usually being carried out manually in a classroom without any CSCL applications support.
- In order to carry out collaborative learning activities, teachers need to incorporate some collaborative learning techniques in their teaching lessons.
- Teachers find the task of preparing collaborative activities are very time consuming and require them to be more creative and imaginative.
- The student monitoring process is not easy since the teachers need to wonder around and make interventions from time to time.

2.7.2 The Workshop Formative Evaluation

During the workshop, the teachers evaluated the WebCL modules. The evaluation covered four major aspects: the activity supported by each module; the contents; appearance and ease-of-use of each modules.

The teachers were asked to access and use each module to perform several tasks. These tasks including setting questions for each activity and answering the prepared questions. Besides, the teachers were also asked to participate in the activity as students. By doing so, the teachers have the opportunity to explore all the system features and functionalities. Based on this investigation, the teachers evaluated the suitability of each collaborative learning activity in supporting the primary schools students.

For the content aspect, the teachers evaluated the suitability of each module in supporting the level of primary students to carry out such collaborative learning activities. For example, the teachers found that the Group Quiz module is suitable to support all primary students from year one to year six. However, module like Group Discussion and Group Debate are much more suitable for year four and above students since these activities require the students to construct their own sentences.

In the appearance aspect, the teachers also evaluated the layouts for WebCL modules and the multimedia elements involved. The teachers also provided suggestions and recommendations for improving the appearance of each module.

In evaluating WebCL modules' ease-of-use, the teachers evaluated aspects such as the easiness to navigate from one module to another; the user interface used in each module as well as the management of WebCL. Based on the feedback, the teachers commented that the system should be more interactive such as prompting the users when a task has been performed or notifying the user about their current location. The teachers also suggested some opinions on how to improve the ease-of-use in assisting the teacher in preparing a task and how to enable the students to participate the activity much easier.

2.7.3 The Workshop Outcomes and Proposal

At the end of the workshop, the following results have been achieved:

- The Group Presentation module should merge with Group Project because most of the group projects normally require students to present their work to the class.
- The Group Study module is omitted since most of its features and functionalities can be found in Group Discussion and Group Project.
- Two new modules have been proposed, named Group Creativity and G-Jigsaw (Group Jigsaw).
- The proposed Group Creativity supports students to collaboratively participate in answering subjective questions.
- The G-Jigsaw proposed in this workshop encourages students to generate ideas, ask questions, helping and learning from each other in the classroom. G-Jigsaw is the focus of this thesis. Section 2.8 further describes this module in more details.

2.8 The Proposed G-Jigsaw Module

G-Jigsaw is proposed with the aim to simulate student's skills and capabilities in generating ideas collaboratively, asking questions and learning from each other, as well as integrating the shared works in a group. Fundamentally, this module is based on the concept of Jigsaw Puzzle, the term used by the teachers to encourage every student in the class to work collaboratively. This group activity has been carried out in primary schools to promote students collaboration. During this activity, the students give general feedback on each group member responsible segment, master a specific segment through the collaboration with members from other groups and present the segment to the group in turns. This activity highly promotes student's collaboration processes.

Nevertheless, it is currently carried out in the classroom manually without any support of CSCL application.

Hence, G-Jigsaw is proposed to support this activity using a web-based tool. The proposed requirements of this module are listed below:

The teacher should play the following roles:

- Create a problem that consists of several segments
- Break the problems into smaller segments
- Distribute the segments to the students
- Monitor and evaluate the students' work.

The students should perform the following activities:

- Students form their own groups consist of 5 – 6 students.
- The segments are divided to each group members accordingly so that each member in the group will responsible a specific segment of the problem
- Students in the same group contribute their ideas and opinions towards their group members segment and receive comments from their members at the same time
- Students group will split in order that students with the same segment will form a new group to discuss among themselves in order to find a solution for their responsible segment
- Students will return back to their original group to present the results from the previous group discussion
- The group leader will combine each segment into a complete solution for the problem

Based on the requirements obtained for this module, it has many similarities with the Jigsaw Classroom technique described in section 2.4.8. This Jigsaw Classroom technique will be studied in depth in chapter 3.

2.9 Chapter Summary

This chapter has reviewed the theoretical aspects of collaborative learning. Various kinds of collaborative learning techniques used in supporting collaborative learning activities are also investigated. CSCL and its applications are discussed. The CSCL in Malaysian schools is reviewed. The WebCL's workshop and the proposed module of G-Jigsaw are enclosed at the end of the chapter.