An Empirical Online Collaborative Learning System with Grid Portal Technology

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***Abstract*—A collaborative learning environment allows building software or digital contents and educational authoring activities namely, creating, editing and sharing artifacts like websites, interactive hypermedia, micro-worlds, and simulations. Uneven task distribution however, is commonly associated with conventional collaborative learning. This study therefore was conducted to develop an efficient authoring infrastructure dealing with online collaborative tools and collaborative authoring environment based on grid portal technology to address the limitations and problems associated with conventional approach. The evaluation process was carried out to obtain students engagement and involvement in collaborative environment activities. The study sample consisted of 36 undergraduate students enrolled in SPM 2332 (Authoring Language) course. Data was gathered using qualitative approach through e-mail interview and blog discussions as a link in UTM Grid Portal. This Grid Portal was developed for students of University Technology Malaysia's Faculty of Education to accomplish their courseware development project. The study was able to identify the critical elements in designing the Grid Portal. These were then incorporated in the resulting online collaborative learning system with Grid Portal.**

***Index Terms*—Grid portal, online courseware development, group work, collaborative learning.**

I. Introduction

Learning process can be classified as synchronous and asynchronous. Asynchronous learning process is where interaction between instructors and students occurs discontinuously with time delay. Examples of asynchronous learning are online discussion group and email. While synchronous learning process is where instructor lead real-time event in which all participants are logged on at the same time and communicate directly with each other. Interaction also may occur via video conferencing or audio. Most conventional web-based education practices the synchronous learning process due to limited space of memory as well as slow performance.

Collaborative learning is considered as one of the most effective teaching methods. It refers to methodologies and environments in which learners engage in a common tusk where each individual depends on and is accountable to each other. The collaborative learning can be in small or large group of people with different ability or level of intelligence. This teaching method allows students to give and share their ideas among the group members. It also encourages pleasant interaction among the group members for a more comfortable learning situation.

A large body of research has shown that collaborative approaches to learning can be effective in producing achievement gains, promoting critical thinking and enhancing problem solving in both face-to-face learning contexts [1]-[4] and more recently in computer-supported learning environments [5].

The introduction of the internet into the educational arena has rapidly changed the way individuals learn and paved the way to widespread collaborative and cooperative learning that was not perceived possible until recent years [6]. Web and interactive multimedia forms can also support the collaborative learning in order to create an attractive environment during the teaching and learning process.

Online collaborative tool and collaborative authoring environment will support online collaborative efforts of students. Some of the activities involved in authoring environments are interactive educational multimedia, example of which are Authorware and HyperCard, multimedia formats in various form (bitmap graphic, vector graphic, etc.), e-learning content editors and many more. The grid portal technology enhances the authoring support web based collaborative group works by improving the speed in terms of searching, supporting the huge memory, high quality of visualization and increasing the computational performance.

A. Background of the Study

Individual work is significant in any learning course but, student should also learn the collaborative behavior. Students' involvements are required in group attempt. Stunkel (1998) identified an increasing use of teams and groups as one of the predominant trends in higher education. Teams have proven to be an excellent vehicle for accomplishing interactive, cooperative instruction. Besides that, research has shown that students learn most effectively when working in groups, where they can verbalize their thoughts, challenge the ideas of others and collaborate to achieve group solutions to problems [7], [8]. The conventional web-based education supports on only one server result in very slow operation of

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searching, uploading, visualizing output and file saving [9].

The design and authoring activities in group on-line requires efficient and powerful web server in parallel fashion, which will support collaborative efforts among students on-line. Grid portal technology with high performance computing platform in supporting Web Based Education (WBE) is very high speed in terms of searching, supporting the huge memory, high quality of visualization and increasing the computational performance. Therefore, grid portal technology with high performance can be potential in enhancing the authoring support for courseware design.

B. Problem Statement

Students are encouraged to learn collaborative behavior besides individual work. This is because collaborative works enable the students to give and share their ideas with other group members. These will lead to producing a better product as well as enhancement in their performance. It has been shown that by having collaborative learning with peers, they may come to externalize their knowledge, monitor each others' learning and jointly negotiate meaning. These activities may trigger significant individual cognitive processes that ultimately lead to individual knowledge construction [4].

Designing and authoring a courseware in a group work is not as easy as we think. Many problems could occur during the development of the courseware. One of the major problems in collaborative work is unequal distribution of task among the group members. Some of the group members might give ideas and do the works while some of them might just sit back and wait for the other members to complete the work. On the other hand, the lecturer has difficulty to evaluate the work group based on the contribution of the group members. With the introduction of collaborative technologies, there are opportunities for collaboration to take place across barriers of time and space.

This study aimed to, a) determine students' perceptions on group work; b) identify the critical elements needed in designing grid portal for collaborative learning and c) design and develop an online collaborative tool through grid portal technology.

II. Research Methodology

This research was pursued using qualitative research method. The data were collected through email interview and discussions through blog.

A. Research Population and Sampling

In this research, the researcher used the purposive sample to meet the requirements of the research. The population which is also the sample of this research consists of 36 undergraduate students who enrolled Authoring Language course in semester I session 2010-2011. The course allow students to learn an overview of basic concept of authoring language, authoring process and types of authoring language for a stand alone application development. It also gives opportunities for students to learn and to build their skills in developing educational courseware or digital learning objects by using current authoring language software. This subject also emphasize on other aspects such as basic programming concept in Authoring Language, packaging and distributing multimedia files for standalone applications.

B. Email Interview

Personal e-mail interview was the main instrument used in determining the students' perceptions on group work. The aim of conducting e-mail interview was to draw out important clues from the participant that can be used in explaining characteristics and their experience working in team. This can be extracted by getting the target participant to talk through their own words of how they perceive a particular idea or issue.

C. Blogs

The method in this forum is open-ended interview. The researcher guides the discussion by introducing the topics or leading questions from the discussion outline and posting follow-up questions. Respondents are free to express their opinions in the forum based on the leading question given by the researcher.

A blog is created to evaluate the effectiveness of the portal. This blog is a link from the UTM Grid Portal for the users to give feedback and make discussion among the group members. The blog also can be accessed directly through http://utmgrid.blogspot.com. The blog is created using Blogger, a free website from the internet.

D. Pilot Study

Pilot study was done to a group of 36 students who enrolled in SPM4332 CD-ROM Based Multimedia Development course. First, they have to give their email address so that they will be invited by the researcher to be an author to the blog. The blog for pilot study could be access through http://spm4332.blogspot.com.

However, this blog is not accessible by the students after a period of time. Based on the feedback through email, they do not know how to access this blog. Therefore, to overcome this problem the researcher posts an entry to guide the students how to accept the invitation to become an author of this blog.

E. Dependability

This research used the within-method triangulation which is the subtype to methodological triangulation. The within-method triangulation involves the use of varieties of the same method to investigate a research issue [10], as cited in [11]. A combination of approaches which are entry posting, comment and chat box involved in the blog of this research.

F. Credibility

To measure the credibility of this research, within-method of methodological triangulation is used. The approaches involved in triangulation for credibility is similar to the triangulation for dependability.

III. Results and Discussion

The research performed qualitative the data analysis to get in depth understanding and find the meaning of the data. This section was discussed further the results obtained from the e-mail interview and the data collected from discussion in Grid Portal Blog.

A. Students' Perception on Group Work

The students' perception on group work and the elements needed in designing grid portal for collaborative learning were determined using e-mail interview and discussion through blog. The results presented herein are the synthesis of the results of both the interview and the blog discussions.

The e-mail interview and the blog discussion results were analyzed based on the three questions posted to target participants. This was done in order to find out characteristics, their experience working in team and their personal problems in conventional authoring activities environment. The data collected are divided into several categories and subcategories.

The first question aimed to determine the student's thought about group work in the course. From the feedback given, five categories were created to represent their thoughts on group work. These categories include cooperation and collaboration, support, task distribution, self management and problem within group members (Figure: 1).

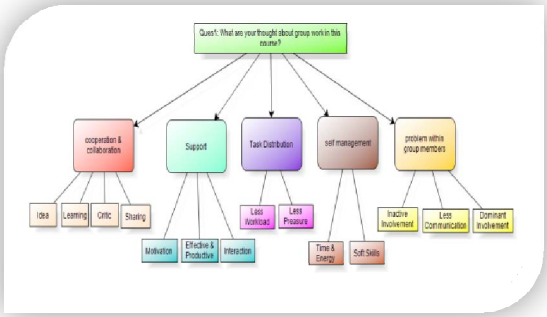

Fig. 1. Categories and Subcategories for Question 1.

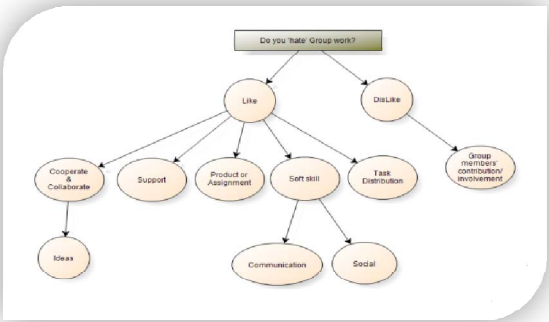

Fig. 2. Categories and Subcategories for Question 2.

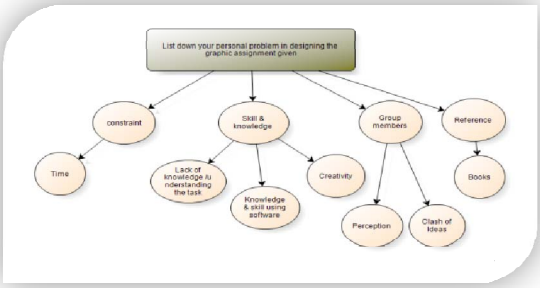

Fig. 3. Categories and Subcategories for Question 3.

In cooperation and collaboration category, the students believed that they can work and learn together from other group members. Most of the students said that group work is about sharing ideas, sharing problems, information, opinion and so on among group members. According to Damon & Phelps [12], peer collaboration where students share ideas to jointly solve the task is one of the peers learning characterized by the type of engagement that is fostered. Moreover, in group work activity they could share problems regarding the task given as well as sharing information and knowledge. Collaborators engage in sharing, proposing, discussing, ratifying and disseminating to create and maintain a common ground [16].

The good part in collaborative learning activity was the students shared any additional information related to the task with group members such as link to other webpage, video and so on that might be useful in completing the task. Each student can exchange information on research design with others using computer mediated communication, thereby shortening the time needed to accumulate the different examples [13]. Furthermore, group work allowed the students expressed their opinion and give suggestion to other group members.

The very crucial element in work group is task distribution. Equal task distribution will reduce the workload as well as the data shows that the students did divide the task equally among group members. Cooperation is associated with tasks that are fairly structured and this makes it relatively easy for group members to divide up the work and to work on sections separately [16], as cited in [14]. Task distribution caused less workload and eased the burden of the students. In addition, doing work in group also is time saving as they could complete the task given within a shorter period. Therefore, the collaborative approach to teaching and learning supported by electronic classroom can support a variety of topics and areas within a short period of time [13]. The disadvantage of group work is the problems within group members. Less communication, inactive and dominant involvements are some examples of problems occurring within the group members.

The second question was posted to know whether the students like or not doing group work. Most of the students like the group work however there are also a number of students who do not like group work. Students like group work because they could support one another, share ideas and thoughts as well as complete the task faster, easier and in more creative fashion. On the other hand, some students dislike group work due to problems with group members such as low commitment and contribution as well as less cooperation.

Lastly, the problem students faced in designing the graphic assignment was determined. One of the problems faced by students was time constraint in completing the task since everybody have their own activity plus the task in designing software requires lots of time. Another problem was lack of skills in using the software and lack of creativity. Sometimes different person have different idea and this might lead to misunderstanding and disagreement within group members. Conflict in group work can also arise from personal issues such as some members not completing the task given, or disagreement over intellectual interpretation of some themes being discussed in the group [13].

The students forwarded some suggestion to improve group work. One of the suggestions was to have an online program

as a medium for students to meet their group members virtually, make discussion and do the tasks through online.

The students also suggested that they will be given the chance to choose their own group members, where the numbers of members should not exceed four people per group. Teams were allowed to select their own members for a number of reasons. Trust within a team improves the likelihood of success [15], as cited in [16].

Further analysis of the data showed that the students gave support to peers by motivating them with words of encouragement and enthusiasm. The motivation could rise up their spirit and increase their effort in doing the task. Furthermore, the interaction provides students with the synergy and motivation to excel [16].

"As for team spirit, they experienced a sense of accomplishment and well-being. Their motivation was very high. They had mutual respect for each other's capabilities and strengths as they had worked together as a team in the classroom before." [17]

The students also showed respect to others opinion and take it positively where it established an essential working environment. Collaborative activities are both socially and emotionally demanding and most often require students not only to articulate their own points of view but also to listen to the views of others [13]. The students also updated the current progress of their project in the discussion.

B. Grid Portal Design

A Grid is a collection of independently owned and administered resources which have been joined together by a software and hardware infrastructure that interacts with the resources and the users of the resources to provide coordinated dynamic resource sharing in a dependable and consistent way according to policies that have been agreed to by all parties. Because of the large number of resources available on a Grid at any given time, an individual researcher can always be provided with the best resources available at that point of time for his/her needs, and overall, resource utilization can be distributed for maximum efficiency.

The Grid portal that was developed in this study is a web server as well as gateway by which users may access web services, manage data and compose workflows. The portal is used by the administrator to construct the service for others to use and by the users who wish to act together with the service by its automatically generated web interface. This Grid portal technology offers a framework for supplying single-point access to Grid services, similarly a Web portal such as Yahoo or MSN comprehensive site information, indexes and web pages. A Grid service that is accessible within the portal. A distinctive feature of this grid portal is, a user navigates to the portal page, and afterward, the portal presents the appropriate applications that the user may interact with, derived from their identity and the authorization policies. In view of this, a virtual organization may be formed. The Grid is a mixture of network infrastructure and software framework distributing computing services based on distributed hardware and software resources.

The study implemented the UCLA Grid Portal open source software with parallel computing system in order to design the efficient authoring infrastructure. In the UCLA Grid Architecture, clusters are connected to the Grid Portal by the addition of a single Grid Appliance to each cluster. A Grid Appliance is a separate machine that that serves as a gateway between the portal and the cluster. It runs a customized Globus Toolkit with additional UGP components. Each Grid Appliance is basically, a parallel head node for the compute cluster to which it is attached. For security, it runs a firewall and is open only to the cluster to which it is attached and the Grid Portal machine. All transactions between the Portal and Appliances use public key cryptography conforming to X-509 certificate standard. Adding a Grid Appliance to a cluster in no way modifies policy decisions at the cluster level. Any participating cluster can always also be used directly, without having to go through the Grid Portal.

Users interact with the Grid Portal through an https connection from a web browser. The Grid Portal uses GridSphere to run the portal and Apache Tomcat to run the web-interface. UGP uses MySQL database for the database of information about users, clusters, applications and job status that it needs to run the Portal. The architecture also includes a MyProxy server to store user certificates, a storage server connected to the Grid Portal to provide storage space for pool only users, and a visualization server to drive the software that is optionally required to provide through-the-web data visualization services to users.

At the same time as the UGP architecture presents a uniform appearance to users, it provides for a Grid made up of diverse computing environments (hardware, operating systems, and job schedulers) and autonomous administrative domains. UGP makes use entirely of open source software: Globus ToolKit, Tomcat, Java, Gridsphere and MySQL. UGP itself is also open source.

The Grid portal that developed makes use of Netbeans IDE platform to create web service because it provides an integrated Development Environment for Java (Desktop and Enterprise) and Service Oriented Architectures. SOA concept can build upon and evolving from older concepts of distributed computing and modular programming.

In grid portal service, the research created schema Web Service Definition Language (WSDL) using tools such as Neatbean IDE, GlassFish as web engine, C compiler and Parallel Virtual Machine (PVM). After finish, clients can access web service portal from a server as called as distributed or grid Computing. Users can access web service portal from a server as called as distributed or grid. Grid portal supports a framework to provide a web service interface to the existing applications without having to write extra code or modify the existing web services.

C. Emerging Results

Present the highlights of sections A and B:

- Categories
- Likes/dislikes about group work
- Students' suggestions for improving group work
- A brief description of the grid portal development in this study.

Apart from the above key research results, the output of this study will provide the following benefits to students, any users and participating universities:

- Facilitate and support work group of students in designing and developing a courseware.

- The successful application of authoring activities environment through grid technology provides enhancements in work group performance, helps to lower cost, and encourages creativity and innovation.
- Learners and faculties can promote the exchange of ideas, information, knowledge, and joint research and development of Web-based teaching materials.
- Help member universities build a network of facilitators to support e-learners (forum with advanced Information and Communication Technology (ICT), i.e., with the use of massive parallel processors of globally distributed and yet interconnected mini-supercomputers through global neural computer network).
- Researchers can partner with colleagues in more advanced faculties, and perform joint collaborative research and development with the use of the emerging global GRID computer networking technology.

IV. Summery

The project has presented a collaborative tool and an authoring environment which is the UTM Grid Portal using the grid portal technology with high performance computing platform supporting Web Based Education (WBE) and has been implemented to the users through blog. The study was able to identify student's difficulties in completing their authoring activity or collaborative work in conventional environment. Results of the study further indicate that some of the problems faced by the students in authoring activity are time constraint, lack of skills using the software and clash of ideas within group members. The results also show the need of having an online program as a medium for students to meet their group members virtually, make discussion and do the tasks through online. Therefore, the development of the UTM Grid Portal offers the best solution to overcome these problems.

The grid portal can overcome problems associated with group work especially time constraint because students can do discussion anytime in the blog with group members virtually without having to meet face-to-face. Furhter, lecturer could monitor the students' progress and performance through grid portal.

The results also showed that the students cooperate and collaborate with other group members by sharing ideas, sharing information, sharing problems on coursework as well as giving suggestion and opinion. Moreover, the students show their support in the group work by motivating others with words of encouragements and update the project progress frequently. Furthermore, the students also do divide the task equally among group members.

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