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Collaborative E-learning Tool for Secondary Schools

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Abstract: Nowadays, educational technology is getting more important for the learning environment. Much research has been done to investigate the effectiveness of e-learning and development of collaborative activities. It is thus viable to develop a web based system so that collaborative activities between users can take place. This means that users can collaborate in doing assignments and projects. In this study the web based system and results from its evaluation are described. The requirements for the web based system are gathered via interviews and surveys. This resulted in the identification of tools and features suitable for collaborative learning which forms the attributes of the system. The evaluation of the system is carried out via questionnaires distributed to learners and teachers after they used the system. Statistical analysis carried out on the collected data revealed that the respondents all agreed to the system being suitable for collaborative learning. The proposed model Lotfi VCL (Lotfi Virtual Collaborative Learning) gives an application of the tools and features of collaborative learning software suitable for learners' and teachers' collaborative activities. The study concludes by highlighting the research contributions and future enhancements of the system.

Key words: Cooperative/collaborative learning, teaching/learning strategies, distance education, interactive learning environments, computer-mediated communication

INTRODUCTION

Computers are created to aid human activities aimed at improving skills. Multimodalities available in the virtual world-the internet-have substituted the significant human culture of yesterdays. The varieties of our requirements and the challenges of globalization have reduced our world into tiny communities linked by computers. Within these tiny units, the philosophy of learning is not forgotten. In fact, learning has become universal and thus we have E-learning (Fernandez-Manjon *et al*., 2007; Wilson and Stacey, 2004; Abrami *et al*., 2011).

Students are no longer restricted in the classrooms with this transformation and innovation. They become skillful learners who are given chances to develop their critical and cognitive skills, understand other cultures and nurture intercultural relationships. Hence, the obstacle right there is to make sure that the education sector permits the current web-based applications approachable to teachers and students alike to enable them to collaborate efficiently along with the academic mission set by their respective educational institutions. More essentially, E-Learning helps in molding the students as the world they live in today and the world they will study in the future, is becoming more competition-based and knowledge-based (Panitz, 1999b; Laal and Ghodsi, 2012).

As educational innovations are shaped to the needs of the more competitive students, various software were designed to supply instruments to guide, assist and monitor online learning activities. Thus, the idea of Collaborative Learning (CL) was born. CL aims at supporting active student involvement in the learning field. In CL, students are able to study together in small groups towards a shared learning target. CL emphasizes on combined working efforts among students in their group along with the teachers' guidance. Students are responsible for their own and the group members' learning. Hence, the one's success helps other students to be successful (Gokhale, 1995). CL gives students the opportunity to express and criticize their opinions and encourages them to be sensitive and analytical (White and Pea, 2011; Dillenbourg, 1999; Ingleton *et al*., 2000).

In this study, we develop collaborative software which can do homework and project together in separate places. This proposed software gives an application of

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the tools and features of CL software suitable for learners' and teachers' collaborative activities.

COLLABORATIVE LEARNING

The education field has changed drastically compared to the yesterdays. The once commonly used teacher-centered strategy in the classroom has become the topic of a heated debate among educators and social scientists. As opposed to the conventional learning method, Collaborative Learning (CL) aims at giving importance to various individuals who are interested in learning something not as separate learners but together (Dillenbourg, 1999).This section highlights the vital role of computers play in education through Collaborative Learning (CL) (Hennessy *et al*., 2007).

Advantages of collaborative learning applications: While students are able to learn more effectively with Collaborative Learning (CL), many educators place a strong emphasis on teaching strategies that are more than just masteries of content and ideas. Experts believe CL promotes a larger educational agenda that encompasses several rationales involving students, teachers and staff and various institutions, especially schools (Liu *et al*., 2011; Laal and Ghodsi, 2012; Panitz, 1999a, 2000; Ingleton *et al*., 2000).

Instead of being teacher-centered, collaborative learning is all about students and learners. Students are the active agencies who are provided with the courseware to complete assigned tasks by cooperating with others. Towards this end, students become more analytical and critical-thinking. Cooperating with peers encourages critical thinking, develops higher level of cognitive skills and sharpens communication skills. As students are actively involved in the learning process, teachers allow them to do the exercises that are less confining. CL also reduces tension by increasing students' persistence to accomplish the tasks. In its wider application, CL gives students the ability and freedom to solve problems using new techniques that they might have discovered by themselves. Weaker students are helped by advanced students in an atmosphere of trust. Through teamwork, the students' learning outcome is shared among themselves (Panitz, 1999b).

In collaborative learning environment, teachers and staff are introduced to a range of themes, topics and topics for students to complete. A wider range of resources through various online links result in a more dynamic engagement between students, teachers and staff. The benefits of CL are outlined and summarized (Panitz, 1999b, 2000). CL is used to personalize large classes to encourage students to participate. It promotes understanding among teachers and staff and provides teachers to explore on assessment techniques aside from the traditional exams or tests after each lesson.

Wilson and Stacey (2004) justified that CL has benefits to institutions. These benefits include Return of Investment, Deployment of Technology and Frameworks of Collaboration.

The classification of the tools and features of CL application: Within the field of Information and Computer Technology (ICT), many literatures exist on CL Applications. In this study, WeRcLeA, a reviewing tool, is used to analyze the applications of collaborated learning. The techniques that are specifically applied were introduced by Ab Rahman (2006). He came up with a model which combines the classification of collaborative tools earlier discovered in the studies of French (2003), Koschmann (1994) and Stahl *et al*. (2006) research. Because Ab Rahman (2006) adopted model is similar to the scope of this study, the same grouping of tools, namely, communication, shared repository, group learning and assessment tools are implemented.

Communication tools can be asynchronous or synchronous tools. The main attributes of asynchronous communication tools are group email, announcements, Calendar (Exam time table)/Progress review tool and discussion forums. However, the main attributes for Synchronous Communication are chat, shared whiteboard, application sharing, virtual space, voice chat and video conferencing.

The main features for shared repository tools are shared facility, curriculum objectives, shared bookmarks, real time data, data collection, list of projects/courses/activities and Frequently Asked Questions (FAQ). The shared repository tools for teachers include Design Activities.

The important features of group learning tools that are made available to students are project space or group space, personal workplace, group forming, negotiation, expert services, presentation and submission, online guide and wiki. Some of the important features introduced for teachers are online authoring and online presentation which are used simultaneously as collaborative software.

The different assessment amenities are self-reflection, self-assessment, group-assessment, progress tracking and online survey. Assessment tools for teachers are very important because they provide ways to monitor students' learning progress. Aside from the monitoring tools, teachers can also use the assessment manager and personal workplace.

Comparison of three existing applications: Based on the comparison of three existing applications that named ATutor, Moodle and Sakai, that mentioned in our previous article (Lotfi and Nasaruddin, 2009). Moodle and Sakai are more powerful than ATutor. There are some features which are only available within Moodle and Sakai, such as on-line course calendar, spell checker in discussion forum, unlimited chat rooms, on-line clubs, forming groups by students, own whiteboard and personal test banks for teachers. Moodle has more functionality than ATutor and is easier than Sakai. It is clearer to be used by the learners of secondary schools. Moodle has been widely used in Secondary Schools. In conclusion there are not group assessments or group questions for each of systems. The comparison shows the lack of group assessment and also there are no online classes individually but they can be made by discussion forum. This research has focused in group questions, group assessments as well as online classes. The lack of group assessments and group questions made us develop Lotfi VCL that will be discussed in the following sections.

MATERIALS AND METHODS

In the process of investigating the applications of Collaborative Learning (CL) activities as well as formulating a system that would improve students' learning, researchers must have a background on different research paradigms. Among academicians, information and technology experts, technocrats, health and medical scientists and others, two paradigms have been used: qualitative and quantitative.

There are various information systems which need processing of the human mind. Throughout centuries, information has been related to communication and since only human beings have the ability to comprehend and interpret information, various models exist. However, before human civilization has truly matured, information sharing was done verbally because of the absence of a much systematic method. As human civilization grows, there seems to be no stopping in innovation and technology. One of the recent contributions in information sharing in the education field is collaborative learning.

The innovation of learning has been revolutionary. From the traditional two-way teaching system of teacher-student, it has revolutionized. Among academic staffs that have to get accustomed to the information highway, CL is a requirement. Until today, the study emphasizes on the importance of CL in education. Specifically, it tries to discuss the different tools, features and applications of CL as well as the advantages that this system poses to both learners and teachers. To accomplish a web-based tool for Secondary School students and teachers to support their CL activities, the following strategies are conducted.

The researcher summarized the philosophy behind computers and education with links to CL and its support system. Since the whole educational system gains profits from CL applications, the perceived advantages of CL are narrowed down to the learners, teachers and institutions. In the process of identifying the different CL applications, the researcher identified those that are considered successful and practical based on the needs of the users. Thus, three CL applications and features are shown.

To determine the usefulness of the CL features, the researcher scheduled two meetings with learners. Since CL has too many important attributes to be focused on, it is nearly impossible for the researcher to enquire every single detail. Hence, the researcher conducted some meeting with a smaller population. Its purpose was to provide the learners the chance to find out which CL tools they find most suitable based on their needs as learners.

From the information obtained during the two meetings, the researcher came up with two questionnaires for the research sample size. In these questionnaires, the learners as well as the teachers were required to rate the significance of the tools and features that they find supportive to the different CL activities. Data from the questionnaires provided the weighted average values (Lotfi, 2009).

Based on the weighted average values of the tools and features, the researcher plotted the rates in a comparative table consisting of the three CL applications (Lotfi *et al*., 2010b; Lotfi and Nasaruddin, 2009).

From the information available from the table, the researcher identified the functional and non-functional requirements necessary in developing the Lotfi VCL (Lotfi *et al*., 2010a).

The researcher's Lotfi VCL system was implemented and tested. Data from the testing were collected, tabulated and documented to determine its strengths and weaknesses so that the system can be improved in the future.

Meetings: To gather suitable CL tools and features, we invited all students that had e-learning experience. Then we arranged two meetings with them, with secondary (containing 22 students) and Pre-University (containing 20 students) students. We followed these steps during each meeting:

- Introduced CL tools and features for learners
- Explained each CL tool and feature for learners
- Discussed the important ones from students' view
- Obtained suitable CL tools and features from learners' view

Questionnaires: Two forms of two-paged structured questionnaires with three sections were made for learners and teachers in order to find the suitable CL tools and features for learners based on the meetings. The general details and students' satisfaction of using CL applications were measured. The application details that indicate the essential tools and features from students' or teachers' point of views and the last section was a free response feedback we also examined in this study.

Implementation of learners' questionnaire: The participants of the questionnaire were 205 students from grades 9, 10, 11 and Pre-University from the Complex of Imam Khomeini in Kuala Lumpur. Before filling up the questionnaires, the following steps were taken:

- The research was explained and introduced
- The Collaborative Learning applications were explained
- Collaborative tools and features were introduced
- One CL application was shown and its tools and features were indicated

Then, the questionnaires were distributed and collected back. This task took about a month.

Implementation of the teachers' questionnaire: The participants of the questionnaire were 55 teachers from secondary school and pre-university. Before filling up the questionnaires, verbal explanations were given to some and for the rest written explanations were sent by E-mail. Then, the questionnaires were distributed and collected. This task took longer than a month.

Data collection and analysis of the questionnaires: From 711 students in Educational Complex of Imam Khomeini in Kuala Lumpur, 224 study in secondary and Pre-University. The questionnaire distributed to all secondary and pre university students that there were many students that had experience in e-learning education system and 205 students answered completely that we used in this research.

RESULTS AND DISCUSSION

The questionnaires are aimed rating the importance of tools and features in supporting Collaborative Learning (CL) activities from students' and teachers' views. The group rating of each tool and feature obtained was used in the development of Lotfi VCL. The results of these two meeting are shown in Fig. 1.

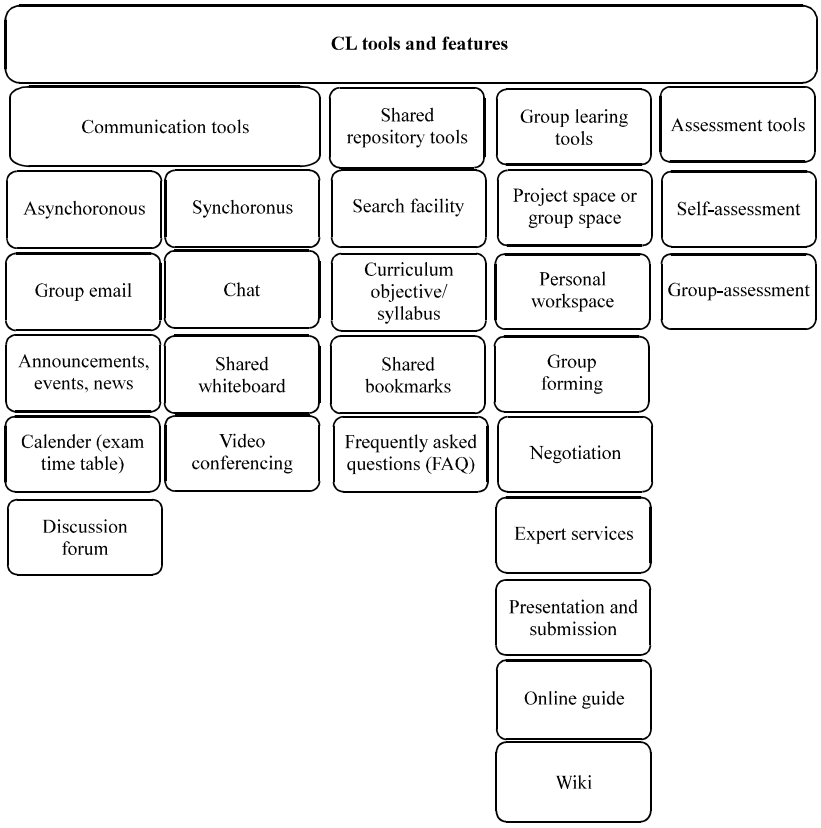

Fig. 1: The important CL tools and features for learner from learners' and teachers' view

Questionnaires results: There were 16 and 21 questions for learners and teachers, respectively. Some questions required general data, such as age, gender and educational experience. There were 150 male and 55 female learners who participated. On the other hand, 4 male and 51 female teachers were involved. There were questions requiring details related to the research, as well. The important statements are listed in Table 1.

Table 1 shows that most participants like to use computer and technology in the learning and teaching fields that is most important tool for working online. They are also interested in sharing activities and tasks and they like to engage to CL applications for learning and teaching. This section can be as the participant description section that shows the motivation of students to study collaboratively online. This speculation is congruent with some researchers that have been conducted in the past. They demonstrate that students and teachers are able to learn better when they actively engage in meaningful activities or when they collaborate with peers (Vrasidas and Zembylas, 2004: Herrington *et al*., 2009; Ab Rahman, 2006; Jamil and Shah, 2011; Wilson and Stacey, 2004; Waycott *et al*., 2010).

CL results: This part contains the results of CL applications that are categorized based on learners' and teachers' views. We used Weighted Average Value (WAV) of each feature and mean value for each category of tools. Weighted Average Value (WAV) of each feature represents the group rating from 205 students of the importance of each feature. Thus the greater the weighted average value (WAV), the more important is that feature for a CL application. Weighted average value (WAV) for each feature is calculated using the formula below:

$$WAV = \frac{P+2Q+3R+4S}{205}$$

Table 1: The important output of both questionnaires

Statements	Learners (%)	Teachers (%)
Having computer at home	97.56	100.00
Having computer at school	100.00	100.00
Using computer every day	87.80	81.82
Using Internet every day	87.05	72.73
To like to work with computer	92.68	90.91
To like to do or plan the homework using a computer	78.05	81.82
Not to like traditional learning	85.37	63.64
To like to communicate together through the Internet to do the homework	80.49	54.55
To like to share the duty or the homework	82.93	60.00
To like to do/plan the assignment through the Internet	70.10	64.40

where P, Q, R and S are the number of responses for the Likert Scale 1, 2, 3, 4, respectively and 205 is the total number of responses.

As the mean value is calculated from the Weighted Average Value (WAV), it is concluded that the greater the mean value, the more important is that category of tools. The mean value of each category of tools is given by the following formula:

$$\text{Mean value} = \frac{WAV1+WAV2+WAV3+\&\&+WAVn}{n}$$

where, n is the maximum number of features in that category of tools.

Table 2 shows that the asynchronous communication and group learning tools are important with 3.13 point mean value. The assessment tool holds the highest importance with 3.45 point value. All other categories are just as highly important with values above 3.00 except for synchronous communication and assessment from learners' view and only synchronous communication from teachers' view. The overall mean value for learners' view is 3.032 while for teachers' view is 3.04.

These results are also supported by the findings discovered by So and Brush (2008), which represent asynchronous communication channel with the instructor as being more preferred by students who tend to be shy in traditional classroom than the vocal and active ones. As well as having the willingness and motivation to participate in group projects, students had a positive view of the course by the students as they enjoyed working with group members and at the same time received high grades on the group project with group learning tools (So and Brush, 2008). Moreover, Schellens and Valcke (2005) and Dillenbourg *et al*. (2009) found positive learning outcomes from the usage of online asynchronous communication tools.

According to Rogers (2009), asynchronous communication can be used to facilitate collaborative learning experiences among students located in different time zones. Rogers (2009) also mentioned that group support systems are an effective medium to improve collaborative learning.

It is essential to know that the purpose of a CSCL environment is not simply to allow collaboration across distance but to provide the required conditions in which effective group interactions are expected to occur. Students who form a group for a learning activity are expected to develop a shared goal for the joint activity (Dillenbourg *et al*., 2009; Lo, 2009).

Table 2: Important of tools and features from learners' and teachers' views

CL tools	Features	Weighted average value for learner	Weighted average value for teacher
Asynchronous communication	Group email	3.07	3.18
	Announcement, event, news	3.05	3.05
	Calendar (Exam time table)	3.41	3.27
	Discussion forum	3.00	3.05
Mean value for asynchronous communication		3.13	3.14
Synchronous communication	Chat	3.39	2.55
	Shard whiteboard	2.82	2.82
	Video conferencing	2.71	2.18
Mean value for synchronous communication		2.97	2.52
Shared repository	Search facility	3.27	3.27
	Syllabus, curriculum objectives	3.12	3.27
	Shared bookmarks	3.02	2.45
	Frequently Asked Questions (FAQ)	3.02	3.00
Mean value for shared repository		3.11	3.00
Group learning	Project space	3.20	3.27
	Personal workspace	3.10	3.00
	Group forming	3.39	3.16
	Negotiation	3.30	3.19
	Wiki	3.00	3.00
	Presentation and submission	3.07	3.01
	Expert services	3.01	3.01
	Online guides and support	3.00	3.07
Mean value for group learning		3.13	3.09
Assessment	Self-assessment	2.82	3.39
	Group assessment	2.82	3.50
Mean value for assessment		2.82	3.45

On the other hand, during a group activity, members might face challenges due to variations in their priorities, respective goals and expectations or conflicts generated by interpersonal dynamics, such as different styles of working or communicating, the tendency for some individuals to rely on others to do their share of the work and power relationships among members (Burdett, 2003). Yet further complications are faced by culturally diverse groups due to more substantial differences in their personal background characteristics. Among these are language barrier and preferred communication style. Due to prior cultural-educational experiences, students might also feel unprepared to come out of their comfort zone and interact with less familiar peers (Dillenbourg *et al*., 2009).

Analysis and develop of Lotfi VCL: Before develop of Lotfi VCL, the suitable tools and features of learner were gathered by two printed questionnaires from learners and teachers' view. Then, these tools and features were compared with three existing systems ATutor, Moodle and Sakai.

Based on the comparison, it was observed that group assessments or group questions were not found in any of the systems. The lack of group assessment and also online classes individually encouraged us to develop Lotfi VCL.

The developing of Lotfi VCL includes three parts: requirements capture, system structure chart and user interface design. Requirements capture is divided in two types: Functional requirements and non-functional requirements. Functional requirements include all users, administration function, teacher function and student function while non-functional requirements include usability, operational, performance, supportability and security.

System structure chart is used to show the hierarchy of the modules in the system where high level module indicates the higher level functionality while the lower level modules show the detailed functionality. Figure 2 shows the main structure of Lotfi VCL system.

The user interface develop of the Lotfi VCL effectively influences its practicality. A good user interface design will reduce the time master the system. It will also increase the users' efficacy as well as enabling users to remember the functions of system even after some time.

Administrators can create new course by choosing a teacher from teachers list and then creating a course for the selected teacher, which can be activated right away or later. Administrators can create new accounts for teachers, students or the other administrators whereas a student can make an account for himself.

Teachers are free to choose a course to manage, which can be done by setting group question, group

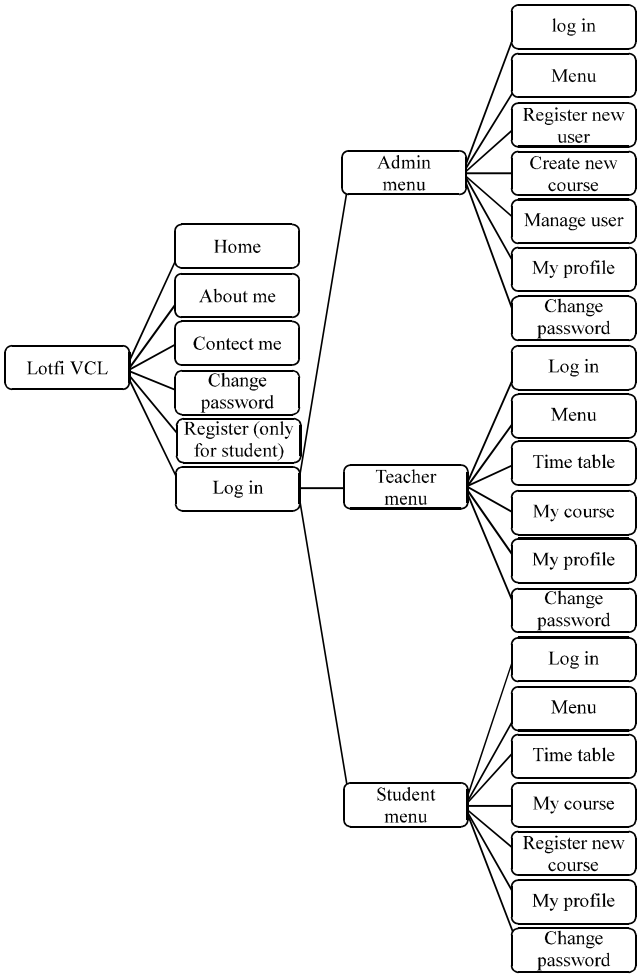

Fig. 2: The main structure of Lotfi VCL system

assessment and or group project then marking them or by creating sub course and new group (Fig. 3). Teachers have the liberty to delete students from their course as well. Also, teachers can go to the time table and select a course to go to the online class. Only the classes that will be conducted on the day will appear red in color and can be entered only after the starting time and before the ending time. Teachers can go in discussion forum and discuss with their students who are registered in the course during the class time.

On the other hand, students can go to the time table during the class time, follow the class board and discuss with classmates and teacher about the on-going lesson. Sometimes the teacher will prepare a set group questions during the class time; there can be a group assessment given to the students during this time as well. Students cannot attempt the group question or group assessment in any other time except the set class time. Students can select items that are shown in Fig. 4 and get the results of group projects, group assessments or group questions. Students can do the group project from this page or even delete themselves from the course. Students can examine their knowledge in two ways. They can answer descriptive question by going to Group Question or answer MCQ by going to Group Assessment. While either page opens, a chat room opens simultaneously whereby students are to discuss the questions and finally the group leader will post the answer. For group assessment, the system marks the questions automatically but group questions are marked by the teacher. Figures 3 and 4 show a few screenshots of Lotfi VCL.

Lotfi VCL implementation, evaluation and results: Here, the implementation, evaluation and results are

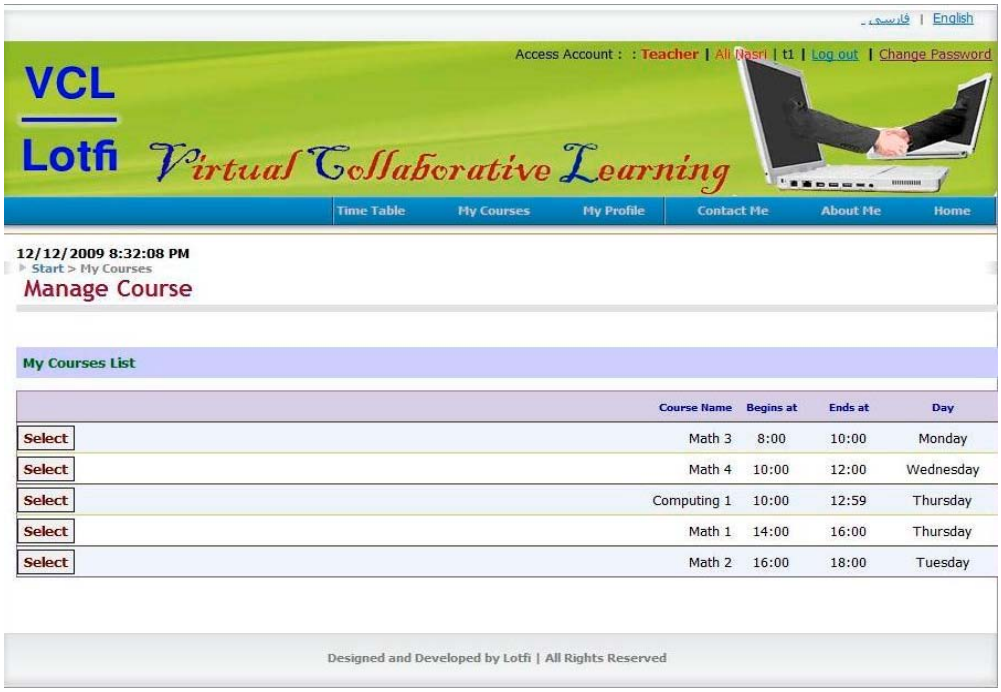

Fig. 3: Screenshot of "Manage Course" page by teacher

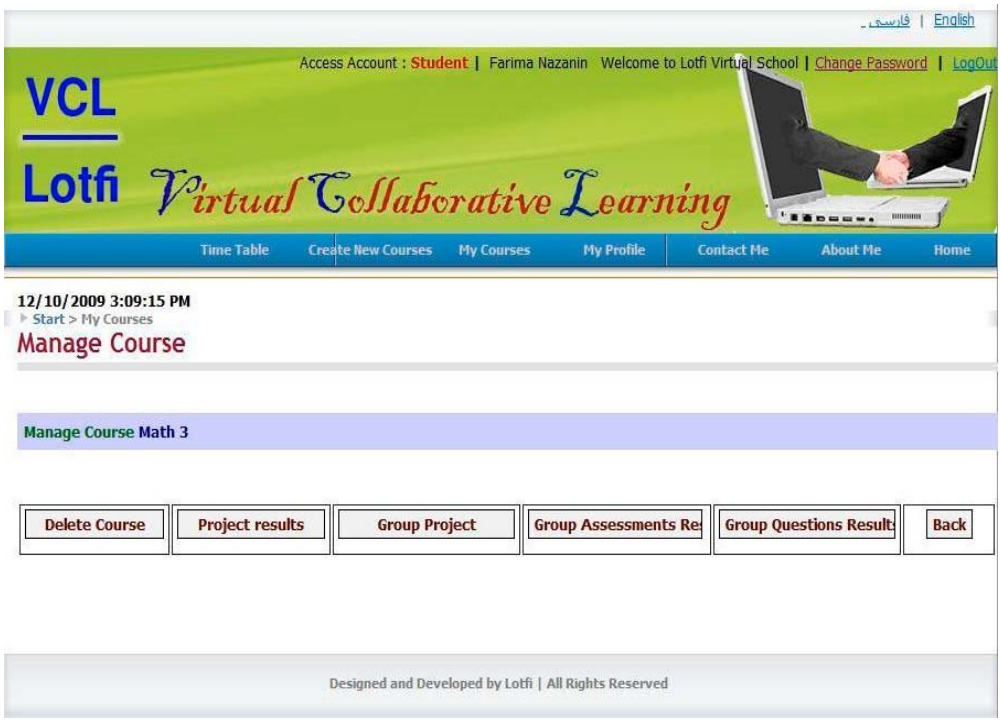

Fig. 4: Screenshot of "Manage Course" page by students

explained. For implementation tools, hardware and software requirements, Lotfi VCL architecture, execution of Lotfi VCL, tools and features for each user such as administrator, teacher or student are described.

There are some hardware and software requirements for Lotfi VCL which need to be specified. The minimum requirements for Lotfi VCL are shown in Table 3 and 4.

Lotfi VCL architecture: Determining where the identified software components of the system will best be located to the various hardware components on which the system will operate is the objective of the architecture design. Many applications today are web based applications mainly because of its easy accessibility and frequency of being updated, satisfying users' expectation for up to date information and task completion. As users' activity is continuously expected, Lotfi VCL is developed to be web based. The popular client server architecture is used, which can balance the process between the client and server.

Dennis *et al.* (2005), classified that all software systems are divided into four functions which act as the basic building blocks of any information system.

- **Data storage:** Data is required to be stored and retrieved in most information systems.
- **Data access logic:** this requires data accessing which often means database queries in SQL
- **Application logic:** Functional requirements and the logic documented in DFDs
- **Presentation logic:** display information to the user and the acceptance of the user's command or the user interface

Table 3: Hardware requirements

	Server	Client
Processor	Intel pentium IIII	Intel pentium or compatible 166 MHz
Memory	1028 MB (for SQL Server 2005 enterprise edition) 256 MB (for SQL server express edition)	256 MB
Disk space	10 MB (for installation of Lotfi VCL only)	-
Display	1024×768 VGA	1024×768 VGA
Keyboard and mouse	Yes	Yes

Table 4: Software requirements

Server	Client
Microsoft windows 2003 server	Microsoft windows XP or later
Microsoft. NET framework 2.0	-
Internet information server v5.0	Internet explorer 5.0
Microsoft SQL server enterprise edition/express edition	-
ASP.NET AJAX extensions 1.0 , AJAX control toolkit 2.0	

Client computers, servers and the web which connects them are the three primary hardware components of a system.

Execution of Lotfi VCL Lotfi VCL aims to guide students in collaborative learning activities. The homepage acts as the center of the system. The homepage provides linkage to login page, register page, about me and contact me in two languages which are Persian and English.

There are many tools and features for administration which are explained below.

Register new user: Administrator can register any user with different access account (Admin, Teacher or Student).

Manage users: Administrator can manage all users. Administrator has to be able to delete a user from system, edit user profile, lock/unlock login name and confirm validation/invalidation of user login name.

Create new course: Administrator can create new course by selecting a teacher for it.

My profile: Administrator can edit his profile in this section.

Change password: Administrator can change his Password by himself.

The tools and features used for teachers are described as following.

My course: In this section, teacher can unregister student from course, create new group and new sub course, edit sub course, set group question, set group assessment, set group project, mark students' questions answers and students' project answers.

Time table: Teacher can login online classes only when the class has begun and teach the lesson and also he can discuss with students in discussion forum.

My profile: Teacher can edit his profile in this section.

Change password: Teacher can change his password by himself.

There are many tools and features for students which are explained in the following.

Register new course: Student can register in course that he wants.

My course: Student can unregister from course by himself, do group project with group members and see Group assessment results, question results and project results.

Time table: Student can login online classes during the class time and look at the class board, go to discussion forum to discuss with classmates and teacher about on-going lesson, do group question with group members and do group assessment with group members.

My profile: Student can edit his profile in this section.

Change password: Student can change his Password by himself.

The evaluation focuses on the following 6 aspects of Lotfi VCL:

- Ability to carry out online classes. This is achieved when the participants' use Lotfi VCL for online classes
- Ability to carry out discussion forum. This is achieved when the participants' use Lotfi VCL for discussion forum during online classes time
- Ability to carry out group assessments. This is gained when students do the assessments with group members in Lotfi VCL during online class time
- Ability to carry out group question. This is gained when students do the question with group members in Lotfi VCL during online class time
- Ability to carry out group projects. This is gained when users do the projects together in Lotfi VCL
- Usability of Lotfi VCL. This is to determine whether Lotfi VCL is user friendly

These are the following evaluation steps i took: 15 students from grade 10, 10 from pre-university and 5 teachers volunteered and participated in the evaluation. First a short description on the objectives and evaluation steps were given to the participants. Then, they worked with the system for a period of about two hours and finally, filled up the questionnaires.

One form of questionnaire being two-page structured consisting three sections was made for learners and teachers in order to evaluate Lotfi VCL and its tools and features. Section 1 measured the general details and users' satisfaction of using CL applications. Section 2, measured the system evaluation that is to test the system usability. In this part, the tester requires to rank Lotfi VCL's functionality according to the usability, criteria of "efficient to use", "easy to remember how to use", "easy to learn", "safe to use" and "have good utility". While the second part of evaluation form is concerned with the system functionality, the third section is user interface evaluation that focuses on the non-functional requirements, such as user interface design and performance. The end of this part is free response feedback. Results of evaluation of Lotfi VCL are divided into 3 sections.

Results of section 1: This section obtained general details. There were 13 questions for users. Some questions required general data, such as age, gender. There are questions requiring details related to the research, as well. The important statements are listed in Table 5.

Table 5 shows that most participants like to use computer and technology in learning and teaching fields. As the percentages shows, users are not really interested in traditional learning and they would prefer using computers to get their homework done through Internet. They are also interested in sharing activities and tasks and they like to engage to CL applications for learning and teaching.

Results of section 2: This section obtained the system evaluation. The results were analyzed and summarized in Table 6. We used 5-point Likert scale (1 = very poor; 5 = very good).

Table 6 shows that all the functional requirements of the system are very applicable as the WAV obtained in all seems to exceed 4.00 and 4 indicates of good. As shown, Group Assessment during Online Class Time scores the least having the value of 4.05. On the other hand,

Table 5: The important output of evaluation form from section 1

Statements	Users (%)
Having computer at home	100
Having computer at school	100
Using computer every day	80
Using Internet every day	80
To like using computer in group activities	80
Not to like traditional learning	80
To like to communicate together through the Internet to do the homework	70

Table 6: The output of system evaluation

System evaluation	Weighted average value for users
Online class	4.30
Discussion forum during online class (for discussing with classmates and teacher)	4.50
Group assessment during online class time	4.05
Group question during online class time	4.50
Group project	4.30
Mean value	4.33

Table 7: The output of user interface evaluation

User Interface evaluation	Weighted average value for user
Hyperlink and navigation between webpages	4.70
Background colors	3.50
Arrangement of information	4.50
Text style	3.50
Text color	3.90
Download/upload time	4.60
Aesthetic design	3.90
Internal consistency (logo, font, label...)	3.90
Information visibility	4.50
Header design	4.20
Footer design	4.20
As overall, what do you think about the system's interface	4.50
Mean value	4.16

Discussion forum during online class and group question during online class time sharing the same value of 4.5 score the highest. The mean value of 4.33 proves that the functional requirements of the system are appropriate for users.

User interface evaluation: The results were analyzed and summarized in Table 7. We used 5-point Likert scale (1 = very poor; 5 = very good).

Table 7 shows that all heuristic evaluation of the system is very useful as the WAV obtained in all of them seems to exceed 4.00 and 4 indicates of good. Background color and Text style are rated to be the lowest having the same WAV of 3.5. Hyperlink and Navigation between Webpages and Download/Upload time are both rated to have the highest WAV of values 4.7 and 4.6, respectively. The mean value 4.16 proves that heuristic evaluation of the system is appropriate for users.

CONCLUSIONS

Creating software and perfecting it are two different things. This section explains the strengths and weaknesses of the Lotfi VCL, software specifically developed for collaborative learning. This is followed by discussing a few suggestions on how to enhance the system. Finally, the section ends with some insights on the processes of software develop and challenges on information technology.

The strengths of the Lotfi VCL are determined by assessing its product aspect and the process aspect. Product aspect pertains to the capabilities of the system to operate based on its specifications. Compared with the other systems available in the market, the strengths and competitive advantages of the Lotfi VCL are as follows:

- Makes group assessments and projects which can be uploaded by the respective teachers for different groups, allowing students to work independently as a group without sharing their answers with other group members provided that the questions are not usually the same. This feature motivates students to work as a team and improves their knowledge
- Allows teachers to create not only a courses but also sub courses, hence encouraging students to work in different groups based on the sub courses. Because the content of the course has been itemized through the sub courses, students have many topics to work on, not only as individuals but more importantly as groups which design their critical thinking, cognitive and communications skills
- Provides separate features for each type of user: Administrators, students and teachers; enabling users to work independently.
- Includes features facilitating collaborative learning for teachers and students. These include online classes, group assessments (i.e. posting and submission) and group discussions. All these are accessible during online classes and group assessments and projects among members. ATutor, Moodle and Sakai do not have these features
- Is insured by a security feature. All posted data are stored in the SQL Server that forbids non-subscribers to access data
- Has an authentication system where only valid users can log in, either as an individual or a member of a group. Authentication is based on the roles in each member
- Uses microsoft ASP. Net which gives the system the ability to run faster compared to the scripting such as PHP
- Uses ASP. Net for its online chatting feature and HTML for the output so users or clients do not have to install chat program because chatting is already activated in the system. In other programs, users need to have Java or ActiveX before they could go to the chat room
- Is bilingual: Persian and English. Although, the aim is to provide a system for the Iranian users in the Education Complex of Imam Khomeini in Kuala Lumpur, this feature will also expose other users to the Persian language

In terms of the process aspect, Lotfi VCL tried to incorporate the development and maintenance aspects. If the development of the product followed the prescribed process, it is more likely that the product is also acceptable. The other features of the Lotfi VCL are as follows:

- Uses the Unified Modeling Language (UML) to specify, visualize, construct and document the system. With UML, the system is simple, clear and efficient
- Is developed for software reuse. The modules in the system, namely user class, course class, group class and admin class are reusable
- Is easy to maintain. Developed for teachers and students whose activities are object-oriented, the system can be modified to allow new requirements and future enrichments.

Although, the system attempted to introduce new features, some of its limitations are listed below:

- Lotfi VCL does not offer shared whiteboard, shared application, voice conferencing and video conferencing. Such features usually require a complex process
- Lotfi VCL provides chatting but it cannot send or receive email. Incorporating the email feature into the system requires the configuration of POP3 server, which at the moment is beyond the scope of this research
- Lotfi VCL is linked with SQL Server so the database is faster and more secured compared to Access database. However, the user has to pay the additional charge for database hosting
- In Lotfi VCL, marking for teachers is limited. She/he cannot simultaneously mark the page of the group leader and also be on the discussion page

Future enhancements are encouraged to enrich the facilities of Lotfi VCL for a more effective collaborative learning among teachers and students. The future enhancements are as follows:

- Include other features like shared whiteboard, shared application, voice conferencing and video conferencing.
- Integrate the necessary software like ActiveMail and devMail.Net as well as POP3 mail server so that Lotfi VCL would have an Email system
- Include a template control so that the user has more freedom to develop and layout the page according to his needs and preferences
- Develop a support system which allows users to choose the database system based on their requirements and financial capabilities
- Make the system multilingual

Teenagers of this generation are generally computer-conscious, if not literate on the different web-based applications available online. In fact, the unprecedented access to the World-Wide-Web (WWW) has reduced the world into small communities of learners, paving the ways for distance learning. Students are now learning via the web through group assessment, group project and online classes. These are new ways that need web-based programs. For this advancement, developing a system for Collaborative Learning (CL) is important. With CL, methods are enhanced for knowledge sharing and for the improvement of students' skills.

The Lotfi VCL is a web-based project conceived to integrate some features that are not available in the existing modules that provide collaborative activities. The main objective of Lotfi VCL is to educate; however, it also offers features for social networking like forming alumni groups and learning communities. Lotfi VCL supports online knowledge sharing while at the same time, it allows the course Instructor (the teacher) to monitor the exchange and quality of the information among students.

The process involved in developing the Lotfi VCL has been a rewarding experience, amidst some limitations and constraints. The knowledge learned has surpassed the difficulties and in the end, a system for CL is now a reality. In developing the software, understanding the different existing programs and applying the various procedures were all integrated in the whole process. Working with the Unified Process, developing the system with UML models, setting up the Web Server as database and programming with DOT.NET have ensured that the system is ready for implementation. The Unified Process provides the development framework and the supporting tools like ASP.NET AJAX Extension 1.0, AJAX Control Toolkit 2.0 helped in the overall develop. All these have been useful for the effective and efficient development of the Lotfi VCL.

Indeed, there are no mountains too high to climb and there are no processes too difficult to integrate in developing a system for CL. The Lotfi VCL is a product of persistence, hard work and dedication. The mission is to share knowledge and to make this software available to those who need it.

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