The Evaluation of the Usability and Effectiveness of TELERECS E-Collaboration System

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ABSTRACT

Electronic Collaboration environments can be used to facilitate collaborative teaching, learning and research environment. However, the current e-learning in higher educational institutions is not facilitating these activities. Hence the proposed e-collaborative system entitled Teach, learn and Research Collaboration System (TELERECS). A total of 30 undergraduate students undertaking introduction to business information system course participated in this study for two months. The objectives of the study were to evaluate the feasibility of the instruments and to evaluate students' perceptions regarding the usability and effectiveness of the system. The methodology employed multiple methods of data collection, including individual and team assessment through activities logs, instructor's personal observation as well as experimental and control group survey using pre-test and post-test. The findings show that the system is a usable and effective environment for e-collaboration. The results of the pre-test and post-test also indicated that there are significant difference between the mean scores of the experimental and control groups.

Author Keywords

e-collaboration; e-learning; usability; effectiveness; wiki

ACM Classification Keywords

H.5.3 [**Information Interfaces and Presentation**]: Group and Organization Interfaces --- Collaborative Computing, Evaluation, Methodology, Asynchronous Interaction, Synchronous Interaction and Computer-Supported Cooperative Work

GENERAL TERMS

Experimentation, Human Factors, Performance, Reliability Verification

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INTRODUCTION

Researches have shown that many higher educational institutions e-learning do not adequately support electronic collaboration (e-collaboration). The e-learning is mainly meant to deliver contents such as slides, lecture notes and other information without supporting student's active participation, discussion and collaboration. E-Collaboration environment are used for collaborative teaching, learning and research among students as well as between students and instructors from anywhere and at any time. However, how can e-collaboration system be evaluated in order to ensure that it facilitates an authentic collaboration in higher educational institutions? This paper presents a pilot study on the evaluation of wiki-based e-collaboration system entitled Teach, Learn and Research E-Collaboration System (TELERECS) based on constructivism learning theory.

The main purpose of the study was to evaluate TELERECS e-collaboration system with regards to the usability (attractiveness, simple navigation, consistencies, visibility, controllability and efficiencies), effectiveness (teaching presence, social presence and cognitive presence) and to carry out hypothesis test using pre/post-test scores from control and experimental study design. These were carried out from the point of view of students within the context of blended learning approach.

RESEARCH BACKGROUND

In this study, the conventional in-class is defined as collaboration in the classroom whereby pairs or group of students collaboratively construct knowledge through discussion, sharing of ideas, cooperating on issues and at the end reaching a conclusion. The pairs of group of students work in the presence of the instructor who serves as a mediator and facilitator for the collaboration process. The students in this context are the collaborators, goal setters and participators. According to [1], the characteristics of collaborative classroom include sharing of knowledge and authority among teachers and students within the classroom.

This paper is part of an ongoing research which main goals are to propose a conceptual framework for effective e-collaboration, to develop an e-collaboration environment and finally to evaluate the framework and the system. Previous studies carried out include an exploration of social media use in higher educational institutions [2], a development of conceptual framework for effective e-collaboration [3], this was then followed by the development and heuristic evaluation of TELERECS e-collaboration environment [4].

Overview of TELERECS

TELERECS e-collaboration system was developed using wiki as the platform. There are two main approaches to e-learning, first is to connect with resources (notes, videos, audio, and PowerPoint presentations) and the second is to connect with people including the educators and learners [5]. These two approaches have been combined to create the TELERECS e-collaboration environment. The environment, however, can be used effectively by the employment of appropriate learning theories and didactics. The current study employed social constructivism theory and its related didactics as described in the methodology.

RELATED WORKS

This section describes the review of literatures related to this study. The first part presents related works on social media used in higher educational institutions followed by the presentations of social constructivism learning theory.

Social Media in Higher Education

Many researchers and educationist have used Social Media Tools (SMTs) in different ways to enhance teaching and learning particularly in a blended mode. [6] experimented the use of wiki and forum in blended mode. Students were allowed to discuss a course related topics using forum to produce new educational materials which was then stored in wiki for future use. At the end, students' activities data and questionnaire were used to evaluate the effectiveness of the system. The results showed that the methodology effectively supported group work, improved students' performance and motivation.

[7] reported on the impact of Twitter on college students engagement and grades. The participants were 125 pre-health professional major students undertaken seminar course. They were divided into two major groups which consist of 70 experimental group and 55 control group. The experimental group was allowed to use Twitter for academic and co-curricular discussions and their engagement was quantified using 19-item scale. Content analysis was also carried out. Findings indicated that the experimental group had a significantly greater experience and also score higher grade compared to the control group. It was concluded that Twitter can highly engaged both faculty and students in the learning process.

In addition, [8] used wiki and blog to support interaction and collaboration among students in a higher educational institution. Students were allowed to use their personal blog for reflection, learning diary and to post comment on others blogs. Wiki on the other hand, was used for interactive, argumentative and collaborative activities. For ease and effective use of wiki for collaboration, the author introduced a five-stage model of online learning activities. Result of the study indicated that the used of wiki and blog in teaching and learning promote positive changes in students in a higher educational institution; it enhanced quality and encouraged individual and collaborative learning wherever they are.

[9] also conducted an empirical investigation of the use of wiki in a final year dissertation module, in a BSc Information Technology degree course. Students were made to write, post comment and review other's articles with the tutor's support. Their findings showed that wiki is an effective tool for collaboration.

On the contrary, [10] developed a Web 2.0 annotation system, MyNote, which allowed learners to discuss, write and share notes with their colleagues and instructors. Their findings showed that MyNote support elements of usability in terms of interactivity, usefulness, helpfulness, and willingness for future.

Furthermore, [11] reported on students opinion on using a system designed for programming language course at the Uludag University, Bursa, Turkey. 21 students were allowed to use the system for 7 weeks. Two sets of survey tools were then administered to the participants. The result indicated that students were satisfied using the environment since it enabled them to work collaboratively to share knowledge and ideas.

Social-Constructivism Learning Theory

This theory as proposed by Lev Vygotsky sees learning as an active process where students actively construct their own knowledge [12, 13]. Thus, learning or cognitive development is an active mental work through the interplay of existing knowledge among learners (collaboration), the social context, and the problems to be solved.

The theory emphasizes the important role of adults (teachers and parents) and more experienced children in learning. Vygotsky also highlighted the importance of culture and social context for cognitive development. Learning is viewed as primarily a process of enculturation into a community of practice. In addition, Vygotsky proposed the zone of proximal development (ZPD) concept, which argued that students can, with help from adults or children who are more advanced, master concepts and ideas that they cannot understand on their own. ZPD focuses on learning with assistance from teachers, parents, adults and colleagues. The aim is to help the learner develop skills that can be independently practiced. Thus, it is expected that what the learner is able to do in collaboration today, the learner will be able to do independently tomorrow as the teacher withdraws his or her services to the learner [14].

Four principles are applied in any Vygotskian teaching [15].

i) Learning and development is a social, collaborative activity.

ii) The ZPD can serve as a guide for curricular and lesson planning.

iii) School learning should occur in a meaningful context and not to be separated from learning and knowledge children develop in the real world.

iv) Out-of-school experiences should be related to the child's school experience.

In this regard, the instructor's roles are to create, maintain and manages a collaborative problem solving environment [12, 13]. He/she is also to facilitate and guide students to become active participants in their learning.

According to [12], the following illustrate what the instructor can do to facilitate the learning process:

"

- encourage and accept student autonomy and initiative;
- use a wide variety of materials, and encourage students to use them;
- inquire about students' understandings of concepts before sharing his/her own understanding of those concepts;
- encourage students to engage in dialogue with the teacher and with one another;
- encourage student inquiry by asking thoughtful, open-ended questions and encourage students to ask questions to each other and seek elaboration of students' initial responses;
- engage students in experiences that show contradictions to initial understandings and then encourage discussion;
- provide time for students to construct relationships and create metaphors;
- assess students' understanding through application and performance of open-structured tasks" [12].

The main focus of this research is collaborative learning and teaching which is fully supported by the social Constructivism theory.

METHODOLOGY

The study employed mixed-method approach that utilized both qualitative and quantitative approach to collect and analysis the data. This approach was to help researchers to collect comprehensive information and to make conclusive decision on various issues regarding e-collaboration.

Participants

A pilot study was conducted to a small group of participants (N=30) who used the TELERECS for collaboration for two months between January and May 2014. The participants were first year undergraduate students taking the Introduction to Business Information System (IBIS) course and aged between 16 and 18.

Evaluation Methods

The study incorporated four main forms of usability testing methods namely participant observations, questionnaires, a pre/post-test survey; and monitoring and taking activities logs of TELERECS e-collaboration website.

Technologies

TELERECS was developed using wikispaces, open-source software as a platform. The environment support users content creation, editing, deleting, sharing, linking, posting, markup language, threaded discussions and email notifications. In addition, the environment was also enhanced to include iconic menu items such as collaboration, resources, contact, lab-exercise, syllabus and privacy to support individual learning. Skype call and text-messaging are also embedded.

Procedures and Course Settings

The study was conducted using a blended learning approach. The experimented course was Introduction to Business Information System. The course involved three hours of theory and two hours of practical. Students were instructed face-to-face during the theory session while the practical session involved using TELERECS for collaborative discussions and problem solving that involved cases and objective-based questions for two hours per week. At the beginning of the semester, weeks 1 and 2 were used by the lecturer to introduce students to the course. This was followed by giving students accessibility and then a walkthrough of the system and group formation in week 3.

Participants were divided into two major groups: control and experimental groups consisting of 15 members each. Each of the control and experimental groups was further divided into five groups of three students each. The experimental group is the group using the TELERECS. The control group is the group using the conventional methods of in-class collaboration.

The subsequent weeks involved groups collaboration to dialogue, discuss, solve problems and produce solutions to problems. TELERECS was configured to allow only group members to post, read, edit, comment, and share files. Group solutions were presented using the section that supported threaded discussions to dialogue/discuss important issues related to the topic among group members only. Content posting and linking were carried out using the markup editor.

Employing the method of in-class collaboration in this study involve five sub-groups of students (3 member each). The total of fifteen students collaboratively solve problem

through discussion, dialoguing, cooperating, and coming to consensus about a particular task, problems and cases for one hour. This is followed by presentation done by a representative from each group presenting the outcome and solution to the whole class in another one hour. Contributions are made in the form of feedback and questions are then asked by member from other groups and instructors. Finally, together both instructor and students reached a consensus.

In addition, email, threaded discussion session within TELERECS was used alongside the editable pages for collaboration. Students can also use TELERECS after the course hours anytime, anywhere to collaborate, post, share, edit, and create new discussions.

Apart from using TELERECS for collaboration, course materials in the form of syllabus, e-books, PowerPoint presentations, notes, important links, videos and quizzes were located on TELERECS.

Sources of data

Data for this study was derived from group discussions logs as archived in groups' homepages and assessment links, another source of data was from students responses from usability questionnaire which was adapted from [16-18] and effectiveness questionnaires also adopted from [19]. Finally, data was derived from participant's observation.

During the participant observation, notes were taken and recorded immediately after the participants' observations. Short quotations were captured verbatim from open ended questions. The evaluator was a participant observer as the online collaboration proceeds. In addition, website logs were captured. The data were finally compared and reported.

Methods of analysis

A quantitative approach was employed in the analysis of the log file data. Descriptive statistics were used to analyze demographic as well as the pre-test and post-test data. Both quantitative and qualitative methods were used to extract important information from questionnaires. Two hypotheses have been developed:

(H1): There is no significant difference in the pre-test scores between the control and experimental group.

(H2): There is no significant difference in the post-test scores between the control and experimental group.

RESULTS AND DISCUSSIONS

The findings of the pilot study are discussed below.

Reliability Test on Usability and Effectiveness Data

A reliability test was conducted on the data obtained from the pilot study. According to [20], the results are considered "Excellent" if the value of the Cronbach's Alpha > 0.9; "Good" if > 0.8; "Acceptable" if > 0.7; "Questionable" if > 0.6; "Poor" if > 0.5; and "Unacceptable" if < 0.5.

Table 1 illustrates the reliability results obtained from sub-components of both the usability and effectiveness questionnaires. Three usability elements: efficiency, consistency and simple navigation have reliability results of > 0.8 (good) compared to attractiveness, controllability and visibility which have reliability result of > 0.7 meaning they are acceptable.

The reliability results with regard to sub-components of the effectiveness questionnaire demonstrated that both teaching and cognitive presences scored higher with Cronbach alpha values of 0.921 and 0.902 respectively. While the reliability score for social presence is 0.757 which means acceptable.

Item	Cronbach's Alpha	Interpretation
Usability Sub-Components		
Attractiveness	0.797	Acceptable
Simple Navigation	0.839	Good
Consistency	0.840	Good
Visibility	0.714	Acceptable
Controllability	0.777	Acceptable
Efficiency	0.887	Good
Effectiveness Sub-Components		
Teaching Presence	0.921	Excellent
Social Presence	0.757	Acceptable
Cognitive Presence	0.902	Excellent

Table 1: Reliability Analysis of Sub-Components of the Usability and Effectiveness Questionnaires.

The overall Cronbach's alpha value of both the piloted usability and effectiveness questionnaires was therefore 0.939 and 0.957 respectively, which means that both the measuring instruments adopted for this study have excellent reliability.

Usability and Effectiveness of TELERECS

The results of the usability elements are illustrated in Figure 1. The result shows that the mean scores of all the six elements are above four. Simple Navigation element has the highest mean score of 4.5 out of 5. This was followed by the visibility with the mean score of 4.48, then controllability 4.46. Efficiency has a mean score of 4.4, consistency 4.38, and finally, attractiveness 4.2.

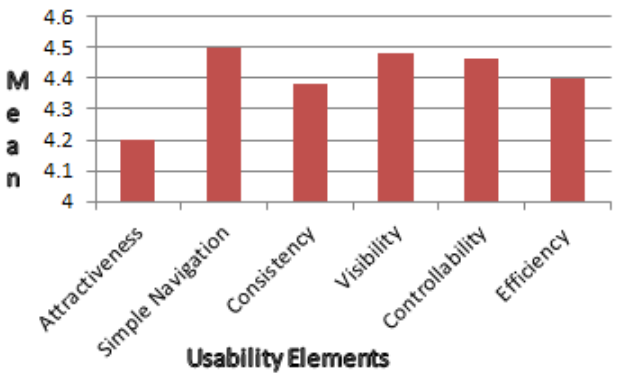

Figure 1: Mean Scores of Usability Elements

Figure 2 illustrates the mean scores of the three elements under the effectiveness questionnaire. The results indicated that the system support social presence with the highest score of 4.4. This is followed by cognitive presence with the mean score of 4.38, and finally, teaching presence with the mean score of 4.30.

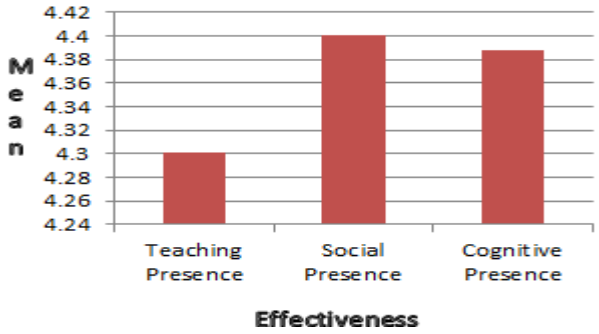

Figure 2: Mean Scores of Effectiveness Elements

Pre-Test-Post-test

Tables 2, 3 and 4 illustrate the results of the independent sample t-test conducted on the control and experimental group. Before the use of TELERECS e-collaboration environment for collaboration, both the control and the experimental group undertook a pre-test in week 3 of the semester the minimum scores are 7 and 6 respectively. The maximum scores for the two groups are 13 and 16 respectively.

However, the result after the use of TELERECS for collaboration at the latter part of the semester indicated a significant increase. The post-test results for the experimental group have a minimum score of 12 and the maximum score of 19 out of the total of 20. On the other hand, the post-test scores for the control group have a minimum score of 10 and the maximum score of 16 out of the total of 20. Looking at the Group Statistics in Table 2 for post-test, it can be seen that the mean score for the control group is 13.3 while that for the experimental group is 15.3. The standard deviations for the two groups are 1.5 and 2.4 respectively. This means that students who experiment with TELERECS have higher scores and perform better than those who used the conventional in-class collaboration method.

	Group	N	Mean	Std Deviation
Pre-Test	Experimental	15	11.47	3.182
	Control	15	9.6	1.957
Post-Test	Experimental	15	15.33	2.350
	Control	15	13.33	1.496

Table 2: Pre-test and Post-Test Group Statistics

Descriptive Statistics and Independent Sample t-test for Control and Experiment Groups

An independent-samples t-test was conducted to compare students' scores in experimental and control groups conditions. The independent samples t-test was used to test the research hypotheses formulated for this study.

Hypothesis 1 (H1): There is no significant difference in the post-test scores between the control and experimental group.

Table 3 shows the independent sample t-test of the Pre-Test score. Since the value in the Sig. (2-tailed) is 0.063 which is greater than $\alpha = 0.05$, these results suggest that there was no significant difference in the scores of both the experimental and control groups. Therefore, the two groups are about the same level which is supporting Hypothesis 1.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreTestGroup	Equal variances assumed	6.629	.016	1.935	28	.063	1.867	.964	-.109	3.842
	Equal variances not assumed			1.935	23.264	.065	1.867	.964	-.127	3.861

Table 3: Independent Sample T-test on Pre-Test

Hypothesis 2 (H2): There is no significant difference in the post-test scores between the control and experimental group.

Table 4 shows that the mean for the post-test scores are significantly different because the value in the Sig. (2-tailed) is 0.010 which is less than $\alpha = 0.05$. This implies that there is a significant difference in the post-test scores for the experimental group and control group; t (23.7) =2.8, p = 0.010. Hypothesis H2 is therefore rejected and concludes that there is difference between the mean scores of the experimental and control groups.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PostTestGroup	Equal variances assumed	6.396	.017	2.780	28	.010	2.000	.719	.526	3.474
	Equal variances not assumed			2.780	23.745	.010	2.000	.719	.514	3.486

Table 4: Independent Sample T-test on Post-Test

Therefore, it can be concluded from the independent sample test that the TELERECS system is an effective medium for teaching and learning since there is significant difference between the mean score of the experimental and the control groups of participants.

Results from Instructor's Personal Observation

Personal observations by the instructor involve two modes of observations. The first mode is the observation of the control group in the classroom while they collaboratively work, and the second mode is the online monitoring of the experimental group activities logs and given feedback while they collaborate and participate in the group's discussion and contributing to knowledge construction. While the control group carried out their discussion, contributions and feedback questions face-to-face, the participants wrote down results on paper before presenting it during the presentation section. The experimental group on the other hand collaborates using TELERECS by directly posting, contributing, editing and arriving at a conclusion. They can participate anytime and anywhere. Examples of online discussions and activities logs are illustrated in Figures 3 and 4 respectively.

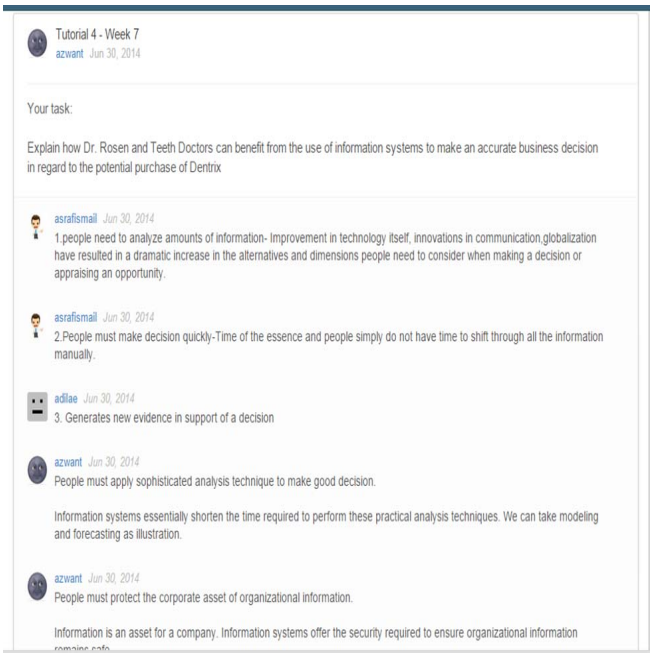

Figure 1: Sample Group Discussion

Figure 4 illustrates the groups' activities log. The red means page saved, green means reading, black means writing, and hash means no activity by individual or group.

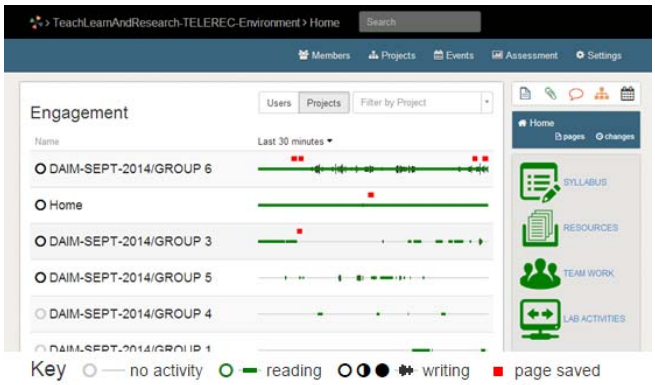

Figure 4: Group Activity Log

CONCLUSION

E-collaboration is very important element in the development of cognitive, social, teaching and learning presences. It will also help to promote trust and team development that is difficult to be achieved through other methods. The discussions above indicated that both the usability and effectiveness test instruments provide important data and good contribution to the ongoing research. The results from the control and experimental group through the use of pre-and-post-tests have also demonstrated that students in the experimental group have achieved more, through the use of TELERECS e-collaboration system as compared to the students in control group who were taught using conventional method of in-class collaboration.

The independent sample test conducted on the data for effectiveness test revealed that TELERECS is an effective medium for teaching and learning. It clearly shows that there is significant difference between the mean score of the experimental and control groups of participants.

Finally, it can be concluded that both the usability and effectiveness test instruments used for this study are reliable. The interpretation of the scores ranges from excellent, to good and acceptable. None of the scores are questionable, poor, or unacceptable. This implies that participants support the use of TELERECS as a novel educational tool.

FURTHER WORKS

Further work includes to improve upon the TELERECS system using users' suggestions and comments, to re-evaluate the environment and compare result with the pilot study.

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