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TURKISH STUDENTS' EXPERIENCES IN USING A COMPUTER SUPPORTED COLLABORATIVE LEARNING (CSCL) TOOL (VIRTUAL MATH TEAMS - VMT)

Gulgun Afacan Adanir
Ankara University Distance Education Center

Abstract: This study aims to identify usability problems related to Virtual Math Teams (VMT) system, which is supporting online collaborative activities of learning groups. For the usability assessment, two major evaluations have been conducted. In the first evaluation, students filled the scale of framework for CSCL system Usability Evaluation including dimensions - Effectiveness, Efficiency, Collaborativity, Error Tolerance, Universal Accessibility, Satisfaction. The second evaluation considers students answers to open ended question related to system's usability problems. These two approaches together released the usability problems related to VMT system. The problems identified are related to four major usability aspects: system design, file upload, process tracking/automated notification, and error prevention. This study also suggests which immediate actions should be taken to improve usability of the system.

***Keywords*:** Computer supported collaborative learning, virtual math teams, usability.

Introductıon

Collaborative learning is defined as "a situation in which two or more people learn or attempt to learn something together" (Dillenbourg, 1999). In recent years, professional work settings involve increasingly more knowledge-based, interdisciplinary and complicated tasks; hence it becomes hard for individuals to perform tasks without the contribution of others (Wang, 2009). Although face-to-face collaboration is possible, computers and Internet facilitate collaboration of individuals, especially of students.

Researchers have recently started to explore the use of Internet and Communication technologies (ICT) to satisfy collaborative learning of student teams, which results in the emergence of Computer Supported Collaborative Learning (CSCL) field. CSCL is one form of online learning that also emerged as a reaction to most traditional educational settings where students learning as being isolated individuals. CSCL aims to offer new software and applications that connect learners, and support creative activities of intellectual exploration and social interaction (Stahl, Koschmann, & Suthers, 2006). While collaborating in a CSCL environment, learners employ computer-mediated-communication (CMC) in order to communicate with their group members. CMC capabilities provided in CSCL environments can be categorized as either synchronous (e.g., via a chat facility or video conferencing), asynchronous (e.g., via a wiki, forum or e-mail), or a combination of both (Janssen, Erkensa, Kanselaara, & Jaspersa, 2007).

Learners may benefit from CSCL in several ways. Petropoulou et al. (2010, p. 232) have provided the list of advantages of CSCL as follows:

- "opportunities for participants to share their knowledge and expertise;
- opportunities for participants to discuss, plan, reflect on and explore learning issues;
- increased inspiration, innovation and motivation amongst participants;
- increased social contact between individuals having different backgrounds;
- a reduction in feelings of isolation (both geographically and emotionally);
- increased access to shared resources."

- Selection and peer-review under responsibility of the Organizing Committee of the conference

*Corresponding author: Gulgun Afacan Adanır- E-mail: gulgunafacan@gmail.com

CSCL environments have been generally investigated according to instructional, motivational and social aspects. For example, the study of Francescato et al. (2006) compared effectiveness of collaborative learning between online and face-to-face groups. The results demonstrated that there is no significant difference in professional knowledge levels of learners. Eales, Hall, and Bannon (2002) compared use of CSCL in various settings – workplace, schools, and universities- and found that CSCL is worthwhile in enhancing learners' motivation for learning and exploration in all these settings. In addition, increase in social interaction and knowledge sharing are potential consequences of CSCL since learning groups are formed in these environments.

In this study, we aimed to investigate usability of Virtual Math Teams (VMT), which was developed as a CSCL environment with several interaction spaces as chat, whiteboard and wiki components. The chat tool of VMT provides a communication channel for the participants to discuss online on those subjects related to their interests. In the context of a course, instructors can assign homework via VMT which enables students in groups to share their ideas and understandings to solve the questions. While chatting online, learners benefit from Whiteboard or GeoGebra to explain their ideas through drawing functionalities. The group work can continue with learners' sharing of their solutions over the Internet. VMT supports this kind of online publication process by offering a Wiki component. Learners can insert appropriate text and images in order to reflect their solutions as Wiki output. In this way, instructors can view the product of the online collaboration and conduct corresponding evaluations.

This study serves the purpose of identifying problems preventing appropriate use of VMT in a course supporting online collaborative activities. In particular, the research objectives of the study are:

- To analyze factors affecting usability of VMT as one CSCL environment,
- To identify main usability problems based on evaluation,
- To suggest what actions should be taken to improve usability of VMT.

In order to accomplish objectives of the study, two different usability studies have been performed. Initially, user based evaluation of the VMT has been conducted. That is, Turkish students are required to fill questions of the framework for CSCL system Usability Evaluation (Huang, 2010). Then, same students were asked about their problems in using VMT. Findings based on these assessments have been reflected in this paper.

The CSCL environment - Virtual Math Teams (VMT)

In this study, we employed the Virtual Math Teams (VMT) system to support learners' collaborative learning activities in the frame of a semester long course on research methods and statistics. VMT offers a set of tools (i.e. chat, whiteboard and wiki tools) that allow learning groups study collaboratively on concepts of the course. Instructors and students can register to VMT system without any payment requirement.

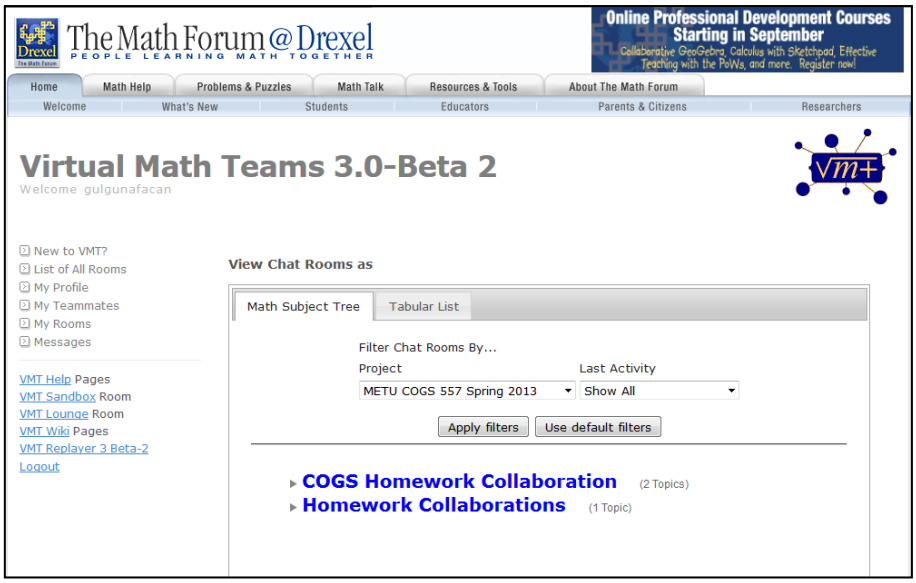

Figure 1. VMT lobby

When users entered to the VMT system, they encounter with the lobby. The major function of the lobby is that it provides a list of current chat rooms created by registered users. By choosing the room learners can enter, and

then communicate with the other members logged into this chat room. By using the "My Profile" page, users can review and change their profiles or their passwords. With the help of the "My Teammates" page, users can review the profiles of their teammates. Additionally, by employing the "Messages" page, users can send messages to each other for coordinating chat sessions, offer an idea, etc.

The chat tool primarily satisfies synchronous communication of members of a learning group. In the chat environment, team members are listed if they signed in the system and entered the chat room. Every member can post messages, and read posts of other members. At the same time, chat environment provides shared whiteboards for the purposes of drawing and organizing ideas. For example, the screenshot of VMT chat in the Figure 2 shows a learning group's work in the whiteboard area. In this work, learners used the tool for sharing their statistical findings related to the question of an assignment. The chat room additionally provides Web browser facility for learners' collaborative web browsing when it is necessary to conduct a research with respect to topic of their group work.

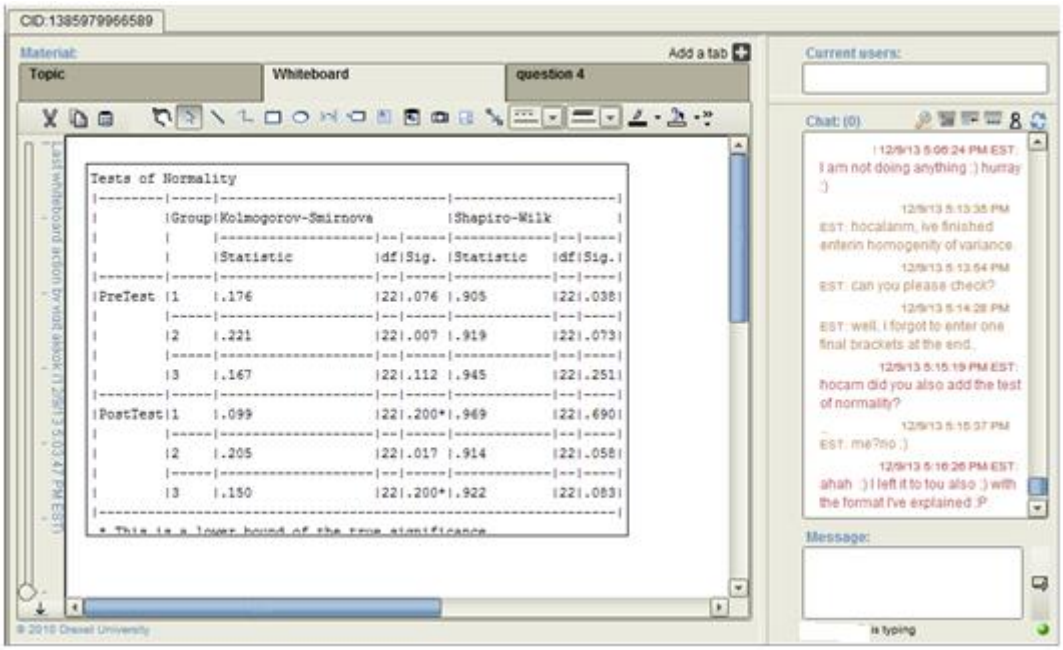

Figure 2. VMT chat

Each chat room provides a corresponding wiki page, by which learners can publish their findings on the Internet. For instance, the screenshot of VMT wiki in the Figure 3 demonstrates a part of the text submitted by one learning group as the solution of an assignment. All Internet users can review Wiki contents but have no permission to perform any changes related to this kind of contents. That is, the Wiki content can be edited by the owner user or owner group. Additionally, by using the help of 'View history' link, learners can review the Wiki edits performed by each member.

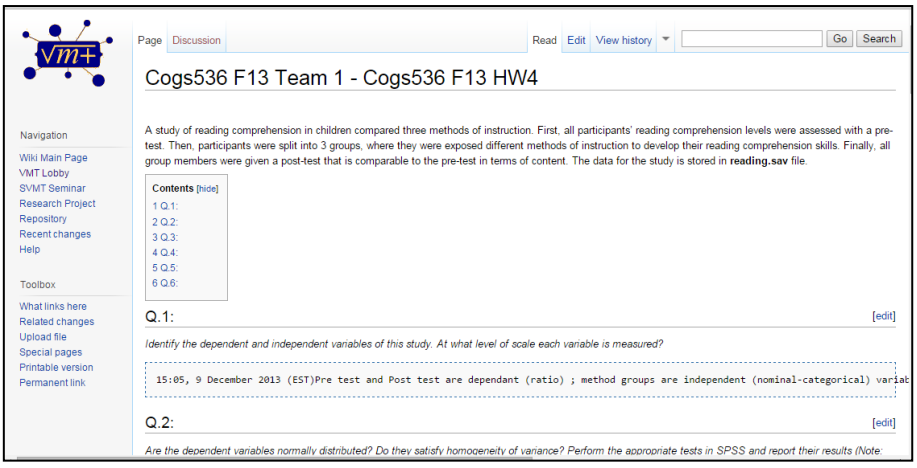

Figure 3. VMT wiki

The Research Methods & Statistics Course

We conducted the study within the context of a graduate level Research Methods & Statistics course, which aims to explain major concepts of empirical research and experimental design. The students were taught the methods and methodology of psychological research (experiment, observation, independent/dependent variable(s), ex-post-facto design, cross-sectional studies, longitudinal studies), Descriptive Statistics (building statistical models, the relation between population-sample, distributions, various central tendency values, variance, standard deviation, standard error, confidence intervals, test statistics), as well as to univariate and multivariate forms of Inferential Statistics (General Linear Model (GLM), ANOVA, ANCOVA, MANOVA, repeated measures ANOVA, mixed design ANOVA, correlation, regression, non-parametric tests, factor analysis). Statistical analyses were performed by using Statistical Package for the Social Sciences (SPSS).

Students were divided into learning groups. All groups were required to perform course assignments by collaboratively working online in the VMT environment. In the first weeks of the semester, students were introduced about the VMT environment with the help of an online orientation session organized by the course instructor. The other weeks were dedicated for execution of weekly assignments. In every assignment, learning groups were firstly required to conduct online chat meetings, then share their findings as co-authored wiki outputs.

Methodology

Research Design

The purpose of this study is to explore experiences of Turkish graduate students in using a CSCL tool (i.e. VMT) in a graduate course having collaborative activities. Mixed methods approach involving quantitative and qualitative methods has been employed in order to provide a deep understanding of the research problem.
The research question of the study can be stated as follows:
1. What are the experiences of Turkish graduate students towards use of VMT tool in a course requiring collaborative activities?

Participants

Table 1. Demographic characteristics of students

Age Group

		Frequency	Percent	Valid Percent	Cumulative Percent
	N.A.	4	19.0	19.0	19.0
	22-29	12	57.1	57.1	76.2
	Over 29	5	23.8	23.8	100.0
	Total	21	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
	N.A.	4	19.0	19.0	19.0
	Female	6	28.6	28.6	47.6
	Male	11	52.4	52.4	100.0
	Total	21	100.0	100.0	

Grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Masters	12	57.1	57.1	57.1
	PhD	9	42.9	42.9	100.0
	Total	21	100.0	100.0	

The study has been conducted in the context of a graduate level course in a major state university of Turkey. Each registered student to this course has been considered as one participant of the study. Totally, there were 21

participants at the beginning of the study. Although we have attempted to collect demographic data from all of the participants, there are some minor missing data, which are indicated with not applicable (N.A.) tag. Age, gender and grade distributions of participants are demonstrated in the following table. Majority of the participants (i.e. 57.1%) are between 22 and 29 years old and male (52.4). They are graduate students with different educational backgrounds and will get MSc or PhD degree after the graduation. 57.1 of participants are master students whereas 42.9 of them are PhD students.

Data Collection Instruments

All students of the course are considered for filling the scale. For the quantitative part, the framework for CSCL system Usability Evaluation (Huang, 2010) was selected (Appendix A). The framework for CSCL system Usability Evaluation includes items within 6 dimensions, namely Effectiveness, Efficiency, Collaborativity, Error Tolerance, Universal Accessibility, Satisfaction.
For the qualitative part, the purpose is identifying the problems that participants encountered in using the system. After filling the scale, the participants were required to reply the open ended question - 'What are your problems with using the VMT Tool?'.

Data Analysis

The descriptive statistics (frequency and percentage) was employed to analyze the scale. The participants' answers to open ended question was analyzed by the content analysis approach.

Findings

Findings of the Scale

This study investigates the experiences of Turkish graduate students towards use of a CSCL tool (i.e. VMT) in a graduate course having collaborative activities. The descriptive statistics of the scale can be seen in the Table 2.

Table 2. Descriptive statistics of the scale

Item no	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
		%/#	%/#	%/#	%/#
Item1.1.1	0/0	0/0	11.8/2	64.7/11	23.5/4
Item1.2.1	0/0	11.8/2	29.4/5	35.3/6	23.5/4
Item1.3.1	0/0	23.5/4	23.5/4	41.2/7	11.8/2
Item1.3.2	0/0	5.9/1	17.6/3	52.9/9	23.5/4
Item1.4.1	0/0	5.9/1	23.5/4	41.2/7	29.4/5
Item1.4.2	0/0	0/0	47.1/8	29.4/5	23.5/4
Item2.1.1	0/0	5.9/1	17.6/3	47.1/8	29.4/5
Item2.1.2	11.8/2	5.9/1	11.8/2	41.2/7	29.4/5
Item2.2.1	0/0	11.8/2	11.8/2	52.9/9	23.5/4
Item2.2.2	0/0	5.9/1	23.5/4	41.2/7	29.4/5
Item2.3.1	0/0	0/0	17.6/3	52.9/9	29.4/5
Item2.3.2	0/0	11.8/2	11.8/2	47.1/8	29.4/5
Item2.3.3	5.9/1	0/0	5.9/1	47.1/8	41.2/7
Item3.1.1	0/0	5.9/1	5.9/1	41.2/7	47.1/8
Item3.2.1	0/0	17.6/3	11.8/2	41.2/7	29.4/5
Item3.3.1	11.8/2	29.4/5	17.6/3	35.3/6	5.9/1
Item3.3.2	5.9/1	29.4/5	17.6/3	29.4/5	17.6/3
Item3.4.1	5.9/1	17.6/3	35.3/6	29.4/5	11.8/2
Item3.4.2	5.9/1	17.6/3	23.5/4	35.3/6	17.6/3
Item3.5.1	5.9/1	0/0	29.4/5	41.2/7	23.5/4
Item3.6.1	0/0	5.9/1	41.2/7	35.3/6	17.6/3
Item3.6.2	0/0	0/0	23.5/4	58.8/10	17.6/3
Item4.1.1	0/0	35.3/6	35.3/6	23.5/4	5.9/1

Item4.2.1	5.9/1	11.8/2	64.7/11	11.8/2	5.9/1
Item4.3.1	0/0	23.5/4	35.3/6	35.3/6	5.9/1
Item5.1.1	0/0	5.9/1	35.3/6	29.4/5	29.4/5
Item6.1.1	0/0	41.2/7	11.8/2	35.3/6	11.8/2
Item6.1.2	0/0	17.6/3	23.5/4	47.1/8	11.8/2
Item6.1.3	0/0	0/0	41.2/7	47.1/8	11.8/2
Item6.2.1	0/0	5.9/1	5.9/1	64.7/11	23.5/4
Item6.2.2	0/0	5.9/1	23.5/4	47.1/8	23.5/4
Item6.3.1	0/0	11.8/2	17.6/3	47.1/8	23.5/4
Item6.4.1	0/0	11.8/2	17.6/3	47.1/8	23.5/4
Item6.4.2	0/0	0/0	35.3/6	47.1/8	17.6/3
Item6.4.3	0/0	0/0	52.9/9	35.3/6	11.8/2
Item6.5.1	5.9/1	23.5/4	5.9/1	52.9/9	11.8/2
Item6.6.1	5.9/1	11.8/2	17.6/3	47.1/8	17.6/3
Item6.6.2	0/0	23.5/4	35.3/6	17.6/3	23.5/4

Effectiveness Dimension

It can be understood from the findings that 88.2% of the students could complete the task on the system with a proper time frame. The finding about the visibility of the system provides average level of satisfaction. That is, 58.8% of them indicated that the system has a good menu or obvious links to support and help to complete a task. Similarly, the system interface and design wasn't found friendly and familiar by 47% of the students. On the other hand, 76.4% of them thought that steps to complete a task follow a logical sequence. Furthermore, 70.6% of them indicated that it is easy to find their location and the necessary information when they were working on a task. Lastly, 52.9% of students agree with the statement that the information in the system clearly points the next step/task in a workflow.

Efficiency Dimension

Related to the Speed criteria, 76.5% of students thought that they were able to access resources, and work on tasks efficiently. What is more, 70.6% of them indicated that the system speed is fast enough. For the Familiarity/Consistency/Standards criteria, 76.4% of them agreed with the idea that icons, menus, and information are familiar and understandable on a task screen. Furthermore, 70.6% of them thought that the layout and interface design are consistent through the whole online system. Regarding the Effort criteria, 82.3% of students agreed that they are not required to continue remembering information throughout several actions, 76.5% of them agreed that they are not required to learn a lot of things before they can get going with this system, and 88.3 % of them agreed that they are not required the get the support of a technical person to be able to use this system.

Collaborativity Dimension

It was revealed in the findings that 88.3% of students approve that they were able to communicate with the teammates and other users on the system as necessary. Furthermore, 70.6% of team acknowledge that they were able to manage their files/notes and the shared files/notes. However, students were not satisfied enough regarding File/Content Sharing & Management criteria. That is, only 41.2% of students indicated that files can be easily uploaded to the system and 47% of them indicated that files can be retrieved easily in the share workspace on the system. The findings related to Process Tracking/Automated Notification criteria don't provide expected level of satisfaction. 41.2% of students thought that they were able to send a notification to the team after completing the task, and 52.9% of them thought that they were able to find out the status of a task/teamwork, e.g. a task in progress, or completion. Regarding the File/Content Protection criteria 64.7% of students stated that the system gives a warning when they try modifying files or notes on the share workspace while their teammates are working on them. Furthermore, 52.9% of them approved that the system seems secure for storing teams' work/files. Lastly, 76.4% of them agree with the statement that "users need to logon to modify their artifacts or contact their teammates on the system."

Error Tolerance Dimension

The finding about the error prevention criteria provides low level of satisfaction. That is, 29.4% of students approved that the system provides warning if they about to make a potential error, 17.7% of them approved that the system gives error alerts that clearly tell how to correct errors, 41.2% of students approved that whenever they make a mistake, they were able to recover it easily and quickly.

Universal Accessibility Dimension

Related to the criteria – support users with different levels of IT expertise, 58.8% of students agreed with the statement "the system supports both novice and expert users, advance features are available to expert users."

Satisfaction Dimension

It was revealed in the findings that nearly half of the students (i.e. 47.1%) agreed that the system has all the functions and capabilities they expect it to have. Moreover, 58.9% of them stated that the system is useful for teamwork, and 58.9% of them stated that the various functions in this system are well integrated. About the criteria Learnability/Predictability/Recognition/Memorability, 88.2% of students indicated that it is easy to learn how to use this system and 70.6% of them indicated that tasks can be performed in a straight-forward manner. Besides, 70.6% of students found the use of the system as simple. Related to the Help/Documentation criteria, 70.6% of students indicated that information (such as online help, on-screen messages, and other documentation) provided on this system is clear, understandable, and helpful, 64.7% of them indicated that it is easy to access help documents. However, only 47.1% of students stated that they can easily switch between help and their work. 64.7% of students found the system interface as pleasant and attractive, and 64.7% of students found the system reliable. However, only 41.1% of students are satisfied with the system.

Findings of the Open-ended Question

For the qualitative part, the purpose is identifying the problems that participants encountered in using the system. The participants were asked the open ended question - 'What are your problems with using the VMT Tool?'.
It can be deduced from the findings that more than half of the participants (i.e. 58.8%) experienced some problems while using the VMT tool.

Table 3. Number of participants that experienced problem

	Frequency	Percent
No	7	41.2
Yes	10	58.8
Total	17	100.0

Students' problems can be investigated in following categories.

- **Login problem:** First of all, the participants experienced login problems. This might occurred because of the distant location of the server, lack of electricity or high traffic in the internet.
- **Problems Related to the Chat Environment:** Some participants indicated usability problems related to the chat environment. They expected that the chat screen has better functionality. That is, one of the participants indicated that the chat part can be opened as a separate and a larger page. In this way, the discussion can be better as it will allow them see and read the comments and arguments better in a large screen. One problem is the lack of sound notification when a message is posted. For instance, some learners entered to the chat environment before his team members. While waiting the members, he could view other web sites or work on other things. The early coming members expected to receive a sound notification to understand coming of remaining members while conducting their other responsibilities.
- **Problems Related to the Whiteboard Area:** Two of the participants indicated the problem of inserting tables to the whiteboard. The participants couldn't achieve the process or couldn't insert the table in a proper way. Additionally, one participant indicated the decrease of the system speed while attempting to insert a table to the whiteboard area.
- **Problems Related to Wiki Environment:** The other common problem is related to posting results and uploading files to wiki page. In editing process, learners have to write a short part and save it, otherwise all the stuff they write may disappear in a short while. If group members attempt to edit the same text simultaneously, then the system may produce errors and delete the text. Learners were required to submit their solutions with the appropriate statistical results as the image format. Some of the participants found

the uploading files to wiki page as a time consuming process, hence offered new ways. For instance one participant stated that "I was too lazy to upload every single file but later I found a way to overcome it. I would join all the pictures in one file for each question and upload one *.jpg file".

Dıscussıon nad Conclusıon

With this study, usability of VMT tool has been investigated according to users' responses to the framework for CSCL system Usability Evaluation, and open ended question. These two approaches have complemented each other in a way to explore existing usability problems related to the VMT tool.

The major usability problem is related to design of the system investigated. In general, the system wasn't found to provide a good menu or obvious links to support and help to complete a task. Similarly, the system interface and design wasn't found friendly and familiar by some students. We can offer that the system should consider aesthetic issues to satisfy a more pleasing interface. Screens should cover visuals besides textual elements; thus memorability aspect of the system can also be enhanced.

Additionally, some students indicated the problems of uploading or retrieving files related to whiteboard and wiki environments. This problem should be eliminated to enhance the system's efficiency. Some links should be improved to satisfy the system' ease of use and effectiveness.

One essential usability problem is related to Process Tracking/Automated Notification criteria. The system doesn't support users' sending of notification to the team after completing the task or when members enter the system. The system should provide an appropriate function to notify users about these issues. Such a behavior of the system would enable a pleasing interaction among members of learning groups.

Furthermore, students indicated the usability problem of the system regarding error prevention criteria.
That is, the system does not address how to fix errors occurring during system use. In case of any error, the system should give error messages clearly informing users about the way of fixing problems. In this way, users would feel comfortable in using the system. This is because users would know that they are able to recover easily and quickly even if they make any mistake.

As overall summary, the system doesn't satisfy the users and usability problems prevent adoption of the system. The system improvement can be carried out to fix usability problems of this technology. In this way, students will be able to experience advanced level collaborative activities.

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Appendıx-A

The framework for CSCL system usability evaluation

Dimension	Item	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Effectiveness	1.1 Completeness 1.1.1 I am able to complete a task on this system within a proper time frame.					
	1.2 Visibility 1.2.1. The system has a good menu or obvious links to support and help me complete a task					
	1.3. Organisation/Design 1.3.1. The system interface and design are user friendly and familiar.					
	1.3.2. Steps to complete a task follow a logical sequence.					
	1.4. Navigability 1.4.1. It is easy to find where I am and the information I needed when working on a task.					
	1.4.2. The information in the system clearly points me to the next step/task in a workflow.					
Efficiency	2.1. Speed 2.1.1. I am able to access resources, and work on tasks efficiently.					
	2.1.2. The System speed is fast enough.					
	2.2. Familiarity/Consistency/Standards 2.2.1. On a task screen, icons, menus, and information are familiar and understandable to me.					
	2.2.2. The layout and interface design are consistent through the whole online system.					
	2.3. Effort 2.3.1. I don‘t have to continue remembering information throughout several actions.					
	2.3.2. I don‘t need to learn a lot of things before I can get going with this system.					
	2.3.3. I don‘t need the support of a technical person to be able to use this system.					
Collaborativity	3.1. Communication 3.1.1. I am able to communicate with the teammates or other users on the system as necessary.					
	3.2. User Control/Moderator & Teacher control 3.2.1. As a user, I am able to manage my files/notes and the shared files/notes.					
	3.3. File/Content Sharing & Management 3.3.1. Files can be easily uploaded to the system.					
	3.3.2. Files can be retrieved easily in the share workspace on the system.					
	3.4. Process Tracking/Automated Notification 3.4.1. After I complete a task, I am able to send a notification to the team.					
	3.4.2. I am able to find out the status of a task/teamwork, e.g. a task in progress, or completion.					
	3.5. File/Content Protection 3.5.1. The system would give me a warning when I try modifying files or notes on the share workspace while my teammates are working on them.					
	3.6. Security					

	3.6.1. The system seems secure for storing teams' work/files.					
	3.6.2. Users need to logon to modify their artifacts or contact their teammates on the system					
Error Tolerance	4.1. Error Prevention 4.1.1. The system warns me if I am about to make a potential error.					
	4.1.2. The system gives me error alerts that clearly tell me how to correct errors.					
	4.1.3. Whenever I make a mistake, I am able to recover it easily and quickly e.g. by using an "undo" or "cancel" or "reverse" button.					
Universal Accessibility (Ubiquity)	5.1. Support different users with different levels of IT expertise 5.1.1. The system supports both novice and expert users, advance features are available to expert users.					
Satisfaction	6.1. Usefulness/Functionality 6.1.1. This system has all the functions and capabilities I expect it to have.					
	6.1.2. The system is useful to my teamwork.					
	6.1.3. The various functions in this system are well integrated.					
	6.2. Learnability/Predictability/Recognition/Memorability 6.2.1. It is easy to learn how to use this system.					
	6.2.2. Tasks can be performed in a straight-forward manner.					
	6.3. Simplicity 6.3.1. It is simple to use this system.					
	6.4. Help/Documentation 6.4.1. The information (such as online help, on-screen messages, and other documentation) provided on this system is clear, understandable, and helpful.					
	6.4.2. It is easy to access help documents.					
	6.4.3. I can easily switch between help and my work.					
	6.5. Aesthetic Design 6.5.1. The interface of this system is pleasant and attractive.					
	6.6. Overall 6.6.1. The system always is reliable.					
	6.6.2. I am satisfied with this system.					