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Combining Collaborative Learning with Learning Management Systems in Teaching Programming Language

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ABSTRACT

The development of collaborative studies in learning has led to a renewed interest in the field of web-based education. In this experimental study, a highly interactive and collaborative teaching environment was created using Moodle, a learning management system with two types of Collaborative Tools (CTs): Standard CT and Advanced CT to create a virtual learning environment to teach programming languages, Java. 36 subjects were attending to this study. The experimental study was carried out between 2 different groups. Each group has 18 subjects who were randomly selected. Group1 used advanced and group2 used standard collaborative learning tool. The aim of this study was to find out the student opinions when using an *advanced collaborative tool* and a *standard collaborative tool*. The system developed has enabled students to follow the lessons in their own places of study, using their own computers. Data was collected at the end of the experimental study by *Student Opinions in Relation to the Used Collaborative Tool* and *The Online Learning Opinion Scale* instruments. The results show that the subjects using the standard and the advanced collaborative tool are interested and willing to try to use a collaborative tool.

***Keywords*:** Virtual Learning Environment (VLE), Learning Management System (LMS), Collaborative Tool (CT), Teaching Programming Languages, Learning Styles.

INTRODUCTION

In recent years, there have been major advances in the field of distant education and educational technology and many new tools and new terms have been introduced in this field. Some keywords, such as Technology based education (TBL), Computer based training (CBT), Distance learning (DL), Web based learning (WBL), and Collaborative learning (CL) are some of the commonly used ones.

A learning management system (LMS) provides the platform for the web-based learning environment by enabling the management, delivery, and tracking of learning. LMS are often viewed as being the starting point of any web-based learning program. Some of the important issues when evaluating a learning management system are (Hall, 2003): high availability, scalability, usability, interoperability, stability, and the security. A good LMS should be 100 percent web-deployable, requiring no additional client applications. It is also important that the LMS should support various sources from different manufacturers and it should be based on open industry standards for web deployments, and support the various learning standards.

Some of the best known commercially available LMS systems are *Blackboard*, *WebCT*, and *Desire2Learn*. There are also many open-source and free LMS systems, such as *Moodle, Segue, Interact*, *CourseWork, Atutor*, *KEWL* and several others. Open source usually means that users have access to the source code of the software. Anyone can download and use the open source code, and more importantly users can write new features, fix bugs, improve performance, or learn how a particular problem has been solved by others.

Collaborative learning is one of the important topics in web-based education. There are several benefits to giving students assignments that they can work on collaboratively. The benefits of collaborative programming has been known and used in industry for some years (William and Upchurch, 2001). Roschelle (2003) and Chi et al. (1989) report that students can undertake more complicated problems and gain a better understanding of the material when the work is done collaboratively. Although in general the benefits of collaborative work have been recognized there are still many open questions about it. Some typical questions are, is it better to pair a novice with an expert or pair two novices, or perhaps pair two experts ? Are individuals better at learning a programming language than pairs?

As it is clear from the above studies, it has not been possible to find any research findings on the use of advanced collaborative tool for the teaching of programming languages in a web-based environment. Consequently, there is need for research results related to use of collaborative tool in advanced level.

There are basically two types of collaborative tools: *standard collaborative tool*, and *advanced collaborative tool*. The main difference between the two is that the advanced tool enables students to compile, save and run their programs inside the collaborative tool, making the learning process more enjoyable and more user-friendly, especially during the teaching of programming language. The advanced tool also enables the instructor and students to see each others screens during a session.

In recent years the development of collaborative tools has led to an increasing interest in web-based education. In this paper, a highly interactive and collaborative teaching environment has been created by supporting Moodle LMS with the collaborative learning tool *GREWPtool* (Taneva, et al., 2004), named as NEU-VLE (Near East University Virtual Learning Environment). Moodle enables the students to follow the course notes on the web, to carry out quizzes and surveys, and to provide communication outside the classroom by means of chat tools. Collaborative tool supports the LMS based learning activity by providing a high level of collaboration amongst students. Students and the instructor can meet and exchange information using the collaborative tool.

The Aim

The goal of the present study was to find out the student opinions when using an *advanced collaborative tool* and a *standard collaborative tool* to learn a programming language in web-based education.

In order to reach this aim the authors have sought answers to the following questions:

1. Are there differences between the opinions of students using the advance collaborative tool and the standard collaborative tool?
2. How are the learning styles of the students using the advanced collaborative tool and the standard collaborative tool?
3. Is there a significant correlation between the learning styles of students using the advanced collaborative tool and the standard collaborative tool?

METHOD

Setting

This web-based education system which consisted of Moodle and GREWPtool is named NEU-VLE (http://cis.neu.edu.tr). An optimistic vision of studying “anytime, anyplace” - own convenient time, place and speed by own computers, according to student’s natural rhythm is accomplished. It was sufficient just to use the Internet Explorer to access the NEU-VLE system.

Subjects

The experimental study was carried out between 2 different groups studying to learn computer programming language, Java. The GCPA (General Cumulative Point Average) grades of the students have been calculated and sorted in a descending list. For the course, 18 subjects were randomly grouped to use the *advanced* collaborative learning tool. Similarly, 18 subjects were randomly grouped to use the *standard* collaborative learning tool. According to Fraenkel and Wallen (2006) there are no specific rules for determining how large groups must be in an experimental research. The subjects are typically sophomore ages 20-22.

In order to determine whether or not the GCPA grades of the subjects in each group may affect the results of the research, and if necessary to form new groups, the GCPA

of subjects in each group were tested using paired sample t-test. The results of the t-test are shown in Table 1.

Table 1: GCPA averages of advanced collaborative tool group and the standard collaborative tool group

Groups	N	M	SD	t	p
Used Advanced Collaborative Tool	18	2.45	0.63	0.80	0.44
Used Standard Collaborative Tool	18	2.30	0.73		

As seen from Table 1, there is no real significant difference ($t = 0.80$, $p > 0.05$) in the GCPA grades of subjects in the advanced collaborative tool group ($M = 2.45$, $SD = 0.63$) and the standard collaborative tool group ($M = 2.30$, $SD = 0.73$).

Based on these results we can say that the two groups are suitable for the research. i.e. there is no real significant difference between the GCPA grades of subjects in each group.

Materials and Procedure

The material is the NEU-VLE system developed by the authors. A highly interactive and collaborative teaching environment has been created by supporting Moodle LMS (www.moodle.org) with the collaborative learning tool GREWPtool (http://groupscheme.sourceforge.net/grewpedit) (Taneva, et al., 2004), named as NEU-VLE (Near East University Virtual Learning Environment). Both of these are Open-Source software products. Various utilities of NEU-VLE system such as interactive course tool, self-test, assignments, resources which can be downloaded, chat, quiz, and internal mail have been offered to the students independently whenever they wanted. Subjects met their instructor twice a week using synchronous collaborative tool, where each session lasted for an hour. Collaborative tool has been used to deliver the lessons to the subjects, and to develop sample programs interactively in cooperation with the subjects. In addition, subjects had the chance of communication and exchanging information with each other synchronously, whenever they wanted, using the collaborative tool.

Data Collection and Analysis

Student Opinions in Relation to the Used Collaborative Tool survey was prepared by the authors in the form of a questionnaire related to collaborative tool. Content and design validity of questionnaires were investigated by 15 experts in this field and were found to be satisfactory. Nineteen carefully prepared questions were given to students who used the advance collaborative tool to answer in the class. Similarly, 15 questions were given to students who used the standard collaborative tool. The 4 extra questions for the first group were specific to the properties of the advanced collaborative tool which were not available in the standard collaborative tool. This questionnaire is formed in 5-point Likert scale type questions, consisting of 19 items, with 5 being a response of

Strongly Agree and 1 representing *Strongly Disagree*. Each question was phrased so that Strongly Agree represented a positive reaction to the project.

Subjects taking the online courses were asked to carry out a survey at the end of their studies in order to determine the opinion to use of NEU-VLE, and also to receive feedback from them. *The Online Learning Opinion Scale* instrument was adapted for use in North Cyprus based upon an instrument developed by James L. Fitch (2004). Ten carefully prepared questions were given to them to answer in the class. Each question was phrased to determine whether or not there was a positive response to different aspects of using NEU-VLE. This questionnaire is formed in 5-point Likert scale type questions, consisting of 10 items, with 5 being a response of *Strongly Agree* and 1 representing *Strongly Disagree*. Each question was phrased so that Strongly Agree represented a positive reaction to the project.

The Application Performed With the Collaborative Tool

During the time where the experimental process was carried out, students using the collaborative tool have carried out to learn the programming languages in their own places of study, in their own time and own pace, using the teaching activities offered within the NEU-VLE system. Students have carried out collaborative studies where they could discuss their problems with their instructor or with their class mates using the internet on the pre-announced days and hours of the week. A typical collaborative session lasted for about two hours a week.

Students were encouraged to study collaboratively without the instructor using the NEU-VLE system for the topics offered to them weekly. Students could access the collaborative tool on the specified day and 5-10 minutes before the start of a session and they could join the group created by the class instructor with their own names. The name of the class instructor and all of the students who joined the collaborative session could be seen in a list-box on the left hand side of the screen. The programming language to be used during the collaborative session was then selected and at this point the group was ready to start the learning process. The common editor section of the tool was used by the students so that they could copy the programs developed by themselves to this area of the tool. Thus, students could get help from their class instructor or from their class mates. During a session a student can either exchange information with all the other people in the group, or with just one particular student in private, or with the instructor. This makes the students to be motivated and also feel more comfortable. During a collaborative tool session students could record and save all communication which took place in the session and then, if they wished, the recording could be re-played. Students using the standard collaborative tool could copy the programs developed jointly to their own PCs and then compile and run the programs. On the other hand, students using the advanced collaborative tool could save the jointly developed program by pressing the “save as” button, and then they could compile the program by pressing the “compile” button at the bottom of the screen. The result of the compilation could be seen in their own screens. After a successful compilation they could run and test their programs. A student could see the screen of the instructor or the screen of another student by clicking on the name in the list-box. As a result of this collaborative

study students could interact with each other, have discussions, and correct each others mistakes, and get help easily from other members of the group.

RESULTS

The Opinion Of Students

A t-test was performed to find out whether or not there was a significant statistical difference between the opinions of subjects in each group for the use of advanced collaborative tool and standard collaborative tool. Table 2 gives the opinions of subjects in each group on the use of a collaborative tool during the study session.

Table 2: Survey Results of Subjects About the Use of a Collaborative Tool

	Survey Items	Used Advanced Collaborative Tool		Used Standard Collaborative Tool		p	t
		M	SD	M	SD		
1.	I felt as if I was in a real class with my class mates.	4.61	.78	2.39	1.33	.000	6.104
2.	Enabled me to study and discuss on the same program with my class mates.	4.78	.43	3.11	1.37	.000	4.936
3.	Enabled me to discuss topics on a one to one basis with my friends.	4.61	.61	2.83	1.42	.000	4.870
4.	Enabled me to use chat and whiteboard on the same screen at the same time, and to learn programming easily.	4.56	.62	3.00	1.37	.000	4.389
5.	Enabled me to communicate with my instructor on one to one basis, and to exchange ideas on a topic.	4.83	.38	3.67	1.37	.001	3.475
6.	I was able to compile and run the programs I developed easily.	4.89	.32	1.50	0.51	.000	23.660
7.	I could communicate easily without being shy with the help of the collaborative tool.	4.44	.61	3.61	1.38	.025	2.343
8.	I was more comfortable during class sessions and this has increased my learning rate.	4.61	.61	3.94	1.26	.051	2.023
9.	I was able to tell my class mates everything I wanted to say.	4.44	.78	2.89	1.32	.000	4.291
10.	I had no trouble communicating with my class instructor with the help of the collaborative tool.	4.61	.61	3.11	1.53	.000	3.866
11.	I was able to ask my class instructor any question I wanted using the collaborative tool	4.56	.62	3.28	1.53	.002	3.294
12.	I was able to communicate and exchange ideas with my class instructor and with my class	4.44	.70	3.17	1.47	.002	3.334

	mates with the help of the collaborative tool.						
13.	Has enabled me to concentrate on my topic while using the collaborative tool in my own place of work.	4.44	.86	3.78	1.44	.100	1.691
14.	I was not shy to ask my class instructor or my class mates any questions I didn't understand with the help of the collaborative tool.	4.17	1.04	4.06	1.30	.780	.282
15.	I think the addition of the collaborative tool to the NEU-VLE system was very useful.	4.67	.49	3.50	1.47	0.003	3.207
16.	The addition of instructor's screen to the collaborative tool helped me to understand the topics easier.	4.78	.55				
17.	The addition of my class mates' screens to the collaborative tool helped me to understand the topics easier.	4.39	.78				
18.	The addition of the capability to run a program inside a collaborative tool helped me to understand the topics easier.	4.67	.49				
19.	The enhancements to the collaborative tool were very useful and as a result the tool has been more usable.	4.72	.46				

Scoring: 5 = Strongly Agree, 1 = Strongly Disagree

As a result of this statistical analysis there was a significant difference of 0.05 in favour of the subjects using the advanced collaborative tool and this difference was observed in most of the answers to questions in Table 2.

Students were grouped according to whether or not they used advanced collaborative tool or the standard collaborative tool. An independent sample t-test compared total mean scores between the two groups. Significant difference was not found ($p > .05$) between the groups at the following items:

- I was more comfortable during class sessions and this has increased my learning rate.
- Has enabled me to concentrate on my topic while using the collaborative tool in my own place of work.
- I was not shy to ask my class instructor or my class mates any questions I didn't understand while using the collaborative tool.

In addition, the answers of students using the advanced collaborative tool indicated that the lowest average was M = 4.39, and the highest average was M = 4.78. In other words, the positive opinion of subjects on the use of advanced collaborative tool is very high.

The general results show that the opinions of the subjects using the advanced collaborative tool are higher than those using the standard collaborative tool and these results are largely statistically significant.

Student Learning Style

An independent t-test was performed to find out whether or not there was a significant statistical difference between the learning styles of subjects using the advanced collaborative tool and the standard collaborative tool. Table 3 gives the data for the learning styles of the subjects.

Table 3: Learning Styles of the Subjects

Groups	N	Mean	SD	T	p
Used Advanced Collaborative Tool	18	144.33	13.47	.606	.549
Used Standard Collaborative Tool	18	141.50	14.58		

*The mean difference is significant at the .05 level.

There was no significant difference ($t = 0.606$, $p > 0.05$) between the learning styles of students using the advanced collaborative tool ($M = 144.33$, $SD = 13.47$) and the standard collaborative tool ($M = 141.50$, $SD = 14.58$). We can say that both groups of subjects have similar properties of learning styles.

The Findings Of The Relationship Between The Learning Styles Of Subjects Using The Advanced Collaborative Tool And The Standard Collaborative Tool

Pearson Correlate test was used to find out whether or not there was a significant relationship between the learning styles and opinions of subjects in each group towards the use of a collaborative tool. Table 4 shows the results of this test.

Table 4: The Relationship Between the Learning Styles of Subjects and their Opinions For the Use of a Collaborative Tool

Survey Items	Used Advanced Collaborative Tool		Used Standard Collaborative Tool	
	Correlation	p	Correlation	p
1. I felt as if I was in a real class with my class mates.	.075	.768	.219	.382
2. Enabled me to study and discuss on the same program with my class mates.	.003	.989	-.035	.889
3. Enabled me to discuss topics on a one to one basis with my friends.	.268	.282	.237	.345

4.	Enabled me to use chat and whiteboard on the same screen at the same time, and to learn programming easily.	-.102	.688	.291	.241
5.	Enabled me to communicate with my instructor on one to one basis, and to exchange ideas on a topic.	.250	.316	.091	.719
6.	I was able to compile and run the programs I developed easily.	-.329	.183	-.145	.566
7.	I could communicate easily without being shy with the help of the collaborative tool.	-.430	.075	.464	.052
8.	I was more comfortable during class sessions and this has increased my learning rate.	-.163	.519	.232	.353
9.	I was able to tell my class mates everything I wanted to say.	-.277	.266	-.030	.904
10.	I had no trouble communicating with my class instructor with the help of the collaborative tool.	-.299	.228	-.135	.595
11.	I was able to ask my class instructor any question I wanted using the collaborative tool	-.329	.183	-.321	.194
12.	I was able to communicate and exchange ideas with my class instructor and with my class mates with the help of the collaborative tool.	-.258	.301	-.406	.094
13.	Has enabled me to concentrate on my topic while using the collaborative tool in my own place of work.	.218	.386	.326	.187
14.	I was not shy to ask my class instructor or my class mates any questions I didn't understand while using the collaborative tool.	.284	.253	-.014	.956
15.	I think the addition of the collaborative tool to the NEU-VLE system was very useful.	-.162	.521	.142	.575
16.	The addition of instructor's screen to the collaborative tool helped me to understand the topics easier.	-.248	.320		
17.	The addition of my class mates' screens to the collaborative tool helped me to understand the topics easier.	-.222	.376		
18.	The addition of the capability to run a program inside a collaborative tool helped me to understand the topics easier.	.135	.593		
19.	The enhancements to the collaborative tool were very useful and as a result the tool has been more usable.	-.060	.813		

Scoring: 5 = Strongly Agree, 1 = Strongly Disagree

It is clear from Table 4 that there is no correlation between the opinions of students about the collaborative tool they have been using and their learning styles. Based on these results we can say that the opinions of groups to the collaborative tool have not been affected by their learning styles.

CONCLUSION

Our experimental study has shown that students using the standard and the advanced collaborative tool tend to be interested in, and willing to try to use a collaborative tool. This is similar to the findings of Mackie and Romanow (2002). Mackie produced an

experiment in which students were given the opportunity to use many different collaborative tools. The results showed students' willingness to use collaborative tools.

The experimental application carried out indicated that the opinions of subjects using the advanced collaborative tool were different in many respects to those using the standard collaborative tool. We can say that this is as a result of the enhanced features of the advanced collaborative tool. Specially, the compile/run option of the advanced collaborative tool has helped students a lot during the teaching of a programming language. Similarly, advanced collaborative tool offers every member of the group the ability to see each other's screen. This point has been a major advantage of the advanced collaborative tool.

It is an important result that the students using the advanced collaborative tool have shown statistically significant opinions towards the use of tools such as asking questions to each other, making discussions, sending messages to each and so on. Although the common properties between the advanced collaborative tool and the standard collaborative tool, such as the ability to communicate with the instructor, sending messages between each other, the presence of an editor are very important properties, they are not sufficient for the teaching of a programming language in web-based environment. We can say that compiler/run feature and the ability of the instructor and students to see each others' screens have added learning richness and effectiveness to advanced collaborative tool. This should be considered as a superiority of the advanced collaborative tool, especially in relation to teaching programming languages. This result is similar to the results reported by Booz (2004). The study "The Teacher Technology Leaders" provided faculty teams with access to an in-house developed online collaboration tool, the Virtual Curriculum Laboratory, where team members could collaborate on their semester-long team project.

According to authors' experiences, it is not sufficient to use only the tools such as chat, discussion forums, or whiteboard in web-based teaching of programming languages. If either the program or the output from the program/compiler can be sent to the instructor, or if better the instructor and the student can see each others' screens and work on the same program collaboratively, then a more efficient study environment can be established. Students can then solve their programming problems easily and with comfort as a result of such collaborative studies. In other words, if the instructor and students work on the same problem at the same time then success can be achieved and students can learn the programming language easier. However, Hietala (2002) investigated almost 60 students on three courses who had an opportunity to use a standard collaborative tool. He found that students were not used to working together in a standard collaborative tool environment. One possible explanation for this is that only the standard collaborative tool was used in the reported study.

Another data collection instrument used during this study was the learning styles of students. The aim here was to determine the learning styles of subjects in two different groups. The learning styles of subjects in both groups are at acceptable and high levels. The statistical analysis carried out has shown that there are no significant differences between the learning styles of both groups. This means that the subjects which took part in the research study had similar learning styles.

This study has shown that significant differences found while using the standard collaborative tool are not as a result of subjects' learning styles. It is almost certain that the differences have emerged as a result of the main properties of the advanced collaborative tool. Sarmiento (2004) preliminary findings show positive outcomes and point to areas where additional research and development is required to investigate the effectiveness of online environments in support of learning.

RECOMMENDATIONS

Although the results are satisfactory, based on the results of the pilot study and the survey, the method described in this paper can further be improved by considering the following recommendations:

- GREWPtool should be integrated inside MOODLE.
- If the aim is to teach a programming language using web-based education and an LMS system, it is recommended that more efficient results can be obtained if an advanced collaborative tool is integrated inside the LMS system.
- Additional programming languages should be integrated inside GREWPtool.
- A more effective teaching environment could be established if MOODLE is incorporated with multimedia tools such as audio and image.
- The teaching of a web-based programming language should not only be considered as the solution of exercises (e.g. writing example programs). Such a study should be enhanced and supported by the use of available internet tools such as chat, discussion boards, forums, collaborative tools, and similar utilities.
- A collaborative tool which is to be used in web based teaching must have the property that private messages can be sent from the instructor to students, or between students.
- Students must be able to see the instructor's and each others screen outputs in web based education where a collaborative tool is used.

Our study suffers from a number of limitations: First, we only studied a small group of students. It may be that more favorable results would have produced with larger groups. Second, the study period was only a semester. A longer period of study should be carried out to obtain more results.

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