A PILOT STUDY ON THE COMPARISON BETWEEN BLENDED AND F2F LEARNING METHODS IN A SQL COURSE

Mithat YAVUZARSLAN
Computer Education and Instructional Technologies, Yeditepe University, Turkey
mithat.yavuzarslan@yeditepe.edu.tr

Hakan OLGUN
Informatics, Istanbul University, Turkey
hakan.olgun@ogr.istanbul.edu.tr

Selim YAZICI
Business Administration, Istanbul University, Turkey
selim@istanbul.edu.tr

ABSTRACT

One of the main outcomes of the current period is to decrease in the cost and energy of accessing the information due to rapid growing of internet and Information Technologies. Therefore, transferring online courses to users via e-learning platforms has became more and more preferred in recent years. This paper aims to investigate the effect of an online course designed in Google Course Builder to teach introductory level SQL (Structured Query Language) on students' knowledge and skills on use of SQL. 61 undergraduate students from a private university in Turkey who were enrolled in "Basic Computer Applications" course participated in this research. To establish an experimental research design, the students were randomly separated into experimental and control groups. Blended learning method was applied to the experimental group whose participants enrolled in the online course (SQL Course) and face-to-face (F2F) method was applied to the control group with the same learning content. While SQL Mid-Test was only conducted to observe the change of experimental group, SQL Final Test was applied to both groups. Since the sample size of the experimental group is under 30 and a normal distribution was not found, Mann-Whitney U Test was performed to compare the means of experimental and control groups. To compare the means of SQL Mid-Test and SQL-Final Test, Wilcoxon Signed-Rank Test was performed. After two weeks of experiment, it was found that there is a significant difference between two groups in favor of participants taught with F2F method. It was also revealed that slightly but significant improvement were found on the academic performance of the experimental group. On one hand, the comparison between two groups demonstrated the constraints for learning a scripting language in a short time, however on the other hand results also showed the positive effect of blended learning environment to students' learning performance towards using introductory level SQL. All findings of the study were discussed in the light of relevant literature.
Key Words: e-learning, blended learning, F2F learning, SQL

INTRODUCTION

In recent years, the advances in information and communication technologies are continuing to change the mentality of education in terms of both academic and institutional. To investigate the relationships and differences between e-learning and traditional methods has always been a significant task for enhancing the quality of education. This study is designed as a pilot study to compare blended and face-to-face (F2F) learning methods and the findings of the experiment were discussed in the light of relevant literature.

E-Learning and Blended Learning Methods

E-learning has emerged with the rapid advance of information technologies and electronic systems in the last 20 years. The widest definition of e-learning is "the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance" (Rosenberg, 2001, p.11). Pollard and Hillage (2001) stated that e-learning concept refers to the processes such as providing information via information and communication technologies to enhance learning performance, preparing interactive learning materials to develop personal skills, and creating a multi-dimensional relationship between learner and instructor (monitoring the learning process, feedbacks, peer learning) by transforming the two previous steps into a broader level.

When compared to F2F learning, a number of advantages makes e-learning more preferable. Schweizer (2004) indicated that institutions give priority to e-learning because of the quality of information in e-learning environment, productivity of new technologies in terms of their costs, spreading culture of e-learning and internet based technologies, increase of online courses, reduction of business cycles, and increasing competition in business

market. Ally (2004) also emphasized that online learning platforms are transcending the boundaries of time and space, facilitating to access contemporary learning materials, and providing to communicate directly with the instructor. Additionally, directing students to valid and qualified knowledge in online learning platforms is more effective and easier than in F2F learning environment.

Today, most of the e-learning platforms are in asynchronous model. While asynchronous e-learning model refers to the e-learning environments which are accessible by users anytime and anywhere, synchronous e-learning model requires students to be gathered in e-learning environment at the same time (Rosenberg, 2001). Beyond these models, a model called "blended learning" which combines synchronous and asynchronous models to support learning environments with the benefits of both F2F education and e-learning is also being preferred. Driscoll (2002) defined blended learning as the combination of instructional technologies and web-based technology with a F2F learning environment guided by instructor. Since blended learning model is facilitating the development of open communication, criticism and discussion skills which are seen as significant personal features in higher education, it can usually cause more effective learning experiences in comparison with the other e-learning models (Garrison & Kanuka, 2004).

NIIT (National Institute of Instructional Technologies) proposed a classification for blended learning concerning institutions and organizations (as cited in Valiathan, 2002):

Skill-Driven Model: It is used to learn skills via web-based courses and online learning platforms covering e-mail groups, discussion forums, face-to-face interviews and self-learning methods.

Attitude-Driven Model: It is used to develop behaviors based on peer learning via online meetings and group work.

Competency-Driven Model: It is used to gain implicit knowledge via observing an expert including mentorship and learning management system (LMS) support.

Despite the lucid difference between the blended learning and other online learning models, there is no exact standard for determining the ratio of internet based technologies to traditional methods within an instructional design. In other words, blended learning refers to a process which is designed considering the contextual needs of instruction, learners' level of development, scope of the subject area, and resources of educational institutions. Thus, it is impossible to come across two identical blended learning designs (Garrison & Kanuka, 2004).

Related Work

Literature review revealed that there are many research made to investigate the role of blended or e-learning in the development of learners' academic performance. In a research conducted by Zhang, Zhao and Zhou (2004), the effects of e-learning environment and traditional classroom on academic achievement concerning database normalization and search engines subjects were examined. 103 undergraduate students were participated in the study and separated into experimental and control groups which refer to e-learning and traditional classroom environments. The students in traditional classroom were taught by the verbal lecture method and they were able to ask questions to instructor in anytime they want. On the other hand, the students in experimental group were enrolled in an interactive e-learning course. Findings of the study were exposed that test scores of students enrolled in e-learning environment were significantly higher than the scores of students in traditional classroom.

A similar study conducted by Zhang, Zhou and Briggs (2006) investigated the effect of an online course platform including interactive videos about internet search engines on learning outcomes of students. Participants of the study were 138 undergraduate students who divided into four groups. Three of these groups were all accessed in e-learning environments categorized as and with no video, with interactive video, and with non-interactive video. Students in the fourth group were trained with traditional methods in a physical classroom. According to the results, the group enrolled in an e-learning environment with interactive videos performed significantly higher academic achievement than the students in other groups.

In the study conducted by Chen and Jones (2007), blended learning and traditional classroom settings were compared to examine students' learning performance and perception towards learning. The participants of the experimental group hold four F2F meetings in an academic term and enrolled online meetings in rest of the term. At the end of the study, it was revealed that participants in traditional classroom were more satisfied and identified learning content more lucid when compared to the participants in blended learning environment. On the other

hand, participants in blended learning environment were internalized the value of concepts within the course and their analytic skills were improved more than the students in traditional classroom.

Al-Qahtani and Higgins (2013) carried out a study with the participation of 148 undergraduate students to explore the effect of blended, traditional and e-learning environments on students' academic performance. The findings showed that a significant difference was found between three groups in favor of the students in blended learning environment. In accordance with these findings, authors emphasized that blended learning has more potential to enhance academic success than traditional and e-learning environments because it combines traditional and online methods of instruction.

In the study conducted by Wilkowski, Deutsch and Russel (2014), researchers designed a Massive Open Online Course (MOOC) by using Google's Course Builder for teaching the use of Google Earth tool. At the beginning, participants were asked to share their past experiences and to select learning goals to specify their expectations from the course. These data is used to remind participants their goals during the learning process. Participants' self-reports show the achievement of learning goals were compared at the end of the study. The results showed that participants who completed the course activities were achieved more learning goals than the participants who did not completed all of the activities. Moreover, the participants who completed the course despite of their low-skills were achieved more success than the participants just watched videos and read texts within the course. These results show the importance of activities and feedbacks towards learning achievement in any e-learning platform. Kay and McKlin (2014) also designed a course with Google Course Builder to improve robot programming skills of K-12 teachers. In the study in which 1100 teachers participated, pretest-posttest design were performed and it was revealed that their knowledge, skills and self-confidence were all significantly higher than their initial level.

A research made by Thai, Wever and Valcke (2017) investigated the effect of not just blended and traditional learning environments but also e-learning and flipped classroom environments on students' academic performance. In this study, intrinsic motivation, self-efficacy and perceived flexibility variables of 90 undergraduate students were examined besides their academic performance. Findings of the study revealed that the learning performance of the students in flipped classroom were significantly higher than the students in blended, traditional and e-learning environments. There was also a significant difference between the learning performance of blended learning and e-learning groups in favor of the students in blended learning environment. However, no significant differences were found between the students in blended and traditional learning environments in terms of their learning performance.

As can be seen from the literature, the studies focused on the comparison between blended and F2F learning were conducted with the large amount of sample and long periods of experiment. However, this pilot study was carried on with a small amount of sample and short period of experiment. This study aims to investigate the effect of a blended learning environment on undergraduate students' knowledge and skills towards using introductory level Structured Query Language (SQL).

MATERIAL AND METHODS

Participants of the Study

The participants of this study consists of 61 undergraduate students who enrolled Basic Computer Applications Course during 2017 fall semester at a private university in Turkey. In Table 1, number and percentiles of participants by the program they study is presented.

Table 1. Numbers and Percentiles of Participants by Programs

Program	N	Percentile (%)
Nutrition and Dietetics	22	36%
Guidance and Psychological Counseling	11	18%
Elementary Mathematics Teaching	8	13%
Sociology	8	13%
Psychology	5	8%
Genetics and Bioengineering	2	3%
English Language Teaching	2	3%
Computer Engineering	1	2%
Biomedical Engineering	1	2%
Turkish Language and Literature Teaching	1	2%
Total:	61	100%

It can be seen from Table 1 that the sample of this study has a broad-spectrum and majority of them are from the programs related with social sciences.

Design of the Study

This study is designed as a pilot study. The experimental method was used and the students were randomly separated into experimental and control groups by using MS Excel's randomize function. In Table 2 and Table 3, numbers and percentiles of experimental and control groups by program they study were listed.

Table 2. Numbers and Percentiles of Experimental Group by Programs

Program	N	Percentile (%)
Sociology	7	32%
Elementary Mathematics Teaching	6	27%
Psychology	3	14%
Guidance and Psychological Counseling	2	9%
Nutrition and Dietetics	2	9%
English Language Teaching	1	5%
Genetics and Bioengineering	1	5%
Total:	N_E= 22	100%

Table 2 shows that while Sociology students have the highest population in experimental group, students from English Language Teaching and Genetics and Bioengineering programs have the lowest population.

Table 3. Numbers and Percentiles of Control Group by Programs

Program	N	Percentile (%)
Nutrition and Dietetics	20	51%
Guidance and Psychological Counseling	9	23%
Psychology	2	5%
Elementary Mathematics Teaching	2	5%
Computer Engineering	1	3%
Turkish Language and Literature Teaching	1	3%
Sociology	1	3%
English Language Teaching	1	3%
Biomedical Engineering	1	3%
Genetics and Bioengineering	1	3%
Total:	N_C=39	100%

In Table 3, it can be seen that students from Nutrition and Dietetics represent the vast majority of control group.

Design of the SQL Course

In recent years, world-wide known universities started to transfer some of the course contents into the web and this trend led Massive Open Online Courses (MOOC) to gain a wide currency (Yuan & Powell, 2013; Waldrop, 2014).

Google Course Builders' features towards instructional design, open and free accessibility, possibility to publish and manage more than one course at the same time makes this platform useful and preferable for instructors, educational technologists and learning designers (Marciel, Michelinakis, Fanou & Muñoz-Merino, 2013). Additionally, in some studies, it was revealed that this tool is able to enhance learners' academic performance (Kay & Mcklin, 2014; Wilkowski, Deutsch & Russel, 2014)

In this pilot study, an introductory level SQL Course is designed by using Google Course Builder's infrastructure. At the beginning of the research, learning content was created for both of the groups and separated into three levels. First level of the course covered the database concept, principles of database design, types of databases, database management systems, and an introduction to SQL. In the second and third level of the course, students learn and practice how to write SQL statements from simple to complex.

In the home page of SQL Course, participants were asked to watch an introductory video that explains how to use the platform and how to answer questions within the experiment. After watching the video, students started to read and interact with the learning materials on the SQL Course platform.

At the end of each section in SQL Course, students were asked to write appropriate SQL statement by using "W3 SQL Tryit Editor" which is an online database editor based on SQL.

Table 4. Research Design

Group	Method	Duration	Mid-Test	Final Test
Experimental (n=22)	Blended Learning	2 Weeks	Yes	Yes
Control (n=39)	F2F Learning	2 Weeks	No	Yes

Students in the experimental group enrolled SQL Course which was designed in Google Course Builder and integrated with the learning content via this online platform during the experiment. Blended learning method was applied to experimental group by allocating the last 20 minutes of each lesson for verbal lecturing and discussion. Students were also able to ask questions in class sessions verbally and out of class sessions via discussion forums. The blended learning model used in this pilot study refers to "skill-driven model" according to categorization of NIIT. SQL Course platform was accessible for 2 weeks and participants were free to access the course content and

materials during the experiment process. At the end of first week, experimental group was tested with a mid-test covers the subjects of first level of the course.

The learning content of the three levels were instructed to the control group by verbal lecturing method and PowerPoint slides were used to show how to write SQL Statements. Since both groups were in the computer lab during the experiment, students in the control group were also directed to make practice using "W3 SQL Tryit Editor".

Instruments

SQL Mid-Test, which consists of 10 multiple-choice questions, was applied to the students from experimental group at the end of the first week. The responses were collected using Google Forms.

SQL Final Test, which measures the knowledge and skills of participants towards database concepts and using SQL was applied to the experimental and control group at the end of the experiment. It consists of 7 multiple-choice questions about the topics of first level and 13 open-ended questions about using SQL on a sample database. Responses of this test were also collected using Google Forms and the responses given to the open-ended questions were evaluated by the second researcher of this study.

Data Analysis

Since the sample size of the experimental group is under 30 and a normal distribution was not found, Mann-Whitney U Test was performed to compare the means of experimental and control groups. To compare the means of SQL Mid-Test and SQL-Final Test, Wilcoxon Signed-Rank Test was performed. While Mann-Whitney U Test is used to compare two independent samples with small size and non-normal distribution, Wilcoxon Signed-Rank Test is used to compare two related samples when the assumption of normality have not met (Kenny, 1987). SPSS (Statistical Package for Social Sciences) v24 software was used to analyze the data.

RESULTS

The means and standard deviations of SQL Final Test scores for experimental and control groups are presented in Table 5.

Table 5. Means and Standard Deviations of SQL Final Test Scores

Group	n	$\bar{X}$	s	Minimum	Maximum
Experimental	22	43.07	26.23	10.0	92.5
Control	39	63.27	20.34	22.5	100.0
TOTAL	61	55.98	24.46	10.0	100.0

As shown in Table 4, the mean of the control group's final scores ($\bar{X}$=63.27, s=20.34) is higher than the mean of the experimental group's final scores ($\bar{X}$=43.07, s=26.23). To explore the difference between the mean scores of two groups, Mann-Whitney U test was performed and the results of this test were presented in Table 6.

Table 6. Results of Mann-Whitney U Test

Group	n	Md	Mean Rank	Sum of Ranks	Mann-Whitney U	z	p
Experimental	22	30.0	22.5	495.0	242.0	-2.813	.005*
Control	39	62.5	35.8	1396.0			

*p<.05

It can be seen from Table 6 that a statistically significant difference was found between the mean scores of control (Md=62.5, n=39) and experimental groups (Md=30.0, n=22) in favor of the control group (U=242.0, z=-2.813, p>.05, r=.36). It can be concluded that students in F2F learning environment performed significantly higher than the students in blended learning environment.

To analyze the SQL Mid-Test and SQL Final Test scores of the experimental group, Wilcoxon Signed-Rank Test was performed and results were presented in Table 7.

Table 7. Means and Standard Deviations of SQL Mid-Test and SQL Final Test Scores of Experimental Group

	n	$\bar{X}$	s	Minimum	Maximum
SQL Mid-Test	22	29.55	23.19	0	90.0
SQL Final Test	22	43.07	26.23	10.0	92.5

In Table 7, it can be seen that mean of experimental group's SQL Final Test scores ($\bar{X}$=43.07, s=23.19) are higher than the mean of their SQL Mid-Test scores ($\bar{X}$= 29.55, s=23.19). On the other hand, it was seen that both scores are below the expected mean.

Table 8. Results of Wilcoxon Signed-Rank Test

SQL Mid-Test /SQL Final Test	n	Mean Rank	Sum of Ranks	Z	p
Negative Ranks	6	10.58	63.50	2.047*	.041**
Positive Ranks	16	11.84	189.50		

*Based on Negative Ranks
**p<.05

According to the results shown in Table 8, there was a statistically significant difference between the mean scores of SQL Mid-Test and mean scores of SQL Final Test of the experimental group (z=2.407, p<.05). It can be stated that blended learning method provided a slight but significant improve on learning performance of the students.

DISCUSSION

In this pilot study, the effect of a blended learning environment on undergraduate students' knowledge and skills towards use of SQL was investigated. Students were divided into experimental and control groups to compare the blended and F2F learning environments. While the mean SQL Final Test scores of both groups were compared, the difference between the mean SQL Mid-Test scores and the mean SQL Final Test scores of experimental group was also examined.

First result of the study revealed that the students in F2F learning environment performed significantly higher in SQL Final Test than the students in blended learning environment. Although there can be found some early studies in e-learning research which discovered significant difference in favor of traditional learning methods or no significant difference between two settings (e.g. Johnson, Aragon & Shaik, 2000; Ponzurick, France & Logar et al., 2000), these results are not in line with the findings of the studies conducted in last years (Zhang et al., 2004; Zhang et al., 2006; Melton, Graf & Chopak-Foss, 2009; Al-Qahtani & Haggins, 2013; Thai et al., 2017). It can be asserted that since the participants except engineering students are from the departments where generally traditional learning methods are used, they may have had the lack of adaptation to a blended learning environment. Furthermore, there are some constraints for learning a programming language in a short time. Hadjerrouit (2007) emphasized that learning a programming language is related with developing a skill rather than gaining a set of knowledge and even an academic term will not be enough to make unexperienced students to reach the expected level. Despite the fact that the difficulties when learning a programming language can be reduced using online tools, the time of the training should be described and organized well to allow learners to develop such skills. In a study conducted by Gülseçen and others (2013), undergraduate students' programming skills were examined in F2F and online learning environments and compared with pretest-posttest design. They found that while the scores of the students in F2F learning environment were higher in the first week, the students in online learning platform performed better but not significantly higher at the end of second week. Thus, the difference between the learning performances found in our pilot study can be explained by the short experiment time which did not allow participants to acquire knowledge of SQL effectively.

According to another finding of this study, it was revealed that there was a slight but significant increase in mean test scores of students in blended learning environment from first to second week. In other words, students in blended learning environment performed slightly but significantly better in SQL Final test than they did in SQL Mid-Test. These results show the positive effect of blended learning environment to students' learning performance towards using introductory level SQL. When these results considered, students may have just started to become more adapted not only to write SQL statements but also to use of SQL Course platform during the two weeks of experiment. In a series of experiment, a problem-solving based environment, SQL-Tutor, which provides students to write SQL queries with the help of feedbacks has been evaluated concerning several variables (Mitrovic & Ohlsson ,2016). In one of these researches conducted with 68 undergraduate students, it was stated that four weeks of experiment was a restriction of the study even the experimental group solved the problems in a shorter

time than the control group (Mathews & Mitrovic, 2007). Another study made by Gálvez, Guzmán and Conejo (2009) implemented a blended learning setting included a problem solving environment called OOPS (Object Oriented Programming System) and found any significant differences between test scores of experimental and control group. However, an improvement can be seen in the scores of all students involved in blended learning or online environments in both studies. These results suggest that although the time of the experiment can make difficult to observe or conclude the effect of blended learning environments on students' learning performance, an overall progress can be seen. Thus, it can be said that the findings of this study is similar with the study conducted by Gálvez and others (2009).

It is known that learning a programming language is a challenging process. Students can face with difficulties in understanding the concepts of programming or developing strong skills when they learn programming in F2F environments (Lahtinen, Ala-Mutka & Järvinen, 2006). In computing education, developing rich learning environments is important to address students' different learning styles and various sources of motivations (Jenkins, 2002). Therefore, use of blended learning design to teach programming has several advantages in terms of its pedagogical opportunities. It allows users for accessing the exercises, course materials, examples and their solutions any time so that they become able to develop a deep comprehension towards the notions of programming. Blended learning environments are also useful for computing education since they may include activities for operating programming tasks which direct students to improve their skills by repeating difficult tasks. Additionally, students faced with difficulties when trying to solve a task can use both discussion forums and F2F meetings for seeking help (Hadjerrouit, 2008). Considering the emerging technologies and services in e-learning industry, all of these advantages are highlighting the functionality of blended learning design in computing education.

In conclusion, it is expected that the results of this pilot study, which was conducted in a short time with a small sample size will shed light on further studies likely to investigate the effect of blended learning method on students' learning performance. It is also considered that there might be found higher and more significant differences in the further studies likely to be conducted in a longer time and with a larger sample size. Further studies should also consider the reflection of students towards the online course and their experiences within training.

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