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Evaluation of Blended Learning Approach in Computer Engineering Education

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Abstract

Blended Learning is a learning model that is enriched with traditional learning method and online education materials. Integrating online and face-to-face learning with blending learning can optimize seat time and improve learning experience. In this paper, we present the teaching of Algorithm and Programming course in Computer Engineering Education via blended learning approach. Since 2011, Computer Engineering education in Süleyman Demirel University Computer Engineering Department is taught with blended learning method. Blended learning is achieved through Learning Management System (LMS) of university by using distance education technology. LMS comprises of course materials supported with flash animations, student records, user roles, evaluation system such as surveys and quizzes that meet SCORM standards. In this paper, performance evaluation of students in traditional and blended education for Computer Engineering is provided. Applied blended learning model is presented and evaluation of students who are taking programming courses is done. Therefore, it is aimed that adaptation period of students in blended education is shortened. Our results show that algorithmic thinking abilities of students who enrolled in the Algorithm and Programming course in blended and traditional education are close.

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1. Introduction

Blended learning has various definitions in literature. In a study (Finn, 2004), (Procter, 2003), it is defined as the combination of best features of traditional learning and online learning. However, the definition has evolved to encompass combinations of various learning strategies such as blending structured and unstructured learning, online

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and offline learning etc. (Singh, 2003), (Lotrecchiano, 2013). The goal is to combine face-to-face education and online education in an efficient way. In this model, students engage in interactive experiences. Additionally, the online courses provide students with rich multimedia content at anytime, anywhere with Internet access from university or home. This increases the scheduling flexibility of students. There are many ways of applying blended learning. Therefore, there are no certain rules to define what the ideal blend might be. The term “blended” has a broad meaning and it includes the integration of e-learning and traditional learning. The blend of these learning models depends on the online materials, the needs of the students, and the instructor requirements.

In our study, we define the blended learning as the coherent integration of e-learning and traditional learning to address our educational goals. When blended learning is understood and applied carefully, it will offer great advantage for students and teachers, (Lefoe, 2012).

In our approach, face-to-face and e-learning models are combined. Main courses such as programming and hardware-based courses are taught face-to-face and the other courses are taught online. Online courses part into two sections as synchronized and asynchronised. Asynchronised courses are applied through Learning Management System (LMS). Students can access the past courses; submit their homework and projects through this system. Additionally, they are allowed to choose how they will access the necessary learning materials. In synchronized section of the online courses, students join the class in specific time determined by the department. Through this education model, the courses are followed interactively and independent of location in the same time zone. Owing to developing technology, students now have the opportunity to participate in education remotely and communicate online without meeting face-to-face as it is in traditional learning model.

2. Blended Learning And Its Components

In traditional learning, the classes are always physically located in specific places and the courses are thought at specific times. On the other hand, in blended learning, the learning process can take place at anytime, anywhere by benefiting from technology. Table 1 shows the main differences between the traditional learning model and the blended learning model (Khan, 2012).

Table 1. Differences between Traditional Learning and Blended Learning Model

Main Features of Education	Traditional Learning	Blended Learning
Location	In Physical Classes (Not Flexible)	Anywhere (Flexible)
Learning Method	Face-to-Face	Face-to-Face and Online
Learning Time	At Specific Time (Not Flexible)	Any Time (Flexible)
Technology Usage	No obligation for using the Technology	It is a necessity to use the technology

2.1 Online Learning (E-Learning)

E-Learning is learning and teaching model that is designed to be carried out by using electronic media (Bourne, 1996). It is less expensive than the traditional learning approach, not limited to a specific geographic location and more flexible in terms of time. It replaces the traditional learning where it cannot operate. While the computers make the learning easier, Internet technology acts as a communication bridge interconnecting other computers and people making the learning process interactive (Bell, 2013). Online learning or e-learning has two sub-parts that are Internet and Web Based Learning (Hadjerrout, 2008).

2.1.1 Internet Based Learning

The formal use of Internet Based Learning began with the establishment of moderated newsgroups in 1960s,

(Georgiev, 2004). However, it is a new type of distance learning model that uses the Internet Technology to deliver the course materials to students (Torkul, 2005). In this model, a virtual communication channel is established between the students and teacher. On one end, teacher lectures and on the other end students join the class and take courses from different cities, countries. The learner does not only take information, she or he also contributes, interacts, constructs the knowledge that enables the learning process (Hill, 2004).

Although there have been many advancements in technology that empower the Internet Based Learning, current bandwidth and speed limitations are the only limiting factors that prevent the Internet Based Learning from being the de facto technology standard for education.

2.1.2 Web Based Learning

Web Based Learning is similar to computer based learning that provides an environment independent of time and location yet differs because web browser is used for communication (Khalifa, 2002). It is a hypermedia based teaching program that uses the resources on World Wide Web (WWW) to promote and support learning process in a rich learning environment. In this model, web is used as learning and teaching tool and it is not the main goal (Boisvert, 2000).

In these types of systems, students' login with a user name and password assigned to them. It is possible to generate student reports containing the exact time a student connected to the system, duration of connection, information regarding the lectures he/she studied, quizzes, exams he/she took. In addition, students' course performance can be evaluated; students and the teachers can meet online and realize interactive learning activities.

3. Evaluation Of Blended Learning In Computer Engineering

This study analyses the Algorithm and Programming course in blended learning program in 2012 and 2013 fall semesters. Algorithm and Programming course is given to the students who are enrolled in computer engineering program in Engineering Faculty in the first year of their education semester. The main purpose of this course is to help students gain programming abilities through participating in C programming applications. This course is taught for duration of 15 weeks with 3 hours theory, 1-hour lab. Subjects are divided into 8 main units as shown in Table 2.

Table 2. Weekly Schedule of Algorithm and Programming Course.

Schedule	Units	Course Subject
Week 1	Unit 1	Description of Algorithm,
Week 2	Unit 1	Using flowchart
Week 3	Unit 1	Mathematical expressions
Week 4	Unit 1	Using conditional expressions in algorithms Loop algorithm
Week 5	Unit 2	Basic input/output libraries
Week 6	Unit 2	Basic input/output transactions
Week 7	Unit 3	While loop, Do-While loop
Week 8	Midterm Exam	Midterm exam that includes first three units
Week 9	Unit 4	For loop, infinite and dead loops
Week 10	Unit 5	Arrays, Powers of array: loops, character arrays and multi-dimensional arrays.
Week 11	Unit 6	Structures in C, Pointer with Structures, Nested structures in C
Week 12	Unit 7	Definition of pointers, Usage of pointers, Pointers with functions
Week 13	Unit 8	Description of Function, Function prototypes, Local and global variables
		Some most frequently used functions in C
Week 14	Repetition Units	Course Summary
Week 15	Final Exam	Final exam that includes all units

3.1 Applied Blended Learning Model

Application of blended learning model involves three methods in learning cycle. First, the teacher determines the concepts and the programming activities to be taught every week through 15 weeks. The teacher identifies the insufficiencies of the applied methods by examining the activities and establishes links between previously known concepts with the new concepts to be taught.

The main purpose of the course is to teach programming and provide algorithmic reasoning skills to students. Teacher cultivates the students' abilities to understand the programming concepts. Subsequently, students endeavour to produce solutions for programming problems. For instance, if the programming concepts that are to be taught are related to "while loop", students perform activities related to "while loop" structure. Students work individually or by joining to small groups. The task of the teacher is to direct the students to think more deeply, creatively. Learning how to program is an iterative and continuous process that lasts for 15 weeks and comprises of renewal, improvement and change. Students spend their most important time on programming activities. Through this time, students provide solutions and present their ideas. Finally, teachers are given the opportunity to improve themselves, renew course materials, and change the way they teach by meeting students face to face or creating online surveys, polls.

3.1.1 Blended Learning Studio Environment

Computer engineering department has a studio that includes synchronous and asynchronous education that is a part of blended learning. Fig.1 shows our Computer Engineering Blended Learning Studio. The studio is built in a 15-m² area that has a high level sound insulation. The studio has a fully equipped computer, a high definition camera and a microphone to create an interactive course environment. In addition, there is a smart board, which provides a large screen for teaching, and a projector that reflects computer screen to smart board.

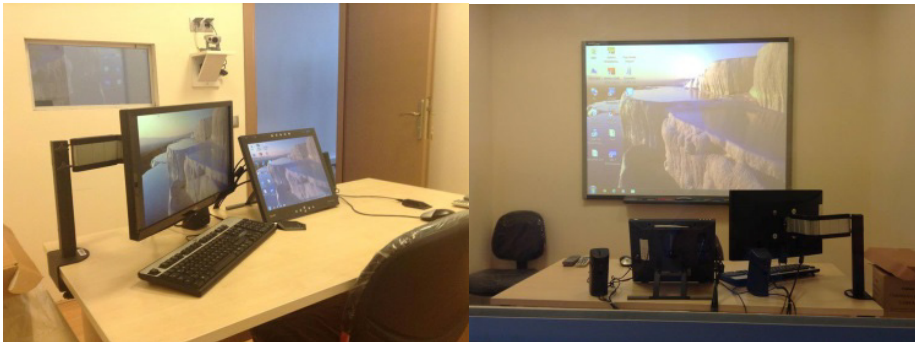


Fig.1. Computer Engineering Blended Learning Studio

3.1.2 Blended Learning Course Delivery Method

In Computer Engineering Blended Learning Program, %30 of courses is taught face-to-face, and %70 is taught online. To protect the education quality, same teachers teach the courses in traditional education program and the distance education program. Additionally, students in traditional education program and blended learning program take the same exams at the same place. Teachers decide carefully when choosing face-to-face courses. Face-to-face courses must be suitable for online delivery and must enable interaction.

3.1.3 Performance Evaluation of Blended Learning Model

We evaluated performance of students in traditional and blended education for Computer Engineering Education. Evaluation was based on the homework, midterm and final exam grades of the students who took Algorithm and Programming course. We analysed 100 students who enrolled in the course during the evaluation process. 50 of

these students who took the course via blended learning approach form the first group. Other half of the students took the course via traditional learning approach form the second group. All students took the same midterm, final exams and did the same homework. Table 3 summarizes our findings. The results show that the first group performed well as the second group in the exams and homework. This indicates that blended learning approach is effective as traditional face-to-face learning model. Therefore, we can conclude that our blended learning approach was successfully applied to Computer Engineering education where it enhanced students' achievements. Our model also provides a time and location independent education environment, reduces the rate of students who dropped classes and saves cost.

Table 3. Grades of students who took the course via blended learning and traditional learning approach

Assignments and Exams	Number of Students Participated in		Average Grade
	Blended /	Traditional	
Assignment – 1	32 /	49	76.025 / 77.025
Assignment – 2	29 /	44	95.40 / 95.31
Assignment – 3	32 /	45	56.86 / 53.34
Midterm	47 /	49	33.22 / 40.363
Final	50 /	50	31.96 / 38.973

4. Conclusion

In this paper, we presented the application of blended learning approach for Algorithm and Programming course in Computer Engineering Department of Süleyman Demirel University. We also analysed and presented the performance of students in blended education in comparison to traditional face-to-face education. We proved that when blended learning is understood and applied carefully, it offers great advantage for both students and teachers. In our blended learning education, we showed that education was more effective; students' achievements were better than expected in comparison to traditional education and algorithmic thinking abilities of students in blended and traditional education were very close.

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