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Implementation of blended learning approach in teaching introductory computer science course

Alaa Obeidat[1], Rola Yaqbeh[2]
[1]Department Basic Sciences, Faculty of Science, The Hashemite University, Zarqa, Jordan
[2]Nursing Faculty, Jordan University of Science and Technology, Irbid, Jordan

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ABSTRACT

Information communication and technology has great impact on modern education architecture of 21st century. This research intends to analyze the effectiveness of blended learning considering its basic principles and factors. Also, this study is focused on determining core problems of blended learning thus highlighting its design approach. A descriptive and inferential statistical analysis has been conducted on the data that reveal that the majority of students prefer blended learning system regardless their major, gender and any other factors if they have good infrastructure and effective electronic platform. It is recommended that for effective implementation of blended system there should be opportunities of face to face as well as online synchronous, and non-synchronous communication between students and teachers.

Corresponding Author:

Alaa Obeidat
Department Basic Sciences, Faculty of Science, the Hashemite University
Zarqa, Jordan
Email: Alaaf@hu.edu.jo

1. INTRODUCTION

Students' ability to take subjective initiative is coordinated by the traditional teaching method, which places teachers in a position of power and places students in a passive acceptance condition. Students in computer skills class often learn the material through a combination of lecture notes, hands-on experience with a computer in a lab, and conversation with the instructor. The term "information, communication, and technology (ICT) integration in education" describes the use of computer-based communication that is woven into the fabric of the typical classroom experience. While students are in a passive acceptance condition as a result of the traditional teaching style, teachers occupy a dominant position in the classroom thus limiting the students' ability to exercise their subjective initiative. In the computer skills classroom, lecturers focus on imparting knowledge and abilities in practicing the basic skills of the course, while students learn mostly through lecturer notes, using a computer in the lab, and discussion with the lecturer about the main subject ideas.

Blended learning, often called hybrid learning, is a teaching method that combines face-to-face classroom instruction with online learning materials and social networking. Multiple settings, including the classroom, can benefit from blended learning. When using a blended approach to education, students can learn at their own pace. The course is designed so that students can go at their own pace, referring back to concepts and materials as they see fit. With the help of a learning management system, students may easily review previously covered topics and work at their own pace through course requirements.

The use of computer-based communication that is integrated into the regular educational process in the classroom is referred to as ICT integration in education [1]. Teachers are considered as the essential players in implementing ICT in their regular classroom settings and training pupils for the contemporary

digital environment. This is a result of ICT's ability to provide an active and dynamic teaching-learning environment. ICT in education has significantly changed how learning and teaching are done [2]. In addition, technology has increased access to educational resources and opened up new avenues for learning outside of what was previously impossible.

The high-end educational institutions especially universities are paying their major focus on developing unparalleled technology infrastructures in their both physical and online setups. Their goal is to adopt and devise most effective e-learning models which could be used to offer advance and useful courses to students. These blended learning strategies are of no use without training students about the use of technology and how to access those knowledge sources to get more insights about any course [3]. One of the most recent advancements in educational technology is the distance learning system, which allows students who are not been able to attend traditional classes to receive the same credentials as those attending regular lectures.

Distance learning is form of E-learning teaching method which is now adopted to overcome challenges faced by traditional methods of teaching. Remotely, this is accomplished by implementing a formal educational program that consists of a variety of courses designed to meet predetermined goals [4]. In distance learning, the organization itself, as well as media and technological interactions like email emphasize on using interactive platforms of communication between learners and instructors [5]. Distance learning focuses on technology supported learning by delivering training using computers. This can be accomplished either online, offline or both depending on the available resources [6]. This new mode of pedagogies is a digital revolution adopted by higher education to offer digital mode of delivering creative knowledge [6].

Blended learning is a brand-new approach to education that combines face-to-face teaching methods with the online and technical platforms having various pros and cons. By combining the best learning opportunities between these two approaches to suit the needs of learners and the desired outcome to be attained by the end of the semester, the term "Blended" was created. There is need to access and understand various challenges associated with distance and blended learning. These factors include financial state of learners, availability of technical resources, teachers' willingness to adopt blended learning approaches and other student barriers [7]. Teaching, knowledge transmission, and lesson planning consider the technical and intellectual abilities of students.

- Elements of a blended learning model

A model can be a description of a phenomenon or system that takes into account it's known or inferred attributes and is employed to learn more about its features (Figure 1). Therefore, a blended learning model is required which helps us to consider various factors, their assessment and co-relations of various elements that would produce an instructional sound learning environment [8], [9]. The learning methods component: assesses the learning environment (face-to-face/online). E-contents component: used to determine the most appropriate media to deliver the content to the students. These components are used to determine the most suitable instructional strategies that support the learning objectives.

Three independent factors: online learning, computer-based learning, and face to face learning) make up the model of blended learning. The research also analyzed the main important factors that affect the results of the study, these factors include (gender, college of student, GPA and type of electronic platform used in blended learning). All these factors have been analyzed deeply to show up their effect on success of blended learning approach as a good and new way of teaching.

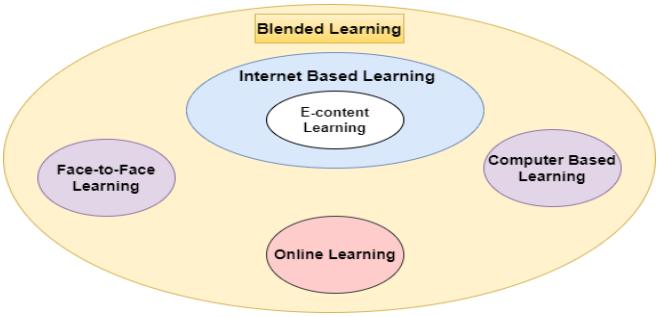

Figure 1. Blended learning model components

- The research's objective

First and foremost, the blended learning development model aids students in improving their learning outcomes by adjusting to their individual learning preferences and styles. It gives instructors and students a practical, satisfying opportunity to pursue independent study. Also, by integrating the ideal

features of traditional and online learning, it increases the flexibility of scheduling for students [10], [11]. Students can participate in an interactive learning environment in (face-to-face) classes. While the online component gives students access to high-quality multimedia information whenever and wherever they have internet access. Finally, it uses a variety of learning techniques to get around learning issues that need to be resolved. In this study we suggested a new model in blended learning based in the past studies that have been done before and added in literature review section, and then in methodology part we made a descriptive and inferential analysis for the collected data. And finally, the conclusion is done regarding the results extracted from the analyzed data.

2. LITRETURE REVIEW

The students of this generation are digitally literate. They are more connected to digital world as compared to physical one. They find online sources credible and feasible to study from. The advancements in technology have matured virtual communications. Cognitive and reflective approach of learning will upgrade student's critical thinking. According to Singh *et al.* [11], there is need to assess basic thinking as well as cognitive skills of students to devise an unbiased and balanced assessment environment. In an inclusive education course related research based activity [12], students perceive that blended learning pave ways for extended and modern learning sources. Variety of learning models expand knowledge horizons thus adopting an independent approach. However, the internet accessibility issues hinder the virtual learning to some extent [13]. The amalgamation of socialization techniques used in physical classes and the digital advancements used for virtual learning have proved to be efficient and cost effective in this digital era. The swot analysis was performed in a study [14] to analyse the possible strengths, weaknesses, opportunities and threats of shifting to online resources and using blended learning approaches. Self-accountability and autonomy are found to be greatest strengths which are inculcated in a learner as a result of virtual learning. Learners are responsible for their own actions which makes them progressive and generate healthy competition. Lack of resources is a weakness which definitely hinders the learning opportunities which can be achieved through face-to-face interaction and using shared laboratories for practical works [15].

There are many opportunities in technological world which would enhance student's cognitive abilities and synergy [16]. Six factors were considered in a literature identifying the willingness and readiness of instructors towards blended learning who are currently teaching face-to face. These factors include technology, online interaction, learning interaction, classroom learning, study management and online learning. The final results revealed that all of these factors are correlated and in-service teachers are willing to adopt this approach regardless of their gender and even if they have very basic knowledge of blended learning approaches [17]. It has been found that interactive language skills are greatly facilitated by integrating online and traditional methods of learning [18], [19]. COVID-19 has paved ways for blended learning specifically in medical field where different models of online learning were assessed and adopted according to the need of institution [20]-[22].

Accorriding to Braiki *et al.* [23], the major ICT issues in the education area are inadequate knowledge and practice of ICT in education, lack of reliablity to use the computer in the classroom and lack of practical skills make ICT difficult to use in education. Many universities seek solutions to support teaching and learning activities in preparation for new normal activities after the COVID-19, especially in higher education [24], the implication of this study will be used to consider top-level adminstration in a university that conducts full online/distance learning. Implementation of massive open online course (MOOC) in several countries can be considered. Sustainble education can be delivered in a developing country like Bangladesh by ensuring these facilities [25]. According to Izkair and Lakulu [26] discovered that only five factors are influencing intention to use mobile learning in higher education institutions (HEI), the factors are "facilitating conditions", "performance expectancy", "effort expectancy", "social influence", and "satisfaction". According to Mahareek *et al.* [27], students in higher education institutions can study more effectively by combining machine learning algorithms with educational data. Higher education is one of the industries that has been most impacted by the usage of information technology (IT), and as a result, top management at these institutions is particularly concerned with the return on investment from IT, which highlights the significance of IT governance [28]. The importance of attitude, motivation, and conduct in the context of students' roles and the efficient and effective use of e-learning is highlighted in [29]. According to Amenduni *et al.* [22], MOOCs are cutting-edge educational breakthroughs that use machine learning algorithms to customise learning materials for students from diverse backgrounds.

3. METHODOLOGY AND MATERIALS

An electronic platform is designed to achieve effective and independent learning. This platform combines lecture notes, demonstration videos, online exercise. A communication module is also part of this

design which allows and learners and teachers to interact with each other. As depicted in Figure 2; before class active learning, preparation, and face-to-face learning in class were the basic components of blended learning.

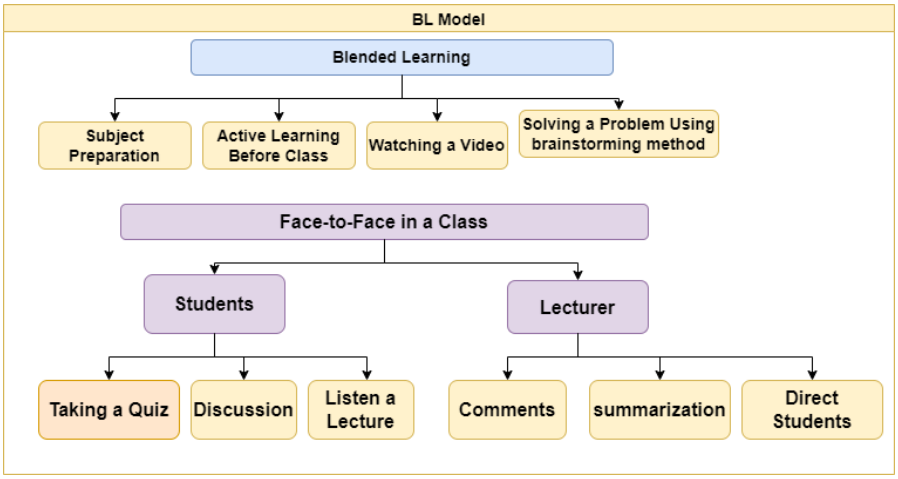

Figure 2. Blended learning workflow

3.1. Student satisfaction

We developed a questionnaire to obtain students' feedback on the teaching satisfaction from the students in computer skills course. There were five items in the questionnaire and its design focused on five key areas; overall student satisfaction, content rationalism, information accessibility, lecturer evaluations, and results that met expectations. Students might rate their responses using the following five-point scale; (extremely disagree), (disagree), (neutral), (agree) and (extremely agree). Students' responses were collected anonymously and the results were analyzed to determine the students' feedback about blended learning method.

3.2. Research questions

Some of the questions that we have included this study are:

RQ1: after studying one or more courses on the blended education system, does teacher has the greatest role in the success of this system in teaching?

RQ2: what are the main obstacles and challenges faced by students in the implementation of blended learning system in teaching process?

RQ3: I prefer blended education because it combines traditional and electronic education?

RQ4: your score is higher in the (online/blended/face-to-face) courses?

3.3. Results

To collect the answers to the study's research questions, a cross-sectional survey was used. The study survey was efficiently filled out by 177 students from various academic departments and colleges at the Hashemite University in Jordan. Answers and feedback of the participants were gathered via an online survey (MS forms).

3.4. Study sample

Table 1 illustrates the frequency distribution of the students participated in the study. The results reveal that 40.4% students from Humanitarian colleges and 59.6% students were from scientific colleges with mean 1.596 and standard deviation (S.D) 0.492. Table 2 illustrates the frequency distribution of the gender participated in the study. The results reveal that 69% female and 31% male with mean 1.31 and S.D 0.464 participated in the study.

As seen in (Figure 3), Microsoft teams tend to dominate the application SW utilized in blended learning. The graph reveals that in blended learning; 159 participants utilized MS Team, 3 used recorded lectures (videos), 2 used Facebook, and 7 used Zoom. Table 3 shows the frequency distribution of problems occurred during blended learning. The results show that 27.5% of students suffer from conflicted blended lectures times while they were at the university. 28.2% participants faced difficulty in delivering the

information appropriately by academic staff remotely, 23.4% participants didn't face any problem, 5.8% participants didn't have computer or smart phone and 20.5% participants faced low internet speed in blended learning with average 2.69 and S.D 1.456.

Table 1. Descriptive analysis of demographic characteristics (N=171)

Variable	*f*	%	Cumulative %
Humanitarian colleges	69	40.4	40.4
Scientific colleges	102	59.6	100.0
Total	171	100.0	

Table 2. Descriptive analysis of gender (N=171)

Characteristic	*f*	%	Cumulative %
Female	118	69.0	69.0
Male	53	31.0	100.0
Total	171	100.0	

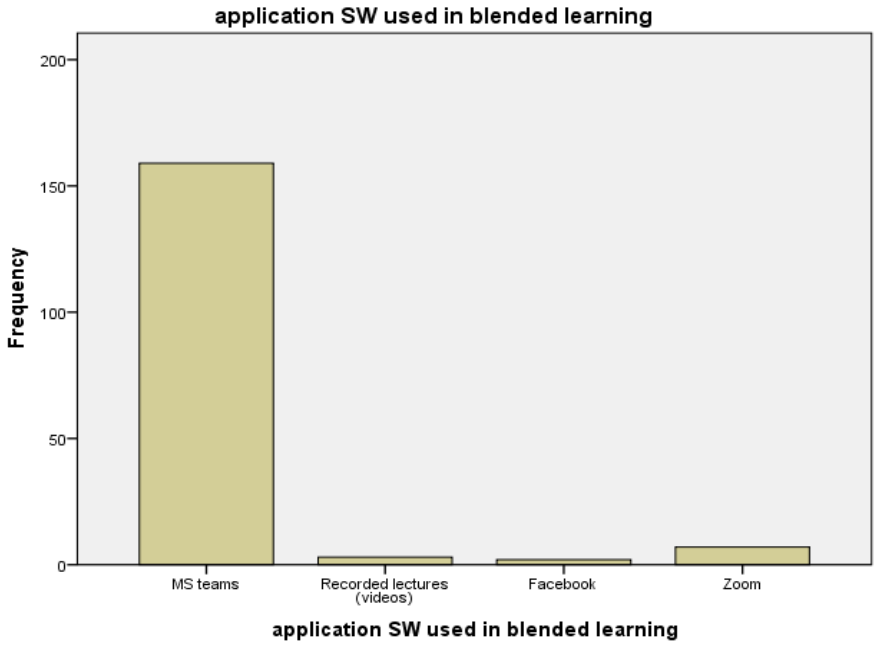

Figure 3. Bar chart of application SW used in blended learning

Table 3. Descriptive analysis of problems occurred during blended learning (N=171)

Problem	*f*	%	Cumulative %
Conflict blended lectures times while you are at the University	47	27.5	27.5
Difficulty in delivering the information appropriately by academic staff remotely	39	22.8	50.3
No problems in blended learning	40	23.4	73.7
Don't have computer or smart phone	10	5.8	79.5
Low internet speed	35	20.5	100.0
Total	171	100.0	

Table 4 shows the frequency distribution of academic achievement in different courses. The results show that 41.5% participants gained knowledge from physical courses as compared to blended courses and online courses, 43.3% participants gained knowledge in blended courses as compared to face-to-face courses and online courses while, 15.2% participants gained knowledge in online courses as compared to blended face-to-face courses and blended courses with average 1.73 and SD (0.71). Moreover, the results show that 36.8% participants got higher during face-to-face courses, 38.6% participants gained higher score in blended courses and 24.6% participants gained higher score in online courses with average 1.87 and SD (0.776). Furthermore, the results revealed that 64.3% participants select that face-to-face course communication is easier as compared to blended courses and online courses meanwhile 21.6% participants select that blended courses communication is easier as compared to online courses and face-to-face courses while 14% participants believe that online courses communication is easier as compared to face-to-face courses and blended course 49 with average 1.87 and SD (0.79).

Table 4. Descriptive analysis of different courses (N=171)

	f	%	Cumulative %
Academic achievement			
Face-to-face courses	71	41.5	41.5
Blended courses	74	43.3	84.8
Online courses	26	15.2	100.0
Higher scores in different courses			
Face-to-face courses	63	36.8	36.8
Blended courses	66	38.6	75.4
Online courses	42	24.6	100.0
Communication with the course instructor is easier in the courses			
Face-to-face courses	110	64.3	64.3
Blended courses	37	21.6	86.0
Online courses	24	14.0	100.0

According to Table 5 which shows there is no statistically significant difference between gender as determined by blended learning system (t=-1.513, p= 0.132), male group respond (M=14.151, SD=1.965) high on blended learning system as compared to female group (M=13.619, SD=2.195). However, there is a statistically significant difference between gender as determined by other learning system (t=-2.053, p= 0.042), male group respond (M=5.509, SD=1.804) high on other learning system as compared to female group (M=4.932, SD=1.652).

Table 5. Gender difference between blended and other learning systems

	Gender					
					95% confident limits	
Variables	Male M (SD)	Female M (SD)	t	Sig.	LL	UL
Blended learning system	14.151 (1.965)	13.619 (2.195)	-1.513	0.132	-1.227	1.620
Other learning system	5.509 (1.804)	4.932 (1.652)	-2.053	0.042	-1.1323	-0.022

According to (Table 6) which shows that there is no statistically significant difference between college groups as determined by blended learning system (t= -0.661, p= 0.509), participant form Humanitarian college respond (M=13.652, SD=2.188) approximately equal to participants from scientific college group (M=13.872, SD=2.104. However, there is no statistically significant difference between college groups as determined by other learning system (t=-1.705, p= 0.090), participant form Humanitarian college respond (M=4.841, SD=1.677) approximately equal to participants from scientific college group (M=5.294, SD=1.727).

Table 6. College difference between blended and other learning systems

	Colleges					
					95% confident limits	
Learning system	Humanitarian colleges M (SD)	Scientific colleges M (SD)	t	Sig.	LL	UL
Blended learning system	13.652 (2.188)	13.872 (2.104)	-0.661	0.509	-0.878	0.437
Other learning system	4.841 (1.677)	5.294 (1.727)	-1.705	0.090	-.979	0.072

4. CONCLUSION

The study aimed to measure the effectiveness of blended learning based on features for blended courses, face to face and online learning. The study was conducted on N=171 students from Humanitarian and Scientific group of colleges. The results showed that 27.5% of students suffer from conflicted blended lecture times while they were at the university. The academic achievement showed in different courses that 43.3% participants gained knowledge in blended courses as compared to face-to-face courses and online.

According to the score in different courses, it is concluded that 38.6% participants gained higher score in blended courses as compared to online courses and face-to-face learning. It is also revealed that 64.3% participants' select in face-to-face course communication is easier as compared to blended courses and

online courses. However, 72.5% preferred theoretical courses as compared to practical courses and lab courses on blended system and 38% participants revealed that they got more time for study in blended learning system which increased the time for study.

It is also concluded that there is no statistically significant difference between gender groups as determined by blended learning system. Meanwhile, there is a statistically significant difference between gender groups as determined by other learning system. Moreover, there is no statistically significant difference between college groups as determined by blended learning system. Furthermore, there is no statistically significant difference between college groups as determined by other learning system.

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BIOGRAPHIES OF AUTHORS

Alaa Obeidat received the computer science degree from Yarmouk university in 2000. He received the Master degree in computer science in 2004. Currently He is Researcher at the Hashemite university, Jordan. He can be contacted at email: alaaf@hu.edu.jo.

Rola Yaqbeh is a researcher from Jordan University of Science and Technology, Irbid, Jordan. Received bachelor degree in nursing in 2008. She can be contacted at email: rolayaqbeh@outlook.com.