The Effect of Blended Learning on the Achievement in a Physics Course of Students of a Dentistry College: A Case Study at Ajman University

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Abstract: This study aims to investigate the impact of the use of blended learning on the achievement of Dentistry College students on a physics course at Ajman University. It compares the results of different ways of teaching the 'Practical physics course'. The study was conducted using a quasi-experimental case study design. The participants of the study were 116 students, divided into two groups: one an experimental group (n = 59) and the other a control group (n = 57). An achievement test was designed to confirm the study's validity and reliability. SPSS was used to analyze the data. The findings revealed that there were statistically significant differences between the experimental and the control groups, in favor of the experimental group. Moreover, the findings also revealed that achievement varied according to the gender of the students in the experimental group (in favor of females). The study recommends further research into the use of blended learning in higher education institutions.

Keywords: achievement, blended learning, effect, Dentistry College students, Ajman University

1. Introduction

The current historical moment is witnessing a revolution in technological advances in all areas of life, and particularly in the field of education, where technology has made a range of new teaching methods possible. Blended learning is one of these, and is now widely used in educational institutions such as universities and schools (Means, Toyama, Murphy, Bakia, and Jones, 2010; Roseth, Akcaoglu, and Zellner, 2013). E-learning started as computer-based courses in the 1980s and 1990s, on stand-alone disk drives. Later, educational courses were hosted on internal networks and then transferred to learning management systems (LMSs) in the late 1990s (Joseph and Nichlavose, 2019). Traditional education is undoubtedly now threatened by the prevalence of rapid e-learning because of its multiple advantages, which makes everyone accept it. Firmansyah and Timmis (2016) pointed out that, in 2012, a new innovation in education called massive open online courses (MOOC) was launched into the globe, which is an online learning course aimed at unlimited participation and open access via the web. Additionally, Beaven, Codreanu and Creuzé (2014) point out that the largest MOOC suppliers are based in North America, Australia, and Europe, with learners from across the globe enrolling in prestigious university courses. Coursera, an online learning platform established in 2012, offers specializations and degrees. It is a for-profit educational technology company (Pomerol, Epelboin and Thoury, 2015). Al Hadhrami and Al Hadhrami (2018) pointed out that e-learning nowadays indicates everything provided for the obvious aim of educating that is allowed or mediated by electronic technology. Additionally, the authors believe that the success of the achievement of the e-learning education system depends on the educational environment in which it operates. Agrawal, Agrawal and Agarwal (2016) identify six factors affecting the efficacy of e-Learning (Figure 1).

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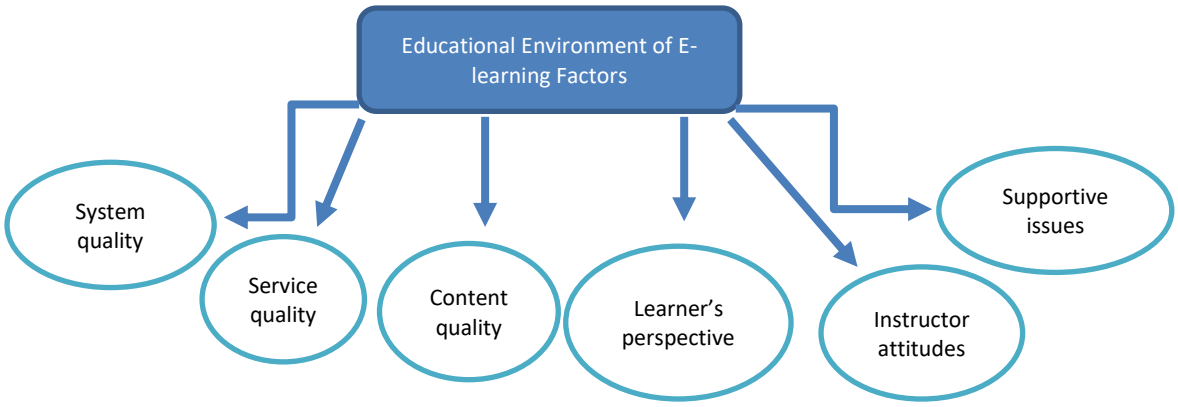

Figure 1: Educational Environment of E-learning Factors

According to Deepali, Wadhai and Thakare (2016), e-learning has become more popular in nations with significant socio-economic variations among the population and growing demand for learning with the appearance of smartphones and tablets and other devices. It was also defined by Park and Jo (2018) as offering learning and training through web network interaction and availability of technologies with the accessibility to knowledge and data. The implementation of e-learning in education provides several benefits, such as flexibility in terms of time and site of the education received. It increases the efficiency of awareness and understanding by making a greater amount of information easily accessible. Also, in e-learning, learners are therefore not forced to depart and it won't cost them large amounts of money. It also takes into consideration the differences between students during the teaching process (Agarwal, 2013; Arkorful and Abaidoo, 2016). Blended learning combines traditional learning with e-learning, and is also a more cost-effective teaching/learning method (Güzer and Caner, 2014; Oweis, 2018).

1.1 Definition of Blended Learning

Nowadays, researchers recognize that there are both advantages and drawbacks to both face-to-face, traditional learning environments and online learning environments (Mortera-Gutierrez, 2006). In an attempt to focus on the benefits of the two different educational approaches and reduce the disadvantages, researchers have started to combine components of them. As a consequence of this, 'blended learning' emerged as a modern instructional model that can combine educational methods to achieve desired educational objectives (Sarıtepeci and Çakır, 2015).

The blended learning model is now being implemented through several higher education organizations to improve the quality of teaching, ease in access to information and educational cost, since technologies and the web are used as teaching techniques to enhance teaching objectives and therefore the educational performance of students (Oweis, 2018; Tongchai, 2016).

Most researchers have confirmed that blended learning is a contemporary and modern approach that combines different models of traditional and online or distance learning and utilizes various types and media of technology, leading to enhanced communication and interaction between teachers and learners, which means that it is a combination of e-learning or distance learning with direct or traditional, face-to-face educational environments (Alsalhi, Eltahir and Al-Qatawneh, 2019; Goyal and Tambe, 2015; Graham, 2013; Isti'anah, 2017; Moskal, Dziuban and Hartman, 2012). Therefore, we can describe blended learning as a contemporary educational approach that combines traditional education in its different types with e-learning in its different designs to enhance learner engagement and outcomes. Thus, the definition of blended learning can be clarified as shown in Figure 2.

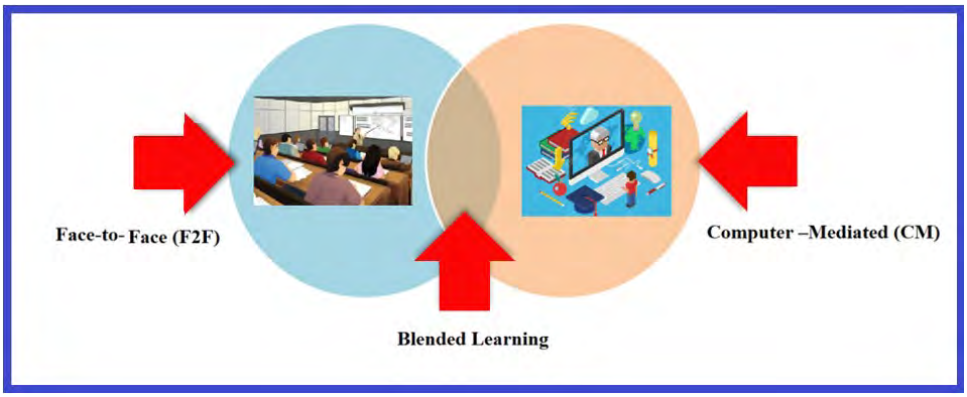

Figure 2: Blended learning definition (Graham, Allen and Ure, 2003; Graham, 2013)

Researchers (Du, 2011; Khan, et al., 2012; Stapa, Ibrahim and Yusoff, 2015) have made some comparisons between blended learning and traditional learning. Table 1 illustrates these comparisons:

Table 1: Comparisons between Blended Learning and Traditional Learning

Comparison Item	Blended Learning	Traditional Learning
Place of application	Any place and flexible	Classrooms fixed and not elastic
Approach of learning	Online and face-to-face	Face-to-face
Learning time	Flexible timing, available at any time	Inelastic and at a certain time
Use of technology	The use of technology is essential and obligatory	No compulsory use of technology
Online support	Conversations, applying online tasks, determining on online missions	None
The education materials	Instructor, group of instructors	Instructor
Assignments	Individual, group	Individual, group

According Ellis, Steed and Applebee (2006) and Moskal, Dziuban and Hartman (2012), in educational institutions such as universities and schools, teachers and faculty use mixed learning because of the benefits it offers. Such benefits include:

- It promotes the cooperation and learning of learners.
- It is project-based education, and is concentrated on problem-solving.
- It decreases the time expended in the schoolroom, and tends to make the use of study time more productive.
- Learners are all much more productive and innovative, and better prepared.
- It is an evolving, responsive, and dynamic approach.
- It is more interesting for students, and potentially offers education from many learning sources while providing the highest performance at the cheapest cost.

On the other hand, Bernard, Borokhovski, Schmid, Tamim and Abrami (2014) refer to how much of the course should be face-to-face and how much online during teaching through the blended learning approach, saying that most courses require the online component to be at least 20–30 percent but not more than 70–80 percent. Furthermore, McSporran and Kind (2005) and Tselios, Daskalakis and Papadopoulou (2011) noted that success factors in blended learning can be due to the design of the blend, the flexibility of time, and an appropriate blend of multimedia with education strategies.

1.2 Blended Learning in Higher Education

The determination of which learning methods and study conditions should be used was one of the most significant problems affecting the quality of education in higher education organizations (Lee and Im, 2014). Moreover, detecting the adoption and implementation of blended learning in higher education institutions is challenging, since departments and teaching staff have direct control over their content and teaching methods (Picciano, Seaman and Allen, 2010).

Bonk and Graham (2006) reported that 93% of their study participants in higher education provided blended learning, although more than 60% do blended learning for less than 20% of their classes or courses. Moreover,

managers, administrators, and faculty members of higher education institutions expect more adoption and application of blended learning in the future (Parsad and Lewis, 2008). Furthermore, Osgerby (2013) reported that 12% of the 12.2 million distance courses registration were given in blended formats. Further, since 2014, institutions of higher education provided 70.7% of their courses in blended learning formats.

1.3 Models of Blended Learning in Higher Education

There is no one way to blend learning; online and face-to-face instruction can be combined into several blended learning models. Several blended models have been formed over the past several years: often the bulk of learning is provided in the teaching hall while some extra activities are provided online. Most of the courses are provided online in many other cases. Perhaps occasionally a student gets to choose which activities to complete online and which to complete in a teaching hall (Spring and Graham, 2017). Our review of studies observed by previous researchers revealed some models of blended learning in higher education, as illustrated in Figure 3 (Kudryashova, Gorbatova and Rozhkova, 2016; Lisetskyi 2015; Staker and Horn, 2012):

- **Face-to-Face Driver Model:** the largest percentage of the curricula involve an interaction between learners and a teacher, such as the flipped classroom model.
- **Station Rotation Model:** allows students, within a given course and schedule, more movement between learning online in a one-to-one, self-paced environment and sitting in a classroom with a traditional face-to-face teacher.
- **Online Lab Model:** includes online courses offered at a specific site through computer lessons. In this model, the laboratory assistant is responsible for supervision. Furthermore, the students have the chance to learn in a traditional learning environment.
- **Self-Blend Model:** gives students the chance to pick extra courses in addition to their main ones, which are provided by various educational institutions. Students require high motivation for this model to succeed.
- **Online-Driver Model:** includes an online platform and a teacher who delivers the entire curriculum.
- **The Flex Model:** authorizes learners to be flexible with their timetable among learning activities, depending on their requirements. Moreover, within the flex model, digital education is seen as the foundation of learners' teaching and learning.

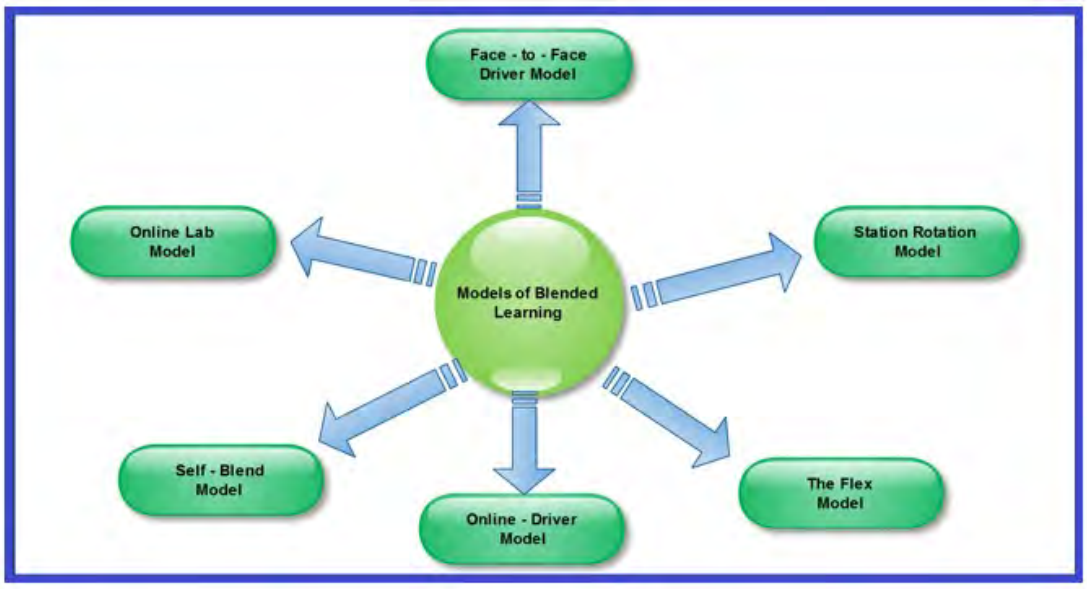

Figure 3: Models of blended learning (Kudryashova, Gorbatova and Rozhkova, 2016; Lisetskyi 2015; Staker and Horn, 2012)

1.4 Previous Studies

Many previous studies have already shown that blended learning is acquiring significance in learning and teaching, particularly in higher education. The American Society for Training and Development (ASTD) decided that blended learning has been one of the top ten models in the information and knowledge delivery sector (Rooney, 2003).

In educational institutions such as universities, blended learning and its impact on student achievement has been studied extensively. Several blended learning studies revealed that the blended learning methodology has beneficial effects on student performance, engagement, and involvement in the learning process, and the grades obtained by the learners have improved since the implementation of blended learning, indicating that a combination of traditional teaching and online techniques is useful to the learners (Ahmed, 2011; Al-Hasan, 2013; Almasaeid, 2014; Chen and Jones, 2007; Dowling, Godfrey and Gyles, 2003; Khader, 2016; Kagohara, et al., 2010; Lança and Bjerre, 2018; McLaughlin, et al., 2015; Qutieshat, Abusamak and Maragha, 2019).

Universities have carried out extensive research on blended learning. Such research results showed that mixed learning is more effective than conventional learning and that students have demonstrated increasingly positive attitudes toward and engagement with blended learning. Furthermore, the results indicate that the use of technology and multimedia such as audio files (mp3), videos, Encarta encyclopedia, and simulations programs may have benefits over the traditional curriculum content, particularly for complicated and difficult concepts (Akbarov, Gonen and Aydogan, 2018; Akkoyunlu and Soylu, 2008; AlQahtani, 2015; Bakeer, 2018; Boyle, et al., 2003; Chen and Jones, 2007; Dowling, Godfrey and Gyles, 2003; Ja'ashan, 2015; Lança and Bjerre, 2018; Okaz, 2015; Pereira, et al., 2007; Vernadakis, et al., 2012). In comparison, there are also other studies whose findings revealed that the use of blended learning had no important impact on the achievement of students (Isti'anah, 2017; Kazu and Demirkol, 2014; Tosun, 2015; Wei, et al., 2017). The researchers summarized these studies in three groups, shown in Table (2).

Table 2: A summary of previous studies

Classification Group	Previous Studies of Group	Aim of Studies	Main Results
Group (A)	(Ahmed, 2011; Al-Hasan, 2013; Almasaeid, 2014; Chen and Jones, 2007; Dowling, Godfrey and Gyles, 2003; Khader, 2016; Kagohara, et al., 2010; Lança and Bjerre, 2018; McLaughlin, et al., 2015; Qutieshat, Abusamak and Maragha, 2019).	Examining and exploring the impact of blended learning on academic achievement and students' performance.	The students' achievements have been improved and their performance developed.
Group (B)	(Akbarov, Gonen and Aydogan, 2018; Akkoyunlu and Soylu, 2008; AlQahtani, 2015; Bakeer, 2018; Boyle, et al., 2003; Chen and Jones, 2007; Dowling, Godfrey and Gyles, 2003; Ja'ashan, 2015; Lança and Bjerre, 2018; Okaz, 2015; Pereira, et al., 2007; Vernadakis, et al., 2012).	Identification and exploration of the effect of blended learning on student engagement and their attitudes towards using it.	Students' have demonstrated increasingly positive attitudes and engagement toward blended learning.
Group (B)	(Isti'anah, 2017; Kazu and Demirkol, 2014; Tosun, 2015; Wei, et al., 2017).	Investigating the effect of blended learning on students' achievement.	The use of blended learning had no significant impact on student achievement.

1.5 Study's Purpose

This study seeks to investigate the effectiveness of using the blended learning approach to improve the achievement of Dentistry College students on a physics course during the spring semester of 2018/2019

1.6 Significance of the Study

The findings of the study are expected to be useful for the following purposes:

- Faculty members will be more convinced of and enthusiastic about implementing blended learning in their universities.
- This research will also make a modest contribution to the literature on methods for use when teaching physics in universities.
- The results of the study may be of interest to academics at universities by providing them with suggestions for the use of a blended learning approach.

1.7 Limitations and Issues

The findings of several educational institutions in numerous countries across the world have demonstrated the effectiveness of utilizing blended learning. Academic institutions such as Harvard University in the United States and Cambridge University in the United Kingdom have implemented various models of blended learning that have encouraged numerous learners to register for and join these courses. Nevertheless, given the fact that research suggests the significance and requirement of implementing blended learning in higher education, it has still not gained enough interest in Middle Eastern institutions, particularly in Arab countries' universities, which still depend on conventional learning.

This would be the justification for why this research has chosen to investigate the results of utilizing blended learning to boost the achievement of Dentistry College students on a physics course. Therefore, this research aims to address the following questions:
RQ1. Does the use of blended learning improve the achievement of dentistry college students in a physics course?
RQ2. Does the achievement of dentistry college students while using blended learning vary according to the gender of the students?

1.8 Hypotheses of the Study

The researchers formulated null hypotheses, which are as follows:

- There are no statistically significant differences between the mean scores of the experimental group, who used the blended learning in their studies, and the mean scores of students in the control group who studied using the traditional education, in the post-achievement test.
- There are no significant differences in achievement of Dentistry College students in the experimental group while using blended learning, attributable to the variable student gender.

1.9 Terms of Study

- *Achievement:* The outcome of what learners studied, at the completion of the course of tuition, evaluated by achievement in exams (Elfaki, Abdulraheem and Abdulrahim, 2019).
- *Blended learning:* A method that combines two distinct forms of learning, online learning and conventional learning (Bonk and Graham, 2006). In addition, blended learning is characterized as a mixture of physical and virtual environments.
- *Effect:* The shift that occurs when something happens: an occurrence, event or condition that is the product of a specific cause (Ishmirekha, 2017).

2. Methodology

We used a quasi-experimental approach because of its adequacy for the research. Another possible explanation for its use is its ability to achieve its objective through the use of a post-achievement test for experimental and control groups. The experimental design of the study is shown in Figure 4.

In the control group, the Dentistry College students were taught the physics course using direct traditional teaching. At the same time, the students in the experimental group were taught the same course topics, but using blended learning. In other words, the same teaching topics were taught to both groups of students for the same time during the spring semester of the academic year of 2018/2019. The teaching topics were as shown in Table 3.

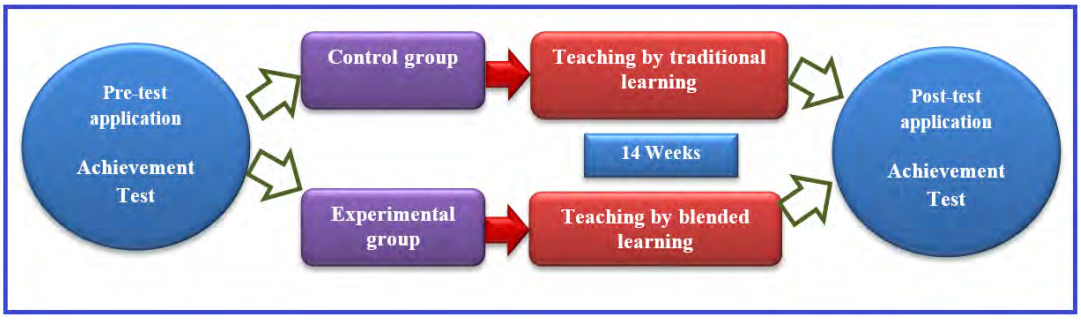

Figure 4: Experimental design of the study (researcher's own design)

Table 3: Teaching Topics in the Physics Course

Topics	Number of times per week
1: Motion in straight line at constant acceleration	1
2: Newton's laws	2
3: Newton's law of gravity, the law of energy conservation, torque & static equilibrium	2
4: Moment of inertia	2
5: Laser and X-ray, properties and applications	2
6: Light reflection and refraction	2
7: Electric charge, Coulomb's law and electric potential	2
8: Thermodynamics	2
Total number of weeks	14

2.1 Research Participants

The participants of this research consisted of 116 students studying in the Dentistry College.

They were divided into an experimental group (n = 59) and a control group (n = 57). The study was carried out during the spring semester of the academic year of 2018/2019. Table 4 shows the demographic information for the participants.

Table 4: Demographic Information of Participants

Group	Number		Percentage (%)	Total
Experimental	59		(51 %)	(116) 100%
Control	57		(49 %)	
Gender	female (65)		56 %	(116) 100%
	Control	Experimental		
	32	33		
	male (51)		44%	
	Control	Experimental		
	25	26		

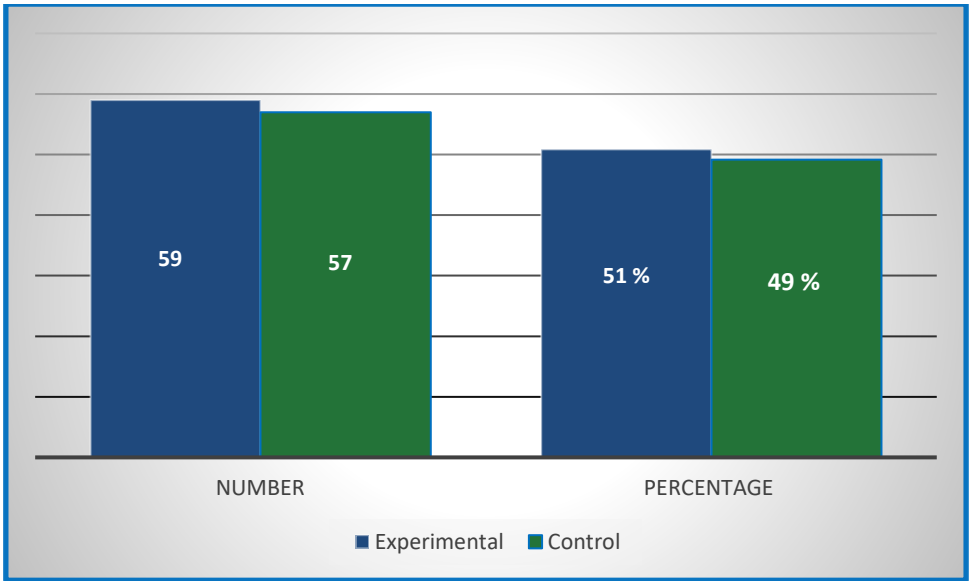

Figure 5: Number and Percentage of the Participants in the experimental and control groups

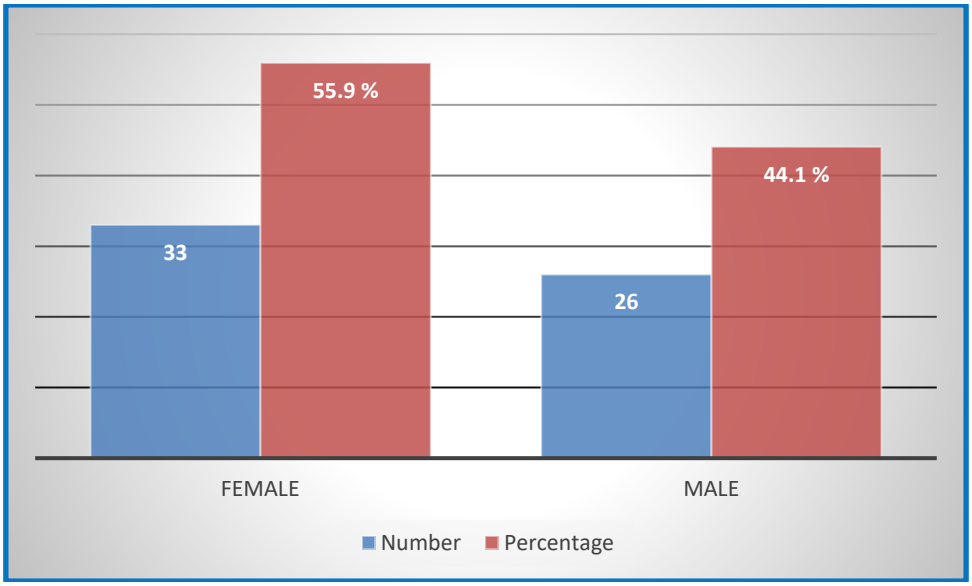

Figure 6: Number and Percentage of the female and Male Participants in the experimental group

2.2 Study Variable

- *Independent variables*, which were the two teaching methods:

1. Blended learning strategy
2. Traditional method
3. Pre-test (before intervention)
4. Post-test (after intervention)
5. Demographic information for participants (gender)

- *Dependent variables*: Achievement scores of students of study groups measured on two occasions (pre-test & post-test)

2.3 Study Tools

The researchers reviewed previous studies and literature on the subject (for example, Ahmed, 2011; Al-Hasan, 2013; Kudryashova, Gorbatova and Rozhkova, 2016; Maccoun, 2016).

2.3.1 Educational material

The authors prepared and organized the topics for the physics course and the activities that pertained to it and put them into the Model of Learning on the Ajman University website, which is called the Ajman University Learning Management System, at the web address: https://mylms.ajman.ac.ae/login/index.php. It was made available for use in blended learning for teaching the experimental group. Meanwhile, in the control group, the topics were taught via face-to-face learning in a classroom environment without using a learning model.

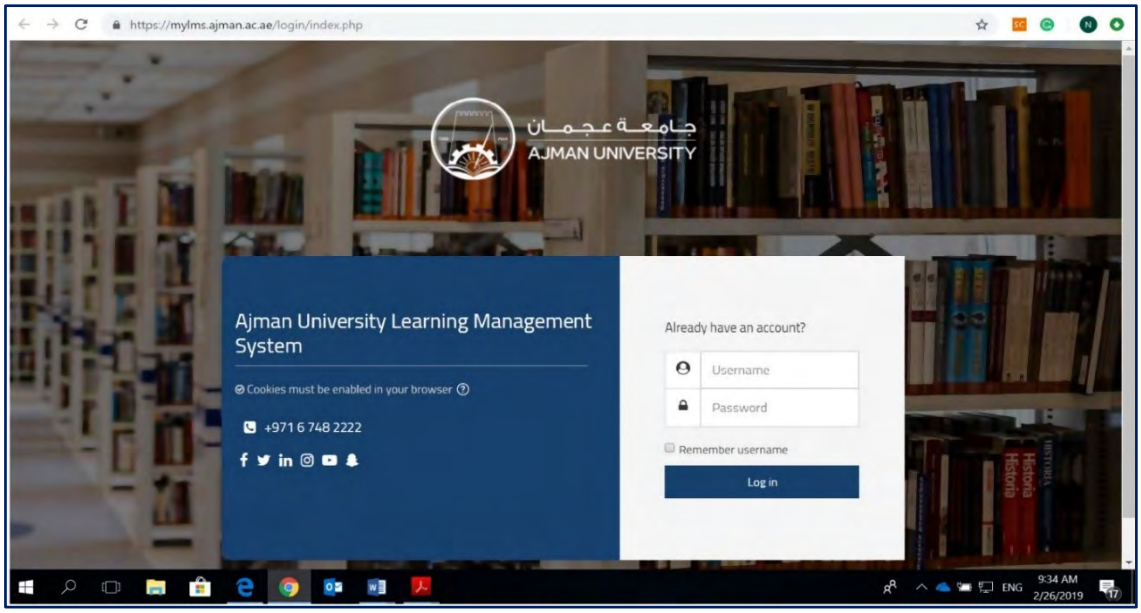

Figure 7: Homepage of Ajman University's Learning Management System Website

All the students logged in to the home page of the learning model by providing the necessary information (their user names and passwords) (see Figure 7). The site contained the topics, PowerPoint presentations, activities, videos, YouTube links, homework sheets, and short online quizzes.

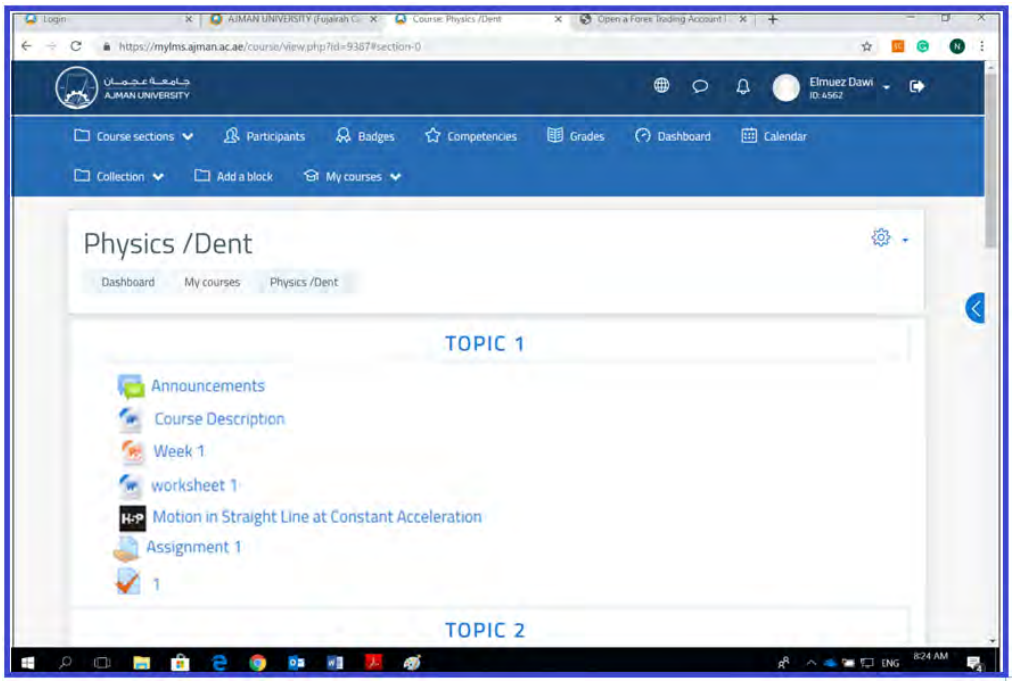

Figure 8: Course screen

When the students began the course using the model, they were presented with the course screen. It consisted of a number of parts (see Figure 8). For example, if the students were asked to go through the learning model

to study the first topic (Motion in Straight Line at Constant Acceleration), they would study this topic using the following parts: lecture presentation, YouTube, worksheet, activity, and an online quiz that formed part of this topic, as shown in Figure 7. For example, if the students opened the lecture presentation of Week 1, the presentation title would be addressed by the same topic that illustration of Motion in Straight Line at Constant Acceleration (see Figure 9)

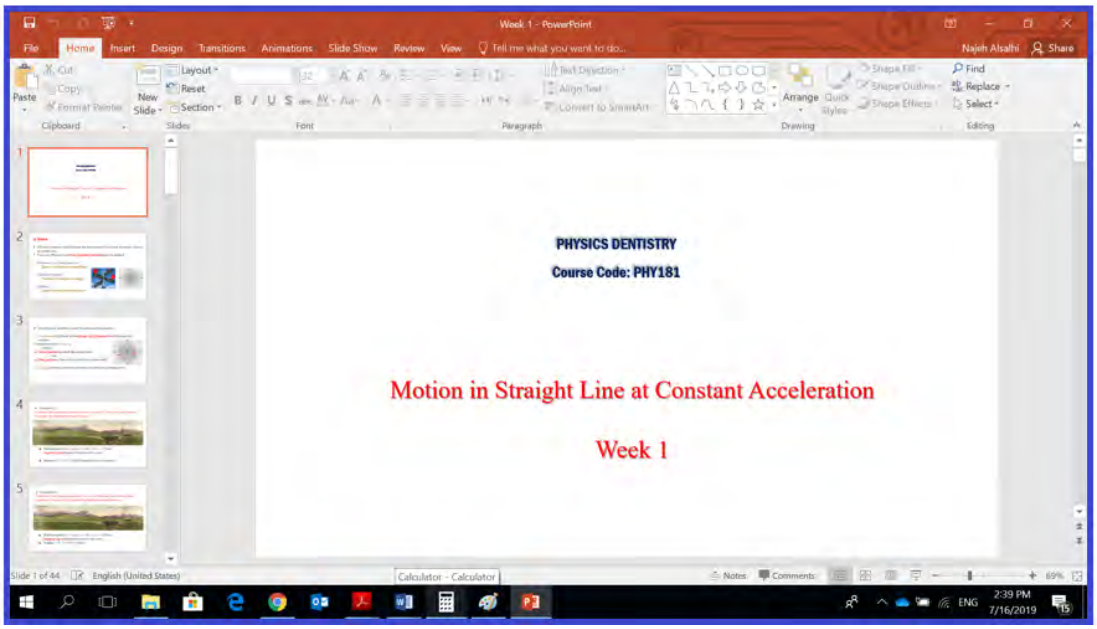

Figure 9: Lecture presentation of Week 1

Students were also directed to watch uploaded videos on the webpage, and the students were very active, posting critical reviews of the videos.

2.3.2 Achievement test

The researchers prepared an achievement test, to measure the blended learning's effectiveness in improving the students' results. The test was prepared according to Bloom's taxonomy of cognitive domains (Hyder and Bhamani, 2016). Further to that, we prepared a specification table for this test (see Table 5). In its final version, the test consisted of 20 multiple-choice questions. Each question item was given one mark for a correct answer and zero for a wrong answer. The maximum possible mark for the test was 20 and the testing time was 60 minutes.

Table 5: Specifications for the test of the topics

Topics	Number of lectures	Relative weight of topics	LOT questions	HOT questions	Total of questions
Motion in straight line at constant acceleration	2	6.7	1	0	1
Newton's laws	4	13.3	2	1	3
Newton's law of gravity, the law of energy conservation, Torque & Static Equilibrium	5	16.7	3	2	5
Moment of inertia	3	10.0	1	1	2
Laser and X-ray, properties and applications	3	10.0	2	0	2
Light reflection and refraction	4	13.3	1	1	2
Electric charge, Coulomb's law and electric potential	6	20.0	2	1	3
Thermodynamics	3	10.0	1	1	2
Total	30	100.0	13 (65%)	7 (35%)	20

*LOT = lower order thinking: remembering, understanding, and applying.
*HOT = higher order thinking: analyzing, evaluating, and creating.

1. Validity of achievement test
   The achievement test was confirmed as a valid virtual testing method by submitting it, in its initial form, to members of the teaching staff at universities where doctorate and master's degree curricula include methods of teaching science courses and education technology. We deleted some of the questions and added others following their recommendations and suggestions, and thereafter the test was considered valid.
2. Reliability of achievement test
   The researchers verified the reliability of the achievement test by using the test-retest method. We ran the test on a sample from outside of the study sample. Two weeks after first applying the test, it was re-applied to the same sample of dentistry college students. After that, the Pearson correlation coefficient between the two applications was calculated, wherein the total reliability coefficient (0.81) was considered appropriate for the purposes of this study.

2.4 Pre-Test

In order to examine the equivalence of the achievements of the dentistry college students in the two study groups, the researchers used a "t-test" to compare the results of the pre-test on the topics of the physics course, before introducing blended learning into the experimental group, as shown in Tables 6 and 7, below.

Table 6: Means and standard deviations of pre-test scores for the two groups

Group	N	Mean	Std. Deviation
Experimental	59	11.97	1.29
Control	57	11.67	1.11

Table 7: T-test results of pre-test between the experimental and the control groups

	Levene's test for equality of variances		t-test			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	0.080	0.778	1.342	114	0.182	0.29944
Equal variances not assumed			1.345	112.535	0.181	0.29944
* Statistically significant at (p<0.05)						

As shown in Table 7, the obtained p (0.182) is greater than 0.05; therefore, the test is not significant at the 0.05 level, which indicates that there is no significant difference between the two studied groups. This proved that the experimental and control groups were equivalent, before the study was begun.

2.5 Procedures

The following procedures were followed:

- Preparation of educational materials for all topics in the Physics course. This included PowerPoint presentations, lectures, activities, videos, YouTube links, homework sheets, and short online quizzes, which were placed on the Model of Learning website.
- The researchers taught students of the experimental group how to use the Model of Learning website.
- The achievement test was prepared according to Bloom's taxonomy of cognitive domains (Hyder and Bhamani, 2016), and the educational objectives of the course.
- The specification table for the achievement test was prepared.
- The study participants were divided into two groups: the experimental group consisting of 59 students, who were taught through blended learning, and the control group consisting also of 57 students, who were taught using the traditional method.
- Teaching for both the experimental and the control group was conducted through the spring semester 2018/2019, for a period of 14 weeks and at a rate of two periods per week, each lasting one and a half hours.

- A post-test was applied to the two groups (experimental and control), which aimed to measure the improvement of students in the experimental group, immediately after completing the educational aspects of the material.
- Results were collected and analyzed statistically.

2.6 Statistical Treatment

The researchers used the SPSS program to analyze the answers to the research questions. We made our calculations through arithmetical means and standard deviations. A t-test independent sample was used to measure the statistical differences in means between the experimental and the control groups in the results of the post-test.

3. Results

3.1 Findings Related to RQ1

The first research question was: Does the use of blended learning improve the achievement of dentistry college students in a physics course?

In order to answer the first question of this study, the following null hypothesis was tested:

There are no statistically significant differences between the mean scores of the experimental group, who used the blended learning in their studies, and the mean scores of students in the control group who studied by using the traditional education, in the post-achievement test.

In order to verify the hypothesis, the difference between the mean scores of students in the experimental and the control groups on the post-test of achievement was calculated using a t-test for two independent samples.

The results are shown in Table 8.

Table 8: Means and standard deviations of post-test scores for two groups

Group	N	Mean	Std. Deviation
Experimental	59	16.53	1.72
Control	57	14.09	1.56

As shown in Table 8, the students who were taught with blended learning had different scores (M = 16.53, SD = 1.72) than those who were taught through traditional face-to-face learning (M = 14.09, SD = 1.56).

Table 9: The independent sample t-test results of post-test

	Levene's test for equality of variances		t-test			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	2.094	0.151	7.995	114	.000	2.43770
Equal variances not assumed			8.008	113.603	.000	2.43770
* Statistically significant at ($p < 0.05$)						

As shown in Table 9, since the obtained p-value (0.000) is smaller than 0.05, this means there are significant differences at the 0.05 level, which indicates that there is a significant difference between the groups, in favor of the students of the experimental group. This means the null hypothesis is rejected. Based on the results of this test, it can be concluded that using blended learning to teach a Physics course to Dentistry College students has a positive impact on the Dentistry students' achievement.

3.2 Findings Related to RQ2

The question was: Does the achievement of dentistry college students while using blended learning vary according to the gender of the students?

To answer the second research question of the study, the following null hypothesis was tested:

There are no significant differences in achievement of Dentistry College students in the experimental group while using blended learning, attributable to the variable student gender.

In order to verify the hypothesis, the difference between the mean scores for the post-test of achievement of male and female students in the experimental groups was calculated using a t-test for two independent samples. The results are shown in Table 10.

Table 10: Means and standard deviations of post-test scores for two groups

Experimental Group	N	Mean	Std. Deviation
Female	33	17.27	1.35
Male	26	15.58	1.68

As shown in Table 10, the female students who were taught with blended learning had different scores (M = 17.27, SD = 1.35) than female students (M = 15.58, SD = 1.68).

Table 11: The independent sample t-test results of post-test

	Levene's test for equality of variances		t-test			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	.005	.945	4.300	57	0.000	1.69580
Equal variances not assumed			4.192	47.447	0.000	1.69580
* Statistically significant at (p<0.05)						

As shown in Table 11, since the obtained p-value (0.000) is smaller than 0.05, which means there are significant differences at the 0.05 level, this indicates that there is a significant difference between the dentistry students in the experimental group in favor of female students. This means the null hypothesis is rejected. Based on the results of this test, it can be concluded that the achievement of the students' in the experimental group varied according to gender (in favor of females).

4. Discussion

The obtained results, for the first research question, are shown in Table 8, and concern the effect of the use of blended learning on improving the achievement of dentistry students on a Physics course. The results indicated that there was a significant difference between students in the experimental and the control groups, in favor of the students in the experimental group. If we examine the results shown in Table 8, we find that the average of post-test scores, for students in the experimental group who were taught with blended learning, is 16.53, compared to 14.09 for the control group who were taught with traditional learning. Additionally, as seen in Table 9, since the acquired p-value (0.000) is less than 0.05, this implies there are significant differences at the significance level of 0.05, which confirmed that there is a significant difference between the two groups of learners in their understanding of physics course topics. This indicates that blended learning had a positive effect on increasing the achievement of undergraduate students in the physics course topics and skills. This may point out that blended learning has had a positive impact on increasing the achievement of higher education students. This may confirm that blended learning has a positive effect on the achievement of dentistry students' when compared to traditional learning. The result can be explained according to researchers' by the fact that students in the experimental group have a chance to learn through an interactive, interesting and motivating way of interacting with physics topics with the ability to expand the acquisition of information from a variety of sources, making them more academic achievement.

This result is consistent with previous studies that examined the effect of blended learning on the academic achievement of learners by comparing traditional learning in different educational institutions, like universities and schools (Ahmed, 2011; Al-Hasan, 2013; Akbarov, Gonen and Aydogan, 2018; Akkoyunlu and Soylu, 2008; Almasaeid, 2014; AlQahtani, 2015; Bakeer, 2018; Boyle, et al., 2003; Chen and Jones, 2007; Dowling, Godfrey and Gyles, 2003; Ja'ashan, 2015; Kagohara, et al. 2010; Khader, 2016; Lança and Bjerre, 2018; Maccoun, 2016; McLaughlin, et al., 2015; Okaz, 2015; Pereira, et al., 2007; Shahin, 2008; Vernadakis, et al., 2012). Where the

results of these studies referred that students who studied through a blended learning approach became more understanding, productive and innovative, and better readiness to learn, which led them to gain better scores and improvement of their academic achievement. The findings have confirmed that blended learning has provided students more energy, inspiration, and enthusiasm for learning because of its features such as flexibility of applied, the flexibility of time, online and face-to-face use, and online submission of assignments, and deciding assignments online. Moreover, the results of this study did not agree with the results of other studies which found that the use of blended learning had no significant effect (Isti'anah, 2017; Tosun, 2015; Wei, et al., 2017).

The second research question concerned whether the achievement of Dentistry College students of the experimental group varied according to the gender of the students. To answer this question, the second null hypothesis was tested. Firstly, we postulated that there would be no statistically significant differences between the mean scores of the female and male students in the experimental group in the post-achievement test. We applied a t-test for two independent samples to verify the hypothesis, and the difference between the mean scores of male and female students in the experimental group on the post-test of achievement was calculated. The results are shown in Tables 10 and 11. These show that the average of the post-achievement test for the female students in the experimental group was 17.27, whereas that for the males was 15.58. Additionally, there was a significant difference ($t(57) = 4.300$, $p < .05$), which means that the null hypothesis was therefore rejected and our results confirmed that there are statistically significant differences in the achievement of students in the experimental group according to gender, in favor of females. This result agrees with the results of Alsalhi, Eltahir and Al-Qatawneh, 2019; Almasaeid, 2014; AlQahtani, 2015; Khader, 2016). Researchers may attribute this, from their point of view to females who may be more organized and follow instructions, who may be more motivated to learn than males, and who are more able to attend lectures, in addition to their ability to complete assignments, tasks, and tests.

5. Recommendations

In light of the results, the researchers offers the following recommendations:

- All faculties' members should be encouraged to use the integration between technology and direct teaching that is offered by blended learning.
- Similar studies should be carried out that incorporate the views and experiences of learning practitioners' blended learning into higher education.

6. Delimitations' of Research

- *Subject limits:* The study was limited to the topics of a Physics course that was taught to the students in the academic year 2018/2019.
- *Human limits*: The study was limited to students of the Dentistry College at Ajman University in the United Arab Emirates (UAE).
- *Spatial limits:* Ajman University in the United Arab Emirates.
- *Time limits:* academic year (2018/2019), spring semester.

7. Conclusions

The current study aimed to investigate the effect of the use of blended learning on the achievement of Dentistry College students on a Physics course at Ajman University. The results of this study show that the use of blended learning had a positive effect on the achievement of students of the Dentistry College. There was a statistically significant difference between the experimental and the control groups, in favor of the experimental group, who were taught using the blended learning. Moreover, the findings also revealed that achievement varied according to the gender of the students in the experimental group (in favor of female). This study is important because it shows that blended learning is effective in education, especially in higher education. This means education can be more effective if the advantages of a web environment are blended with face-to-face interaction in courses that contain more visual elements.

References

Agarwal, E. S. 2013. E-learning: new trend in education and training. *International Journal of Advanced Research*, 1(8), pp.797-810.

Agrawal, V., Agrawal, A. and Agarwal, S. 2016. Assessment of factors for e-learning: an empirical investigation. *Industrial and Commercial Training*, 48(8), pp.409-415.

Ahmed, M. 2011. The impact of the use of blended learning in the teaching of chemistry on achievement and guidance towards it and the survival of the impact of learning among secondary students. *Journal of Scientific Education*, 14(3), pp.173-211.

Akbarov, A., Gonen, K. and Aydogan, H. 2018. Students' attitudes toward blended learning in EFL context. *Acta Didactica Napocensia*, 11(1), pp.61-68.

Akkoyunlu, B. and Soylu, M. 2008. A study of student's perceptions in a blended learning environment based on different learning styles. *Educational Technology and Society*, 11(1), pp.183-193.

Al Hadhrami, G. and Al Hadhrami, N. 2018. Using dashboard tools to evaluate e-learning: TICS approach. *IOSR Journal of Research and Method in Education (IOSR-JRME)*, 8(6), pp.42-46.

Al-Hasan, I. 2013. The effectiveness of using the blended learning on the academic achievement in the biology course among the second graders in the private secondary schools in Um Aldurman and their trends towards it. *Psychological and Educational Research Journal*, (36), pp.59-85.

Almasaeid, T. 2014. The effect of using blended learning strategy on achievement and attitudes in teaching science among 9th grade students. *European Scientific Journal*, 10(31) , pp.1857-7881.

AlQahtani, A. 2015. Effect of traditional, blended, e-learning on student' attitudes in a course on Islamic culture. Paper presented at the International Conference on Education and Social Sciences, Turkey, 2-4 February. Available at: <https://pdfs.semanticscholar.org/9fb0/a2eb84917b32634fa8aac99e874cdc51bf0b.pdf.> [Accessed 13 April 2020]

Alsalhi, N., Eltahir, M. and Al-Qatawneh, S. 2019. The effect of blended learning on the achievement of ninth grade students in science and their attitudes towards its use. *Heliyon*, 5(9), pp.1-11.

Arkorful, V. and Abaidoo, N. 2016. The role of e-learning, the advantages and disadvantages of its adoption in Higher Education. *International Journal of Education and Research*, 2(12), pp.397-410.

Bakeer, A. 2018. Students' attitudes towards implementing blended learning in teaching English in higher education institutions: a case of Al-Quds Open University. *International Journal of Humanities and Social Science*, 8(6), pp.131-139.

Beaven, T, Codreanu, T, and Creuzé, A. 2014. Motivation in a language MOOC: issues for course designers. In: E. Martín-Monje and E. Bárcena, eds. 2014. *Language MOOCs: providing learning, transcending boundaries*. Berlin: De Gruyter Open. pp.48–66.

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M. and Abrami, P. C. 2014. A meta-analysis of blended learning and technology use in HE: from the general to the applied. *Journal of Computing in Higher Education*, 26(1), pp.87–122. DOI: 10.1007/s12528-013-99077-3.

Bonk, C. and Graham, C. 2006. *The blended learning handbook: global perspectives and local design*. San Francisco, CA: Pfeiffer Publishing.

Boyle, T., Bradley, C., Chalk, P., Jones, R. and Pickard, P. 2003. Using blended learning to improve student success rates in learning to program. *Journal of Educational Media*, 28, pp.2-3.

Chen, C. and Jones, K. 2007. Blended learning vs. traditional classroom settings: assessing effectiveness and students' perceptions in an MBA accounting course. *The Journal of Educators Online*, 4(1), pp.1-15.

Deepali, P., Wadhai, V. and Thakare, V. 2016. E-learning system and higher education. *International Journal of Computer Science and Mobile Computing*, 5(2), pp.274-280.

Dowling, C., Godfrey, J. M. and Gyles, N. 2003. Do hybrid flexible delivery teaching methods improve accounting students' learning outcomes? *Accounting Education*, 12(4), pp.373-391.

Du, C. 2011. A comparison of traditional and blended learning in introductory principles of accounting course. *American Journal of Business Education*, 4(9), pp.1-10.

Elfaki, N., Abdulraheem, I. and Abdulrahim, R. 2019. Impact of e-learning vs traditional learning on student's performance and attitude. *International Journal of Medical Research and Health Sciences*, 8(10), pp.76-82.

Ellis, A. R., Steed, F. A. and Applebee, C. A. 2006. Teacher conceptions of blended learning, blended teaching and associations with approaches to design. *Australian Journal of Educational Technology*, 22(3), pp.312-335.

Firmansyah, M. and Timmis, S. 2016. Making MOOCs meaningful and locally relevant? Investigating ID Courserians—an independent, collaborative, community hub in Indonesia. *Research and Practice in Technology Enhanced Learning*, 11(11), pp.2-23. DOI: 10.1186/s41039-016-0032-6.

Goyal, E. and Tambe, S. 2015. Effectiveness of Moodle-enabled blended learning in private Indian business school teaching NICHE programs. *The Online Journal of New Horizons in Education*, 5(2), pp.14-22.

Graham, C. R. 2013. Emerging practice and research in blended learning. In M. G. Moore, ed. 2013. *Handbook of distance education* (3rd ed.). New York, NY: Routledge. pp.333-350.

Graham, C. R., Allen, S. and Ure, D. 2003. *Blended learning environments: a review of theresearch literature*. Unpublished manuscript. Available at: <https://www.researchgate.net/publication/267774009_Blended_Learning_Environments > [Accessed 13 April 2020]

Güzer, B. and Caner. 2014. The past, present and future of blended learning: an in-depth analysis of literature. *Procedia - Social and Behavioral Sciences*, 116, pp.4596-4603.

Harrell, K. B. and Wendt, J. L. 2019. The impact of blended learning on community of inquiry and perceived learning among high school learners enrolled in a public charter school. *Journal of Research on Technology in Education*, 51(3), pp.259-272. DOI: 10.1080/15391523.2019.1590167.

Hyder, I. and Bhamani, S. 2016. Bloom's taxonomy (cognitive domain) in higher education settings: reflection brief. *Journal of Education and Educational Development*, 3(2), pp.288-300.

Ishmirekha, H. 2017. A study on attitude of college students towards e-learning with special reference to North Lakhimpur of Lakhimpur District, Assam. *International Journal of Information Science and Education,* 4(1), pp.1-9.

Isti'anah, A. 2017. The effect of blended learning to the students' achievement in grammar class. *Indonesian Journal of English Education (IJEE)*, 4(1), pp.16-30. DOI: 10.15408/ijee.v4i1.5697.

Ja'ashan, M. 2015. Perceptions and attitudes towards blended learning for English courses: A case study of students at University of Bisha. *English Language Teaching*, 8(9), pp.40-50.

Joseph, S. and Nichlavose, P. 2019. Effectiveness of e-learning among high school students with special reference to Educomp. *Asian Journal of Research in Social Sciences and Humanities,* 9(2), pp.1-9.

Kagohara, D. M., Van Der Meer, L., Achmadi, D., Green, V. A., O'Reilly, M. F., Mulloy, A., Lancioni, G. E., Lang, R. and Sigafoos, J. 2010. Behavioral intervention promotes successful use of an iPod-based communication device by an adolescent with autism. *Clinical Case Studies*, 9(5), pp.328-338.

Kazu, I., Demirkol, M., 2014. Effect of blended learning environment on high school students' academic achievement. *Turkish Online Journal of Educational Technology,* 13(1), pp.78–87.

Khader, N. 2016. The effectiveness of blended learning in improving students' achievement in third grade's science in Bani Kenana. *Journal of Education and Practice*, 7(35), pp.109-116. Available at: <https://files.eric.ed.gov/fulltext/EJ1126508.pdf> [Accessed 15 April 2020]

Khan, A. I., Shaik, M. S., Ali, A. M. and Bebi, C. V. 2012. Study of blended learning processin education context. *International Journal of Modern Education and Computer Science (IJMECS)*, 4(9), 23.

Kudryashova, V., Gorbatova, N. and Rozhkova, E. 2016. Developing a blended learning based model for teaching foreign languages in engineering institutions. *SHS Web of Conferences* (Vol. 28). New York, NY: EDP Sciences.

Lança, C. and Bjerre, A. 2018. A retrospective study of orthoptic students' and teaching experience with the introduction of technology promoting a blended learning environment. *British and Irish Orthoptic Journal*, 14(1), pp.56–63. DOI: 10.22599/bioj.119.

Lee, O. and Im, Y. 2014. Innovation of higher education in the globalized era – emerging trends report 2013-2014. In R. H. Kinshuk, and J. K. Price, eds, *ICT in education in global context*. Albuquerque, NM: Springer. pp.221–247. DOI: 10.1007/978-3-662-43927-2.

Lisetskyi, K. A. 2018. Blended learning model in the system of higher education. *Advanced Education*, 4, pp.32-35.

Maccoun, H. 2016. The effect of using blended learning on the achievement of students and information retention of fifth graders in the biology course. *Journal of Faculty of Education*, 22(95), pp.209-240.

McLaughlin, J. E., Gharkholonarehe, N., Khanova, J., Deyo, Z. M. and Rodgers, J. E. 2015. The impact of blended learning on student performance in a cardiovascular pharmacotherapy course. *American Journal of Pharmaceutical Education*, 79(2), 24. DOI: 10.5688/ajpe79224.

McSporran, M. and King, C. 2005. Blended is better: choosing educational delivery methods. In *EdMedia+ Innovate Learning*. Waynesville, NC: Association for the Advancement of Computing in Education (AACE). pp.4932-4939.

Means, B., Toyama, Y., Murphy, R., Bakia, M. and Jones, K. 2010. Evaluation of evidence based practices in online learning: A meta-analysis and review of online learning studies. US Department of Education.

Mortera-Gutiérrez, F. 2006. Faculty best practices using blended learning in e-learning and face-to-face instruction. *International Journal on E-Learning*, *5*(3), pp.313-337. Available at: <http://www.editlib.org/p/6079. > [Accessed 15 April 2020]

Moskal, P., Dziuban, C. and Hartman, J. 2012. Blended learning: A dangerous idea? *The Internet and Higher Education*, 18, pp.15-23. DOI: 10.1016/j.iheduc.2012.12.001.

Okaz, A. 2015. Integrating blended learning in higher education. *Procedia – Social and Behavioral Sciences,* 186, pp.600-603.

Osgerby, J. 2013. Students' perceptions of the introduction of a blended learning environment: An exploratory case study. *Accounting Education*, 22(1), pp.85-99.

Oweis, T. 2018. Effects of using a blended learning method on students' achievement and motivation to learn English in Jordan: a pilot case study. *Education Research International*, 2018, online. DOI: 10.1155/2018/7425924.

Park, Y. and Jo, I. 2018. Development of the learning analytics dashboard to support students' learning performance. *Journal of Universal Computer Science*, 21(1), 110- 133.

Parsad, B. and Lewis, L. 2008. *Distance education at degree-granting postsecondary institutions: 2006–07* (NCES 2009–044). Washington, DC: National Center for Education Statistics.

Pereira, J., Pleguezuelos, E., Meri, A., Molina-Ros, A., Molina-Tomas, M. C. and Masdeu, C. 2007. Effectiveness of using blended learning strategies for teaching and learning human anatomy. *Medical Education*, 41, pp.189-195.

Picciano, A. G., Seaman, J. and Allen, I. E. 2010. Educational transformation through online learning: To be or not to be. *Journal of Asynchronous Learning Network*, 14(4), pp.17-35. Pomerol, J.-C., Epelboin, Y. and Thoury, C. 2015. *MOOCs: Design, use, and business models*. London: ISTE Ltd.

Qutieshat, A., Abusamak, M. and Maragha, T. 2019. Impact of blended learning on dental students' performance and satisfaction in clinical education. *Journal of Dental Education,* 83(12), pp.1464-1466.

Rooney, J. E. 2003. Blending learning opportunities to enhance educational programming and meetings. *Association Management*, 55(5), pp.26-32.

Roseth, C., Akcaoglu, M. and Zellner, A. 2013. Blending synchronous face-to-face and computer supported cooperative learning in a hybrid doctoral seminar. *Techtrends*, 57(3), pp.54-59.

Sarıtepeci, M. and Çakır, H. 2015. The effect of blended learning environments on student's academic achievement and student engagement: a study on social studies course. *Education and Science*, 40(177), pp.203-216.

Shahin, S. 2008. The effect of blended learning on achievement and the development of science operations among the students of the elementary level and their trends towards it. *Journal of Faculty of Education*, 1(38), pp.105-142.

Spring, K. J. and Graham, C. R. 2017. Blended learning citation patterns and publication across seven worldwide regions. *Australasian Journal of Educational Technology*, 33(2), pp.24-50. DOI: 10.14742/ajet.2632.

Staker, H. and Horn, M. 2012. *Classifying K-12 blended learning*. San Mateo, CA: Innosight Institute.

Stapa, M., Ibrahim, M. and Yusoff, A. 2015. Engaging vocational college students through blended learning: improving class attendance and participation. *Procedia – Social and Behavioral Sciences*, 204, pp.127-135.

Tongchai, N. 2016. Impact of self-regulation and open learner model on learning achievement in blended learning environment. *International Journal of Information and Education Technology*, 6(5), pp.343-347

Tosun, S. 2015. The effects of blended learning on EFL students' vocabulary enhancement. *Procedia – Social and Behavioral Sciences*, 199, pp.641-647.

Tselios, N., Daskalakis, S. and Papadopoulou, M. 2011. Assessing the acceptance of a blended learning university course. *Educational Technology and Society*, 14(2), pp.224-235.

Vernadakis, N., Giannousi, M., Derri, V., Michalopoulos, M. and Kioumourtzoglou, E. 2012. The impact of blended and traditional instruction in students' performance. *Procedia Technology* 1, pp.439-443.

Wei, Y., Shi, Y., Yang, H. and Liu, J. 2017. Blended learning versus traditional learning: a study of students' learning achievements and academic press. *International Symposium on Educational Technology*, Hong Kong, China, pp.223.