A comparative study of Blended learning versus Conventional learning in higher education on the academic achievement of undergraduate students in the general chemistry course

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ABSTRACT

The main goal of this study was to examine the impact of blended learning on the academic achievement of undergraduate students in the general chemistry (CHE101) course. The participants' learners of the study were (326) learners, who were randomly split into two groups, one of which taught by using blended learning (empirical group A, n = 163) and the other which with taught by using the conventional method (control group B, n = 163). To accomplish the objectives of the study, the researchers prepared the study tool, which is an achievement test, after confirming its validity and reliability. Data analyses showed that there is a statistically significant difference among the mean scores of learners in the two study groups on the achievement test, for the benefit of empirical group learners, who taught through blended learning. Moreover, the results revealed that achievement varied according to the College of the learners in the empirical group (in favor of those students of Pharmacy and Health Sciences College). However, there is no statistically significant difference in students according to the students' gender variable and, according to the Academic year variable. The study recommended that blended learning be used more widely to cover different sectors of education.

Keywords:

Blended Learning, Conventional learning, chemistry Course (CHE101), academic achievement, higher education, undergraduate students.

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Introduction

Education acts as a key role in the process of progress of nations and people so all nations in the world seek to attempt to develop their education. Therefore, educational institutions seek to find quality teaching methods that aim to generate active and positive students, and the teachers are guided in order to achieve the educational outcomes and are accomplished through mixing traditional education with elearning with its multiple types and technological and electronic innovations inside the classroom and outside it Mula (2015). So it is focused on two types of education are both conventional and elearning together in the same time. Where the current twenty-first-century faces many changes in all areas of life, including the educational field. Where the emphasis in the field of education has moved to active learning for students, instead of merely transferring information, which means concentrating on the quality of education outcomes, which are directly connected to the goals of the constructivism theory in teaching and learning. According to constructivism theory, the learner builds his own knowledge through social interaction with others and the environment and builds his new knowledge based on previous knowledge and experience (Ayse, 2008). To achieve the goals of constructivism theory, a set of constructivist learning strategies have emerged that link technology to learning in accordance structural philosophy and with call for cooperative, collaborative learning and social interaction through which learners build their own knowledge (Yılmaz & Orhan, 2010). This is why the philosophy of blended learning emerged, which is an extension of classroom instruction over the Internet. provides educational institutions, such as universities and schools, with modern teaching methods and approaches to addressing the challenges they face and interesting new learning methods (Maccoun, 2016).

A number of academic researchers have reported that blended learning has emerged as a logical consequence of e-learning; as e-learning combines and integrates e-learning with conventional face-to-face classroom learning in a single learning model to gain the benefits and advantages of each and to achieve the desired objectives. In fact, e-learning or traditional education is not cancel e-learning or traditional education, but rather it is a mixture of both (Abidoye, 2015; Alzahrani and Toole, 2017; Elfaki. Abdulraheem Graham. 2013: and Abdulrahim, 2019; Moskal, Dziuban and Hartman, 2012; Sicilia, 2018; Wright, 2017). Moreover, it is one of the types of e-learning in which e-learning is merged with traditional education in one framework. Where e-learning tools, whether computer-based or network-based, are used for lessons, lectures, and training sessions, which are often conducted in real classrooms equipped with the ability to connect to the Internet or web (Sarıtepeci and Çakır, 2015; Shang, & Liu, 2018; Yeou, 2016). Additionally, David (2016) and Trapp (2006) defined blended learning as widely integration of electronic teaching media with traditional teaching methods. Alvarez (2005) and Francis & Susan (2013) highlighted the significance of blended learning,

which integrates the benefits of conventional teacher-led learning and the advantages of information technology (IT) for the development of educational programs that include the content of the prepared scientific subject, web-based instructor, workshops, conferences, and live sessions with teachers on the Web. Therefore, a number of educators and experts believe that blended education may encounter resistance that hinders its success if it violates the course of the educational process. The teacher and the learner represent the basic components in addition to the educational curricula. Thus, in order for this to happen, the teacher must be able to use modern education techniques, as well as the student who must have the skills with the use of computers, the Internet, and e-mail that helps transfer this education to classrooms (Huang, 2002). Blended learning is among the most appropriate and innovative methods for university education to familiarize the learner with continuous learning to educate himself and enrich his information because the goal of university education is to develop critical and creative thinking skills, and provide them with methods of generating knowledge. Thus, the university student can continue his learning in the future (Oweis, 2018; Tongchai, 2016).

Milheim, (2006) and Valerie (2005) pointed out the most important features of blended learning like, education costs have decreased substantially compared to e-learning alone, Shift from lecture-style teaching to student-centered teaching, increase engagement between learners and instructors, learners with each other, and content. students. and resources external. increased access to information and knowledge. Moreover, Dangwal and Lata (2017) pointed to a blended learning comparison between and conventional learning, which was listed in table 1. Below.

Fostures	Conventional Learning	Blanded Learning
i catul cs	Conventional Learning	Dentee Learning
Application location	Fixed classrooms and not flexible	Any place and flexible
Method of learning	Face-to-Face	Online and Face-to-Face
Time of learning	Not flexible and at specific time	Time flexible and any time
Usage of technology	Using technology not mandatory	Using the technology is necessary and mandatory
Online support	None	Talks, submitting assignments online, assignments online
Learning materials	Teacher	Teacher, Group of teachers
Assignments	Individual, Group	Individual, Group

 Table 1. A comparison between blended learning & conventional learning

Moreover, Eduviews (2009) and David (2016) pointed out that blended learning can be implemented in the education sector like schools and universities utilizing a diverse range of models, Figure 1. Summarizes of these models.

Face-to-Face Driver Model A face-to-face driver model is a form of blended learning in which technology is used together with traditional teaching to improve and increase the academic achievement of learners.

Self-Blend Model ______ In this model, students take online courses in addition to their traditional face-to-face learning.

Online-Driver Model

By this model, Students study from distant places and take courses, instruction, and evaluation through internet platforms. The role of Teachers in this model as facilitators. _Online Lab Model _

The online lab model of blended learning uses technology to deliver most or all content. Students complete most learning in the computer lab housed in a traditional school.

_ The Flex Model

Allows students to be flexible about their schedules between learning activities, according to their needs. Online learning is considered the backbone of student learning in the Flex model.

Figure 1: Blended Learning Models.

When looking at the educational institutions in the United Arab Emirates, we find that e-learning has been introduced to education in universities through the computerization of education. This was done via the introduction of elements of development based on modern technological methods in the educational system, as well as electronic networks, and the preparation of classrooms and virtual laboratories, in order to integrate these programs with the traditional system to improve learning outcomes. So the utilize of blended learning has become present in the classroom and accompanying both the teacher and student in Emirate Universities with ease to facilitate the process of education and to achieve educational goals. Each faculty member through the availability of these capabilities and services in universities can use it with his students hence; the researchers were interested in conducting this study.

David (2016) pointed out that numerous prior studies have already said that blended learning is earning significance in teaching and learning, particularly in university education.

Numerous studies have highlighted the significance of blended learning in the education

system. It is noted from the check of previous studies that these studies have shown the efficacy of blended learning, which has contributed to the achievement of many educational benefits in the fields of academic, mental, psychomotor, and emotional skills. The achievement variable as a dependent variable has received the attention of many researchers in these studies due to its importance in changing the methods used in the teaching reality and its better reflection in the development of students' capabilities, skills, attitudes, encouragement and engagement for learning. The results of all studies indicated the positive impact of blended learning in the enhancement of academic achievement of the students. Several studies have highlighted the significance of blended learning in improving academic achievement, increasing motivation, and developing positive attitudes for learning mathematics and science as studies (Almasaeid, 2014; Harahap, Nasution, and Manurung, 2019; Kazu and Demirkol, 2014; Maccoun, 2016; Mondal, Majumder, and Mandal, 2019; Ocak and Topal, 2014; Mabuan and Ebron, 2017; Manguire, 2005; Qarariha, 2013; Seage and Türegün, 2020; Shaheen, 2008; Yılmaz and Orhan, 2010). The importance of blended learning is demonstrated by what Al-Derbashi, Khaled & Osama (2017) mentioned, that it helps increase the social interaction between teachers and learners and also achieves self-learning. Thus, the current study comes to examine the impact of using blended learning in the academic achievement of undergraduate students at Ajman University in a general chemistry course (CHE101).

Study Questions

Questions study in the current study were formulated as follows:

1. Is there a significant difference in the post-test mean scores of control

group students and empirical group students in their academic achievement of the general chemistry course topics that they have learned?

2. Does the academic achievement of empirical students group that have learned through blended learning vary by gender, College, and academic year of the students?

Significance of the study

- 1- It comes in response to trends that call for attention to teaching methods and strategies that are really based on Constructivist theory
- 2- This study is agreement with the instructions of the UAE Ministry of Higher Education to the improvement of quality of education.
- 3- The members of the faculty encourage the utilize of blended learning in the educational process and contribute to developing a practical plan for training educators in higher education institutions to adopt this type of learning.

Methodology

Participants

The Participants in the present study were 326 undergraduate students enrolled in general chemistry course (CHE101), which is a mandatory course for all students of scientific colleges at Ajman University. They were split evenly into an empirical group of 163 students and a control group of 163 students. Figure 2 illustrated the participants' of study and Figure 3. Illustrated the demographics of the empirical group.







Figure 3. Demographics of the participants of empirical group.

Study Approach

Due to its appropriateness for the study's objectives, semi-experimental approach was used. In the current study, the researchers utilized two groups of students (Empirical group 163 students)

and (control group 163 students). The topics of general chemistry (CHE101) course were taught to the students in the control group utilizing conventional learning, while in the empirical group the students were taught the same topics of the general chemistry course by utilizing blended learning. That implies that during the first term of the 2019/2020 scholar year, the two groups studied same topics through 10 weeks. Teaching topics are shown in Table 2:

Week	Topics	Number of lectures
1	Atomic Electronic structure	3
2	Quantum Mechanics	4
3	The periodic table	4
4	Types of bonds	3
5	Molecular orbital Theory and Hybridization	3
6	Introduction to organic chemistry	4
7	Alkenes and alkynes	3
8	Polymers	2
9	Semiconductors	2
10	Superconductors	2
	Total	30

Table 2.	The	learning	topics	of	general	chemistry	course	(CHE101)
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Study tools

The investigators' study analyzed prior literature and studies pertaining to the study, such as studies (Davis, 2003; Epstein, 2007; Maccoun, (2016) and Mondal, Majumder, and Mandal (2019). Therefore, this study data depends mainly on Achievement exam, which is in detail as the following:

Achievement test design

The investigators' formulated achievement test to explore the impact of utilizing blended learning on

student academic achievement in the general chemistry course. The test was designed in line with Bloom's cognitive domain taxonomy (Birlik, 2015; Brady, 2005; Hyder and Bhamani, 2016). Moreover, a specification table for this exam was designed (see Table 3 and Figure 4). The test consisted, in its finished product, of 20 Multi-

Choice questions. The question item earned one mark for a correct response and zero for incorrect response. Highest test scores were 20, and the test time was 90 minutes.

N	Topics	No. Lectures	Topics Relative Weight	Lower thinking Q	Higher thinking Q	Total Q
1	Atomic Electronic structure	3	10 %	1	1	2
2	Quantum Mechanics	4	13.33%	2	1	3
3	The periodic table	4	13.33%	2	-	2
4	Types of bonds	3	10 %	1	1	2
5	Molecular orbital Theory and	3	10 %	1	1	2

Table 3. Specifications for the test of the topics

N	Topics	No. Lectures	Topics Relative Weight	Lower thinking Q	Higher thinking Q	Total Q
	Hybridization					
6	Introduction to organic chemistry	4	13.33%	2	1	3
7	Alkenes and alkynes	3	10 %	1	1	2
8	Polymers	2	6.67%	1		1
9	Semiconductors	2	6.67%	1		1
1 0	Superconductors	2	6.67%	1	1	2
Tot	al	30	100%	13 (65%)	7 (35%)	20 (100%)



Figure 4. Specifications for the test of the topics

Validity and Reliability of achievement test

Achievement test was verified by presenting it, in its initial shape, as a valid virtual test method; Members of the academic staff of educational institutions whose doctoral and master's degree owners are in teaching and learning strategies. We removed a few of the questions and introduced others as recommended and suggested, even the test became valid. In addition, the researchers utilized the test-retest way to verify the reliability of the achievement test. It was re-applied on the same students' sample two weeks after the first test application. Afterward, the Pearson correlation coefficient among the two processes was determined, the overall reliability coefficient (0.853) deems acceptable for the study objective.

Equivalence of empirical and control groups (Pre-test)

To check the equivalence of participants between the students of the two groups studied. The researchersx utilized a t-test to compare the results of the pretest of the topics of the chemistry (CHE101) course topics, before implementing the blended learning, as seen in Table 4, and Table 5:

Table 4. T-test of pre-test results of the two study groups

Table 4. Means and standard deviations of pre-test scores for two groups.

Group	N	Mean	Std deviation (SD)
Pre-test control	163	11.77	1.79
Pre-test empirical	163	11.55	1.83

Table 5.	T-test of pre-test	results of the tw	o study groups
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	Levene's	s Test			t-test		
	F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	
Equal variances assumed	0.020	0.888	1.071	324	0.285	0.2147	
Equal variances not assumed			1.071	323.894	0.285	0.2147	

As presented in Table 5, given that the p (0.285) extracted is larger than 0.05, the test is not significant at a scale of 0.05. This proves that there is no significant variation among the two study groups. Moreover, Table 3. Shown that the Mean of the two groups nearly the same value which was the values respectively (empirical group 11.55), (control group 11.77). This detects that the empirical group and the control group were identical before the implementation of the quasi-experimental method.

Preparing the educational chemistry course material

• The authors organized learning activities and presentations PPT for educating of Chemistry (CH101) topics course utilizing blended learning. The authors organized learning activities and presentations PPT of Chemistry (CH101) topics course. They utilized blended learning. In addition, the related multimedia, tasks, and pop quizzes found on the web link:

https://mylms.ajman.ac.ae/login/index.php

- Empirical Group given access to the Model of Learning for utilize in blended learning for the teaching. In meantime, topics were taught in the control group through face-to-face training in a school environment without utilize design of learning.
- Preparation of computer-based lessons for the topics of the chemistry (CHE101) course included multimedia, activities, tasks, and online quizzes and assignments.
- The researchers trained the empirical group students on how to access and utilize the educational materials on the Model of Learning system.
- All empiric group students signed in to the main page of the learning model system

via supplying the required details (Account

and Passwords) (see Figure 5).

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Figure 5: Homepage of Ajman University's Learning Management System Website

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- Chemistry course topics screen as seen in Figure 6, For example, explains the learns chemical bonding and the related resources of this topic of the chemistry course.
- Empirical group students were quite engaged, more motivated, and critical video reviews were submitted.
- Achievement test designed in line with Bloom's cognitive domain taxonomy.

- Students split into two groups: empirical group (n= 163) students' who have educated via blended learning and the control group (n= 163)' who were educated via the conventional method.
- The application of teaching students in both study groups (empirical & control group) began for a duration of 10 weeks.
- The post-test was implemented to the two groups (empirical and control), in order to investigate the impact of blended learning on the empirical group and comparing the result with the students of the control group.
- The investigators collected and analyzed the data using the SPSS program to derive findings and conclusions.

Statistical processing methods

The investigator used the SPSS software program to analyze the study data by performing a descriptive analysis, such as frequency calculation, average, and standard deviation (SD), including independent sample test (T-test). In addition, to the one-way ANOVA, and the LSD test.

Findings

Findings of the study attributed to Question 1.

RQ1: Is there a significant difference in the posttest mean scores between the control and empirical group students in their academic achievement of the chemistry (CHE101) course topics that they have learned?

The variance among the mean of students' scores in the empirical group that used the blended learning in their understanding topics of the chemistry (CHE101) course and the students of the control group that has not been used blended learning (conventional learning was used) was calculated. In addition, a t-test used for two independent samples as presented in Tables 6 and 7.

Group	Ν	Mean	SD
Post-test control	163	12.37	1.44
Post-test empirical	163	17.67	2.00

 Table 6. Means and SD of post-test results.

As seen in Table (5), the results refer that the students who were used the blended learning in their understanding the chemistry (CHE101) course, as appear in Table 5. The empirical group

grades were different (M = 17.67, SD = 2.00) from the control group of students (M = 12.37, SD = 1.44).

Table 7. The	e independent	sample t-test	of post-test.
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	Levene's Test		t-test			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	3.364	.068	27.451	324	0.000	5.2945
Equal variances not assumed			27.451	294.664	0.000	5.2945

As appear in Table 7, given that the p-value (0.000) is lower than 0.05, this confirms there are significant differences at the significance level of 0.05, which implies that there is a substantial difference among the two groups of participants in favor of the students of the empirical group. This implies based on the results of this T-test, it can be concluded that the use of the blended learning has a positive effect on understanding and increases scores students of the empirical group in the topics of the general chemistry course.

Findings of the study attributed to Question 2

RQ2: Does the academic achievement of empirical students group that have learned

77

86

17.81

17.69

through blended learning vary by gender, College, and academic year of the students?

Average scores and standard deviations have been computed, the T-test used one-way ANOVA tests, and LSD tests were performed to determine the significance of average differences.

Gender variable among students

T-test utilized to assess the significance of the differences among Mean of scores of students of empirical group students, according to gender in terms of using blended learning, as indicated in table 8.

Gender	Ν	Mean	SD	df	T. Value	Sig. (tailed)		
Female	77	17 81	1 52	161				

1.52

2.48

The findings recorded in Table 7 illustrate that the observed p (0. 716) is larger than 0.05. Thus, the test in 0.05 scale is not significant, suggesting that there is no significant difference among the mean values for males and females in the students of empirical group.

Male

College variable among Students'

0.364

161

143.092

The findings of the one-way ANOVA test of students' answers to this variable are appearing in Table 9.

0.716

		Sum of squares	df	Mean square	F	Sig. (tailed)
	Between Groups	40.146	3	13.382		
Student college variable	Within Groups	661.032	159	4.157	3.219	.024
	Total	701.178	162			

Table 9: ANOVA test for student College variable.

As presented in Table 9, the findings clearly illustrated that there are statistically significant differences in the academic achievement of empirical group students that have learned through blended learning according to variable of college, given that p is 0.024, That it is less than

the statistical significance level needed (0.05). Therefore, in order to identify the origin of the differences, the LSD test utilized for the next comparisons and the findings appear in Table 10 below.

		Mean Difference (I-	
(I) College	(J) College	J)	Sig.
	Dentistry	027	.973
Medicine	Pharmacy and health Sciences	-1.264	.060
	Engineering and IT	375	.571
	Medicine	.027	.973
Dentistry	Pharmacy and health Sciences	-1.237-*	.028
	Engineering and IT	348	.527
Pharmacy and health	Medicine	1.264	.060
Sciences	Dentistry	1.237*	.028
	Engineering and IT	.889*	.013
	Medicine	.375	.571
Engineering and IT	Dentistry	.348	.527
	Pharmacy and health Sciences	889-*	.013

Table 10: LSD test findings for variable of College of the students'.

The findings appear in Table 10 emphasize that the origin of the variations in in the academic achievement of empirical group students that have learned through blended learning according to the variable of college based on the variable of college arose from students with Pharmacy and health Sciences college.

Academic year variable among Students'

The findings of the one-way ANOVA test of students' answers to this variable are appearing in Table 11.

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		Sum of squares	df	Mean square	F	Sig. (tailed)
Student	Between Groups	4.670	4	1.168		
Academic year variable	Within Groups	696.508	158	4.408	0.265	0.900
	Total	701.178	162			

As presented in Table 11, the findings clearly illustrated that there are no statistically significant differences in the academic achievement of empirical group students that have learned through blended learning according to the variable

of Academic year, given that p is 0.900, That it is larger than the statistical significance level needed (0.05).

Discussion

The results achieved in connection to the first research question about whether there is a significant difference in the post-test mean score between the control group and the empiric group of students' in their academic achievement of the chemistry CHE101) course topics that they have learned. Stated that there was a significant difference among learners in the empirical and control group in favor of students in the empirical group, who studied the chemistry topics course by using blended learning. The average score of students in the empirical group who utilized blended learning was 17.67, compared to 12.37 for the students of the control group who not blended learning and studied via utilized conventional learning, as indicated in Tables 6.

Moreover, as shown in Table 7, as the pvalue (0.000) obtained is less than 0.05, this implies that there are significant differences at the significance level of 0.05, which emphasizes the existence of a significant difference between the two groups of students that were studied. This indicates that utilizing blended learning had a positive impact on the empirical group students' academic achievement through their more depth understanding of the chemistry course topics that they have learned. The investigators may attribute this result to the positive features of a blended learning application in the teaching process, like flexibility, meet students' needs, and take into account individual differences between them. Eryilmaz (2015) refer that during blended learning a student can stop the lesson whenever he wants and watches it again at any time. Moreover, Students can view the lesson repeatedly within different times and periods. Seage and Türegün (2020) pointed out, that classroom activities and interaction with content and the teacher also motivate and encourage students to be more which makes them deeply think, more understanding of the topics of the academic content. Moreover, investigators may attribute the findings that blended learning has enabled students to interact directly in the classroom through the utilize of modern communication mechanisms such as computers and the internet, employing multimedia, and websites related to the topics of the lesson. Which enabled providing educational experiences closer to reality and providing an interactive environment that made students more active and interactive in the educational process. This results are consistent with previous studies (Ceylan and Kesici, 2017; Dangwal and Lalima, 2017; Harahap, Nasution, and Manurung, 2019; Kazu and Demirkol, 2014; Maccoun, 2016; Mondal, Majumder, and Mandal, 2019; Ocak & Topal, 2014; Mabuan & Ebron, 2017; Manguire, 2005; Qarariha, 2013; Seage and Türegün, 2020; Yılmaz & Orhan, 2010). The results of these studies have supported the significant impact of blended learning in the improvement of the academic achievement of the students. In addition, it indicated the significance of blended learning in increasing motivations, and developing positive attitudes for learning science like chemistry topics. The results of these studies also verified that blended learning made students be more motivated to learn, and developing positive attitudes towards learning courses of The results of these studies also verified that blended learning made students be more motivated to learn, and developing positive attitudes towards learning science courses like the chemistry topics.

The second study question concentrated on the investigation of whether the academic achievement of empirical group students that have learned through blended learning vary by gender, College, and academic year of the students. Our findings (illustrated in Table 7, 8, 9, 10 and 11) showed that students' of the empirical group varied according to the variable of college (in favor of those students of Pharmacy and health Sciences College). However, there is no statistically significant difference in students' according to the students' gender variable and, Academic according to year variable. Nevertheless, the findings of the study were not compatible with the findings of the study conducted by Yusoff, Md Noh, and Yusoff (2017) about the effect of blended learning on the science

and mathematics courses and academic achievement of students in these courses. Where its results referred that, the post-test scores did not appear a significant difference between the empirical group and the control group, which indicates that the student scores in the post-test were close to each other.

Conclusion:

The level of quality education has become an essential criterion for the progress and growth of nations and societies around the world. Thus, the higher education institutions in the UAE are presently interested in developing learning strategies, techniques, and merge information technology (IT) into processes of learning, teaching, and instruction systems. The expansion of using IT, e-learning, and blended learning and its models in the learning and instruction system is one of the most essential goals in the higher education institutions in the UAE. This study seeks at examining the impacts of the use of blended learning on students' achievement in the general chemistry (CHE 101) course at Ajman University. The finding of this study revealed that using blended learning had a positive impact on increasing students' academic achievement in chemistry course topics. Where the data analyses confirmed that there were statistical differences between the empirical group students' and the control group students', in the benefit of the empirical group.

Moreover, results showed that students' of the empirical group varied according to the variable of College (in favor of those students of Pharmacy and health Sciences College). However, there is no statistically significant difference in students' according to the students' gender variable and, according to Academic year variable.

Recommendations

The study recommended the following:

1- Expanding the application of blended learning at universities and supplying all the materials needed for it. 2- Conduct similar studies on the implementation of blended learning.

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