



Effects and Perceptions of Mobile Learning in Higher Education

Sami Al-Qatawneh ¹ , Najeh Alsahhi ^{1, 2, 3*} , Mohd. Eltahir ^{1, 2} , Fayiz Althunibat ¹,
Mazan Jaradat ¹, Khaled Aljarrah ¹

¹ College of Humanities and Sciences, Ajman University, Ajman, UAE.

² Humanities and Social Sciences Research Center (HSSRC), Ajman University, Ajman, UAE.

³ Nonlinear Dynamics Research Center (NDRC), Ajman University, Ajman, UAE.

Abstract

Objectives: This study aimed to investigate the effect of mobile learning on students' achievement in the grammar of the Arabic language, and their attitude towards the use of mobile learning. **Methods/Analysis:** The study was conducted using a quasi-experimental design, case study. The sample comprised 170 students, divided into two groups: an experimental group (n = 87) and a control group (n = 83). An achievement test and a questionnaire were used to collect data, which was analyzed using SPSS. **Findings:** The findings revealed statistically significant differences between the two groups, with the experimental group showing better scholastic achievement on the test. The results also show that the students of the experimental group were more positive towards mobile learning. **Novel contribution:** The study recommends further studies on the use of mobile learning in universities and schools. It is necessary to emphasize and focus on further studies on the use of mobile learning within universities and schools to confirm and provide evidence of the significance of mobile learning in terms of facilitating, promoting, and enhancing the educational process.

Keywords:

Mobile Learning;
Achievement; Attitude;
Undergraduate Students;
Higher Education.

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1- Introduction

At present, during the twenty-first century, contemporary societies face many challenges in various social, cultural, and educational fields. The rapid developments and changes in modern information and communication technology (ICT) in the education system throughout the world raise some of the most prominent of these challenges. Developments in ICT have contributed to changing the nature and form of institutions, including educational institutions, in radical ways. One aspect of this change is the emergence of modern education systems such as e-learning, most notably mobile education systems.

In light of this explosion of knowledge and information technology and scientific development, it is no longer acceptable to leave instructional systems and the planning and implementation of the educational process to improvisation and randomness. It has become necessary to prepare in advance in light of a clear philosophy from which the goals of the educational process emerge and from which appropriate learning strategies for students can be chosen. Such strategies include those such as distance learning, E-learning, computer-based learning (CBL), and other accelerated educational strategies. Taken together, these have led to the wireless revolution, with the emergence of a new form of learning called mobile learning or M-learning, which relies on the use of wireless technologies and has

* **CONTACT:** n.alsalhi@ajman.ac.ae

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imposed itself strongly on all sectors, including the education sector [1]. In fact, technology is linked to all teaching and learning processes that function according to students' psychological characteristics, their abilities, their readiness to learn, and the requirements of their growth in a specific cultural and learning environment to keep pace with the framework of the concept of ICT [2]. Educators need to be capable of conducting instruction with the help of technology to the point where it goes beyond the traditional classroom setting and, at the same time, whereby learners will learn in ways that were unthinkable before active learning and they will also have a positive opportunity for learning [3]. Educational institutions are currently facing significant problems in their education system, which can trigger many issues, such as low quality of education and thus the potential of learners and their knowledge and practical skills [4, 5]. According to Toquero (2020), universities urgently need to develop educational systems and curricula through the use of innovative teaching methods and strategies [6]. Using M-learning as a modern strategy may be one of the solutions available to overcome the difficulties and challenges of education. This facilitates the educational process and makes it accessible to a wide range of students. M-learning is described as an expanded version of e-learning using wireless technologies such as the smart phone [7]. Moreover, nowadays, M-learning is the most highly developed method for education, allowing students to communicate and react directly with many other teachers and students via messaging functions such as WhatsApp and e-mail [8]. Mobile apps are now being utilized as study aids by students, such as human organ models and human torso models in medical and nursing colleges, and will also develop English or Arabic grammar learning for learners, thus allowing students to easily access the relevant content anywhere [9]. Furthermore, M-learning could lead to the transformation of the education process as it focuses on student-centered learning where the instructors act only as facilitators of learning [10].

In the United Arab Emirates, the Ministry of Education will move forward to complete the process of planning and implementing the development and improvement of the educational system and frameworks according to modern educational philosophies, encompassing all the educational institutions across the UAE, including both government and private [11]. The UAE Ministry of Education initiated this approach with the launch of the Emirati School in 2017/2018, which is based on the best modern education systems in the world [12]. The Ministry of Education is also studying ways to increase the adoption of a system of distance learning and e-learning for all students of state schools and universities as a supporter and enhancer of face-to-face learning, or even a substitute for it in exceptional circumstances, such as when there is an obstacle to face-to-face learning. Thus, academic institutions are urgently required to develop their learning and teaching system strategies, activities, and techniques via the use of modern teaching methods and using ICT to serve and support the educational processes [6]. Mobile learning is a virtual learning concept that means undergraduate students can access learning material while they are away from the classroom. This increases the students' opportunities for learning, because it is designed to give them flexible access to their courses and allow them to interact widely and more openly, without restrictions of time and place. This can affect the student's ability, efficiency of reading, and facilitate the learning process by allowing them to interact with the instructors via communication techniques. Therefore, accessing educational content through M-learning can be described as a model of electronic learning/E-learning that is totally dependent on technology [13].

1-1-Purpose and Research Questions

This research seeks to understand the effect of mobile learning on the learning process for undergraduate students. To do so, it evaluates their performance and achievement on a university course on Arabic grammar. It also seeks to understand their attitudes toward the use of mobile learning.

Thus, this study tries to answers the following questions:

RQ1: What is the effect of the use of M-learning on undergraduate students' achievement on an Arabic language grammar course?

RQ2: What are the attitudes of undergraduate students in the experimental group towards the use of mobile learning?

1-2-Research Importance

- The results of the research may add new ideas and discoveries to the literature in regard to understanding the impact of mobile learning on students' achievement, and their attitude toward the method.
- It may open the way for other researchers, especially those interested in modern technologies, to carry out related studies.
- The discoveries in this research will be of value for universities and other educational institutions outside of the UAE.

2- Review of Literature

Technological advances have led to the continuous development of hand-held devices and wireless technology, which

has led to a transformation in many aspects of the daily life of individuals around the world, with the educational system being one of most significant aspects influenced by this technology [1, 2]. M-learning differs from e-learning insofar as e-learning occurs without involvement in the classroom, but M-learning is considered to be part of e-learning. Some researchers have used the term M-learning (mobile learning) to describe the use of smart phones as a method of delivering learning materials to students [14]. M-learning has therefore been defined as the use and exploitation of mobile technologies, along with wireless and mobile networks, to facilitate, promote and expand educational process [15]. It also refers to the ability of students to utilize smartphones for educational technology at a suitable time [16, 17].

Moreover, M-learning promotes the ability to teach and learn, and through it, the educational process can occur at any venue, anytime and anywhere, not being constrained to any specific place or time [18, 19]. Furthermore, M-learning is appropriate because students can easily access it from almost anywhere, and student interaction with each other and with instructors is almost immediate for everybody using the same content, which leads to immediate feedback and suggestions [20, 21]. Smart mobile devices are likely to promote learning due to features such as mobility (which facilitates access at any time and location), lightness, cheap price, and connectivity [22]. Figure 1 illustrates the features and benefits of M-learning.

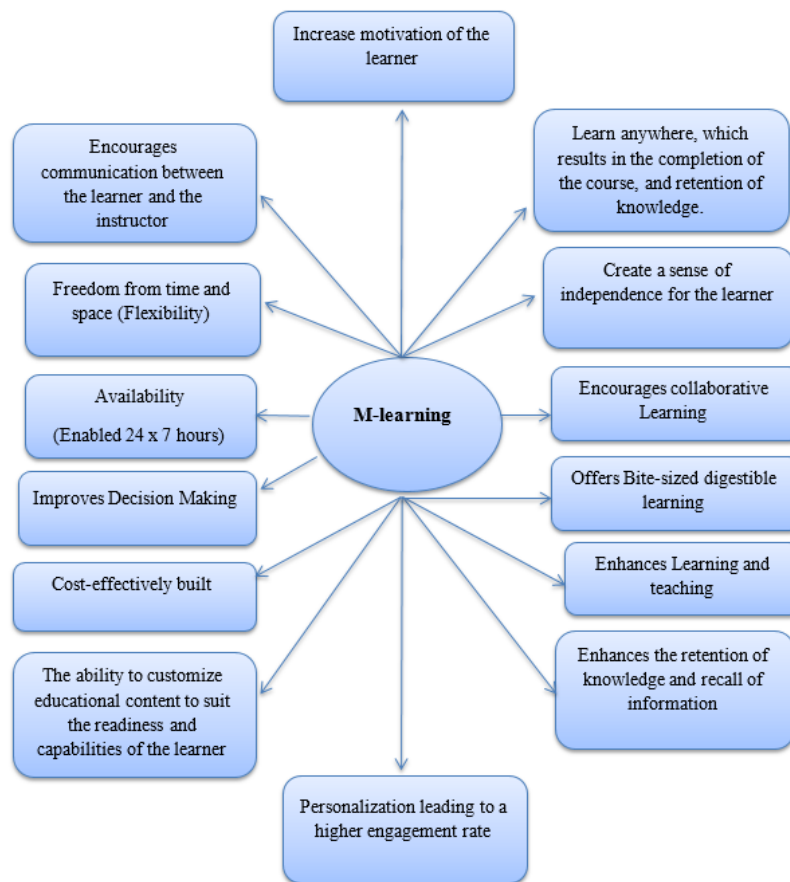


Figure 1. Features and benefits of M-learning

Digital learning appears to have a considerable effect on the success of education, enhancing the quality of education by encouraging self-learning, cooperative learning, critical thinking, social skills, and capacity for real-time interaction. M-learning is considered an evolving learning and teaching approach in universities [23, 24]. Supported by IT, faculty members would be encouraged to teach in a way that goes beyond the traditional classroom setting [25-27]. Alexander et al. (2019) report that mobile devices are currently essential for learning and teaching, and within a few years the M-learning approach will be adopted in most higher education institutions and likely even in schools [28].

A review of the literature identifies several studies on the use of M-learning in universities and students' attitudes towards it [29-32]. The results of these studies are focused on the acceptance of M-learning in the educational sector. Findings also showed that learners are largely accepting of M-learning in their universities, and they see it as an effective approach for their learning, as it promotes their self-regulation, and their ability, desire, and readiness to learn. Furthermore, the outcomes recommend that learning through M-learning is an effective way to enhance student accomplishment at university. These studies also confirmed that the M-learning approach can be a key factor in successful methods for other types of educational materials. Additionally, Marawan (2019) sought to identify the uses of M-learning and its role in academic achievement for students in the secondary stage in Algeria [33]. The results

showed that the use of M-learning had a significant impact on academic achievement of students, and they provided the means of different applications. Also, the results of a study conducted by Demir and Akpinar (2018) confirmed that M-learning promoted students' academic achievement [34]. Another study by Gasaymeh et al. (2017) showed that the number of students at the University of Yarmouk who use the mobile learning process via application was at a moderate level [35]. The study also shows some obstacles, such as restrictions by the university and the university regulations. Furthermore, the outcomes of another study done by Chu (2014) reported that the students in the control group performed better than the students of the experimental group on an exam [36]. The results showed that the virtual learning process had a negative impact on the student's achievement. Another study conducted at the Vocational University in Selangor in Malaysia showed that students were more interested in and familiar with the traditional learning process [37]. The students could not identify any benefit of the virtual learning approach, which indicates unwanted or negative aspect of using technology in delivering learning materials. Additionally, some studies focused on the health hazards of smartphones. For example, findings have shown that bad use can lead to addictive behaviors [38], and there may be a relationship between the use of mobile devices and emotional imbalance [39].

3- D Method

3-1-Approach of the Study

The current analysis was carried out using a quasi-experimental method due to its appropriateness for the aim of the research, which is to explore the effect of M-learning on undergraduate students' achievement, and their perceptions of the method. Figure 2 illustrates the design of the analysis.

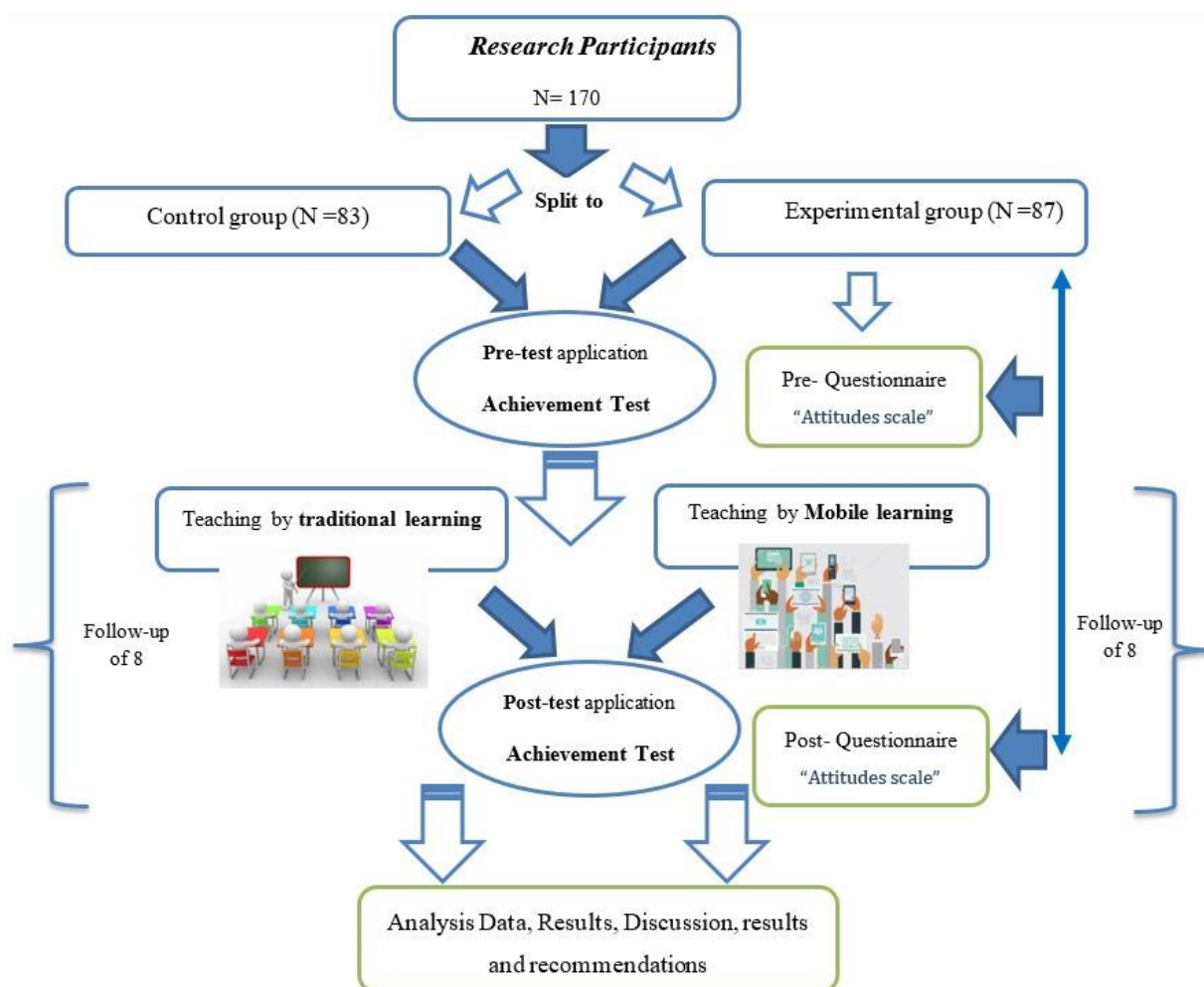


Figure 2. Design of the analysis (the researchers' own formulation)

As shown in Figure 2, students of the control group were taught the topics of the Arabic Language Grammar Course (see Table 1) using traditional learning, which indicates that students of this group did not study the grammar topics using M-learning. The same Arabic grammar topics were taught to students in the experimental group for eight weeks using M-learning in the fall term of 2019/2020.

Table 1. Arabic grammar course topics

Topics	Weeks
Adjectives, adverbs	1
Subject and object pronouns	2
Active participle, passive participle	3
The relative pronouns	4
Prepositions	5
Active voice, passive voice	6
Haal accusative	7
An accusative object	8
Total week	8

3-2-Participants in the Study

The study participants included 170 students from the College of Humanities and Sciences. They were randomly divided into two groups, experimental (n = 87) and control (n = 83). The study was conducted throughout the fall term of the educational year 2019/2020. Table 2 and Figure 3 display the participants data in detail.

Table 2. Participants' details

Group		Frequency (f)	Percentage (%)
Experimental		87	51.2%
Control		83	48.2%
Total		170	100%
Gender	Female (F)	81	52.4%
	Male (M)	89	47.6%
Student academic evaluation (GPA)	2-less than 2.5	45	26.5%
	2.5-less than 3	52	30.6%
	3-less than 3.5	41	24.1%
	3.5-4	32	18.8%
	Total	170	100.0%
Information Technology (IT) skills	Poor	28	16.5%
	Moderate	62	36.5%
	Good	58	34.1%
	Excellent	22	12.9%
	Total	170	100.0%

In addition, Table 3 and Figure 3 illustrate the demographics of participants in the experimental group (n = 87).

Table 3. Demographics of the participants of the experimental group

Study variables	Variables levels	(f)	(%)
Gender	F	42	48.3%
	M	45	51.7%
	Total	87	100.0%
Student academic evaluation (GPA)	2-less than 2.5	27	31.0%
	2.5-less than 3	24	27.6%
	3-less than 3.5	21	24.1%
	3.5-4	15	17.2%
	Total	87	100.0%
Information Technology (IT) skills	Poor	12	13.8%
	Moderate	34	39.1%
	Good	22	25.3%
	Excellent	19	21.8%
	Total	87	100.0%

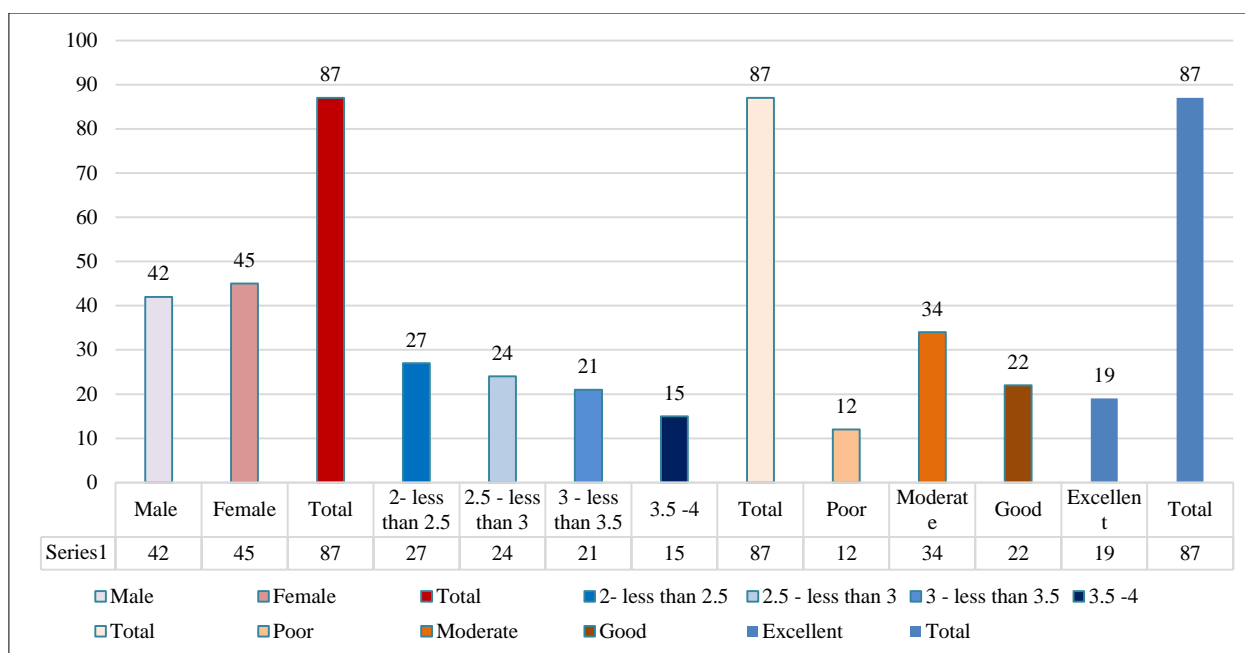


Figure 3. Demographic information of experimental group

3-3- Study Instrument

Having considered prior studies of relevance to the current topic [35-37, 40], the researchers decided on two instruments: an achievement test, and a questionnaire. These are explained in detail in the following sections.

Achievement Test

The researchers formulated an achievement test to explore the effect of the use of the M-learning strategy on student achievement in the course contents taught. The achievement test was designed in line with Bloom's cognitive domain taxonomy [41]. A specification table for this exam was designed (see Table 4). The test comprised 20 questions, each of which was worth one mark. The total mark of the test was 20.

Table 4. Specifications for the test of the topics

Subjects	The number of lectures	Relative weight of topics	Lower-level thinking questions	Higher-level thinking questions	Total marks
Adjectives	2	9%	1	1	2
Adverbs	2	9%	1	1	2
Subject and object pronouns	3	13%	2	2	4
Possessive pronouns, Demonstrative and relative pronouns	3	13%	2	1	3
The genitive construct and other ways to express possession	4	17%	3	1	4
Prepositions	3	13%	1	1	2
Feminine, numbers	3	13%	1	1	2
Negation, pronouns	3	13%	1	0	1
Total	23	100%	12 (60%)	8 (40%)	20 (100%)

Validity and Reliability of Achievement Test

The achievement test was verified by presenting it to 10 faculty members from several universities in UAE with doctoral and master's degrees whose work focuses on curricula and teaching methods. Also, the investigators used the test-retest method to check the reliability of the achievement test. The test was piloted on a sample not to be included in that of the actual study, and re-applied to the same sample 14 days later. The Pearson correlation coefficient between the two phases was determined to be 0.844, and this was deemed to indicate adequate reliability for this analysis.

Questionnaire

The researchers decided to use the Likert-scale method for the questionnaires to determine the attitudes of the undergraduate students who used the mobile learning approach. A total of 20 elements were included. The Likert scale was formulated by determining the rating period of each point. The range of the period is higher with higher points, so one point is equal to a range period of 1.00–1.80. The following structure explains more about the relationship between

the two values (point and range period): two points equal to 1.81–2.60, which represents a small range period; three points equal to 2.61–3.40, which is considered a moderated range period; four points equal 3.41–4.20, which is considered a high range period; and finally, five periods equal to 4.21–5.00, which means the highest or very high range period.

The Validity and Reliability of the Questionnaire

It is important for the researchers to consider the validity and reliability of the questionnaire, so they selected faculty members from various UAE universities with master's or doctoral degrees and specialized in teaching and curriculum. These faculty members were asked to provide their feedback on the questionnaires in written form. The researchers then modified the questionnaires in consideration of the collected feedback, and the questionnaire ultimately included 20 elements. Cronbach's alpha was used to measure reliability, as shown in Table 5. The table illustrates the values of the reliability for Cronbach's coefficients. The average is 0.832, which indicates logical value of usage.

Table 5. Cronbach's alpha reliability coefficients

No.	Item (I)	Cronbach's Alpha	No.	Item (I)	Cronbach's Alpha
1	I1	0.818	11	I11	0.821
2	I2	0.810	12	I12	0.818
3	I3	0.813	13	I13	0.840
4	I4	0.828	14	I14	0.819
5	I5	0.819	15	I15	0.825
6	I6	0.817	16	I16	0.825
7	I7	0.815	17	I17	0.817
8	I8	0.854	18	I18	0.817
9	I9	0.839	19	I19	0.822
10	I10	0.828	20	I20	0.832
Total		0.832			

3-4-Equivalence of Experimental and Control Groups

A t-test was used to evaluate the equivalence of the two groups, as shown in Table 6:

Table 6. Means (M) and standard deviations (SD) of pre-test scores for the two groups

Group	N	M	SD
Control	83	11.31	1.09
Experimental	87	11.02	1.08

As set out in Table 7, the p (0.083) observed is higher than 0.05, which means that the test is not significant at 0.05. Additionally, as shown in Table 6, the scores of the participants in the experimental group did not differ significantly (M = 11.02, SD = 1.08) from those of students in the control group (M = 11.31, SD = 1.09). This proved that the participants of the two groups were identical prior to the start of the research.

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	1.969	0.162	1.743	168	0.083	0.2903
Equal variances not assumed			1.743	167.386	0.083	0.2903

* Statistically significant at (p<0.05)

4- Results

4-1-Results Regarding Research Question 1

RQ1 asked, "What is the effect of the use of M-learning on undergraduate students' achievement on an Arabic language grammar course?"

The T-test was used to compare the results of those students who used smart phones for their learning in the Arabic grammar course with those who used the traditional learning approach. The results of these two tests are shown in Tables 8 and 9.

Table 8. Means and SD of post-test results

Group	N	Mean	SD
Control	83	12.04	2.18
Experimental	87	15.56	2.31

Table 9. The independent sample t-test of post-test

	Levene's Test for Equality of Variances		t-test			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	3.113	0.080	10.230	168	0.000	3.5271
Equal variances not assumed			10.243	167.991	0.000	3.5271

* Statistically significant at ($p < 0.05$)

Table 8 shows that the mean value for the students who used mobile learning is different by looking at ($M = 15.56$, $SD = 2.31$) from the students who used the traditional learning approach, which had the value ($M = 12.04$, $SD = 2.18$). The Table 9 shows that the rate of p equals to 0.000, and this is considered a low value compared to the significance level of 0.05, therefore indicating that there is significant difference at this stage. By considering the results shown in Tables 8 and 9, it can be concluded that the use of the M-learning approach had a positive effect on the students' performance during their studying and tests.

4-2- Results Regarding Research Question 2

RQ2 asked, "What are the attitudes of undergraduate students in the experimental group towards the use of mobile learning?"

In order to identify the attitudes of the experimental group students towards the use of M-learning in their learning of the topics of the Arabic Language Grammar course before and after use, paired t-test samples were used for the pre-application and post-application scores of the M-learning attitude scale. The findings are presented in Table 10.

Table 10. Results of paired samples t-test

Exp. Group	N	Mean	Mean Differences	SD	t	df	Sig. (2-tailed)
Post-application	87	3.47	1.05	0.48349	20.265	86	0.000
Pre-application	87	2.42		0.30856			

* Statistically significant at ($p < 0.05$)

The results in the above table demonstrate a significant change ($t(86) = 20.265$, $p < .05$) between the post-application mean of the experimental group of students (3.47) and their pre-application mean (2.42). On the basis of this finding, it can be stated that there are positive attitudes towards the use of M-learning in the Arabic Language Grammar course on the part of the experimental group students.

4-3- Results Regarding Research Question 3

RQ3 asked, "Do the experimental group students' attitudes towards the use of mobile learning vary according to their gender, academic evaluation (GPA), and computer skills?"

Mean score and SD were calculated for questions, and t-test, one-way ANOVA, and LSD post-hoc comparison test were implemented for the purpose of the determination of the significance of the variations between the averages. The results for the answers were analyzed below based on the specified variables.

First Variable: Gender

The T-test was used to detect the difference between the averages of acceptance of M-learning by the experimental group students according to the variable gender. The results are set out in Table 11.

Table 11. Means and SD of the students' answers based on gender

Gender	N	Mean	SD	Mean Difference	T. Value	df	Sig.
Male	45	3.12	0.634	0.24722	2.056	85	0.043*
Female	42	2.88	0.469				

* Statistically significant at ($p < 0.05$)

The t value in Table 11 is 2.056, which is greater than the one in the t-table, indicating that there are differences in the values between the two genders. This value of 0.043 is less than the required value for males, which is 0.05. These findings indicate females were less accepting of mobile learning compared to males, who preferred using mobile learning approach.

Second Variable: Academic Evaluation (GPA)

A one-way ANOVA test was used to detect the difference between the averages of acceptance of M-learning by the experimental group students according to the variable academic evaluation (GPA). The results are set out in Table 12. Table 12 shows that there are significant differences between groups at the level of 0.470, which this value is greater than the required value of 0.05

Table 12. One-way ANOVA test for variable academic evaluation (GPA)

		Sum of squares	df	Mean square	F	Sig. (tailed)	Sig. level
College variable	Between Groups	2.313	3	0.771	0.851	0.470	Not Significant
	Within Groups	75.244	83	0.907			
	Total	77.557	86				

* Statistically significant at (p<0.05)

Third Variable: Computer Skills

A one-way ANOVA test was used to detect the difference between the averages of acceptance of M-learning by the experimental group of students according to the computer skills variable. The results are set out in Table 13.

Table 13. One-way ANOVA test for variable computer skills

		Sum of squares	df	Mean square	F	Sig. (tailed)	Sig. level
College variable	Between Groups	7.172	3	2.391	2.819	0.044	Significant
	Within Groups	70.385	83	0.848			
	Total	77.557	86				

* Statistically significant at (p<0.05)

Table 13 above shows that there are again considerable differences at the level of 0.044, and this is less than the required value of 0.05, based on the skills of the students in using computers. To understand the root cause of these differences, the LSD test is used to provide a better understanding, as presented in Table 14.

Table 14. LSD test findings for computer skills variable

(I) Computer skills	(J) Computer skills	Mean Difference (I-J)	Sig.
Poor	Moderate	0.50245	0.108
	Good	0.09470	0.775
	Excellent	0.78728*	0.023
Moderate	Poor	-0.50245	0.108
	Good	-0.40775	0.109
	Excellent	0.28483	0.283
Good	Poor	-0.09470	0.775
	Moderate	0.40775	0.109
	Excellent	0.69258*	0.019
Excellent	Poor	-0.78728 *	0.023
	Moderate	-0.28483	0.283
	Good	-0.69258*	0.019

*Statistically significant at (p<0.05)

The findings displayed in Table 14 indicate that the basis of variations in student point of view according to the variable “computer skills” was in favour of students with poor computer skills.

5- Discussion

The findings relating the RQ1, pertaining to the effect of m-leaning on scholastic achievement, indicated that there was a large and significant difference between the two groups (experimental and control groups). Students within the

experimental group, who were taught the content of the Arabic grammar course by M-learning, performed better than their counterparts in the control group in the exam that assessed academic attainment. It can be observed in Table 8 that the respective averages of the experimental and control groups were 15.56 and 12.04, showing significantly higher attainment for the experimental group. The value of p is equal to 0.000 (Table 9), which is lower than the value of 0.05, and this indicates that there are large differences between the two groups at the significance level of 0.05. Thus, this means that using mobile learning has a positive impact on the learning process and student acquisition of the contents of the Arabic grammar course.

This result may be attributed to the positive benefits and functions of M-learning applications in education, such as increased motivation for students, flexibility, meeting students' needs, availability (enabled 24/7), encouraging communication between the student and the instructor, and taking into consideration individual differences between them.

Another study showed the convenience of M-learning for the students [42], as evidenced by the fact that the student has the opportunity and the ability to pause the learning lessons whenever they so desire. This also gives them the chance to come back to the material whenever they want and view the same material many times. Also, research has shown that, during M-learning, student interaction with each other and with instructors is almost immediate for everybody using the same content, which leads to immediate feedback and suggestions [20]. Moreover, smart mobile devices are likely to promote learning due to features such as mobility, which makes learning accessible at any time and place, and a cheap price [21, 43]. On the other hand, research has also shown that M-learning activities can improve the preparedness and achievement of students much better than conventional learning during the instruction and learning process [44].

These outcomes originate from previous studies whose objective was to understand if learning a foreign language via the virtual learning approach can be a successful method for the students in university by adapting M-learning [31]. The results of this study showed it can enhance students' performance when it comes to learning a non-native language, especially with respect to understanding vocabulary and phrases. Moreover, other research aimed to identify the uses of M-learning and its role in academic achievement for students in the secondary stage in Algeria [33]. The results showed that the use of M-learning has positive effects on the academic achievement of students, and the study provided the means of different applications. Also, research has aimed to examine the effect of M-learning on students' achievement and conversational skills [45]. The results revealed that M-learning had a positive influence on both student academic achievement and conversational skills; with such findings corroborated in other research that reported that the use of M-learning had a major impact on the academic achievement of students [46]. Another study found that college students who used mobile devices extensively, the results showed students benefited from the advantages of these devices during their studies at the university [47]. Likewise, Research conducted in Nepal to examine the perception of higher education students regarding the use of M-learning similarly showed that the majority of students had positive attitudes towards M-learning [48]. The academic achievement and knowledge of the metacognition of these students have been developed and improved by using M-learning. Other research also confirmed that M-learning promoted students' academic achievement [34].

The findings achieved relating to RQ2, regarding students' perceptions of M-learning methods, also showed positive outcomes for M-learning. The investigators surveyed students with a questionnaire before they started using M-learning, and re-implemented it after eight weeks of using virtual learning teaching by phones. They used a paired samples t-test on the pre- and post-application scores of the M-learning attitude scale. The findings shown in Table 10 indicate that the mean of post-application was 3.47, compared to the pre-application mean of 2.42. Additionally, there was a significant difference ($t(86) = 20.265$, $p < 0.05$) in favour for the post-application, indicating that the students in with experimental group had a positive experience with adapting and using their smart phones for acquiring learning material, as it showed significant enhancement after using the application. These results are consistent with those of previous studies [29] that aimed to explore the acceptance of mobile learning by students in a higher education setting. The findings showed that enjoyment and achievement expectations were significant factors that affected the acceptance of M-learning in this context. Also, research has shown that the theory of planned behavior (TPB) and technology acceptance model (TAM) are important factors in students' acceptance of M-learning [30]. Moreover, research has also shown that the students' behavioral intentions were highly positive attitudes toward M-learning as a learning supporting approach [49]. Furthermore, research has been conducted to explore the perspectives of college students on the use of mobile learning during the COVID-19 pandemic [50]. The results indicated that students had positive attitudes towards M-learning. Another study that examined students' attitudes toward the use of M-learning at Kuwait University showed that 80.3% of students were pleased with the use of the digital phone as a learning tool and pointed out that mobile learning improved their understanding of English language skills [51]. Similar research that aimed to explore the acceptance of M-learning among learners in Saudi Arabia found that M-learning was accepted among university learners [52, 53].

The third research question sought to provide more granular insight into the relationship between certain personal variables and attitude to M-learning. These variables were the academic performance of the students, measured by GPA (grade point average), technological skills such as using a computer, and students' gender (male and female). The

findings in Tables 11 to 14 illustrate that male students and those with a poor knowledge about using computers exhibited the highest levels of acceptance of M-learning. No significant variation in acceptance was demonstrated according to academic performance. These variations may be attributed to the fact that male students are more motivated to be flexible in the learning process than female students, whereas some females prefer to be committed and disciplined in following instructions during the learning and instruction process.

Nonetheless, the discoveries in this study differed from those of previous research, which has found that the students of the control group performed better than the students of the experimental group when it comes to their achievement in the exam [36]. Therefore, the outcome indicated that virtual learning has a negative impact on the achievement of the students, while the traditional learning process has a better impact. Similar findings were obtained among students of Vocational University in Selangor, Malaysia, which showed that the students were more interested in and familiar with the traditional learning process [37]. The students could not identify any benefit to the educational experience for themselves through the use of the virtual learning approach, which indicates unwanted or negative aspects of using technology in delivering learning materials.

However, there are some limitations that should be acknowledged. First, the researchers at the universities had limited information about mobile learning techniques, which affected their use for this matter. The second factor is the limited number of students (170) enrolled in the Arabic grammar module, which affected the possible size of the control and experimental groups. The third factor was that the investigators applied the questionnaire only to the experimental group of students who were trained through M-learning and did not apply it to the control group of students because they studied through traditional learning (non-M-learning).

In light of these limitations, the following recommendations are made for practice as well as for future research into the impact of mobile learning on students' academic achievement:

- The findings of the questionnaire indicate that students of the experimental group tend to accept the use of M-learning methods that enhance communication, teamwork, and the sharing of learning experiences. This requires that education officials constantly reconsider their teaching strategies and models in the next few years during the current digitalization age.
- The contradictory results in the literature indicate the need for more research to identify the total effect of mobile learning techniques on students' academic achievement.
- Practical and more detailed research is required to identify in depth the advantage and the challenges while adapting mobile learning in the learning process at universities.
- Further studies are required to identify more aspects of engaging, motivating, and improving academic performance for students by taking further advantage of the features of mobile learning that are likely to provide better opportunities for students.
- Traditional teaching techniques will not address the issue of student demotivation and lack of interest in engaging with class at universities, so it is in the interest of the universities to use online teaching methods to deliver educational content through M-learning.
- Higher education institutions need to develop strong technology-driven education environments to address the needs of the current "on-demand economy" and, more specifically, to meet the demands of *Young Millennials* and *Generation Z* students for customized and customizable educational programs in institutions of education.

6- Conclusion

The results of this current study indicate that the implementation of M-learning, which is focused on students' needs and readiness and is also consistently supported by a teacher, is effective in enhancing and improving student achievement. The results comparing the students of the experimental group (who studied using M-learning) with those of the control group (who used conventional learning) showed that there was a significant difference between learners in the experimental and control groups, in favour of those in the experimental group. In addition, data from the questionnaire also verified that the students in the experimental group had a positive experience with adapting and using their smart phones for acquiring learning materials, as it showed significant enhancement after use of the application. The results regarding attitudes of undergraduate students in the experimental group towards the use of mobile learning also illustrated that the targeted students in the study varied according to gender (with males demonstrating higher levels of acceptance of M-learning) and according to knowledge about using computers (with less computer-literate students demonstrating higher levels of acceptance). Higher education institutions need to conduct future studies that focus on the impact of M-learning on students' achievement, motivation, and involvement in order to obtain more conclusive results.

7- Declarations

7-1-Author Contributions

Conceptualization: N.A. and S.A.; methodology: N.A. and M.E.; software: N.A.; validation: K.A.; formal analysis: N.A.; investigation: S.A.; resources: M.J.; data curation: F.A.; writing—original draft preparation: M.E. and N.A.; writing—review and editing: N.A. and S.A.; visualization: K.A.; supervision: S.A. and M.J.; project administration: F.A.; funding acquisition: M.E. All authors have read and agreed to the published version of the manuscript.

7-2-Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7-3-Funding

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7-5-Institutional Review Board Statement

Not applicable.

7-6-Informed Consent Statement

Not applicable.

7-7-Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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