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The impact of mobile learning in English language classrooms in Pakistan

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Abstract

In the wake of the COVID-19 pandemic, a discernible shift towards mobile learning tools has emerged, supplanting conventional pedagogical methods. Mobile learning (m-learning) constitutes a subset of e-learning, involving the utilization of portable devices for educational purposes. This research undertakes an examination of the impact of m-learning within the context of Pakistani English language classrooms. The study's target population consisted of university students in Pakistan. Five universities in Lahore, Pakistan, were selected using a convenience sampling method. From these universities, a sample of 100 students, enrolled in the first semester of a Bachelor of Science English language learning preparatory year course, were selected based on a simple random sampling technique. Before the experimental phase, the students underwent a pre-test assessment. Subsequently, based on the results, they were evenly divided into a control group and an experimental group. It was ensured that both groups included students of mixed ability levels. The treatment duration spanned 4 months, equivalent to 48 credit hours. The experimental group engaged in learning activities through mobile phones, while the control group adhered to conventional instructional methods. Finally, upon completion of the treatment period, a post-test assessment was administered to the students. Data analysis revealed that the experimental group (Mean: 15.93) exhibited notably superior performance compared to the control group (Mean: 10.12). This outcome highlights the positive influence of m-learning on learners' academic achievements. Furthermore, this enhanced performance reflects learners' favorable reception of mobile phone utilization within the context of English as a second language academic learning.

Keywords: Mobile learning, Mobile phones, English as a second language, Connectivism, Pakistan

Introduction

Technology in the language classroom

The use of technology in modern classroom environments is a trend now (Choi & Chung, 2021). There is a belief that the modern world is a world of visual literacy where computers, televisions, mobile phones, mobile games, social networking websites, chat rooms, emails, and instant messages are common features for communication and entertainment. However, technology aims to go further, precisely in connection with learning (Rafiee & Abbasian-Naghneh, 2021). Learning with the help of technology not

only fosters the process of creativity but also empowers the learners to be autonomous. There are various technological tools used in academic situations. One important aspect of technology inside the classroom is mobile learning (m-learning) which becomes possible by the use of mobile technology, including mobile phones and other communicative devices like laptops, tablets, etc. (Abduljawad & Ahmad, 2023).

Technology in Pakistani classrooms

Pakistani classrooms follow traditional techniques vigorously. The conventional methods of learning and teaching are rigorously practiced, and there are no signs of the latest technology tools in classrooms (Ali, 2023). Since COVID-19, the intrusion of technology has opened up a new window of learning and teaching in Pakistani classrooms, yet it has not been implemented completely. There are glimpses of some new technology tools used in local institutes, yet a huge percentage of learners, teachers, and institutions still focus on traditional ways of learning and teaching (Ali et al., 2021). The most common technology tool utilized in Pakistan is multimedia and speakers. Surprisingly, there is no other tool that has marked its presence in local classrooms. Pakistan is a multilingual country where the value of English is rising rapidly with time. English enjoys the status of an official language, and it is utilized in every discipline. Moreover, English is also the medium of instruction in the Pakistani education system. Despite its popularity, English as a second language (ESL) learning has been a challenge for local learners (Ali, 2022). Being an official language, English enjoys high status, but the majority of Pakistani citizens are unable to communicate in English properly. Research works proved that one of the major reasons behind this failure is the traditional way of learning. This situation calls for the inclusion of modern methods that can significantly help to improve ESL learning in Pakistan.

Mobile learning and Pakistan

Mobile learning, also known as m-learning, is one of the latest sensations in education. A mobile phone can assist in various learning types. Wiboolyasarin and Jinowat (2023) shared that m-learning can be taken as a process that involves learning at multiple levels and instances like content and social interactions and also through the use of personal technological and electronic devices. ÇALIŞIR et al. (2022) explained that m-learning is a method of distance types of education in which learners use a mobile device for learning purposes, keeping in view their convenience and comfort.

Despite the several advantages and capabilities presented by mobile service providers in Pakistan, like high-speed internet and the multiple products and offers, Pakistan is still far behind in using mobile phones for learning purposes by institutions, teachers, and learners. Though there are instances of using mobile phones for learning, holistically they are not used in schools, colleges, and universities (Ali et al., 2020). Using mobile phones for language learning purposes can be considered to be in its very initial phase in Pakistan, and though people are generally aware of this, it is yet to be implemented properly.

The focal point of m-learning is the learner's level of comfort and mobility. With the help of technology, the learner can learn anywhere anytime. This paper aims to investigate the effectiveness of using mobile phones as a tool for m-learning in Pakistan.

Statement of the problem

Like any underdeveloped country, Pakistan is lacking in implementing modern ways of learning and teaching in educational contexts. A country where English is highly valuable as an official language finds it challenging to have teachers and institutes that can provide effective ESL learning. Traditional methods are followed rigorously with the least focus on learning outcomes. Therefore, ESL learning poses a problem in Pakistan. Following COVID-19, the world has seen the value of applying technology in education, and therefore, the use of conventional methods in local settings has raised a lot of questions. There is a strong need to introduce modern technology tools in Pakistani classrooms.

Rationale of the study

In Pakistan, the English language is compulsory till graduation, yet the majority of the learners face difficulties because of their mother tongue background, classroom ambiance, and conventional methods of teaching that focus on rote learning. Traditional methods like grammar-translation are losing their impact on learners, and as a result, learners are reluctant to learn English. On the other hand, the use of mobile phones is getting higher popularity in Pakistan as 189 million are mobile subscribers (Pakistan Telecommunication Authority, 2022). Also, Begum and Hussain (2023) justified the craze of using mobile phones and their impact on the psychological level in their investigation with a sample of 200 participants. This has provided a space where mobile phones can be used for learning purposes. M-learning is an established phenomenon across the globe. It has created positive impacts on learning and teaching, and several researches can prove the reliability and validity of m-learning. The current problems Pakistani learners face in English language learning call for the use of the latest technological tools and techniques to revolutionize and transform traditional learning methods (Abbasi et al., 2022).

Purpose of the study

The core purpose of this study is to take the initiative of applying m-learning inside Pakistani ESL classrooms. The prime objective is to develop attraction amongst ESL learners regarding the exploitation of m-learning and to explore its efficacy amongst Pakistani learners.

Research questions

The following is the main research question that the paper attempts to address:

- What impact does m-learning have on the grammatical skills of English language learners in Pakistan?

Significance of the study

This study serves as a reference point to look at the effectiveness of m-learning in local classrooms in Pakistan. This is important as it will open up new opportunities for new research works to experiment with technology tools in ESL classrooms. This

study is also important since it aims to transform the local learning and teaching environment by involving one of the latest tools for learning and teaching. From the perspective of policymakers, this study can serve as a reference to introduce syllabi that support technological tools in ESL settings. This investigation is also helpful for heads of institutions to support the use of modern technological tools. Moreover, from the teachers' perspective, it can help them to introduce new methods that support technology tools in their teaching.

Literature review

Significance of English as a second language

Second language learning has become a requirement because of international communication among nations. People are now closely connected through different gadgets and tools of technology. The era of global autonomy and the rise of a multiethnic and multicultural society are paving the way for second language learning as it provides individuals with insight and awareness into the cultures of other nations. This view is also supported by Jaekel et al. (2022) who explained that in current times, the need for a second language has gained immense popularity because of hybrid cultures and the social needs of people. The ESL market is evolving because of the rapid growth, appreciation, and popularity of English as a preferred language in various countries, cultures, and societies. In educational contexts, ESL courses help learners to improve their understanding of various aspects of English. ESL learners have a strong desire to learn English to develop their social needs and communication to be a part of globalization. Keeping in view all these aspects, the curricula of English demand the latest methods that lead to more profitable learning and teaching ambiance.

Likewise in Pakistan, English has gained appreciation in society because it helps in the development of career and personal achievements (Ali et al., 2016). It is also a mandatory subject in all classes till graduation.

M-learning

Mobile devices have the quality of being ubiquitous. This has created a revolution in society, which has gradually replaced the paths of communication, learning, and working as well. Particularly after COVID-19, many entities have utilized mobile devices in their operations. This applies to the educational context as well. According to Talan (2020), mobile devices are now a major element in instruction and learning processes. The inclusion of mobile devices has changed our ways of learning, and with the inclusion of high-speed processors and high-speed internet, mobile devices have now become the desired choice in education (Yu et al., 2022). In ESL contexts, the use of mobile phones is gaining popularity in developing countries as well (Al-Temimi, 2017). This has transformed the roles of teachers and learners. Earlier teachers were the central point in the class, whereas now their role has shifted to be a facilitator. Shi and Kopcha (2022) supported this argument stating that teachers are now presenters of information and their role is to mentor the learners. Similarly, content is also an important factor on which learning relies. If the content is not relevant to the needs of learners, it can affect the outcomes of learning scenarios. In m-learning, the content is flexibly connected with methodologies according to the pedagogical needs of learners (Wang et al., 2022). The

environment has also a key role to play in the m-learning situation which can be online or face-to-face. Learners can learn anywhere. Lastly, the assessment mode in m-learning is also different, as quizzes, assignments, and exams are done either online or through different project-based assessments (Alturki & Aldraiweesh, 2022) according to the convenience of learners, and the basic feature of m-learning is the immediate feedback they receive which enables them to improve quickly.

Advantages of m-learning

Criollo et al. (2021) stated that there are some advantages of m-learning which are unique for the learners, instructors, institutional administrations, and other staff as well. Some of these features are usability (Kukulska-Hulme & Viberg, 2018; Tatte et al., 2022), portability (Hameed et al., 2022), ubiquity (Wang, 2022), ease in the learning process (Stecuła & Wolniak, 2022), cost-effectiveness (Inel-Ekici & Ekici, 2022), improvement in communication and social interaction (Park et al., 2012), lifelong and personalized learning (Dalili Saleh et al., 2022), exclusion of spatial and temporal limitations (Belousova et al., 2022), the facility of collaborative learning (Kumar Basak et al., 2018), autonomous learning (Elaish et al., 2023), connectivity (Hussein et al., 2022), mobility (Rohanai et al., 2022), and blended learning (Buraimoh et al., 2023).

Disadvantages of m-learning

Some research works mentioned some disadvantages of m-learning, however. An important disadvantage is the issue of distraction in which the user's attention can be diverted and distracted, and rather than learning they can use social media websites like Twitter and Facebook (Mandasari & Agusty, 2018). Another disadvantage is the factor of privacy of the user which can be preached when learning takes place in a public place or network (Pachler et al., 2009). Furthermore, connectivity is also an issue sometimes as the use of the internet is related to the speed of the internet and data processing (Sung et al., 2016). However, these disadvantages can be controlled with proper management and monitoring.

Theoretical framework

Connectivism: a new paradigm for digital learning

The theory of connectivism posits that knowledge is not confined solely within the learner but rather exists within the informational network of the learner, including organizational networks and social contexts (Siemens, 2005). Consequently, the role of connectivity through blogs, social apps, and social media has become integral to learning (Khan et al., 2023), making it a theory tailored for the digital age (Koutropoulos, 2023).

According to connectivism theory, technology plays a pivotal role in learning. In this theory, learners are regarded as nodes, and the connections they establish through various means such as webpages and mobile apps contribute to knowledge creation. In short, connectivism advocates that technology is reshaping the location, methodology, and content of learning (Langseth et al., 2023).

Hussein (2021) asserts that connectivism is a contemporary learning theory well-suited to the challenges and learning demands of modern classrooms. This theory can

benefit both learners and educators by fostering active and autonomous learners, aligning with modern teaching methods (Omodan, 2023). Connectivism also encourages diverse perspectives through collaborative learning (Dziubaniuk et al., 2023), enabling the social community to connect, share ideas, and enhance their knowledge, making collaboration a cornerstone of m-learning (Wang & Xu, 2023).

Another key facet of connectivism is that, for knowledge acquisition, learning is the connection residing in technological gadgets. Modern tools have significantly impacted learning and teaching methods (Bozkurt, 2023). Yaqian and Qinhua (2023) emphasize that the learning process must be engaging for learners to effectively acquire knowledge, thus necessitating the incorporation of the latest tools to make learning attractive.

Connectivism is learner-centered, with learners responsible for constructing their learning experiences (Adam et al., 2023). Teachers assume the role of mentors who shape learning communities and expose learners to various learning contexts. This perspective is supported by Diordieva and Bonk (2023), who stated that modern learning environments are driven by learners and facilitated by teachers. Parida et al. (2023) advocated that when learners take responsibility for their learning, they become independent and accountable, distinguishing connectivism from other theories like behaviorism and cognitivism. Learners actively engage in decision-making and expanding their learning networks.

Connectivism is technology-dependent, emphasizing the integration of technology for digital learning, including m-learning. This theory finds practical application through mobile phones, utilizing various apps such as social media, purposefully developed apps, and gamification. M-learning enables learners to connect with desired resources and content without being constrained by physical location (Mohammedeen et al., 2023). In summary, connectivism aligns closely with the features of m-learning.

However, it is important to note that some studies have criticized connectivism. Critics argue that it may not be a comprehensive theory but rather a framework for teaching and learning. Ally (2009) suggests that while the world is evolving, it doesn't necessarily render previous theories obsolete; instead, it may be beneficial to integrate older theories with newer ones. Chatti et al. (2010) point out that connectivism may lack elements such as error detection and correction mechanisms and addressing failures, which could leave the theory incomplete.

Recent research works on connectivism

In this era of digitalization, many research works utilized the connectivism theory.

Belda-Medina and Calvo-Ferrer (2022) conducted an investigation into a teacher training program that emphasized a collaborative learning environment utilizing mobile and computer tools. The study included 47 teachers and employed a mixed-method approach to collect data. The findings suggested that learners positively embraced the integration of technology. Furthermore, the study highlighted that the traditional notion of learning as an individual and internal activity no longer holds, as learners adapt to new tools and contexts, viewing the world through a different lens aligned with connectivism theory.

Al Maawali (2022) explored the impact of connectivism on 43 learners from Oman, focusing on its efficacy in enhancing their writing skills. Mobile devices were employed

as study tools, with pre- and post-performance evaluations conducted to analyze the outcomes. The study revealed that connectivism positively influenced learner performance, particularly when learners engaged in collaborative exercises, leading to improvements in their writing abilities.

Mohammedeen et al. (2023) investigated the effect of connectivism on communicative writing through a quasi-experimental study involving 30 first-year university students in Egypt. The study assessed descriptive and narrative writing skills, employing pre- and post-performance tests for data analysis. Results indicated significantly better post-performance outcomes, affirming that connectivism enhances learning by extending it beyond individual boundaries into various contextual realms.

Kilag et al. (2023) conducted a quasi-experimental study with 200 Grade 11 and 12 students in the Philippines, examining the influence of connectivism-based blended learning on learning outcomes. The experimental group, taught with the connectivism theory, displayed notably higher scores in critical thinking and problem-solving tests compared to the control group using traditional methods. The survey indicated positive student perceptions of connectivism-based instruction, particularly online activities and interactions. The study contributes to the literature on blended learning and technology integration, emphasizing its potential relevance to the Philippines' educational landscape. Alam (2023) delved into the shift from teacher-centered to student-centered learning in response to technological advancements and evolving learner needs. The study compared constructivism and connectivism as pedagogical approaches in modern education, identifying their similarities, differences, strengths, and limitations. It underscored that while constructivism is well-established, connectivism is gaining traction for fostering relevant learning in the digital age. Both approaches can enhance student outcomes but require context-specific adaptations. Effective implementation necessitates learner-centered strategies, fostering creativity and critical thinking. The study emphasized the importance of educator training, resource accessibility, and supportive policies in overcoming challenges.

The above research works intended to utilize connectivism to explore the efficacy of m-learning in a local environment. There are earlier studies that focused on other aspects of computer-based learning or mobile phones, but either they have not used connectivism as their baseline theory or they have performed their study in a different environment. This study is one of the earlier ones to explore the efficacy of m-learning in ESL settings using the modern theory of connectivism in this digital age. This study also serves as a guideline for others to perform research using a theory that is pertinent to this era of technology and digitalization.

Materials and methods

Research design

This is a descriptive study. A descriptive study is usually a large-scale study to have an overall picture of a particular group and its characteristics (Strydom, 2013). This research aims to explore the influence of m-learning on the grammatical abilities of ESL learners. For this purpose, a quantitative research design was utilized. According to Creswell and Poth (2016), the quantitative design of research uses statistical ways to present data in a numeric form.

Population of the study

The population of this study comes from all across Pakistan. Going further, the population was precisely BS (bachelor's) 1st semester ESL students who were learning taking fundamentals of English grammar as their course subject in the preparatory year program.

Sampling for the study

According to the need of the research, the sample was collected through a convenient sampling method. Only Lahore was taken as the sample of the study. 100 students were chosen to take part in the study. These students were picked through a simple random sampling method. Before choosing them, their previous marks, family background, social status, health, and other variables were considered. This action was performed to collect the sample from a population that possesses equal abilities and similar backgrounds. In this way, the validity of the procedure of data collection can be assured.

Research instrument

The instrument utilized for this research was mobile phones. Moreover, pre- and post-tests were given to the study participants. The pre-test time was 45 min. This made both groups homogeneous, and there was no bias in the selection of the learners in the groups.

Treatment

This experimental study divided the sample into control and experimental groups. Prior to the pre-test, content validity was established using questions randomly selected from the entire syllabus, encompassing mixed-ability assessment questions. Subsequently, a pre-test was administered to all participants for randomization. Based on their scores, students were allocated to either the control or experimental group, both comprising mixed-ability learners. Special classes were created for both groups to ensure parity in terms of syllabus coverage, instructional time, teaching personnel, and classroom environment. Daily instruction sessions lasting 40 min were conducted for both groups over two months, six days a week. A regular classroom setting was not employed; instead, a dedicated class group was arranged.

The independent variable was mobile phone usage and m-learning, while learners' performance constituted the dependent variable. Several confounding variables, such as learners' socio-economic backgrounds, demographics, teacher mood, and intelligence levels, were minimized to enhance the study's validity. The following steps were taken to minimize confounding variables:

- It was considered that all the participants are coming from the same social and economic conditions and background.
- All the learners were Pakistani natives and residing in Lahore, Punjab.
- Only professional teachers who had the experience and temperament to teach were made part of the study. Therefore, maybe with the exception of rare instances, their mood was positive and they were professional in their dealing with the class.

- The intelligence level here means academic intelligence. For this, students' previous marks in English from their last higher secondary school certificate were the criteria of choosing the participants. This avoided any under-performer to be part of the study.

Additionally, moderators like gender, age, race, marital status, education, digital literacy, ethnicity, subject, teacher, test, classroom settings, prior performance, and lecture timing were considered. MAXMINCON principle by Kerlinger and Pedhazur (1973) was applied to diminish the influence of moderators, and efforts were made to equate both groups to observe a valid impact of the independent variable on the dependent variable. This principle relates the variance to the experimentation procedure.

Procedure of collecting data

Students were taking fundamentals of grammar as their core course. This course relates to teaching tenses, subject-verb agreement, and language functions. This course was similar for all students. Also, the teacher was the same for both groups. After the pre-test, the learners were taught the whole English language syllabus for four months. The class time was 40 min. The learners from both groups were given a similar time and duration for the study. As mentioned earlier, the control group was taught by the traditional method, which was based upon class learning only using the whiteboard and hard copy of the textbook focusing on the grammar-translation method. Contrary to that, the experimental group's learning was done by mobile phones where multiple pertinent software programs were there to assist them in learning even out of class. The monitoring of both groups was made on similar principles. A WhatsApp chat group was also made for the learners of the experimental group where they can collaborate and discuss things related to the syllabus.

It is pivotal to mention here that WhatsApp as an impactful m-learning software was utilized by experiment group learners as it is connected with the m-learning process. It also aids the concept of learning beyond the classroom vicinity. However, the control group learners only learned inside the classroom. Moreover, the control group learners were not restricted to contact the teacher or any peer. So, no implicit contact was formally designed for the control group learners. WhatsApp learning groups have gained a lot of success among education experts (Usman & Bukar, 2022). The aim was to make a collaborative learning and ubiquitous learning platform which is the hallmark of m-learning (Naghdipour & Manca, 2023). It is aptly in line with the connectivism approach. The teacher was part of that group to make sure only academic and related discussion was done in the group. After the completion of the prescribed syllabus, a post-test was conducted. Both the pre- and post-test were of 45 min.

Experiment and results

Data analysis

This research was aimed at exploring the answer to a major research question concerning the impact of m-learning in ESL settings on local learners in Pakistan. For this purpose and to interpret the data collected from pre- and post-tests, SPSS 23.0 was applied.

Table 1 Normality testing and descriptive testing statistics on the control and experimental groups (pre- and post-test scenarios)

Conditions of treatment		M	SD	Skewness (S)	Kurtosis (K)	Shapiro–Wilk
Control group	Pre-test	8.38	1.31	0.64	0.63	2.96
	Post-test	10.12	1.17	0.13	0.41	2.95
Experimental group	Pre-test	8.41	1.28	− 0.11	− 0.59	2.96
	Post-test	15.93	0.87	0.19	− 0.17	2.08

N = 100: experimental group = 50; control group = 50

M mean, *SD* standard deviation, *S* skewness, *K* = kurtosis, *SW* Shapiro–Wilk

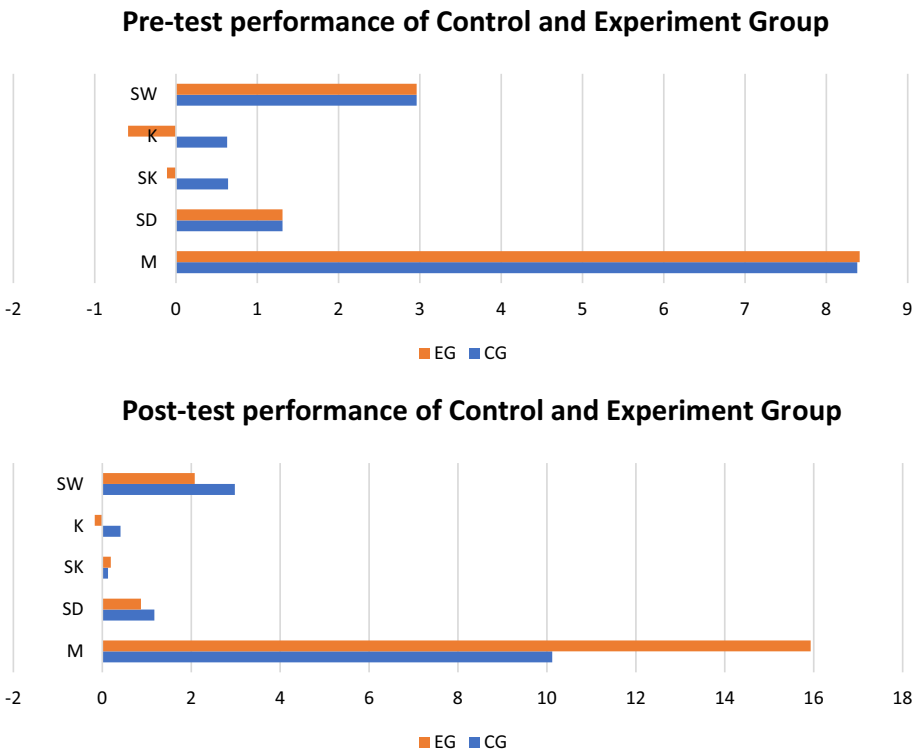

Fig. 1 Pre-test and post-test performance of control and experiment groups

Comparing conditions of treatment and preliminary assumption

Before performing an inferential investigation (for comparing conditions of treatment), preliminary assumptions were observed through kurtosis and skewness. Moreover, an outlier analysis was performed through box-plot and Q-Q-plot, whereas data normality was checked through the Shapiro–Wilk test.

Table 1 and Fig. 1 values reflect the difference in the performance of both groups of mean, standard deviation, skewness and kurtosis, etc. However, focus here to look at the kurtosis and skewness distribution. The kurtosis and skewness distribution show that the values of the data are under the range of acceptability and data are distributed normally. Data are normally distributed if the values of kurtosis are within the range of − 7 to + 7 and skewness from − 2 to + 2 (Byrne, 2010). Moreover, the Shapiro–Wilk test was non-significant, which shows that the data of both groups were distributed normally.

Table 2 Comparison of pre-test scores of both groups ($N = 100$)

Variable	Experimental group ($n = 50$)		Control group ($n = 50$)		*t (118)*	*P*	*95% CI*		*Cohen's d*
	M	*SD*	*M*	*SD*			*LL*	*UL*	
Pre-test	8.41	1.28	8.38	1.33	− 2.79	0.007	− 1.18	− 0.17	0.47

CI confidence interval, *LL* lower limit, *UL* upper limit

Boot-strapping is also a method of validating the analysis which includes independent and paired sample *t*-tests (Laaziri et al., 2019). Then, the next step was to examine the prior results of both groups through independent-sample *t*-testing.

Comparative analysis of pre-test applying independent-sample t-testing for the experimental and control groups

Table 2 reveals that there were significant differences found in the experimental and control groups ($t = -2.79$, $p < 0.01$). The mean score of the pre-test of the experimental group was M = 8.41, SD = 1.28, and that of the control group was M = 8.38, SD = 1.33. The difference here shows that the pre-test mean score of the experimental group was on the higher side. Furthermore, the difference in magnitude or effect size (magnitude of the differences) between both groups was 0.47, and this is Cohen's *d* value. This reflects that the effect size is of medium magnitude as far as difference is concerned (Cohen, 1988).

Comparative analysis of post-tests applying independent-sample t-testing for the experimental and control groups

Table 3 reveals that there were significant differences in post-test found in experimental and control groups ($t = -25.99$, $p < 0.01$). The mean score of the post-test of the experimental group was M = 15.93, SD = 0.87, and that of the control group was M = 10.47, SD = 1.17. The difference here shows that the post-test mean score of the experimental group was on the higher side. Furthermore, the difference in magnitude or effect size (magnitude of the differences) between both groups was 4.86, and this is Cohen's *d* value. This reflects that the effect size is of medium magnitude as far as difference is concerned (Cohen, 1988).

The next step was to analyze the scores of both the experimental and control groups applying paired-sample *t*-testing. This was done to validate the results.

Table 3 Comparison of post-test scores of both groups ($N = 100$)

Variable	Experimental group ($n = 50$)		Control group ($n = 50$)		*t (118)*	*P*	*95% CI*		*Cohen's d*
	M	*SD*	*M*	*SD*			*LL*	*UL*	
Post-test	15.93	0.87	10.40	1.17	− 25.99	0.000	− 5.29	− 4.59	4.86

CI confidence interval, *LL* lower limit, *UL* upper limit

Table 4 Paired samples *t*-testing comparing pre- and post-test of the control group

Variable	Pre-test		Post-test		*t (149)*	*P*	*95% CI*		*Cohen's d*
	M	*SD*	*M*	*SD*			*LL*	*UL*	
Control group	8.38	1.33	10.40	1.17	− 26.13	0.000	− 2.79	− 2.2	4.29

CI confidence interval, *LL* lower limit, *UL* upper limit

Table 5 Item-total statistics

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
Pre-test	10.40	1.298	0.771	0.609	
Post-test	8.38	1.639	0.771	0.609	

Statistical presentation of the items and conditions of what if items deleted along with total and multiple correlation

Comparative analysis of pre-test by paired-sample t-testing for control group learners with Cronbach alpha

Table 4 reveals that there were some differences in the pre-test and post-test results of control groups ($t = -2.79$, $p < 0.01$). The pre-test mean score (M = 8.38, SD = 1.33) was lower in comparison with post-test mean score (M = 10.40, SD = 1.17). The difference here shows that the post-test result was slightly better yet there was no significant variation in their performance. Going further, the difference in magnitude or effect size (magnitude of the differences) amongst both groups was 0.47, and this is Cohen's *d* value. This reflects that the effect size is of a medium magnitude as far as difference is concerned (Cohen, 1988).

Table 5 reflects the total statistics of the items involved in the analysis. The value of pre- and post-tests presents the performance difference, which is further supported by the value of variance and total correlation.

Comparative analysis of pre-test by paired-sample t-testing for experimental group learners with Cronbach alpha

The supposition of the variance of homogeneity was assumed to be F = 0.489 ($p > 0.05$). This shows that the pre-test's variance was invariant amongst both sample groups. Table 6 reveals that there were significant differences in the pre-test and post-test results of experimental groups ($t = -58.96$, $p < 0.01$). The pre-test mean score (M = 8.41, SD = 1.28) was lower in comparison with the post-test performance (M = 15.93, SD = 0.87) which shows significant variation in the performance of

Table 6 Paired samples *t*-testing comparing pre- and post-test of the experimental group

Variable	Pre-test		Post-test		*t (149)*	*P*	*95% CI*		*Cohen's d*
	M	*SD*	*M*	*SD*			*LL*	*UL*	
Experimental group	8.41	1.28	15.93	0.87	− 58.96	0.000	− 6.92	− 6.68	6.28

CI confidence interval, *LL* lower limit, *UL* upper limit

Table 7 Item-total statistics

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
Pre-test (× 1)	16.83	0.955	0.721	0.520	-
Post-test (× 2)	9.85	1.655	0.721	0.520	-

The conditions of scale mean variance and total and multiple correlation of the items if deleted

experiment group. Moreover, the difference in magnitude or effect size (magnitude of the differences) between both groups was 6.28, and this represents Cohen's *d* value. This reflects that the effect size is of a medium magnitude as far as difference is concerned (Cohen, 1988).

Table 7 reflects the total statistics of the items involved in the analysis. The value of pre- and post-tests presents the performance difference which is further supported by the value of variance and total correlation.

Findings of the study

The results of both groups interpreted through SPSS 23.0 reflect pivotal findings. The validity of normal distribution was explored through kurtosis and skewness. The results showed that data distribution was normal. Further, this proof also ascertained that all the values come in the range of acceptability of normal distribution. The values of the Shapiro–Wilk test were not significant, which also validated that the data were distributed normally amongst the groups, and the effect size of both groups was under acceptability range. Moreover, independent-sample and paired-sample *t*-tests were applied to the data. The values showed that there was no vivid difference in the achievement of both groups, and they had identical performance in their pre-tests. However, the results collected from the paired-sample *t*-test showed that there was a remarkable difference in the performance of the control and experimental groups in the post-test. The later group's performance was notably better, and these values ascertained that m-learning created a positive impact on the performance of learners.

Discussion

The study outcomes reveal that learners in the experimental group outperformed those in the control group. While there was little difference in the performance of both groups in the pre-test, a notable difference emerged in the post-test. This validates the positive and effective impact of m-learning intervention, aligning with the findings of Yu et al. (2022) who emphasized mobile phones' role in fostering mutual learning relationships and facilitating the learning process.

Similarly, Ali et al. (2022) shared that m-learning creates an environment conducive to excellence in ESL classrooms. The results are consistent with the observation that the control group's performance exhibited minimal change between the pre- and post-tests. This may be attributed to the fact that conventional settings can often lead to learner disengagement. Wang et al. (2022) had a similar view regarding the uninspiring and demotivating nature of certain ESL lessons conducted through traditional methods.

This study corroborates earlier research indicating that ESL learning has been enhanced through the incorporation of mobile phones, offering features such as mobility and ubiquity (Hameed et al., 2022). The portability and convenience associated with mobile phones are particularly noteworthy. Ubiquity, a hallmark of m-learning, fosters autonomous learning environments (Elaish et al., 2023).

Furthermore, the results shed light on several contributing factors to enhanced m-learning performance. Collaborative learning and interaction played a pivotal role, realized by a WhatsApp group for m-learning sessions. Collaborative learning has had a positive impact on learners, transforming the passive nature of conventional methods. This aligns with the findings of Kumar Basak et al. (2018) and Buraimoh et al. (2023), who emphasized that collaborative learning develops social connections and makes learning impactful and meaningful.

Lastly, another important feature of m-learning is to make learners self-dependent. Here, the performance of the learners showed that they were confident and self-dependent in their learning. Elaish et al. (2023) opined that m-learning makes learners self-dependent as it has changed the role of the teacher from being a dominant figure to that of a facilitator and mentor. It can be seen that the learners became more confident in learning when they started taking ownership of their learning which is exactly the opposite of traditional methods (Shishov et al., 2021). Therefore, m-learning possesses features that increase the efficacy of ESL learning and brings about a modern learning ambiance.

From the perspective of connectivism, the results show that as connectivism is a theory of the digital age, it was aptly used and provided effective results in this study. According to connectivism, learning occurs with connections. This can be validated from the findings here as experimental group learners were connected through m-learning. In particular, the WhatsApp group made their connection easier and supported learning. Ali et al. (2021) stated that WhatsApp has been a modern and vital tool in ESL learning which fosters learning. In the words of Khan et al. (2023), connectivism suggests that technology is changing how, where, and what we learn, and this can be seen in this study. In this study, the place, method, and content became pertinent to the m-learning aspects. This is also supported by Langseth et al. (2023) who claimed that connectivism has changed the previous procedure, place, and style of learning.

Another feature of learning according to connectivism is that it is done through gadgets. AlDahdouh (2017) supported this stating that learning focuses on technological gadgets and their smooth operations help in elevating learning procedures. This feature can also be seen from the findings of this study where all the learning of the experimental group was done through mobile phones which ultimately increased their performance. Moreover, an important feature of connectivism is that learning lies in the diversification of opinions. This can be seen in this study where learners discussed through collaboration various opinions regarding different aspects of the syllabus and chapter. During the discussion, sharing of ideas and knowledge through digital communication took place which ultimately made their learning effective in contrast with the control group as the flow of information through m-learning was faster. This idea is supported by Yaqian and Qinhua (2023) who pointed out that digital communication helps

in having a rapid learning flow and sharing mutual knowledge due to interesting methods. Finally, connectivism admits that the concept of learning can no longer be taken as an individual and internal activity, and the methods of working and functioning of the people are changed when new tools are introduced and utilized (Diordieva & Bonk, 2023). This is true when viewing the results of this study where the induction of a new tool changed the overall procedure of learning and teaching and ways of working. The learners and the teachers of the experimental group were introduced to new methods of learning while using mobile phones.

Inclusively, the outcomes drawn from this study are identical to the study performed by Shadiev et al. (2022) who shared that for the acquisition of knowledge, the digital networking of learning is pivotal and this is a baseline aspect of connectivism. Likewise, the results drawn here support those of the study conducted by Al Maawali (2022) who concluded that connectivism methods helped to learn significantly and the learners developed collaborative learning situations when using mobile phones. Finally, the outcomes of this study are similar to those of Hussein (2021) which was based on connectivism for the development of EFL learners' critical literacy in the Egyptian context. It was found that the involvement of digital learning created a positive impact, which validates the notion of the connectivism theory that claims that collaboration and a different learning environment can elevate learning.

Conclusion

This study was aimed at exploring the influence of m-learning on Pakistani learners. Due to the aims and objectives of this research, a quantitative design was applied for collecting and interpreting results. M-learning has placed its value in other societies. However, in the Pakistani context regarding the said sample, this is one of the initial studies that has tried to explore the worth of m-learning on preparatory year BS students. The results here justified that m-learning is equally effective, interesting, and useful in Pakistani learning situations. It can not only overhaul the old methods of learning but also aid in overcoming language learning inhibitions. Furthermore, the application of m-learning can help to open up new paths of learning in which the learners can be interested and feel independent.

This study has powerful implications for local educationists and policy developers and implementers. M-learning can equip local students with modern methods that can increase their learning horizon as well as performance. Moreover, from the perspective of administrators and policy developers, m-learning can help to achieve realistic and up-to-date learning objectives that are already preactivated in advanced countries from the learner's perspective. M-learning can benefit them in changing the concept of learning and also help to increase their understanding and performance.

This study suggests the following recommendations:

- M-learning training should be cascaded amongst ESL teachers.
- Courses should be designed to include m-learning activities.
- Learners should be encouraged to use m-learning in their learning situations.

- Regular experimentations should be done to select and implement pertinent tools that are in line with the local context.
- Institutional heads should be given awareness and training about m-learning.
- Teachers should be incentivized to use m-learning.

Appendix 1

Background information of the participants of the research.

No		Experimental group	Control group
1	Gender	All students were male	All students were male
2	Age	All students were 18-19	All students were 18-19
3	Previous knowledge of English in terms of marks in the last high school certificate	All students in experiment group got around 75% It is important to mention that the sample's previous marks were identical. They were divided after pre-test and mixed-ability learners were there in both groups to have validity and balance to the sample	All students in the control group got around 75%
4	Number of years of English education	All students in the experiment group received 12 years of English education	All students in the control group received 12 years of English education
5	Previously using mobile learning or not?	No student in the experiment group used mobile learning previously as it is a new method in Pakistan	No student in the control group used mobile learning previously as it is a new method in Pakistan

Abbreviations

BS	Bachelor's
CI	Confidence interval
ESL	English as a second language
LL	Lower limit
M	Mean
m-learning	Mobile learning
SD	Standard deviation
UL	Upper limit

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