**International Journal of Emerging Engineering and Technology (IJEET)**
ISSN (e): 2958-3764
Volume: 5, Number: 1-2, Pages: 63 - 72, Year: 2026 (Special Issue)

# Interactive Mobile-based Learning Environment: A Practitioner's Approach

Ghulam Murtaza Khan *

Department of Computer Science, Shaheed Benazir Bhutto University, Sheringal, Dir (U), 18050, KP, Pakistan

*Corresponding author: Ghulam Murtaza Khan (Email: gmkhan@sbbu.edu.pk)

**Received: 21/08/2026, Revised: 15/10/2026, Accepted: 20/10/2026**

***Abstract*— The aim of this research work is to integrate a mobile-based learning technology ('1Paki mBL') with the Conventional Learning System (CLS) in Pakistan's primary education as a case study. The study was conducted in three phases: planning, conducting and reporting. In planning phase, the input instrumentation including '1Paki mBL', pretests and posttests, and open and close ended questionnaire were designed for data collection. To compare the mobile-based learning technology with conventional learning methods, the pretests were conducted based on conventional learning methods or paper-based, whereas posttests were conducted based on mobile learning technology or '1Paki mBL'. Similarly, open- and closed-ended questionnaires were used to extract teachers' viewpoints on the suitability of the mobile-based learning technology environment. The outcome pointed out that several components of the 'learnability' aspect in terms of mobile-based learning technology were found more efficient compared to the conventional learning system.**

***Index Terms*— Mobile learning, ubiquitous computing, computer-assisted learning, educational technology.**

## I. INTRODUCTION

The rise and widespread use of networked digital media have significantly transformed how people share and learn. Particularly among teenagers and young adults, this "new culture of learning" [1] has led to expertise in various subjects outside formal education and structured training, thanks to diverse digital media resources. Mobile devices [2] offer optimal opportunities for teaching and learning due to their user-friendly touch screens, which facilitate rapid learning. Touch screens [3] are the primary interface for most mobile devices, including smartphones, tablets, and smartwatches, allowing users to engage actively in their digital environments as either producers or consumers [4]. Communication technologies have reshaped not only how we communicate but also how we receive and deliver training. Advances in wireless technology have enabled mobile phones to transmit text, animations, and videos anytime and anywhere. With the decreasing cost and increasing sophistication of mobile devices [5], they have become more prevalent than laptops and desktops in developing countries [6]. Mobile devices offer the potential to integrate learning into everyday environments and enhance learner engagement [7]. In areas with limited educational resources, mobile learning with interactive features may be particularly beneficial [8]. Researchers have explored various uses of mobile phones for education, noting that mobile learning environments can be tailored to learners' abilities and technical skills [9]. Literature suggests that mobile-based learning can make education more engaging and prevent boredom among children [10]. However, due to a lack of comprehensive research, further studies in mobile learning are needed [11]. This study aims to investigate the impact of mobile-based learning technology on traditional educational methods within Pakistan's primary education system.

## II. LITERATURE REVIEW

A software tool was created to enhance grammar instruction within the primary education system in Chile, leading to noticeable improvements in grammar skills for 70% of the students [12]. The authors recommend integrating mobile devices with educational content to further enhance learning. The surge in network and mobile technologies has significantly altered children's learning behaviors [13]. For instance, a mobile-learning tool aimed at children aged 10-12 was developed in Malaysia, featuring science materials aligned with classroom syllabi. This tool included three main components: 'Reading of Notes,' 'Exercise of Lessons,' and 'Get Help' [14]. Heuristic evaluation, effective in assessing usability during the design phase, was used to identify issues and measure usability for a mobile-game-based learning tool [15]. In the Philippines, research was conducted to create a mobile video game for 6th graders to complement classroom learning and gauge student motivation and engagement [16]. The literature includes studies comparing traditional learning systems with mobile learning environments, utilizing both qualitative and quantitative data to assess performance [17]. An interactive game-based learning

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platform was developed to simplify learning processes [18], and a mobile-game-based learning (mGBL) engineering model was proposed to guide the creation of mGBL applications [19]. This model integrates portable game devices into existing e-learning systems, enhancing the appeal of learning and reducing the monotony associated with engineering and science subjects [20]. In the context of methodology, the literature encourages the use of pretest and posttest techniques [21]. Researchers have proposed that placing training in real-world contexts could help students adapt what they learn in the classroom to their daily lives, improving their learning motivation and academic performance [22]. The authors designed an app in order to support pre-literate kids by focusing on audio-based communication and video navigation [23].

However, some researchers point out that insufficient technology is a significant barrier to Pakistan's learning system [24]. The authors in [21] identified several challenges in designing mobile training content, including technological, pedagogical, and management issues. To address these challenges and the technology gap [20], this research integrates a mobile-based learning technology ('1Paki mBL') with the Conventional-Learning System (CLS) in Pakistan's primary education system.

Thus, this study aims to answer the following hypothesis:

RQ:- How does a mobile-based learning technology affect the Conventional-Learning System in the view of 'learnability' in Pakistan's primary education?

## III. METHODOLOGY

Case study is a suitable research method in the field of software engineering because its aim is to analyze the existing phenomenon in a natural context [20]. To support the effort well and achieve the desired outcome, a case study as a research method was planned. Additionally, to conduct and report a case study in software engineering, the guidelines by [22] were followed in this research work. According to these guidelines, the study was performed in three phases: planning, conducting, and reporting.

### *A. Case Study Planning*

In the planning phase, mechanisms were developed to analyse outcomes and evaluate the effects of integration. As per the guidelines, these mechanisms were applied to two groups: children and teachers. The team acknowledged that cultural factors play a role when introducing new technologies or processes. Although Pakistan has diverse education systems, cultures, and standards, these factors were excluded from this study to concentrate on the suitability of mobile-based learning (mBL), as they were deemed outside the research's scope. The focus remained on the 'learnability' aspect, which aligned with the research question concerning the impact of mBL technology adoption.

#### *1) Input-Instrumentation*

The instruments detailed below were meticulously crafted through collaborative efforts for data collection. These tools were designed to address the question, "How can the desired outcome be achieved?" The team involved in this process included a psychologist, a software programmer, a software ergonomics expert, and three senior education specialists.

#### *2) Paki-mBL*

To confirm the proposition and assess its efficacy, a technology called "1Paki mBL" was deployed in objective-C/Xcode platform. This technology was created to offer practice and training materials as part of the initial planning phase of the case study. To ensure precise outcomes, all defined components and their functionalities were integrated into "1Paki mBL'," shown in Fig. 1, which incorporates conventional learning methods used in Pakistan's primary education system. The technology includes a primary category for nursery-level education, with the main menu serving as the entry point for accessing the nursery-level content.




Fig. 1: Main Menu

Upon clicking on the nursery level in the main menu, as given in Fig. 2, the next screen provides the student with the choice to select either the 'Learning-Session' or the 'Exercise-Session', as given in Fig. 3.




Fig. 2: Choice




Fig. 3. Writing-Learning: 'How to draw an alphabet'

This learning component is designed to enhance children's writing skills by providing practice exercises aligned with their classroom work. Specifically tailored for nursery-level students, the activity focuses solely on building foundational writing skills, rather than covering a broad range of tasks like pronunciation and spelling. The "1Paki mBL" device features a touch screen that displays images related to each letter. By touching a specific alphabet key, children can view the corresponding image. In the learning component, labels and arrow keys around the alphabet outline guide users on "how to draw an alphabet" using either a finger or a pointing device. This process is visually demonstrated in the screenshot shown in Fig. 4.

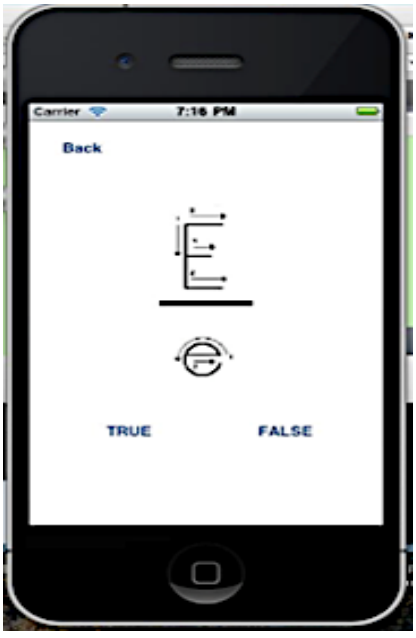



Fig 4: Exercise for Writing

This activity focuses on developing pronunciation skills for kindergarten students by improving their foundational abilities. A single touch on a specific alphabet triggers a multimedia file where a digital tutor pronounces the alphabet and an English word that begins with it. An accompanying image of the word is shown to help reinforce vocabulary associated with each letter. For instance, Fig. 5 shows the digital tutor pronouncing 'C for Cat', accompanied by an image of a cat.




Fig. 5: Pronunciation Learning

The exercise part of this activity contains logical true/false choices for the alphabet images to select from, as given in Fig. 6.




Fig 8: Exercise of Spelling

*3) Pretests and Posttests:*

*Pretest and Posttest* instruments were structured to assess the children's performance. Pretests were created to be administered before the integration of Mobile-based learning (mBL) with the Conventional-Learning System (CLS). The aim was to assess the effects of launching mBL in the company of CLS. The tests were designed to closely align with the Conventional-Learning System, utilising techniques derived from existing teaching techniques in schools. Pretests were intended to be paper-based, and posttests were incorporated following the newly developed mobile technology, '1Paki mBL'. These tests were designed for the nursery level, taking into account children's typical understanding levels, with input from a psychologist and senior education specialists on the team. All tests were conducted according to the current CLS setup. After extensive discussions, the test materials were finalized with the approval of the teachers involved to ensure that children had previously undergone the skill sessions. To maintain consistency, English was chosen as the language for the case study. From the outset, the Pakistani school system emphasized foundational writing skills, and the existing learning techniques were considered effective. Education specialists recommended that the nursery-level test materials focus on writing capital letters from A to Z. These tests were developed upon the recommendations of team members and were used for both pretest and posttest sessions according to our planned case study.

*4) Open- and closed-ended questionnaire:*

To assess the impact of integrating mBL technology with CLS, questionnaires were designed and administered following the implementation of pretests and posttests. Based on the outcomes from these tests, the questionnaires were provided to the relevant teachers to gather their insights, both in freeform and single-choice formats. The case study sessions were conducted at the nursery level in all 11 schools involved in the study. The team psychologist presented several viewpoints for consideration to evaluate the impact of integrating mobile-based learning technology with conventional learning technology. The ages of the children were from 7-10 years, often. They were of both genders. The sample was selected on the recommendation of our team. It is worth noting that prior to the case study execution at these schools, ethical consent was obtained from the school administrations for the purpose of conducting the scholarly research work only at these institutes. To evaluate the effects of mBL technology upon integration with CLS, both open-ended and closed-ended questionnaires were designed, addressing the following viewpoints:

1. 'Interesting': in learners means
2. 'Learnability': in improvement terms
3. 'Exciting':for learners
4. 'Quick Learn': in views of propensity to learning
5. 'Helpful': hope outside the walls of institute
6. 'Like': in terms of teacher views
7. 'Difficult': in terms of teacher views
8. 'User-Friendly': in terms of teacher views
9. 'mBL Suitability': in the holistic views of teachers
10. 'mBL Environment': as a whole (to both learners and teachers) while integrating with CLS

These viewpoints were intended to collect teachers' perspectives and were incorporated into closed-ended questionnaires. On the other hand, the open-ended questionnaires provided additional context and helped to interpret the responses from the closed-ended questionnaires. Both types of questionnaires were completed by the relevant school teachers.

*B. Case Study Conduct*

*1) Data Collection*

During the implementation of the case study, both direct and indirect communication occurred through the pretests and posttests for students, and through questionnaires for teachers. The pretests were conducted using the Conventional-Learning System (CLS), while the posttests were administered using the software application "1Paki mBL'.' Data collected through the questionnaires were both quantitative & qualitative, aiming to compare the authenticity and validity of outcomes for efficient analysis. Cross-questions in the questionnaires further enhanced the soundness of the outcome. Any vagueness or discrepancies found in rare data were returned to the concerned participants for clarification. During the pretests and posttests, the researcher acted as an external examiner for students, which fostered more serious engagement from the students. Throughout the case study, archival data was meticulously managed according to prescribed protocols, ensuring that each step in the workflow was properly documented. The implementation model for the case study is shown in Figure 9, where pretests and posttests are used at the nursery level to compare mBL in the company of CLS, and the suitability of mBL is evaluated using both open- and closed-ended questionnaires for instructors.

*2) Data Analysis*

Analysis of the data was performed based on quantitative & qualitative methods. 'Descriptive' figures were employed to analyze the data, including calculating mean values, valid data, frequencies, and standard deviations, as illustrated by a bar graph.

*3) Reporting*

The hypothesis was initially formulated based on the literature and further clarified after data collection. The constant comparison technique was employed for this purpose. This technique was used to compare both pretests and posttests, as well as to analyze open-ended and closed-ended questionnaires. Initially, the case study provided an unclear picture of the hypothesis. However, after generating the outcome, the hypothesis was confirmed, particularly regarding the mBL suitability in the Pakistani schooling system. This confirmation was supported by additional analysis of statistical outcome presented in tabular & graphical means. The analysis was conducted by both the evaluators and the early planners of the set. At such stage, the previously unclear proposition was clarified through the consolidation of information.

*3.1) Pretests and Posttests Reporting*

A total of 47 children participated in the written tests conducted in separate sessions: the pretest (based on CLS) and

the posttest (based on mBL). The experimental outcome pointed out that mBL is very efficient compared to CLS in terms of 'learnability'. Integrating mBL in the company of CLS represents an advancement in the learning system at the primary education level in Pakistan. Table I shows the outcome of this test, showing that the mean score for the pretest (based on CLS) is 6.43 out of 10, while the mean score for the posttest (based on mBL) is 8.17 out of 10.

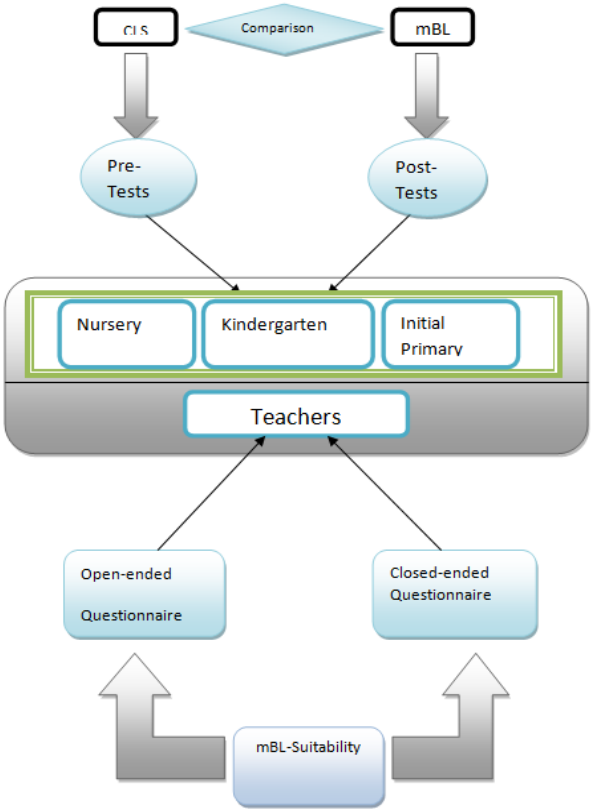



Fig. 9: Case study implementation model.

TABLE I. Outcome of Written Test

| N=47 | Mean |
|---|---|
| Pretest | 6.43 |
| Posttest | 8.17 |

This is illustrated in Fig.10 through bar chart.

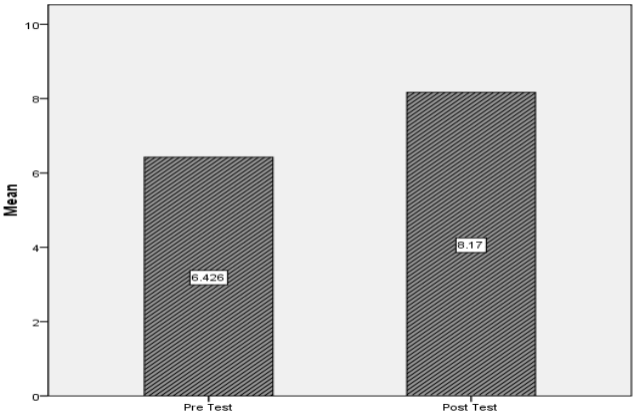



Fig. 10: Writing-Test Outcome

3.2) *Pronunciation-Test Outcome*

A total of 35 children participated in this test. The outcome showed that 'mBL' is more efficient than CLS. If it is incorporated alongside CLS, it conveys advancements to the primary learning system in Pakistan. Table II provides the outcome of this test, showing that the mean score for the pretest (CLS) is "5.77" out of 10, while the mean score for the posttest (mBL) is "9.03" out of 10.

TABLE II: Outcome of Pronunciation Test

| N=35 | Mean |
|---|---|
| Pretest | 5.77 |
| Posttest | 9.03 |

This is shown in Fig. 11 by a bar chart.

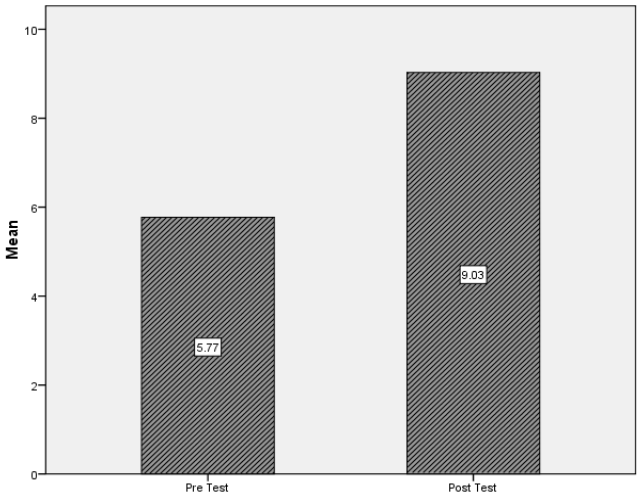



Fig. 11: Pronunciation-Test Report.

*3.3) Spelling-Test Outcome*

A total of 38 children participated in this test. The outcome showed that mBL is valuable compared to CLS in terms of learnability and, if incorporated along with CLS, conveys advancements to primary education in Pakistan. Table III shows the outcome of such a test, showing that the mean score for the pretest (CLS) is '4.39' out of 10, while the mean score for the posttest (mBL) is '6.76' out of 10.

TABLE III: Outcome of Spelling-Test

| N=38 | Mean |
|---|---|
| Pretest | 4.39 |
| Posttest | 6.76 |

This data is illustrated in Fig. 12, which displays the outcome in a bar chart.

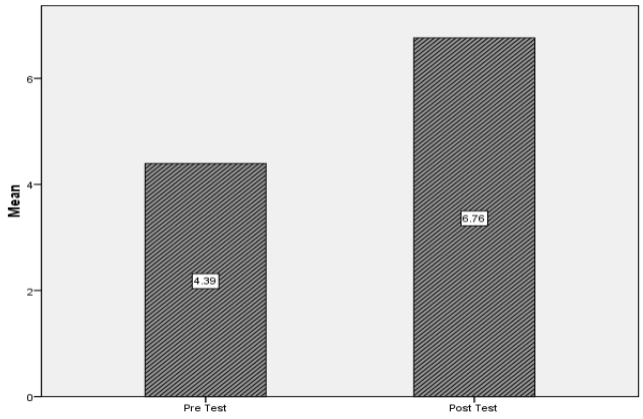



Fig. 12: Spelling Test

### C. Open-Ended Questionnaire Outcome

This section highlights the responses of teachers to open-ended questions.

Q No.1: Teachers suggested that successful integration of mBL in the company of CLS creates a more efficient learning environment for the future. Some teachers from phonics-based schools recommended the development of mBL technologies that align with the reading materials used at their institutions. This feedback was given from a 'learnability' perspective.

Q No.2: During the tests, teachers observed the students carefully and noted that the mBL environment was beneficial for their learning. Teachers remarked that students displayed increased interest in learning while using the technology. This feedback was given from a 'likability' perspective.

Q No.3: Teachers noted that the primary reason for students' attention and engagement in learning was the interesting nature of the mBL technology. This feedback was given from an 'interest' perspective.

Q No.4: Teachers agreed that mBL technology should be utilized for students outside the school environment and acknowledged its usefulness in various settings. This feedback was given from a 'helpfulness' perspective.

Q No.5: Teachers emphasized that student interest is crucial for effective learning, and mBL technology successfully generates this interest. This feedback was a follow-up to Question No. 4.

Q No.6: Teachers observed that students learned in effective way and enjoyed the process with mBL technology. This feedback was given from both 'learnability' and 'excitement' perspectives.

Q No.7: Teachers reported no significant negative outcomes associated with mBL technology. This feedback was given from a 'difficulty' perspective.

Q No.8: Teachers found mBL technology to be user-friendly. They observed that students achieved good outcomes with the touchscreen interface and the overall user-friendly design. This feedback was given from a 'user-friendliness' perspective.

Q No.9: Teachers supported the idea of incorporating mobile-based learning technology in higher classes as well. This feedback was given from a 'mBL environment' perspective.

Q No.10: Teachers considered mBL technology to be an innovative addition to the learning environment and noted that students showed significant interest in using it. They recommended its integration into the education system alongside conventional methods for optimal outcome. This feedback was given from an 'mBL suitability' perspective.

### D. Closed-Ended Questionnaire Report

Thirty (30) teachers filled out the closed-ended questionnaires, offering quantitative assessments of their perspectives. This section offers a numerical evaluation of their views and presents a detailed report on each standpoint.

#### 1) Interesting

As mentioned, one of the key advantages of mBL is its ability to capture interest, which explains why children remain attentive during their learning process. Research has confirmed this benefit across various contexts and cultural backgrounds. Table IV illustrates the findings on this intriguing aspect, with 11 teachers selecting Likert-Scale 4 ("61-80%") and 19 teachers opting for Likert-Scale 5 ("81-100%").

TABLE IV: Interesting-Report

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 4 | 11 | 36.7 | 36.7 |
| 5 | 19 | 63.3 | 100.0 |
| Total | 30 | 100 | |

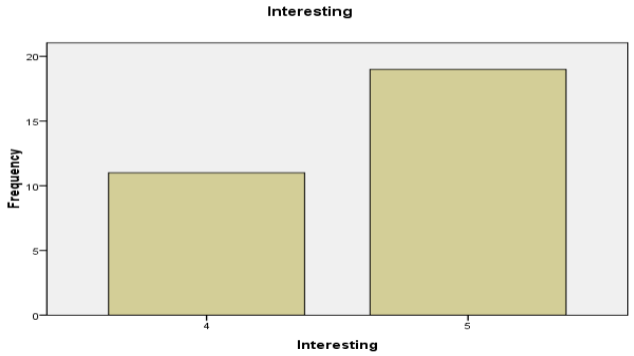



Fig. 13: Graph of Interesting-Report

Table V: Learnability-Report

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 2 | 3 | 10.0 | 10.0 |
| 3 | 4 | 13.3 | 23.3 |
| 4 | 21 | 70.0 | 93.3 |
| 5 | 2 | 6.7 | 100.0 |
| Total | 30 | 100.0 | 100.0 |

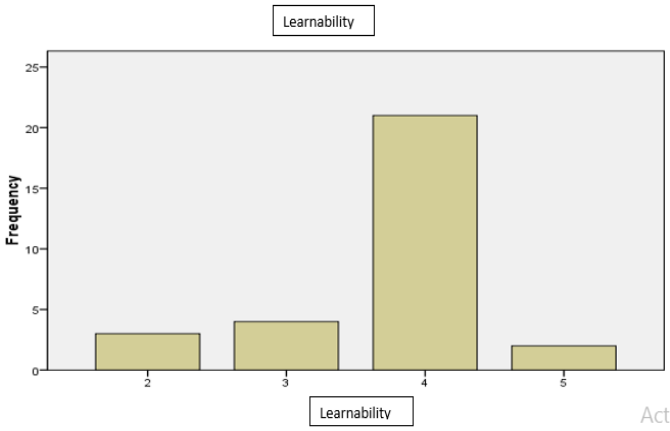



Fig. 14: Learnability-Report as shown in Table V.

*2) Exciting*

Table VI presents the findings related to the exciting perspective. Out of the 24 instructors who selected Likert Scale 5 ("81-100%"), 6 opted for Scale 4, indicating that the predominant rating for the exciting component is nearing Scale 5. The corresponding data is shown as a bar chart in Fig. 15.

*TABLE VI: Exciting-Report*

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 4 | 6 | 20.0 | 20.3 |
| 5 | 24 | 80.0 | 100.0 |
| Total | 30 | 100.0 | |

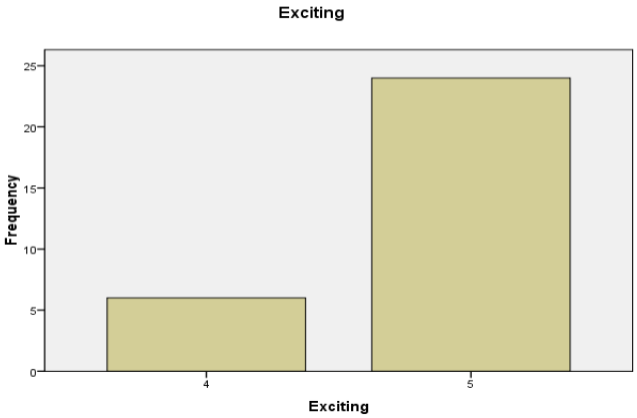



Fig. 15: Exciting Report.

*3) Quick Learn*

Table VII presents the data that opposes the Quick Learn perspective. Among the teachers who used the Likert-Scale, 15 ("41–60%") selected Scale 3, while the other 15 chose other scales, suggesting that the Quick Learn feature is more commonly rated on Scale 3. The corresponding data is illustrated in a bar chart in Figure 16.

TABLE VII: Quick-Learn Report

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 2 | 3 | 10.0 | 10.0 |
| 3 | 15 | 50.3 | 60.0 |
| 4 | 6 | 20.0 | 80.0 |
| 5 | 6 | 20.0 | 100.0 |
| Total | 30 | 100.0 | |

*4) Helpful*

Table VIII displays the findings related to the helpful perspective. Out of the teachers who used the Likert scale, 17 selected Scale 4 ("61-80%"), while the remaining 13 chose different scales. This suggests that respondents predominantly rated the helpful element on Scale 4. The corresponding data is presented in a bar chart in Fig. 17.

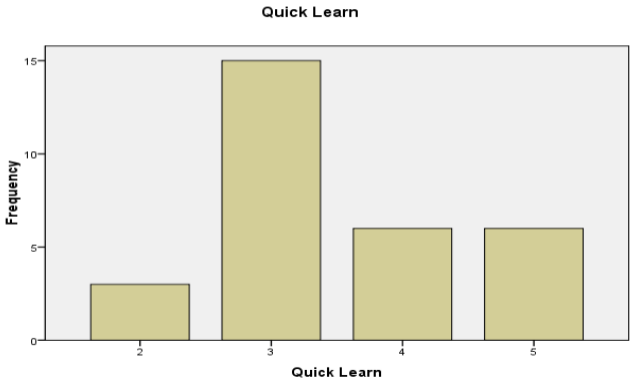



Fig. 16: Graph for Quick-Learn Report

TABLE VIII: Helpful-Report

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 3 | 6 | 20.0 | 20.0 |
| 4 | 17 | 56.7 | 76.7 |
| 5 | 7 | 23.3 | 100.0 |
| Total | 30 | 100.0 | |

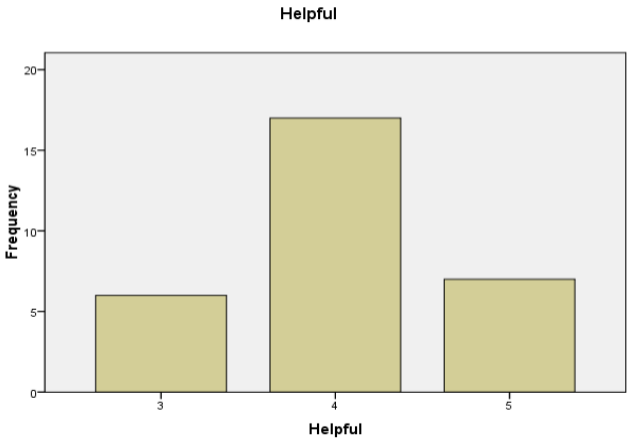



Fig. 17: Helpful-Report

*5) Like*

Table IX shows the findings related to the Like perspective. Among the teachers who used the Likert scale, 17 chose Scale 5 (81–100%), while the remaining 13 selected different scales. This suggests that the predominant rating for the Like component is on Scale 5. The corresponding data is illustrated as a bar chart in Figure 18.

*TABLE IX: Like-Report*

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 2 | 2 | 6.7 | 6.7 |
| 3 | 1 | 3.3 | 10.0 |
| 4 | 10 | 33.3 | 43.3 |
| 5 | 17 | 56.7 | 100.0 |
| Total | 30 | 100.0 | |

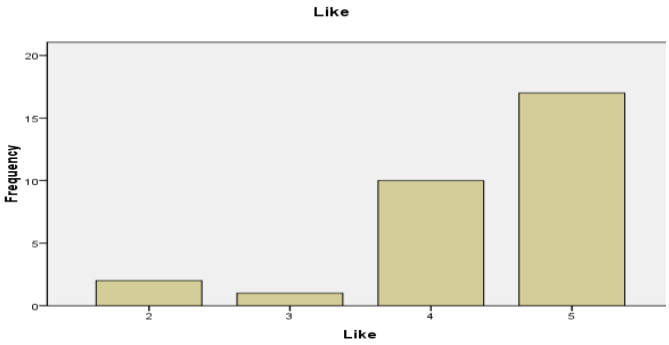



Fig. 18: Like-Report

*6) Difficult*

Table X presents the findings related to the difficult perspective. Ten teachers selected Likert-Scale 2 ("21–40%"), while the remaining twenty chose different scales. This indicates that the predominant rating for the difficult aspect is close to Scale-2. The corresponding data is depicted in a bar chart in Figure 19.

*TABLE X: Difficult-Report*

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 1 | 10 | 33.3 | 33.3 |
| 2 | 10 | 33.3 | 66.7 |
| 3 | 6 | 20.0 | 86.7 |
| 4 | 4 | 13.3 | 100.0 |
| Total | 30 | 100.0 | |

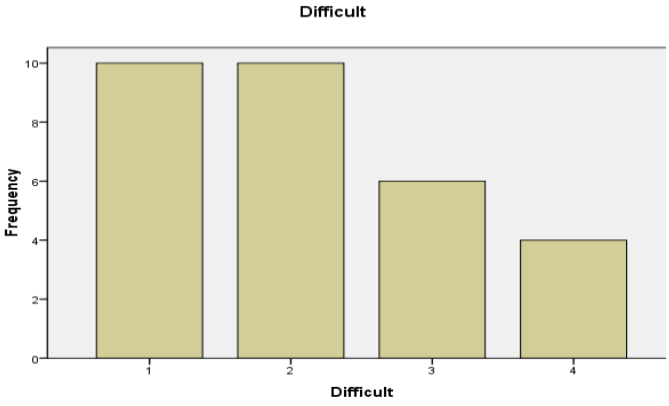



Fig. 19: Difficult-Report

*7) User-Friendly*

Table XI presents the findings regarding the User-Friendly perspective. Out of the teachers who responded, 25 selected Likert-Scale 4 ("61-80%"), while the remaining 5 chose different scales. This indicates that the predominant rating for the User-Friendly element is on Scale-4. The corresponding data is depicted in a bar chart in Fig. 20.

*TABLE XI: User-Friendly Report*

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 3 | 4 | 13.3 | 13.3 |
| 4 | 25 | 83.3 | 96.7 |
| 5 | 1 | 3.3 | 100.0 |
| Total | 30 | 100.0 | |

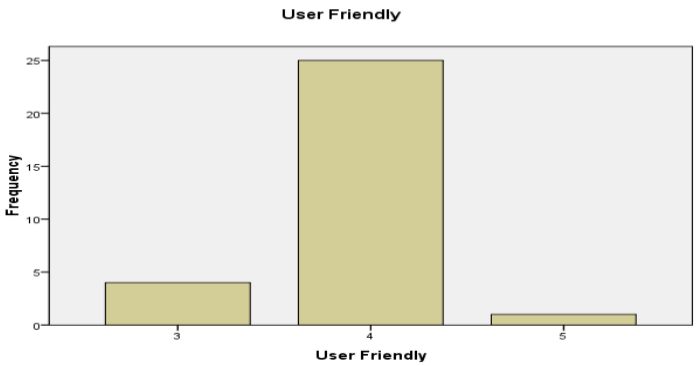



Fig. 20: Graph of User-Friendly Report

*8) mBL-Environment:*

Table XII provides an analysis from the perspective of the mBL Environment. Among the teachers, 14 chose Likert-Scale 4 ("61-80%"), another 14 chose Likert- Scale 5 ('81-100%'), and 2 chose Scale 3 ('41-60%'). This suggests that the most common rating for the User-Friendly aspect falls between Scales 4 and 5. Figure 21 displays this information in a bar chart.

*TABLE XII: mBL-Environment*

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 3 | 2 | 6.7 | 6.7 |
| 4 | 14 | 46.7 | 53.3 |
| 5 | 14 | 46.7 | 100.0 |
| Total | 30 | 100.0 | |

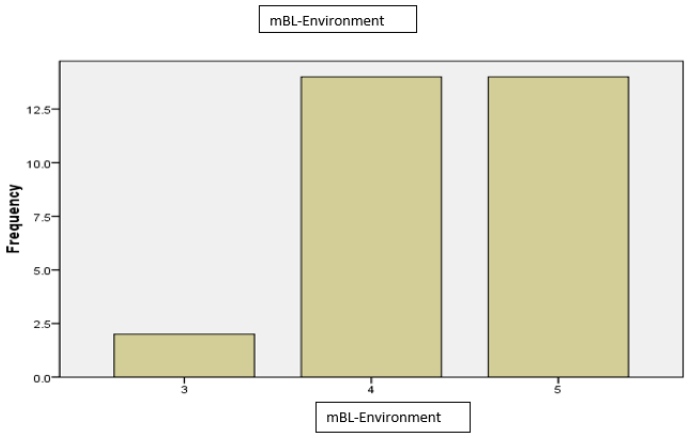



Fig. 21: mBL-Environment Report

*9) mBL-Suitability for Learning-Environment*

Table XIII summarizes the outcome from the mBL-Suitability perspective. Among the teachers surveyed, 19 chose Likert- Scale 5 ("81-100%"), 10 chose Likert Scale-4 ("61-80%"), and one chose Scale 3 ("41-60%"). This indicates that such aspect is predominantly rated at Scales 4 and 5. The findings are illustrated in Figure 22 as a bar chart.

*TABLE XIII: mBL-Suitability*

| Likert-Scale | Frequency | % | Cumulative% |
|---|---|---|---|
| 3 | 1 | 3.3 | 3.3 |
| 4 | 10 | 33.3 | 36.7 |
| 5 | 19 | 63.3 | 100.0 |
| Total | 30 | 100.0 | |

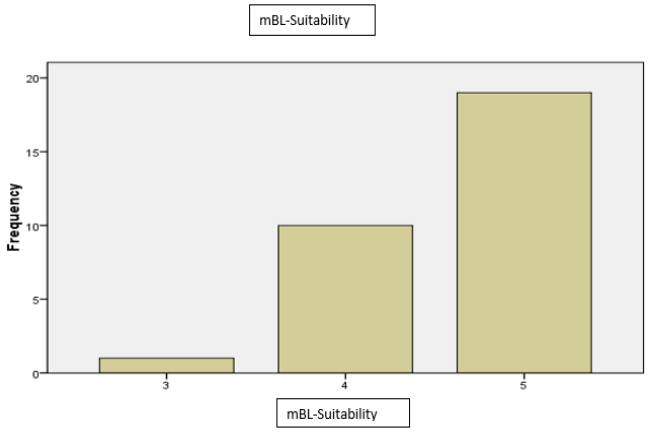



Fig. 22: mBL-Suitability

*10) Summarizing overall mBL-Suitability Report:*

Table XIV summarizes the viewpoints on the suitability of mBL, presenting the mean values, standard deviations, and statistical terms for each viewpoint. These mean values are based on a five-point Likert scale (1 through 5), with N indicating the total number of teachers who filled out the questionnaire. Figure 23 displays the data from Table XIV in a bar chart format.

*Table XIV: Summarizing outcome of overall mBL-Suitability*

| N=30 | Mean-value | Std-Deviation |
|---|---|---|
| 'Interesting' | 4.63 | 0.490 |
| 'Efficient' | 3.73 | 0.740 |
| 'Exciting' | 4.80 | 0.407 |
| 'Quick-Learn' | 3.50 | 0.938 |
| 'Helpful' | 4.03 | 0.669 |
| "Like' | 4.40 | 0.855 |
| 'Difficult" | 2.13 | 1.042 |
| 'User-Friendly" | 3.90 | 0.403 |
| "mBL-Suitability' | 4.40 | 0.621 |
| "mBL-Environment' | 4.60 | 0.563 |

Figure 23 depicts the said report via a bar chart.

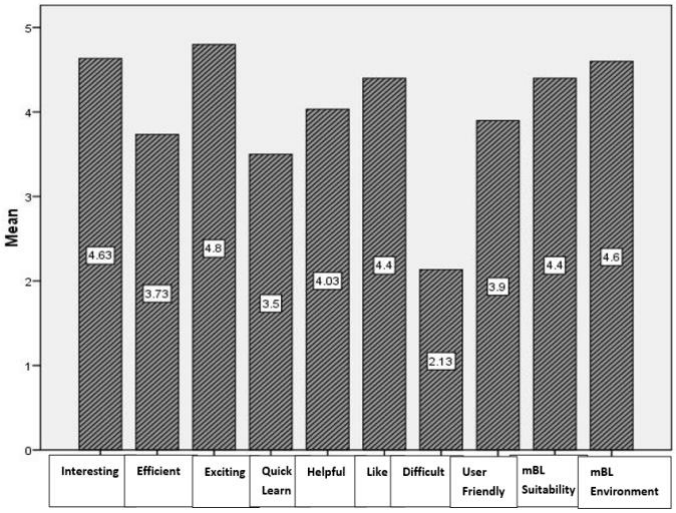



Fig. 23: Close-ended Questionnaire based mBL Suitability

## IV. STUDY LIMITATIONS & FUTURE WORK

This research effort only focuses on the primary learning system of Pakistan. Other education systems were disregarded in order to concentrate on the suitability of the mBL and were deemed outside the purview of this study. Future research could be done to increase awareness of the applicability of mBL in Pakistan's higher education system.

Some testing results present mixed outcomes that might be clarified with future studies on mBL.

The "'1Paki mBL'" prototype supports focuses on English subjects taught in Pakistani primary schools. Additionally, the "'1Paki mBL'" prototype needs to be improved in accordance with the elements listed under each of the four Heuristic Evaluation Strategy aspects. The "'1Paki mBL'" prototype can only be used with the iOS (iPhone) operating system, but an Android prototype of the same design may be created in the future.

## V. CONCLUSIONS

Modern society is increasingly adopting mobile-based-learning technology for educational purposes, tailored to various cultural and educational contexts. In this vein, this research explores the use of mobile-based-learning technology within the framework of Pakistan's primary education system as a case study. The study's outcome indicate that the 'learnability' aspects of mobile-based-learning is very efficient than Conventional-Learning Systems. Additionally, various viewpoints suggest that integrating mobile-based learning with conventional methods is well-suited to Pakistan's education system, creating a more effective learning environment. The author hopes that the study will serve as a foundational study for other scholars in the domain.


## FUNDING STATEMENT

The author(s) received no specific funding for this study.


## CONFLICTS OF INTEREST

The authors declare no conflicts of interest to report regarding the present study.

## AUTHOR CONTRIBUTIONS

Conceptualization, methodology, software, validation, writing: original draft preparation, writing: review and editing, data curation, investigation, visualization, formal analysis, resources, G.M.K.

## INSTITUTIONAL REVIEW BOARD STATEMENT

Not applicable.

## INFORMED CONSENT STATEMENT

Not applicable.

## DATA AVAILABILITY STATEMENT

Data is available on reasonable request.

## CONSENT FOR PUBLICATION

All authors have read and approved the final version of the manuscript and consent to its publication.

## DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

For preparing this manuscript, the authors have only made use of generative artificial intelligence systems to enhance language proficiency, grammar, and readability.

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**Ghulam Murtaza Khan** secured his PhD in computer science / Software Engineering from University of Malakand, Pakistan. Earlier, he secured MS degree in software engineering from International Islamic University Islamabad, Pakistan.

He is serving as a Lecturer in the Department of Computer Science at Shaheed Benazir Bhutto University, Sheringal, Dir Upper, KP, Pakistan, since 2014. He is also serving as a member of Software-Engineering-Research-Group (SERG) at University of Malakand, Pakistan.

His research interest includes mobile learning, computer assisted learning, e-learning, interactive learning, artificial intelligence, machine learning, software engineering, software outsourcing, global software development, empirical software engineering, cloud computing, requirements engineering, and green computing. He has published dozens of papers in reputed journals, for example PLOS ONE, IEEE Access, Journal of Software: Evolution and Process, and Security and Privacy etc. He also provides his services as a guest reviewer in numerous reputed journals like computers & education, J. of Software: Evolution and Process, and Common Ground Network etc.