Assessing the Impact of Mobile-Based Training on Teachers' Achievement and Usage Attitude

https://doi.org/10.3991/ijim.v16i09.30519

Nisar Ahmed Dahri[1](✉), Muhammad Saleem Vighio[1], Omar A. Alismaiel[2], Waleed Mugahed Al-Rahmi[3]
[1]Quaid-E-Awam University of Engineering, Science and Technology, Nawabshah, Pakistan
[2]College of Education, King Faisal University, Alhasa, Saudi Arabia
[3]Faculty of Social Sciences & Humanities, School of Education, Universiti Teknologi Malaysia, Johor, Malaysia
dahrinisar@gmail.com

Abstract—Teachers' professional development plays a key role in imparting quality education. However, the design and delivery of quality professional development is a challenging problem due to numerous issues. The COVID-19 pandemic has further escalated the challenging situation and severely affected trainers' and trainees' interests, motivation, and engagement. Due to its ubiquitous, flexible, and cost-effective nature, technology is playing a key role in carrying out educational activities even in the pandemic situation. However, little emphasis has been provided on the use of technology for the professional development of teachers. This study investigates the effects of mobile-based training apps on teachers' learning outcomes and attitudes towards their usage. For the training and assessment purposes, 308 in-service elementary school teachers from division Shaheed Benazirabad were chosen and divided in experimental and control groups. Pre and post-tests were designed to examine the effects of mobile-based training on the teachers' learning outcome and attitude toward the use of the training app before and after the training intervention. The analysis of the results determined that the training through a mobile app significantly affects teachers' learning outcomes in terms of knowledge, skills, and dispositions. Furthermore, teachers showed a positive attitude towards the use of training app.

Keywords—CPD, mobile learning attitude, academic achievement, ICT, professional development, Teachers Training, COVID-19

1 Introduction

The COVID-19 outbreak has not only sparked a worldwide health catastrophe but has also impacted the learning process all over the world, particularly in developing countries. Since the first wave of COVID-19, the education system all around the world has been disrupted with the closure of institutes. This has badly affected learners' knowledge acquisition, interest, and engagement. Thanks to technology, even after the closure of institutes, learning activities have continued using distance (or online) learning modes. In Pakistan, to ensure educational continuity, the national

and provincial governments moved fast to implement several programs. The multimodal approach comprised television, radio, and text messages to offer educational content [1]. However, up to now, the sole focus of the educational emergency programs has been school education. In contrast, only a little or no emphasis has been paid to the professional development of teachers. Due to the negligence, the overall learning outcome of teachers has been very disappointing [2]–[4]. In addition to that, many other obstacles also hamper developing countries from having a robust teaching profession, including teacher absenteeism, lack of a training system, lack of content knowledge and skills, and politically influenced appointments, all of which contribute to poor learning outcomes [5]. Effective professional development for teachers is essential in reforming the education system. Alhassani (2012) said that student achievement and teaching quality are strongly linked; therefore, teaching requires information, skills, and awareness. The teachers' professional development has to be rethought. Educators and learners alike may benefit from technological and pedagogical advancements that allow for a better learning experience. Technological advances make education more widely available, more easily scaled, and more adaptable than ever before [6] Franklin describes mobile learning as "learning that takes place anywhere, at any time." This concept highlights the ability of learners to engage with other professionals regardless of their economic, geographical, cultural, or socio-political disparities, as well as their flexibility, empowerment, and ability to learn. To overcome teachers' technophobia, UNESCO discussed the potential of the mobile device to support teacher development in the following areas: 1) mobile support for teacher training; 2) supporting teachers' professional development; 3) supporting teachers' teaching practices 4) supporting learners' interaction and collaboration 5) On-the-job assistance, and so on [7].

1.1 Purpose and importance of the study

The school education sector plan [8] promulgated by the Sindh government emphasizes increasing teachers' professional skills by designing training plans, optimizing the organizational structure of teachers, raising the professional level of teachers, and teaching more effectively. The Teacher Education Development Policy (TED) is being suggested at the same time to promote the development of education and the general enhancement of educational quality [9]. However, this is not possible without improvements in current teaching (or professional development) trends and skilled teaching staff. Teachers' professional development is a systematic and targeted learning activity as part of the teacher's overall professional development strategy to increase the knowledge and skills of teachers to provide quality education [10]. Although most institutes (particularly in developing countries) strive to improve their learning outcomes, many fall short of the mark because of their dependency on ineffective conventional continuous professional development (CPD) programs. The traditional professional development models, such as the cascade model, the top-down training approach, or school cluster-based CPD models, have been in use in the province of Sindh for many years. Still, they have significant limitations, like the lack of use of technology and the lack of professional and academic assistance [10], [11]. Teachers' professional development needs more attention and better delivery mechanisms supported by technology to provide state-of-the-art education to teachers. Many mobile communication technologies

and devices have become available in recent years with a broader acceptance and interest from individual and collaborative learning perspectives. The flexibility and simplicity of mobile-based teachers' continuous professional development make it convenient and practical for teachers to get professional competency [11]–[15]. The use of portable electronic devices such as PDAs, tablet PCs, and cell phones (including smartphones) as technology integration is becoming increasingly common in the academic world. Similarly, the use of M-Learning in educational institutions is also on the rise [16]. Mobile technologies have grown in popularity because they provide learners with numerous opportunities to learn both inside and outside of the classroom [1], [16], [17]. According to research, mobile technology in teacher education institutes has been identified as a vital component of teachers' continuous professional development [14], [18]. That m-learning can reach learners who cannot attend training in person is an important consideration. In addition, it can assist learning and adapt to a wide range of teaching methods [19]. The government of Pakistan has taken various national initiatives during the pandemic COVID-19, such as the Tele School (an educational television initiative that reaches up to 6 million learners per day). Education.pk (an online portal that contains educational materials) and education radio (which broadcasts four hours of educational programming on the radio, nationally, per day) have been complemented by provincial initiatives such as Punjab's Taleem Ghar and Sindh's Digital Learning Platform [1]. The literature analysis suggests that boosting learning outcomes through mobile-based professional development apps is a new and emerging trend requiring special attention, particularly in Sindh, Pakistan.

1.2 Problem context and objectives of the study

Mobile learning is seen as an alternative learning method to support teachers' professional development; it becomes more customized and convenient for teachers, allowing them to work, learn, and attain training courses in the workplace. This research aims to evaluate the effectiveness of a framework that will be utilized to construct mobile-based training for the professional development of teachers in Sindh that is tailored to the requirements of Pakistani instructors. In a step forward, in [20], we have developed an MCL (Mobile Collaborative Learning) framework for the CPD of teachers in Sindh, Pakistan. However, its impact on professional growth has not been analysed in the context of developing nations. The study's main objective is to investigate the effect of mobile-based training on teachers' achievement and attitudes towards its usage. Furthermore, the study sub-objectives are as follows:

- To find out how a mobile-based training app affects teachers' learning results,
- To find out how a mobile-based training app affects teachers' attitudes.

2 Related work

For many years, traditional professional development models such as the cascade model, mentoring, and, more recently, school based CPD training approaches have been

used without the support of any technology tools in the province of Sindh. Yet, they have significant limitations [10]. According to a policy suggestion from the school administration, every teacher should have the opportunity to participate in in-service training at least once every five years. However, current training practices in Pakistan, where a primary school teacher typically receives an opportunity for in-service training after 13 years of service, an elementary school teacher gets this opportunity after eight years of service, and a secondary school teacher receives this opportunity after 16 years of service [3], [4], [8]. Aside from that, several donor agencies, including the Canadian International Development Agency (CIDA), the United States Agency for International Development (USAID), the World Bank (WB), the Asian Development Bank (ADB), the Department for International Development (DFID), the European Commission (EC), UNICEF, and UNESCO, are assisting in the dissemination of teacher education programs in Pakistan in order to improve teaching quality throughout the country [3], [4], [8].

Major CPD implementation challenges are lack of financing or budgeting for institutions to train a vast number of teachers every year, and adhoc training initiatives without considering the requirements of students and instructors are implemented with donor assistance in Pakistan [9], [15], [21], [22]. Nowadays, it is becoming increasingly common in academia to use smartphones to communicate. Similarly, mobile learning (M-Learning) is gaining popularity in educational settings [16]. While mobile learning can meet this demand, most existing research focuses on the benefits of mobile-based training for teachers. There is a lack of research on teacher professional development. A research-informed, theoretical framework for integrating mobile learning into teacher professional development is required. Franklin describes transferable knowledge as "learning that takes place anywhere, at any time."

UNESCO and Nokia created a mobile learning program for pre-primary teachers in rural Pakistan between 2012 and 2014. After a three-day face-to-face session in Early Childhood Education (ECE), participants received six months of free internet access to download a series of follow-up video lectures through their mobile phones. The study was conducted on 150 rural Pakistani pre-primary schoolteachers. In the final assessment, UNESCO observed that teachers were using more innovative teaching approaches and had increased mobile phone skills. However, some substantial connectivity issues were also noticed, prohibiting many rural teachers from downloading videos. This highlighted the lack of basic infrastructure, preventing many rural pupils from using educational technologies [7]. Even though there is a rising trend towards mobile technology for improved student learning, there is currently little research on the use of technology for the capacity building of teachers in Pakistan [1], [10]. The use of m-learning applications in teacher training and its association with learning outcomes might have major consequences for altering educational systems and providing instructors with a more enriching learning experience. Rahimi and Miri utilized a pre-test and post-test quasi-experiment to assess the learners' learning outcomes. The experimental group utilized a mobile dictionary loaded on their phones, and the control group used just the printed edition of the same dictionary. According to the research findings, the experimental group performed better than the traditional one in the post-test [23].

Various research has shown that the usage of mobile apps has an impact on learning outcome [12], [16], [23], and [24]. Arian et al. [16] conducted experimental research to determine the influence of a mobile learning app on engineering university students, and

a mobile app was designed to evaluate first-year university students. The experimental group received an anatomy smartphone app, whereas the control group received traditional face-to-face classroom instruction. According to the study's findings, the experimental group utilizing the mobile app performed better than the control group [24].

Abu-Al-Aish and Love (2013) proposed a model that identifies the factors influencing M-learning acceptance in higher education based on the unified theory of acceptance and use of technology (UTAUT). The research used gender, major, age, mobile device experience, M-learning use, frequency of M-services for learning, and M-learning understanding to identify participants [25]. Dahri et al. (2021) enhance the UTUAT2 model by including additional collaborative learning theory constructs to accept mobile-based teacher training. The study demonstrates a very positive attitude of participants regarding the use and acceptance of technology in their classroom setting [20]. Most mobile learning projects occur in isolation, with little connection to teacher development programmes or more significant ICT efforts and aims [7]. As a result, many mobile learning initiatives may not have directly influenced educational practice. Professional development is an active, constructive, progressive, and self-directed process that is based on the learner's mental activity [6], [13], [26] state that because of the advanced technology integrated within, mobile learning can provide such cognitive, social, contextual, and spatial activities through microlearning all day long, making education more self-directed and controlled. The literature study shows that adopting mobile apps to improve learning abilities is a new trend that requires attention, especially in developing countries where mobile apps are not utilized as a standard for teacher training. As a result, this research aims to contribute to the existing body of knowledge within the framework of teacher education and development. Mobile-based CPD framework of teachers.

The current CPD training offered in Sindh, Pakistan, is based on traditional face-to-face approaches that fail to recognize the critical role of technology to support collaborative learning, provide ongoing and mentoring support to teachers, facilitate interaction between peers, and receive help from educators [15]. By keeping in mind the limitations of traditional CPD, in [20] we have developed an enhanced CPD model for schoolteachers in the province of Sindh, considering the advantages of technology usage. The key features of the improved CPD model are its cost-effectiveness, flexibility, contextualization, collaborative learning, resourcefulness, and facilitation. Figure 1 depicts the enhanced CPD model proposed for teachers' professional development. As shown in Figure 1, the CPD activity starts at the taluka level at which the targeted school clusters are formed. Guide teachers (GTs) are chosen for each cluster of 15–20 schools for teachers' training, mentoring, and support. As shown in Figure 1, initially, student learning needs are identified based on provincial or national curriculum standards for all classrooms using large-scale assessment reports. In addition, data from programmatic activities related to continuing professional development (CPD) is used to identify student learning needs. In the second phase, the professional development needs of teachers (to meet the needs of students) are identified. Based on the results of the first and second steps, the third step determines and matches CPD interventions with the requirements of students and teachers. In the fourth step, the development and implementation of CPD activities/materials and training are carried out through the mobile app. In the fifth stage, TEI specialists and guide teachers (GTs) will be brought in to provide training, mentoring, and support at the taluka, cluster, and school levels. Finally, in the last step, the evaluation of CPD programs is performed to assess teachers' learning outcomes.

Fig. 1. Enhanced CPD model [20]

2.1 Mobile-based app: an overview

Based on the enhanced CPD model, a mobile app has been developed to facilitate the continuous professional development (CPD) of teachers in approved clusters and schools. Teachers, GTs, and TEIs can use the app to connect, discuss, and share context information in order to improve their teaching and learning practices. Using the App, all teachers, guide teachers, and experts register for CPD sessions, including workshops, CPD courses, promotion-linked training, etc. These activities include live sessions, text, video-recorded sessions, audio, polls, quizzes, group assignments, discussion forums, etc. In the absence of an industry-standard or an official rating system for children's apps, websites or blogs are often consulted when choosing apps by parents and educators [19]. According [27], it was determined that school administrators in the younger age group experienced greater levels of COVID-19 phobia and family work/work family conflict than their peers from other age groups. Also, scientific mapping on management and administration related to COVID-19 has shown that the trend of publications revolves around specific groups and the field of health, so making progress in other professional collectives can enrich scientific knowledge [26]. Previous research on mobile learning and social networking and their practical utility yielded similar results [13], [28]–[30]. It is foreseeable that the implementation of mobile learning, big data, and online learning would sweep away the sharing of information and knowledge, consigning it to a drawer of institutional history [31], [32]. Alternatively, the adoption of mobile learning and online learning could lead information management back to the dark ages, with a strong focus on correlation and technology and a recorded heightened

risk of failure [33], [34]. As well, Karakose et al. (2021) revealed that the level of use of digital technologies by school principals during the COVID-19 pandemic was perceived as adequate by teachers [26]. In addition, it was determined that school principals support digital transformation and technology-based professional development in schools. Similarly, Karakose et al. (2022) revealed a positive relationship between the COVID-19 related quality of life and loneliness, and that loneliness significantly positively predicts Internet addiction [35]. However, it was found that burnout associated with COVID-19 significantly and positively predicted depression and directly affected COVID-19-related burnout, depression, and social media addiction [36].

The App's ongoing assistance feature allows teachers and professionals (GTs, TEI specialists) to connect and discuss problems and solutions. The ongoing assistance allows teachers to post problems relating to content, pedagogy, or assessment in a discussion forum for debate with peers to guide teachers and subject specialists in clusters. Teachers and their mentors exchange and discuss ideas and practices. They emphasize methods, talk about their needs, and link their professional capacity development activities together. Teachers can improve their performance and overcome their weaknesses by utilizing ongoing support (see Figure 2). The App also implements many advanced features, such as online training courses, live meeting option, activity calendar, live workshop facility, collaborative learning tools for group work and collaborative tasks, the discussion forum for group and peer discussion, a chatbot for private discussion, and resources (like textbooks, curriculum, training manuals, lesson plans, worksheets, videos, audio, classroom observation tools, assessment tools, online assignment submission, help and FAQ, and so on). Appendix A gives screenshots of the app's features.

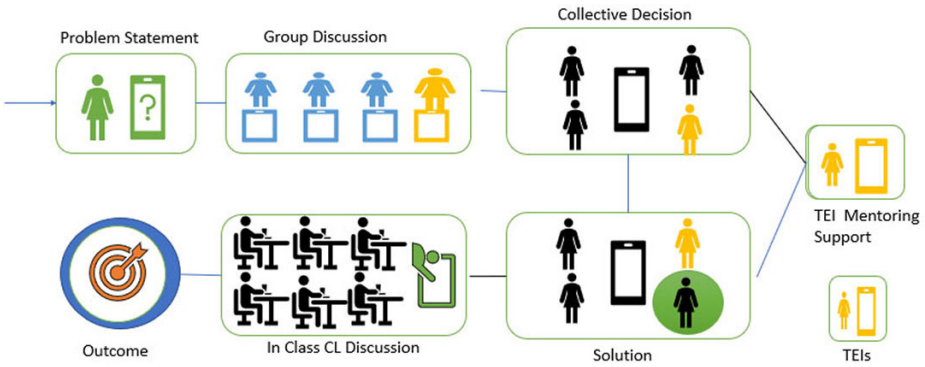


Fig. 2. Ongoing support system

3 Methodology

To assess the impact of the training app on the learning outcomes of teachers and their attitude towards the use of the app, Total Population Sampling, which is a convenient and purposeful method of sampling, is used to pick respondents with similar attributes or those who fit particular criteria. For the two-week training activity for the academic session 2021–22, 308 in-service Junior Elementary School Teachers

(JESTs) from three districts of the Shaheed Benazir Abad (SBA) were selected for the two-week training activity. Based on the random selection, teachers are grouped into experimental and control groups. The experimental group consists of 158 teachers who are trained through the mobile app. On the other hand, 150 control group teachers are trained using the traditional face-to-face mode of training. A quasi-experimental approach is employed with the help of pre and post-test questionnaires in order to assess the effects of mobile-based training on the learning outcomes of teachers and their attitude towards mobile-based training. The study's independent variable is induction training, which is supported via a mobile application and conventional training. The experimental model employed in the investigation is depicted in Table 1. An achievement test is conducted on both experimental and control groups before and after the experimental procedure to determine the effects of the experiment on the teachers' learning outcomes. The pre-test is used to determine the teachers' prior knowledge of the training course. The learning outcomes of trainees are tested using a standard MCQ test containing 30 questions authorised by "content developers and training experts" from teacher training institutions. According to all experts, the test was used to measure past understanding of the training course. The prior knowledge used in this study has a specific significance related to the training course. The MCQ test is designed with the subject domain in mind to determine prior knowledge as a control variable to see both groups' initial understanding levels in terms of knowledge and skills. After the training sessions, the same MCQ test is conducted as a post-test to assess the teachers' learning outcomes for the training course. The learning outcomes were evaluated based on content knowledge and skills acquired during the training [16]. An attitude scale with 55 items drawn from 14 constructs has been used (see section 4.3). The impact of all 55 items has been assessed for both experimental and control groups before and after the experimental procedure. The 5-point Likert-type attitude scale is adapted from the literature with some paraphrasing [20]. The 5-point Likert-type scale was graded into five categories: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). For the data analysis, SPSS 21.0 software is used.

Table 1. Research design

Groups	Pre-Test	Experimental Manipulation	Post Test
Control Group	Pre-Test (Achievement Test) Attitude scale toward mobile-based training	Attend two-week Traditional Method Face to face training (Physical) Access training manual in hard and soft copy via mobile But have online support via the App They don't have access and collaborative learning tool	Post Test (Achievement Test) Attitude scale toward mobile-based training
Experimental Group	Pre-test (Achievement Test) Attitude scale toward mobile-based training	Attend two-week Induction Training via Mobile App Access training content via mobile App Learn in a collaborative environment Attend Live Session Group work, Pair activities, and Discussion activities via the App	Post Test (Achievement Test) Attitude scale toward mobile-based training

3.1 Data analysis

Achievement test (Pre and Post Test). The goal of the achievement test was to see whether there was a difference in teachers' learning outcomes before and after training. With the help of test development specialists, the exam was created using a table of specifications (ToS) that kept the training material in mind. The researcher had to analyze, correct, and remove some aspects in light of the reviewers' input and remarks. So, as a final version, the researchers formulated a 40-item accomplishment exam that was pre-tested on 75 instructors while maintaining test validity and reliability. The TAP (Test Analysis Program) tool was used to conduct statistical analysis. Due to poor item uniqueness power, 10 items were eliminated from the test. The reliability coefficient of a 23-item KR-20 test was 0.84, which is close to 1, indicating that the test is trustworthy (Perry & Nichols, 2014). The test items' distinctiveness index was determined to be very good (0.49), while the test item difficulty was judged to be average (0.63).

Attitude scale toward mobile-based training. The 5-point Likert-type attitude scale is adapted from the literature with some paraphrasing [20]. The 5-point Likert-type scale was graded into five categories: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). Before the main study, a pilot test of 75 instructors was undertaken to confirm that the questionnaire was reliable. The Cronbach's alpha technique was used to ensure that the data was consistent. According to [37], Cronbach's alpha value should be more than 0.7. All of the constructions have Cronbach's alpha values greater than 985. Furthermore, the demographic data were analyzed in SPSS 20.0 using descriptive statistics. Descriptive statistics describe and arrange the features of the responses. In addition, t-tests (independent t-test and pairwise t-sample test) were used to compare the performance and attitudes of the two groups.

4 Results

4.1 Demographic data analysis

The study's sample consisted of 308 in-service elementary school teachers selected from the division of Shaheed Benazir Abad. Table 2 gives information about the sample's demographic characteristics. Based on the random selection, the experimental group contained 159 teachers, with 100 male and 58 female teachers. On the other hand, the control group included 150 teachers, with 126 male and 24 female teachers.

Table 2. Distribution of population-based on gender and group

Distribution	Group	N	Male	Female	Total
	Experiment	158	100	58	308
	Control	150	126	24	

According to the age categories of instructors, 90 (29.2%) teachers are aged between 25 and 30 years, 195 (63.3%) are aged between 31 and 40 years, and 23 (7.5%) teachers are aged between 40 and 50 years. Participants' qualification records show that out of 308 teachers, 73 (23.7%) hold bachelor's degrees, 230 (74.7%) have Master's or

MPhil qualifications, and only one percent have a PhD degree. Aside from academic qualifications, 136 (44.2%) teachers hold a B.Ed. Professional degree, 162 (52.6%) teachers hold an M.Ed. Certification, and 6 (1.9%) teachers have an associate degree in education. When questioned about their internet connection at home, 61% said they used a cellular connection, 20% had access to a broadband Evo internet connection, and 19% had access to a DSL internet connection. On the other hand, teachers have access to 4G internet service on their mobile phones, with only 22% having 3G or 2G internet service. It is also important to note that 300 (95%) of the teachers/respondents already had face-to-face training experience. In comparison, only 3% have participated in web-based training courses, and 2% of teachers have experience of both modes of training. However, none of the respondents had previous experience with mobile-based training activities.

4.2 Impact of the mobile app on teachers' achievement

At the beginning of training, a pre-test was conducted to assess teachers' prior knowledge and confirm that both groups possessed equivalent subject matter knowledge and skills. The findings of the pre-test are provided in Table 3. As shown in Table 3, the mean and standard deviation of the pre-test for the experimental group are 15.7 and 4.2864, respectively, and for the control group, the values are 14.79 and 4.1665, respectively. The mean and standard deviation values indicate no significant difference in the subject knowledge of both groups before the training. This is evident from the significant value, which is 0.05 [16], [20], [24], [38], [39].

Table 3. Pre-test achievements

Test	Group	N	Mean	Std. Deviation	T	Df	Sig.
Pre-Assessment Test	Exp	158	15.7	4.2864	1.899	306	0.058
	Control	150	14.79	4.1665			

Besides the pre-assessment test, an independent t-test was conducted to compare the learning outcomes of both groups. The findings in Table 4 show that the mean value of the post-test for the experimental group is 25.13, and for the control group it is 23.6. The post-test values for both groups indicate that mobile-based training significantly impacts teachers' learning outcomes compared to traditional training. This is consistent with [16], [38], [39] results about the growth of learners' success and enhanced cognitive abilities as a result of mobile-based training.

Table 4. Achievement test (independent sample t-test)

Test	Group	N	Mean	Std. Deviation	T	Df	Sig.
Pre-Test	Exp	158	15.7	4.2864	1.899	306	0.058
	Control	150	14.79	4.1665			
Post-Test	Exp	158	25.134	5.014	2.64	306	0.009
	Control	150	23.66	4.8089			

In addition to the independent t-test, a paired t-test is also conducted to compare teachers' achievement levels based on pre-test and post-test scores of both experimental and control groups. The results provided in Table 6 shows statistically significant differences in the pre-test and post-test scores of both the experimental and control groups with $p<0.001$. As evident from the pre and post-test results, the findings prove that both groups' learning outcomes have improved. While the experimental group's learning outcomes are higher than the control group, the control group's pre-and post-tests are also statistically significant, as shown in Table 5.

Table 5. Paired sample t-test

Group	Test	N	Mean	Std. Deviation	T	Df	Sig.
Control	Pre	150	14.79	4.1665	–20.405	149	0.000
	Post	150	23.66	4.8089			
Experiment	Pre	158	15.709	4.286	–22.781	157	0.000
	Post	158	25.139	5.014			

4.3 Teachers' attitude toward mobile-based training

Many factors, such as performance expectancy, effort expectancy, and so on, can have a direct impact on one's attitude toward the use of training apps. By following Nisar et al. [14], an attitude scale has been adopted containing 55 times from 14 constructs with four items for performance expectancy (PE), four items for effort expectancy (EE), four items for facilitating conditions (FC), four items for hedonic motivation (HM), four items for mobility, three for knowledge acquisition (KA), five for content and information quality (CIQ), five for on-the-job support (S), four items for reward (R), four items for collaborative learning (CL), four items for interactivity with peers and experts (INT), three for engagement (ENG), and four items for behavior intention (BI) [20]. It is worth mentioning that all constructs are designed from the perspective of an updated CPD model and the mobile-based training software to gain a better understanding of mobile usage.

Pre-assessment of the attitude of teachers toward mobile-based training: Before the start of the training, a pre-attitude assessment test was conducted for all the constructs to determine the attitude of participants towards the use of the training app. Results for the mean value for the positive attitude of experimental (E) and control (C) groups are depicted in Table 6. Factor-wise results for both groups suggest no statistically significant difference between the experimental and control groups in terms of their mean scores and significant values, which is > 0.05.

Table 6. Independent t-test of attitude based on all constructs

Factor	Group	N	Mean	Std. Deviation	Std. Error Mean	T	df	Sig.
PE	Exp	158	3.0	.719	.057	–6.837	306	0.060
	Control	150	3.5	.694	.057			
EE	Exp	158	3.5	.778	.062	1.903	306	0.058
	Control	150	3.3	.728	.059			
HM	Exp	158	3.1	.731	.058	–0.360	306	0.719
	Control	150	3.1	.800	.065			
FC	Exp	158	2.7	.673	.054	–0.865	306	0.388
	Control	150	2.8	.690	.056			
INT	Exp	158	2.8	.823	.065	–3.967	306	0.000
	Control	150	3.2	.920	.075			
ENG	Exp	158	3.0	.964	.077	–1.107	306	0.269
	Control	150	3.1	.945	.077			
CL	Exp	158	3.1	.785	.062	–3.398	306	0.001
	Control	150	3.4	.901	.074			
KA	Exp	158	3.0	.593	.047	–3.018	306	0.003
	Control	150	3.2	.575	.047			
CIQ	Exp	158	3.2	1.001	.080	–2.832	306	0.005
	Control	150	3.5	1.023	.084			
S	Exp	158	3.1	1.114	.089	0.625	306	0.532
	Control	150	3.0	1.251	.102			
SM	Exp	158	3.3	.983	.078	–1.418	306	0.157
	Control	150	3.5	.958	.078			
M	Exp	158	3.5	1.136	.090	2.488	306	0.013
	Control	150	3.2	1.040	.085			
R	Exp	158	3.5	1.070	.085	3.430	306	0.001
	Control	150	3.1	1.143	.093			
BI	Exp	158	3.8	1.037	.083	2.364	306	0.019
	Control	150	3.5	.957	.078			

Performance expectancy (PE) on attitude toward mobile-based training: Teachers' attitudes and opinions about the effectiveness of the mobile-based training application were investigated using the paired-sample t-test before and after the training intervention. As a result, a statistically significant difference is seen between the pre- and post-test of participants, as reflected by the mean scores of both groups. As shown in Table 7, the post-test results prove that the training through the mobile App significantly improves the performance of the participants. The effects of the training app on participants' performance for both groups are shown in Table 8 in terms of their mean scores, standard deviation, and significant values.

Table 7. Effect of PE on attitude toward mobile-based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	t	Df	Sig.
PE	Exp	Pre	3.0	158	.7193	.0572	–25.077	157	0.000
		Post	4.7	158	.4689	.0373			
	Control	Pre	3.5	150	.6942	.0567	–16.579	149	0.000
		Post	4.7	150	.4872	.0398			

The influence of effort expectancy (EE) on attitudes toward mobile-based training: Before and after training interventions, the same pair t-test was utilised to assess the training app's ease. As shown in Table 8, there is a statistically significant difference in the mean scores of both groups of teachers toward utilising the training app. The ease-of-use future of the App changed the participants' perceptions towards the use of the App due to its simple and user-friendly environment.

Table 8. Effect of EE on attitude toward mobile-based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	T	df	Sig.
EE	Exp	Pre	3.5	158	.7776	.0619	–10.879	157	0.000
		Post	4.3	158	.6170	.0491			
	Control	Pre	3.3	150	.7277	.0594	–13.564	149	0.000
		Post	4.3	150	.5888	.0481			

Hedonic motivation (HM) and attitudes toward mobile-based training: The t-test was used to calculate the average degree of motivation among teachers regarding the adoption of the mobile-based training application. The results provided in Table 9 show the statistically insignificant difference in average motivation between the experimental and control groups (t = –24.087, t = –20.458, respectively) and p 0.05. See Table 9. The study findings indicate that both groups have a high level of motivation to use mobile-based training applications because of the enjoyment, pleasure, and fun-based training activities.

Table 9. Effect of HM on attitude toward mobile-based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
HM	Exp	Pre	3.1	158	.7309	.0581	–24.087	157	0.000
		Post	4.7	158	.4881	.0388			
	Control	Pre	3.1	150	.7996	.0653	–20.458	149	0.000
		Post	4.7	150	.5025	.0410			

Effect of facilitating conditions (FC) on attitude toward mobile-based training: Teachers can employ a mobile-based training system in their schools if they have access to favorable conditions such as technological resources and organizational support. The pre-assessment results determined that teachers have fewer enabling resources

available to utilize mobile-based training for their ongoing professional development. The t-test was used to assess the adoption of a training app based on the availability of resources. Based on the results as shown in Table 10, there is a statistically significant difference in the mean scores of both groups' pre-and post-tests towards the adoption of the mobile app in terms of facilitating conditions. Teachers believe that they will be able to manage resources such as smartphones, the Internet, and other resources that will be required for attending training programs.

Table 10. Effect of FC on attitude toward mobile-based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
FC	Exp	Pre	2.7	158	.6731	.0535	–22.737	157	0.000
		Post	4.4	158	.6339	.0504			
	Control	Pre	2.8	150	.6904	.0564	–22.746	149	0.000
		Post	4.4	150	.5489	.0448			

Interaction with peers and experts (INT), engagement (ENG), and collaborative learning (CL) influence attitudes toward mobile-based training: Teachers' attitudes toward the training app, which allows them to communicate and engage with peers and experts while also leading them in knowledge exchange within cluster groups, have also been evaluated. The test has been performed by considering numerous dimensions such as interactivity with peers and experts (INT), engagement (ENG), and self-management (SM) in connection with collaborative learning (CL). The paired-sample t-test was used to assess the participants' attitudes before and after the training program. For the experimental group, the pre-test and post-test mean scores for interactivity with peers and experts were 3.5 and 4.3, respectively. For engagement, the mean scores are 3.5 and 4.3, respectively. For self-management, mean scores for pre and post-tests are 3.5 and 4.3, respectively. For collaborative learning, the mean scores are 3.5 and 4.3, respectively see Table 11.

The result for the control group show that there is a statistically significant difference in average teachers attitudes toward engagement (ENG), interactivity with peers and experts (INT), and Self-Management (SM) and Collaborative learning in mobile-based training based on their t-test and significance values: engagement (ENG) (t = 0.3.991, p 0.001), INT (t = 0.235, p 0.001), and self-management (SM) (t = 0.08, p 0.05), collaborative learning (t = 0.235, p 0.001). The findings of this study encourage teachers' and experts' participation in mobile-based training activities, which has a positive attitude of teachers on their professional accomplishment in the long run.

Table 11. Effect of INT, ENG and CL on attitude toward mobile-based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
INT	Exp	Pre	2.8	158	.8231	.0655	–20.359	157.000	0.000
		Post	4.5	158	.5994	.0477			
	Control	Pre	3.2	150	.9199	.0751	–12.889	149.000	0.000
		Post	4.4	150	.5884	.0480			
ENG	Exp	Pre	3.0	158	.9643	.0767	–20.175	157.000	0.000
		Post	4.7	158	.4584	.0365			
	Control	Pre	3.1	150	.9451	.0772	–19.000	149.000	0.000
		Post	4.7	150	.4331	.0354			
CL	Exp	Pre	3.1	158	.7854	.0625	–19.248	157.000	0.000
		Post	4.5	158	.5731	.0456			
	Control	Pre	3.4	150	.9011	.0736	–11.084	149.000	0.000
		Post	4.4	150	.6145	.0502			
SM	Exp	Pre	3.3	158	.9831	.0782	–10.077	157.000	0.000
		Post	4.3	158	.6768	.0538			
	Control	Pre	3.5	150	.9584	.0783	–7.381	149.000	0.000
		Post	4.2	150	.7327	.0598			

Effect of mobility (M), Knowledge Acquisition (KA), and Content and Information Quality (CIQ) on attitude toward mobile-based training:

When compared to the other elements, teachers' perceptions of mobile-based training are highly influenced by the mobility factor. The findings determined that the ability to access mobile-based training from any location and at any time motivates teachers to take advantage of it by receiving real-time support from domain experts at the classroom level. Table 10 highlights that the teachers' attitude has increased in the post-test as compared to the pre-test score of participants. There is a statistically significant difference in the mean scores of the experimental group (pre-test 3.5, post-test 4.5) and the control group (pre-test 3.2, post-test 4.5). Moreover, the significance values for both the experimental ($t = 9.771$) and control ($t = 13.368$) groups are also less than p 0.05.

Other sub-dimensions of KA and CIQ also significantly impact participants' views about mobile-based instruction. The findings relate to improving instructors' overall performance in terms of knowledge acquisition (i.e., developing new skills and information) and encouragement. Teachers were excited to discover new teaching approaches, assessment techniques, and instructional planning techniques using mobile technology for professional development. In addition to classroom support, the mobile-based training app assisted teachers in gaining new expertise. Aside from that, content and information quality are also important aspects of this research that impact teachers' perceptions. Teachers' views on the quality of content and information have a greater influence on satisfaction than students' views on providing up-to-date and relevant content information that is comprehensive, easy to understand, and well-organized.

Table 12 shows a statistically significant difference between the two groups' mean scores before and after the study.

Table 12. Effect of M, KA and CIQ on attitude toward mobile based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
M	Exp	Pre	3.5	158	1.1356	.0903	–9.771	157	0.000
		Post	4.5	158	.5387	.0429			
	Control	Pre	3.2	150	1.0402	.0849	–13.368	149	0.000
		Post	4.5	150	.5849	.0478			
KA	Exp	Pre	3.0	158	.5928	.0472	–22.789	157	0.000
		Post	4.5	158	.5375	.0428			
	Control	Pre	3.2	150	.5754	.0470	–20.188	149	0.000
		Post	4.5	150	.5439	.0444			
CIQ	Exp	Pre	3.2	158	1.0007	.0796	–15.027	157	0.000
		Post	4.5	158	.5059	.0402			
	Control	Pre	3.5	150	1.0233	.0836	–10.189	149	0.000
		Post	4.4	150	.5795	.0473			

Effect of Ongoing support (S), Reward (R) on attitude toward mobile-based training: The trainees' attitude toward the ongoing support facility has also been assessed. The ongoing support assists in overcoming worries about pedagogy, evaluation, and content that arise while on the job. The teachers believe that the training application's support and facilitation were extremely helpful in addressing classroom-level challenges, exchanging information with peers or experts, and receiving feedback from specialists. The results of the attitude analysis are provided in Table 13, which shows that there is a substantial difference in the pre and post-test mean scores of both groups with p 0.05. The t-test was used to determine the average degree of reward benefits among teachers of mobile-based training applications. Besides ongoing support, the reward factor has also been investigated. The results provided in Table 13 show that the reward has a statistically substantial impact on performance, motivation, interest, and learning outcomes. The results also show that on-the-job support (S) and reward (R) statistically impact teachers' learning attitudes with M = 4.7 and p 0.05.As evidenced by the data, the findings reveal that the experimental technique has a statistically significant impact on the attitude toward using mobile-based training. The experimental and control groups' post-attitude mean scores were 4.8 and 4.5, respectively, which highlights that the teacher's attitudes towards using a mobile-based training program in the future are favorable.

Table 13. Effect of S, R and BI on attitude toward mobile-based training

Factor	Group	Test	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
S	Exp	Pre	3.1	158	1.1142	.0886	–14.175	157	0.000
		Post	4.5	158	.5374	.0428			
	Control	Pre	3.0	150	1.2512	.1022	–11.519	149	0.000
		Post	4.4	150	.5728	.0468			
R	Exp	Pre	3.5	158	1.0696	.0851	–12.684	157	0.000
		Post	4.7	158	.4349	.0346			
	Control	Pre	3.1	150	1.1435	.0934	–15.140	149	0.000
		Post	4.6	150	.4449	.0363			
BI	Exp	Pre	3.8	158	1.0372	.0825	–10.973	157	0.000
		Post	4.8	158	.4996	.0397			
	Control	Pre	3.5	150	.9574	.0782	–11.092	149	0.000
		Post	4.5	150	.63314	.05170			

5 Discussion and conclusion

Learning outcomes improve as learning experiences become more varied and richer. As a result, the enrichment of learning experiences improves learning outcomes. The learning outcomes of training can be influenced by various factors such as background knowledge of the training intervention, attitudes about the technology-based training system, motivation to learn, and involvement and engagement in the training courses. This study investigates the impact of mobile-based training apps on the learning outcomes of schoolteachers and their attitudes towards the use of the apps. Specifically, two instruments have been developed: pre and post-test questionnaires and an attitude survey tool. A random drawing is used to divide the participants in the CPD activity into two groups, i.e., experimental (n = 158) trained through the mobile App and control (n = 150) trained through traditional face-to-face training. The information gathered from the participants was analyzed with the help of the SPSS 21.0 software by employing multiple statistical analysis techniques. According to the findings, the experimental technique had a statistically significant impact on the achievement of the learning outcomes of participant teachers. Before the training intervention, teachers had the same level of fundamental prior knowledge based on their previous educational background. The findings revealed no statistically significant difference between the experimental and control groups ($P > 0.05$) in terms of prior understanding of the course and attitude toward mobile-based training. During the treatment process, participants in the study took part in an intensive two-week training course with ongoing support, which provided them with opportunities to learn new skills and improve their knowledge. Teachers also participated in collaborative learning activities, which allowed them to improve their prior knowledge. After the experimental treatment, the experiment and control groups' pre and post-test results differed statistically (p 0.001). Pre and post-test results

imply that both groups improved their learning outcomes. The results of these studies [12], [14], [16], [24], [38] have shown that mobile-based training or learning improves learners' academic performance in terms of learning outcomes and support the results of this study in depth. Furthermore, teachers' positive attitudes towards mobile-based training applications are very satisfying and show their positive learning experience when using mobile learning. Furthermore, the study revealed that mobile learning was more effective than the use of traditional teaching methods in engaging learners to achieve higher performance levels, with achievement test scores of m = 25 for mobile-based training via App (experimental group) and m = 23 for traditional training methods (control group). In other words, teachers' understanding, and knowledge acquisition of the training content provided through the mobile-based training app was substantially better than their colleagues' understanding and knowledge acquisition of the same content provided through the use of traditional teaching methods, i.e., face-to-face training. Such achievement and impact may be associated with a number of factors in mobile-based training. Smartphones have the potential to make learning more convenient and faster by eliminating the need for time and location limitations. On the other hand, learners might benefit from the flexibility that M-learning provides by being able to easily communicate and debate the learning themes with peers or educators at any time and from any location. As a result of teachers' active interaction with the instructional materials through mobile devices and the support of interactive features in the learning and teaching environment, mobile learning has contributed to enhancing the effectiveness of the teacher's role. [40] showed that teachers had a positive attitude toward mobile learning, which supports their findings. It was discovered in this study that both groups had positive attitudes towards mobile learning, which was consistent with the findings of research [14], [18], [20], [32], [41], [42]. The study's findings indicate that in-service teachers in school education who utilised the mobile app for their continuous professional development had better learning outcomes. The difference between the two groups was considered statistically significant because the experimental group received higher scores on their post-test achievements than the control group. As a result, the app has considerably improved the overall performance of teachers in terms of knowledge, skills, and dispositions. One of the key objectives of this study was also to determine how teachers felt about mobile-based training programs. The aptitude test results showed that teachers have a positive attitude toward mobile-based training due to its convenience, flexibility, and ease of use features. The rapid development of mobile applications and easy network connections enable individuals to self-develop, share knowledge, and access information at any time.

Limitations: The study sample size was limited since just one teacher type was chosen for the intervention, and other teachers, such as primary, elementary, secondary, and subject specialists, were eliminated. Researchers will need to learn more about what other teachers think about mobile-based teacher professional training to conduct a more in-depth study, including conducting interviews to uncover deeper impacting factors and paying attention to this group. Under this expanded CPD paradigm and its mobile app-based professional development and support of teachers in Sindh, Pakistan, the long-term achievement of students and teachers may be disregarded in the future.

6 References

[1] A. Zubairi, W. Halim, T. Kaye, and S. Wilson, "Country-Level Research Review: EdTech in Pakistan," 2021.

[2] SAT, "Government of Sindh Standardized Achievement Test (SAT) Phase–V," 2017. [Online]. Available: http://www.iba-suk.edu.pk/

[3] Government of Pakistan, "Pakistan Education Statistics 2016–17. Government of Pakistan," 2018. [Online]. Available: http://library.aepam.edu.pk/Books/Pakistan_Education_Statistics%0A 2016-17.pdf%0D

[4] A. Pakistan, "Annual status of education report: Aser pakistan 2015 national (urban)," in *Lahore, Pakistan: South Asian Forum for Education Development*, 2015, vol. 30.

[5] T. Béteille, N. Tognatta, M. Riboud, and S. Nomura, *Ready to learn: Before school, in school, and beyond school in South Asia*. World Bank Publications, 2020.

[6] A. S. Alawani and A. D. Singh, "A smart mobile learning conceptual framework for professional development of UAE in-service teachers," *Int. J. Manag. Appl. Res.*, vol. 4, no. 3, pp. 146–165, 2017. https://doi.org/10.18646/2056.43.17-012

[7] UNESCO, *Supporting teachers with mobile technology: lessons drawn from UNESCO projects in Mexico, Nigeria, Senegal and Pakistan*, vol. 34. UNESCO Publishing, 2017.

[8] SESP, "School Education Sector Plan And Roadmap for Sindh," 2019. [Online]. Available: https://seld.sesp-rsu.com/

[9] G. of Sindh, "Continuous Professional Development (CPD) Model," *Report*, 2017. [Online]. Available: http://www.sindheducation.gov.pk/Contents/Menu/CPD Model.pdf

[10] B. Jamil, "From Teacher Education to Professional Education Devleopment in Pakistan: A Position Paper." Retrieved from ITA: http://itacec.org/document/Teacher …, 2004

[11] D. Peng, "Mobile-Based Teacher Professional Training: Influence Factor of Technology Acceptance," in *Foundations and Trends in Smart Learning*, Springer, 2019, pp. 161–170. https://doi.org/10.1007/978-981-13-6908-7_23

[12] M. Al-Emran, H. M. Elsherif, and K. Shaalan, "Investigating attitudes towards the use of mobile learning in higher education," *Comput. Human Behav.*, vol. 56, pp. 93–102, 2016. https://doi.org/10.1016/j.chb.2015.11.033

[13] A. M. Al-Rahmi *et al.*, "The influence of information system success and technology acceptance model on social media factors in education," *Sustainability*, vol. 13, no. 14, p. 7770, 2021. https://doi.org/10.3390/su13147770

[14] A. Gloria and A. Oluwadara, "Influence of mobile learning training on pre-service social studies teachers' technology and mobile phone self-efficacies," *J. Educ. Pract.*, vol. 7, no. 2, pp. 74–79, 2016.

[15] A. K. Singh, I. A. Rind, and Z. Sabur, "Continuous professional development of school teachers: Experiences of Bangladesh, India, and Pakistan," *Handb. Educ. Syst. South Asia*, pp. 1–27, 2020. https://doi.org/10.1007/978-981-13-3309-5_31-1

[16] A. A. Arain, Z. Hussain, W. H. Rizvi, and M. S. Vighio, "An analysis of the influence of a mobile learning application on the learning outcomes of higher education students," *Univers. Access Inf. Soc.*, vol. 17, no. 2, pp. 325–334, 2018. https://doi.org/10.1007/s10209-017-0551-y

[17] B. Spar, C. Dye, R. Lefkowitz, and D. Pate, "2018 Workplace Learning Report: The Rise and Responsibility of Talent Development in the New Labor Market," *LinkedIn Learn.*, 2018.

[18] M. Metin, G. K. Yilmaz, K. Coskun, and S. Birisci, "Developing an attitude scale towards using instructional technologies for pre-service teachers," *Turkish Online J. Educ. Technol.*, vol. 11, no. 1, pp. 36–45, 2012.

[19] S. Papadakis, "Advances in mobile learning educational research (AMLER): Mobile learning as an educational reform," *Adv. Mob. Learn. Educ. Res.*, vol. 1, no. 1, pp. 1–4, 2021. https://doi.org/10.25082/AMLER.2021.01.001

[20] N. A. Dahri, M. S. Vighio, J. Das Bather, and A. A. Arain, "Factors influencing the acceptance of mobile collaborative learning for the continuous professional development of teachers," *Sustainability*, vol. 13, no. 23, p. 13222, 2021. https://doi.org/10.3390/su132313222

[21] I. Ahmad, "Critical analysis of the problems of education in Pakistan: Possible solutions," *Int. J. Eval. Res. Educ.*, vol. 3, no. 2, pp. 79–84, 2014. https://doi.org/10.11591/ijere.v3i2.1805

[22] I. A. Chaudary, "A new vision of professional development for tertiary teachers in Pakistan," *Prof. Dev. Educ.*, vol. 37, no. 4, pp. 633–637, 2011. https://doi.org/10.1080/19415257.2010.539008

[23] M. Rahimi and S. S. Miri, "The impact of mobile dictionary use on language learning," *Procedia-Social Behav. Sci.*, vol. 98, pp. 1469–1474, 2014. https://doi.org/10.1016/j.sbspro.2014.03.567

[24] F. N. Al-Fahad, "Students' attitudes and perceptions towards the effectiveness of mobile learning in King Saud University, Saudi Arabia," *Online Submiss.*, vol. 8, no. 2, 2009.

[25] A. Abu-Al-Aish and S. Love, "Factors influencing students' acceptance of m-learning: An investigation in higher education," *Int. Rev. Res. Open Distrib. Learn.*, vol. 14, no. 5, pp. 82–107, 2013. https://doi.org/10.19173/irrodl.v14i5.1631

[26] T. Karakose, H. Polat, and S. Papadakis, "Examining teachers' perspectives on school principals' digital leadership roles and technology capabilities during the COVID-19 pandemic," *Sustainability*, vol. 13, no. 23, p. 13448, 2021. https://doi.org/10.3390/su132313448

[27] T. Karakose, R. Yirci, and S. Papadakis, "Exploring the interrelationship between covid-19 phobia, work–family conflict, family–work conflict, and life satisfaction among school administrators for advancing sustainable management," *Sustainability*, vol. 13, no. 15, p. 8654, 2021. https://doi.org/10.3390/su13158654

[28] M. M. Alamri, M. A. Almaiah, and W. M. Al-Rahmi, "The role of compatibility and task-technology fit (TTF): On social networking applications (SNAs) usage as sustainability in higher education," *IEEE Access*, vol. 8, pp. 161668–161681, 2020. https://doi.org/10.1109/ACCESS.2020.3021944

[29] Q. Al-Maatouk, M. S. Othman, A. Aldraiweesh, U. Alturki, W. M. Al-Rahmi, and A. A. Aljeraiwi, "Task-technology fit and technology acceptance model application to structure and evaluate the adoption of social media in academia," *IEEE Access*, vol. 8, pp. 78427–78440, 2020. https://doi.org/10.1109/ACCESS.2020.2990420

[30] A. M. Al-Rahmi, W. M. Al-Rahmi, U. Alturki, A. Aldraiweesh, S. Almutairy, and A. S. Al-Adwan, "Exploring the factors affecting mobile learning for sustainability in higher education," *Sustainability*, vol. 13, no. 14, p. 7893, 2021. https://doi.org/10.3390/su13147893

[31] W. M. Al-Rahmi and S. Alkhalaf, "An empirical investigation of adoption Big Data in higher education sustainability," *Entrep. Sustain. Issues*, vol. 9, no. 2, p. 108, 2021. https://doi.org/10.9770/jesi.2021.9.2(7)

[32] A. M. Sayaf, M. M. Alamri, M. A. Alqahtani, and W. M. Alrahmi, "Factors Influencing University Students' Adoption of Digital Learning Technology in Teaching and Learning," *Sustainability*, vol. 14, no. 1, p. 493, 2022. https://doi.org/10.3390/su14010493

[33] A. M. Sayaf, M. M. Alamri, M. A. Alqahtani, and W. M. Al-Rahmi, "Information and communications technology used in higher education: An empirical study on digital learning as sustainability," *Sustainability*, vol. 13, no. 13, p. 7074, 2021. https://doi.org/10.3390/su13137074

[34] A. M. Al-Rahmi, W. M. Al-Rahmi, U. Alturki, A. Aldraiweesh, S. Almutairy, and A. S. Al-Adwan, "Acceptance of mobile technologies and M-learning by university students: An empirical investigation in higher education," *Educ. Inf. Technol.*, pp. 1–22, 2022. https://doi.org/10.1007/s10639-022-10934-8

[35] T. Karakose, T. Y. Ozdemir, S. Papadakis, R. Yirci, S. E. Ozkayran, and H. Polat, "Investigating the Relationships between COVID-19 Quality of Life, Loneliness, Happiness, and Internet Addiction among K-12 Teachers and School Administrators—A Structural Equation Modeling Approach," *Int. J. Environ. Res. Public Health*, vol. 19, no. 3, p. 1052, 2022. https://doi.org/10.3390/ijerph19031052

[36] T. Karakose, R. Yirci, and S. Papadakis, "Examining the associations between COVID-19-related psychological distress, social media addiction, COVID-19-related burnout, and depression among school principals and teachers through structural equation modeling," *Int. J. Environ. Res. Public Health*, vol. 19, no. 4, p. 1951, 2022. https://doi.org/10.3390/ijerph19041951

[37] J. F. Hair, M. Sarstedt, C. M. Ringle, and J. A. Mena, "An assessment of the use of partial least squares structural equation modeling in marketing research," *J. Acad. Mark. Sci.*, vol. 40, no. 3, pp. 414–433, 2012. https://doi.org/10.1007/s11747-011-0261-6

[38] Q. Suleman, I. Hussain, M. N. ud Din, and F. Shafique, "Effects of Information and Communication Technology (ICT) on students' academic achievement and retention in Chemistry at secondary level," *J. Educ. Educ. Dev.*, vol. 4, no. 1, 2017. https://doi.org/10.22555/joeed.v4i1.1058

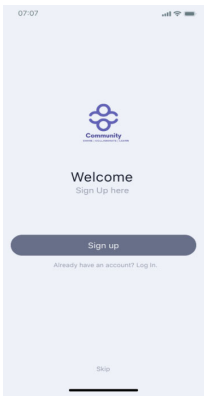
[39] K. Demir and E. Akpinar, "The effect of mobile learning applications on students' academic achievement and attitudes toward mobile learning," *Malaysian Online J. Educ. Technol.*, vol. 6, no. 2, pp. 48–59, 2018. https://doi.org/10.17220/mojet.2018.02.004

[40] H.-C. Chu, G.-J. Hwang, C.-C. Tsai, and J. C. R. Tseng, "A two-tier test approach to developing location-aware mobile learning systems for natural science courses," *Comput. Educ.*, vol. 55, no. 4, pp. 1618–1627, 2010. https://doi.org/10.1016/j.compedu.2010.07.004

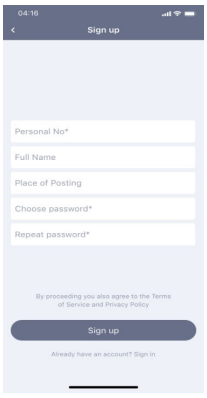
[41] S. Yang, "Exploring college students' attitudes and self-efficacy of mobile learning," *Turkish Online J. Educ. Technol.*, vol. 11, no. 4, pp. 148–154, 2012.

[42] A. A. Arain, Z. Hussain, W. H. Rizvi, and M. S. Vighio, "Evaluating usability of M-learning application in the context of higher education institute," in *International conference on learning and collaboration technologies*, 2016, pp. 259–268. https://doi.org/10.1007/978-3-319-39483-1_24

7 Appendix – App screens

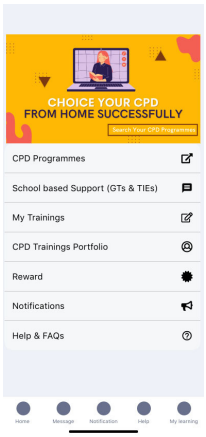


a. Login Screen

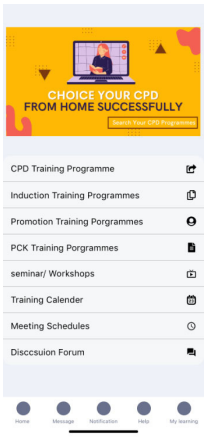


b. Sign up Screen

c. Clusters Screen

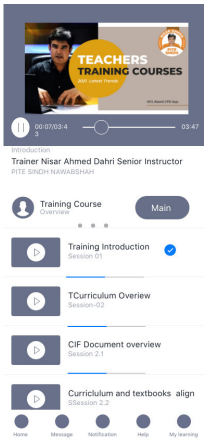


d. Main Screen

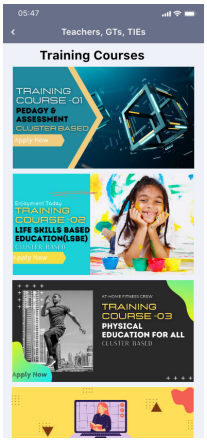


e. Training Screen

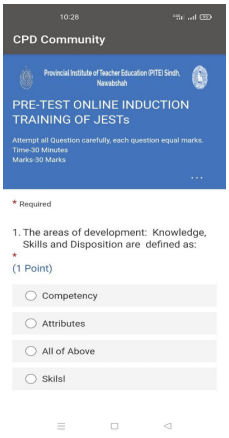
f. Course Screen



g. Session Video



h. Courses Screen



i. Course Test Screen

8 Authors

Nisar Ahmed Dahri completed BS(CS), MS(IT) from QUEST and currently perusing Ph.D. from Quest University, Pakistan, He is currently working as an Assistant Professor at Provincial Institute of Teacher Education (PITE) Sindh Nawabshah, Pakistan. Email: dahrinisar@gmail.com

Dr. Muhammad Saleem Vighio received the M.Sc. and Ph.D. degrees in computer science from Aalborg University, Denmark, in 2009 and 2012, respectively. He is currently working as an Associate Professor and the Head of the Department of Computer Science, Quaid-e-Awam University of Engineering, Science and Technology, Nawabshah, Pakistan. He has been credited with several national and international conference papers and journal articles. His research work focuses on the verification of software systems, including real-time and embedded systems, and web services protocols. He is a member of the editorial boards of many research journals. He is also a member of the statutory bodies of many national universities. Email: saleem.vighio@quest.edu.pk

Dr. Omar A. Alismaiel is an assistant professor in Educational Technologies, and Head of Curriculum and Teaching Methods Department, College of Education at King Faisal University, Alhasa, Saudi Arabia. He had his Doctoral degree in Educational Technology from University of Wollongong, Australia, 2013. He also had his Master degree in Information Technology in Education and Training from University of Wollongong, Australia, 2007. He got his Bachelor degree in Teaching Science for Elementary Education from Teachers College, Alhasa, Saudi Arabia, 2002. Dr. Alismaiel research interests include Blended Learning, E-Learning, Collaborative Learning, Mobile Learning, Virtual Classroom, Online Learning Tools, Interactive Multimedia and Social Media Technologies. Email: oalismaeel@kfu.edu.sa

Dr. Waleed Mugahed Al-Rahmi is an assistant professor of Computer and Education at Faculty of Social Sciences & Humanities, School of Education, Universiti Teknologi Malaysia. He completed PhD degree from Faculty of Computing – Information Systems, Universiti Teknologi Malaysia. And he got Best Student Award, Doctor of Philosophy (Faculty of Computing – Information System), Excellent academic achievement in conjunction with the 56nd Convocation Ceremony, Universiti Teknologi Malaysia (UTM), 2016. Waleed experiences had teaching assistant 2.5 years in Faculty of Computing at Universiti Teknologi Malaysia. Moreover, Post-Doctoral in Faculty of information and Communication Technology at International Islamic University Malaysia, Moreover, Post-Doctoral in Faculty of Science at Universiti Teknologi Malaysia. Furthermore, Currently Post-Doctoral in Faculty of Education at Universiti Teknologi Malaysia. His research interests are information system management, information technology management, human-computer interaction, implementation process, Technology Acceptance Model (TAM), communication and constructivism theories, impact of social media networks, collaborative learning, E-learning, knowledge management, Massive Open Online Course (MOOCs), statistical data analysis (IBM SPSS, AMOS, NVIVO and SmartPLS). Email: waleed.alrahmi@yahoo.com

Article submitted 2022-03-01. Resubmitted 2022-03-23. Final acceptance 2022-03-30. Final version published as submitted by the authors.