Usability Evaluation of Mobile App for the Sustainable Professional Development of Teachers

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Abstract—Teachers' professional development plays a significant role in the sustainability of quality education. However, providing sustainable professional development programs is difficult because of various challenges, such as a scarcity of qualified personnel and Lack of training opportunities, lack of access and resources, etc. For teachers' professional development, educational institutions currently favor adopting and using modern educational technologies. As a result, various mobile apps have been developed and implemented in educational institutions in recent years. This paper presents the findings of a study that looked at the Usability of our designed mobile App for teachers training in Sindh by employing one of the most widely used usability criteria, SUS. It also investigates the relationship between these variables and the impact of teachers' demographic characteristics on the SUS Score. The study's findings achieved a 100% completion rate for all tasks, indicating an extremely effective, efficient, and sustainable system. Moreover, the satisfaction percentage was also found to be 84.1 percent, considered highly satisfactory.

Keywords—sustainable CPD model, teacher's training, mobile-based training app, usability, effectiveness, efficiency, satisfaction, digital learning use for education sustainability

1 Introduction

Sustainability and access to high-quality education have long been a source of concern across the globe. Teachers play a critical role in all educational institutions' teaching and learning processes. Professional development programs that are well-designed are crucial to the success of the teaching process and the delivery of high-quality education.

In the wake of the COVID-19 epidemic, the globe has been thrown into a state of emergency, which has impacted the learning process worldwide, especially in developing nations, and has caused significant disruption to the education sector. As a

result, learners' ability to acquire knowledge and interest, motivation, and engagement have suffered the most [1]. In Pakistan, the national and provincial governments reacted quickly to launch several programs to assure educational continuity for the country's children. The educational content was transformed using various modes, including television, radio, and text messages [1]. However, none of the programs focused on the continuous professional development of teachers, which significantly influences the quality of education delivered in schools.

On the other hand, the sustainability of such initiatives is a big concern. In-service training is provided to teachers to keep their knowledge, skills, and competence up to date and refreshed. During training, teachers learn various content knowledge, teaching and assessment approach, and learning experiences that are restored throughout; ultimately, it improves the overall professional competency of teachers [1]–[5]. Several studies have shown that professional development interventions enhance the quality of the teacher in terms of their knowledge and teaching abilities. Professional development programs, for example, may assist teachers in gaining a broad and comprehensive knowledge of their subjects [6]–[8]. Vogt and Rogalla (2009) found that a content-focused mentoring professional learning intervention helped improve adaptive teaching competence [9].

Professional development programs are essential for career advancement in today's workplace [7], though challenging to impart due to many issues such as a lack of government regulations, inadequate training opportunities, lack of technology trends, and substantial political influence on appointment processes and so on [1]–[5]. Even though most institutes are working hard to enhance teachers' learning outcomes, many fail to achieve this goal due to their reliance on inadequate traditional in-service continuous professional development (CPD) programs [10].

1.1 Sustainability of education in Pakistan

Teachers are needed to meet SDG 4's aims. The maldistribution of professionally trained teachers, especially in poor communities, exacerbates the education equality gap. Teachers and educators should be empowered, engaged, rewarded, motivated, and taught through Support programs for quality education [6], [11].

Professional development is an integral approach for improving the quality of schools, raising teacher quality, and enhancing student learning outcomes [6], [7], [9], [12], [13]. According to the National Staff Development Council, professional development is widely considered high-quality when it allows ongoing training courses, workshops, or seminars with intensive follow-up and on-the-job support or mentoring. Study reports of schools in Pakistan reveal that children's literacy (Urdu/Sindhi/Pashto) and numeracy skills decreased in 2021 compared to 2019 (see Figure 1). ASER report 2021 determined that the fundamental levels in grade 3 are not maintained, and learning obstacles arise, as seen by learning outcomes in higher grades. 15% of grade 3 students could read a story in Urdu, Sindhi, or Pashto, compared to 18% in 2019. In 2019, 59% of grade 5 pupils in Urdu/Sindhi/Pashto could read a grade 2 story, up from 55% in 2018. Similarly, in ASER 2021, 74% of grade 8 pupils could read a story in Urdu/Sindhi/Pashto, compared to 86% in 2019 [14].

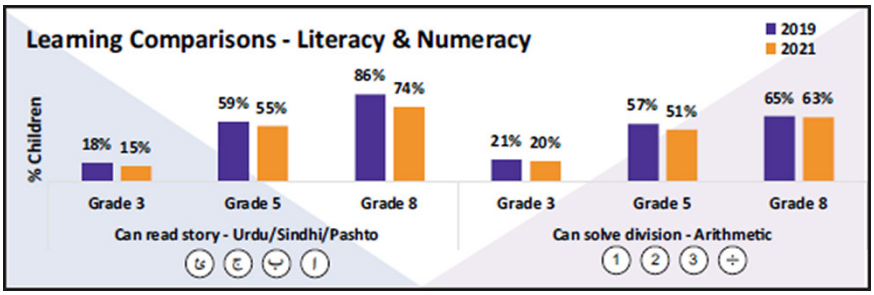


Fig. 1. Numeracy and numbers results [14]

Also, students in grades 3, 5, and 8 struggled with Arithmetic. 20% of grade 3 children could solve division problems at the grade 2 level in 2020, compared to 21% in 2019. Furthermore, in 2021, just 51% of 5th-grade children could manage division problems, compared to 57% in 2019. In 2021, compared to 2019, 63% of grade 8 pupils could finish division problems.

With just 15% to 20% of students reading and math by grade 3, the pre-epidemic learning difficulty causes the formation of "lost generations." Ages 3–8 years old need urgent large-scale efforts to address learning.

These large-scale reports determine the poor teaching as reflected in student level of achievement in various subjects. The number of teachers has not been trained sufficiently in Sindh and Punjab due to non-sustainable CPD models [10], [15]–[18]. However, teacher education and training have the most significant influence on the teaching workforce's quality. According to Alif Ailaan's 2017 assessment, lousy management and teacher development (inadequate and low-quality CPD training) significantly contribute to the country's low language, math, and science proficiency [14]. In Pakistan, in-service teacher training and continuing professional development (CPD) have traditionally been inconsistent and of poor quality [15], [19]–[22]. Even after several rounds of in-service training (in which many donor-funded organizations have invested much), teachers' pedagogical practices have not changed significantly. But some of the reasons are indeed due to a lack of regular financial support, reliance on donors for ad hoc financing for project-based training, and a failure to scale up sustainable models on a long-term basis [5]–[7], [10], [18], [21]–[24].

1.2 Teacher education and training in Pakistan and their limitations

The "overarching paradigm of the United Nations," Education for Sustainable Development (ESD), is gaining traction in the education sector [21], [22]. Concerning the preparation of pre-service teachers, teacher education institutes are expected to examine their role in achieving education for sustainability [21]. Teacher training and education are tools for providing educational opportunities to attain educational goals and establish a knowledge-making process that will lead to long-term growth. Various techniques and strategies have been used to achieve academic goals in teacher education.

Traditional Sindh's professional development techniques, such as the cascade model or top-down training, have achieved significant results. Nevertheless, they have substantial limitations as a result of a lack of usage of technology and an absence of provision of professional and academic aid (classroom support and follow-up methods) [10]. Every teacher needs to be given a chance to participate in in-service training at least once every five years, according to a recommendation for an education policy made by the school's management. In Pakistan, a primary school teacher obtains in-service training after 13 years, an elementary school teacher after eight years, and a high school teacher after 16 years [20], [21]. The cascade model is restricted in its use. Transferring knowledge and material from experts to teachers/trainers results in a constant loss of quality and substance over time. In addition, the period of training of trainers (ToT) for professional teachers has been shortened. Lack of local teaching instructors, particularly in rural and remote areas, and inadequate classroom teaching practices and support.

The lack of funding for organizations to train many teachers periodically is a CPD implementation hurdle. Second, in Pakistan, teacher capacity-building training programs are ad hoc and donators help school teachers [2], [3], [7], [24].

[17], [25], [26] found problems with professional development models and claimed that the quality of education given in Pakistani government schools was poor owing to low levels of teacher competency, an absence of classroom-based assistance for teachers, a lack of mechanisms to measure student learning outcomes, unequal supervision, an insufficient resource for essential teaching and learning resources, and a lack of sector management and governance. Furthermore, researchers, trainers, or educators are also undertrained and undermotivated, and they employ ineffective teaching methods [5], [10], [17], [27]. Therefore, professional development for teachers is a systematic and targeted learning activity [10]. Therefore, teacher training and delivery mechanisms must be upgraded.

1.3 Sustainability issues in teachers' professional development in Pakistan

Education fosters social, economic, and environmental change in society, and development via education and training must be long-term for creative and behavioral change to be beneficial and long-lasting. According to [21], new experiences gained via education and training result in long-term changes in creativity and behavior. Sustainability is balanced social, economic, and environmental thinking for the future, focusing on development and ensuring a high quality of life [20]. Sustainable development is fulfilling existing needs without compromising future generations' ability to do so. [6]–[8], [23], [28]. Integrating education into all development elements is a significant challenge in terms of long-term sustainability. The sustainability of professional development programs is seen as a necessary method for teachers to increase their knowledge and competence, resulting in better student outcomes [7]. According to researchers, educators, and policymakers, student learning achievement is dependent on a strong teaching force, which depends on sustainable and high-quality professional development programs [29]. Recently school education and literacy department Govt of Sindh recruited 46000 teachers on a merit basis; the basic criteria for recruiting were

bachelor's and master's level without considering their basic requirement of a teacher education degree such as ADE (2-year degree) or B. Ed (Hons). All new teachers have no teacher education or teaching background; they will be appointed in schools without knowing about teaching pedagogies, assessment, and classroom management. It will create a big challenge for appointing authorities to train all teachers without any sustainable CPD model in Sindh. Currently, in-service training is offered with the help of donors in a few important areas/themes and on an irregular basis, drawing the same participants repeatedly without necessarily improving teaching quality. The failure of donor programs to integrate with the wider professional development framework in place in the nation is perhaps the most significant governance-related failure. Donor-funded initiatives are often focused on the short-term goals. In order to be sustainable, donor programs must overcome an inherent issue of ownership with the government authority, which is not always the case [5], [10], [17]. An analysis of key professional development of teachers related to donor initiatives in Pakistan indicated that the majority of the programs were unsustainable, both because of a lack of integration into the policy framework or not part of any CPD system and because teachers' professional development is given a low level of importance by the government [6], [21], [25], [26], [30]. According to the findings of the research [6], [26], [30], initiatives that are formed in close partnership with the government have a greater chance of being sustainable. Although there is no follow-up system between teachers and trainers at this time, it is dire to bring a sustainable, efficient, and effective teachers' professional development model in Sindh which overcomes all these issues and creates a linkage between all stakeholders. A significant commitment to professional development is needed to assist the development of these abilities and increase teachers' familiarity with technology. However, the reality of establishing and implementing technology based professional development systems to progress toward the objective of sustainable quality education.

1.4 Mobile learning for sustainable professional development of teachers

The usage of mobile technology in educational institutions in Pakistan is increasing; however, there is currently insufficient research into how teachers might benefit from this technology to improve learning results. So far, none of the platforms we've looked into in Pakistan has primarily focused on teacher professional development at the provincial or national level. According to the literature, various new and novel tendencies determine the long-term sustainability of M-learning. These are as follows: the ability to react to current educational demands and the intended purpose of M-learning; the ability to be widely accepted by users; the ability to adjust to likely changes; the ability to keep a specific condition eternally or to make progress [29], [31], [32].

There's little research on tech-based teacher PD. A research-based theoretical framework is needed to integrate m-learning into teacher professional development. "Learning that takes happen anywhere, at any time," Franklin says of mobile learning. This notion emphasizes learners' flexibility, empowerment, and capacity to learn regardless of socio-economic, regional, cultural, or sociopolitical differences. To help teachers get over their fear of technology, UNESCO discussed the application of mobile devices to

enhance the professional development of teachers in the following places: 1) mobile facilitating teacher training and guidance; 2) supporting teachers' teaching methods; and 3) supporting teachers' overall instructional strategies 4) Facilitating interaction and collaborative activities among learners 5) assistance with job support and other relevant issues [35].

Numerous research from the literature [33]–[35] showed that there was no socialization and that interactions between students, student-teachers, and teacher-parents in urgent distant education processes were often insufficient. Additionally, it was discovered that there was a shortage of technology resources and expertise, insufficient educational content, and both teachers and students experienced a range of happy and negative feelings. However, urgent educational initiatives also had some advantages for the teachers.

M-learning uses mobile devices, ubiquitous communication technology, and enhanced user interfaces, according to [36], [37]. M-learning enables personalized learning on smartphones. Many new mobile services that digital mix applications with the academic educational system have evolved [38].

UNESCO and Nokia created a mobile training program for Pakistani pre-primary teachers in 2014. Early childhood education (ECE) participants were given a free internet membership for six months after a three-day face-to-face training program so they could download instructive films to watch on their mobile devices. A total of 150 pre-primary schoolteachers from rural areas of Pakistan took part in the study. UNESCO found that teachers were employing more creative teaching methods and were becoming more adept at using their mobile phones. However, many rural teachers could not download videos due to significant network challenges. Many rural students cannot use instructional technology because of a lack of fundamental infrastructure [1], [38]. M-learning may be able to give new possibilities in the sphere of education for implementing continuous learning sustainability [39]. The teacher's function as an educator for autonomous digital training in sustainable distance education must be considered while creating M-learning technologies or mobile apps. Self-directed learning is key to long-term learning [40].

1.5 Problem statement and research questions

In Pakistan, the use of mobile technology for better student and teacher learning outcomes is on the high rise; however, there is currently limited research into how teachers might benefit from this technology. So far, none of the platforms we've researched has primarily focused on teacher professional development at the provincial or national level in Pakistan [41]–[44]. Although mobile devices and apps have become one of the most effective tools for teaching and learning to assure the sustainability and applicability of mobile learning initiatives, assessing the usability of mobile-based training apps needs much attention for long-term sustainable professional development of teachers.

This study evaluates the usability of a mobile app for sustainable teacher development in Sindh based on its ease of use, efficacy and effectiveness, learnability, and teacher satisfaction. The impact of demographics and system usage on SUS score is another matter. The second portion describes the mobile CPD framework and app.

1.6 Mobile-based CPD framework for teachers

In [17], we developed a mobile-based CPD framework for teachers' professional development as an alternative to the traditional CPD model, which features cost-effectiveness, flexibility, contextualization, collaborative learning, resourcefulness, and facilitation, based on the critical use of technology as an effective and sustainable approach to providing quality education.

The abstract model of the traditional and enhanced CPD techniques is shown in Figure 2. The upgraded CPD framework, as illustrated in Figure 2, extends the previous framework in terms of the design, implementation, on-the-job support, and evaluation of CPD activities conducted using a mobile phone. Each step of the training activity is defined in the text that follows.

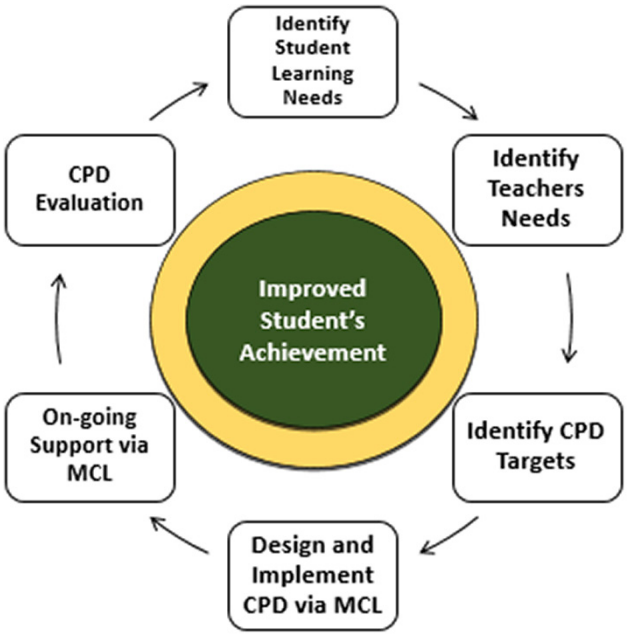


Fig. 2. Sustainable mobile-based CPD model [17]

- In the first step, students' learning needs are identified based on large-scale assessment reports. The identified needs relate to curriculum, content (knowledge, skills, values, and attitude), and resources.
- In the second phase, the professional development needs of teachers (so they can meet the needs of their students) are identified.
- The third step is based on the results of the first and second steps. It identifies and figures out CPD interventions that meet the needs of students and teachers.
- The fourth phase creates and implements continuing professional development activities/materials and training programs using mobile technology.

- In the fifth stage, on-the-job support is provided to teachers at any time. Through mobile technology, TEI specialists and guide teachers (GTs) will provide mentoring and support at the Taluka, Cluster, and School levels.
- In the final phase, feedback on the training activity is received. The CPD program is evaluated based on teachers' performance and students' learning. This phase helps to determine new CPD targets.

Figure 3 depicts the key features of the enhanced CPD framework for the design, implementation, and evaluation of CPD activities through mobile technology.

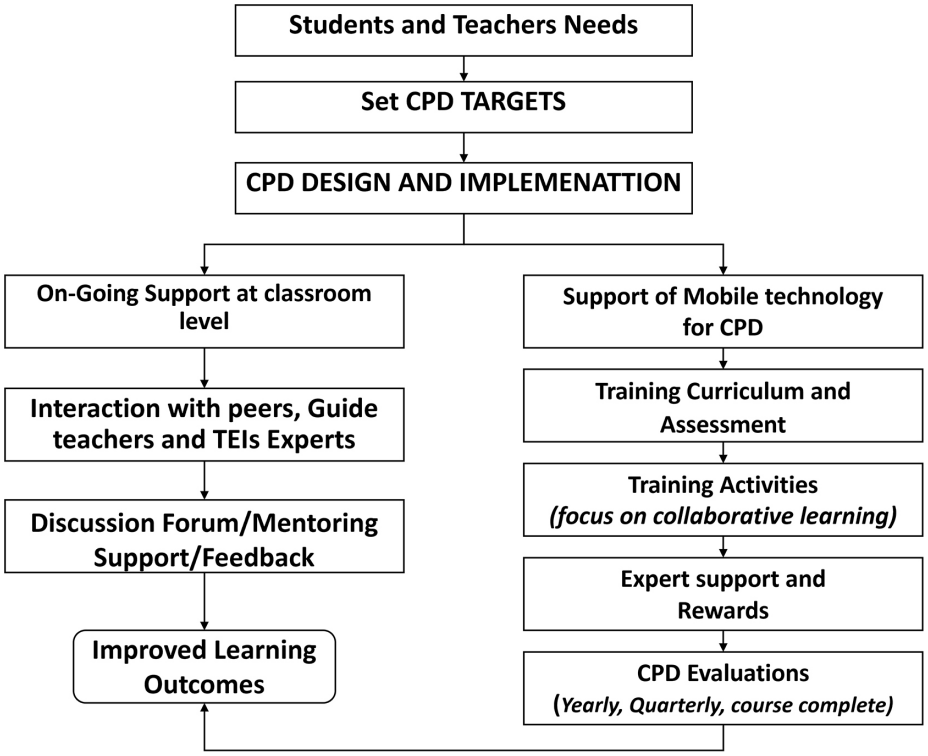


Fig. 3. CPD framework for mobile app

2 Mobile-based training app overview

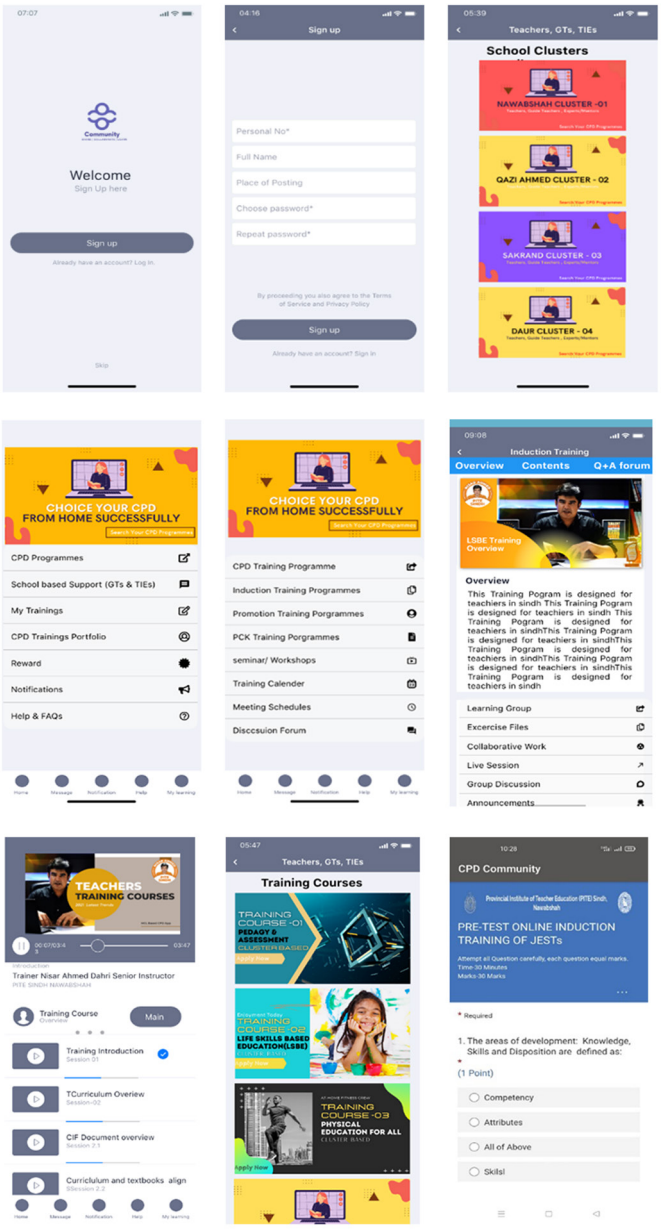
A mobile app has been developed to allow teachers in authorized clusters and schools to carry out professional development activities. The App helps teachers, GTs, and TEIs interact, chat, and share information regarding teaching and learning. Real-time text, audio, and video are recorded. The app includes polls, quizzes, discussion rooms, and more.

The mobile App provides training sessions, and each has multiple training activities Like (Recorded Videos and Live Sessions) and online discussions. A mobile app has been developed to help teachers in approved clusters and schools carry out professional development activities. The app's ongoing support function lets teachers and professionals collaborate. The app had numerous new features Go live meetings, an activity calendar, a live workshop, collaborative learning tools for group work and collaborative projects, a discussion forum for group and peer conversation, a chatbot for private communication, and resources.

The teachers, GTs, and TEIs can use the App to connect, talk, and share information about teaching and learning to improve their work. Activities that take place in real-time are recorded, including text, audio, and video. The App also features polls and quizzes, discussion forums, collaborative learning activities, Help, FAQ, report exporting, etc. A few screenshots of the app interface are provided below.

Similar outcomes were reported in prior studies on mobile learning, social networking, and its practical relevance. [29]. The use of mobile training, big data, and learning will likely demolish information and knowledge exchange [45], [46]. Adopting mobile and online learning may bring management systems back to the dark ages, with a significant emphasis on correlation and technology and a high likelihood of failure [37]. Karakose et al. (2021) found that instructors regarded school administrators' use of digital tools during COVID-19 was suitable [47]. School administrators support digital transition and technology-based classroom growth. Karakose et al. (2022) found a connection between COVID-19-related quality of life and loneliness [48]. COVID-19-related burnout predicts depression and directly affects burnout, depression, and social media addiction [49].

The following are some screenshots of the App's user interface for your convenience.



3 System usability evaluation

Modern information and communication technologies, particularly mobile technology, profoundly impact all aspects of life, including education and learning. According to [50], [51], usability and ease of use are crucial in application design and

development. Whether subjective (based on user observations) or objective, assessing a system's usability is crucial (based on the efficacy, efficiency, and performance of users using the system). The aim of usability testing for developers is to identify and improve the interface features, reduce the cost of development and support, and increase the product's market attractiveness [52]. A growing body of empirical evidence suggests that usability testing is necessary for the elimination of usability issues [51], [53], [54].

Various methods and tools have been developed to make software easy to use. Standardized questionnaires are key for assessing usability. Traits, views, feelings, observations, behaviors, and attitudes must be collected using a standardized questionnaire. [55]. These surveys are easy to perform, don't require expensive technology, and reflect users' opinions. Literature suggests many standardized surveys for testing software usability. These questionnaires include: 1) System Usability Scale (SUS) [56], 2) the Questionnaire for User Interaction Satisfaction (QUIS) [57], 3) Usability Metric for User Experience (UMUX) [57], 4) Software Usability Measurement Inventory (SUMI) [58], and 5) Post-Study System Usability Questionnaire (PPSUQ) [59]. The System Usability Scale (SUS) has been in use for more than two decades as a credible end-of-test subjective assessment measure for evaluating the perceived usability of a computer system [56]. It was first developed by Brooke in1996 and has since been widely utilized in industry to give reliable and consistent design input for assessing the usability of human-machine systems, software, and websites [60], as well as everyday products [61]. Raptis et al. examined the effects of mobile phone screen size on efficiency, effectiveness, and usability. Three Samsung screens were evaluated. Participants numbered 60.

3.1 System usability scale

According to the ISO 9241-11 standard, usability refers to the degree of quality at which certain users may use a system effectively, efficiently, and satisfactorily [62]. ISO 9241-11 identifies three usability factors: effectiveness, efficiency, and satisfaction [63]–[66]. Usability testing examines how people use an application or product [63], [67]. The most commonly used usability metrics are the efficacy, efficiency, and satisfaction of a product or service. Different measurement criteria are being employed to analyze other usability elements, with the system's effectiveness being assessed by assessing the task completion rate. Efficiencies are examined by looking at how long it takes users to accomplish tasks, and satisfaction can be measured by looking at how confident users are that the application will meet their expectations [64]–[66], [68].

Aijaz et al. tested an M-learning application's efficacy, efficiency, and user satisfaction. It uses two usability assessment methodologies (a formal experiment and a post usability questionnaire (SUS) with 100 participants, according to the conclusions of this study, the application is effective, efficient, and user-friendly [66].

Various studies show that SUS is an easy-to-use usability scale was created to measure System Usability [56], [60], [62], [64]–[66], [68]. SUS is a ten-item measure that provides subjective system usability assessments. Even-numbered items are worded negatively. Participants rate items on a 5-point Likert scale from 1 to 5, with 1 indicating the highest disagreement and 5 the strongest agreement. Unanswered questions

are scored 3 points (the centre of the rating scale). SUS produces a single number that provides an overall usability assessment of the studied system. According to Tullis and Stetson, 68 is a cutoff SUS score. If the score is over 68, it's above average; below 68, below average [64], [66].

Procedure for calculating SUS score as adopted in many studies [56], [58], [60], [61], [66]. Baillie and Morton examined two mobile apps; both are based on the same concept, but one is built using HCI principles while the other is built without. Both apps were put to the test in the field to discover which one was the easiest and most simple to use. The System Usability Scale was used to assess its usability [69].

4 Methodology

This study uses an experimental research design. The study examines the Usability of mobile App from multiple dimensions, i.e., to measure the effectiveness (E), efficiency (F), and satisfaction (S) in the specific context of mobile app use for continuous professional development of teachers in Sindh, Pakistan., The questionnaire was used to collect information for the research. For whole population sampling, the most convenient and intended approach was used. Total 120 newly appointed junior elementary school teachers from division SBA in Sindh, Pakistan, were included in this research study. Out of 120 teachers, 70% were male and 30% were female. All the teachers had smartphone experience, and most had internet experience on a smartphone. Through this experiment, the mobile training software features such as training live sessions, Live Support forum, Training collaborative activities and group sharing, group discussion, and diversity of quizzes & assignments were briefly shared with the experimental groups via multimedia slides.

Before the usability tasks, all participants filled out a demographic's questionnaire. During the usability test, all participants used the same devices and internet bandwidth the researcher gave. Each participant's time and pace were recorded. After completing usability tests, participants filled out a post-test questionnaire to provide feedback. The same participants also completed a System Usability Scale questionnaire to measure the overall ease of use of the training app and to acquire a more general perception of the program after completing the usability activities, as shown in Table 1.

Table 1. Research design

	Pre-Test	**Experimental Manipulation**	**Post Lab Test**
Research Design (Lab Experiment)	Pre-Test Demographic	Explore CPD mobile App Perform Usability Task (1–8) Effectiveness (Task Completion) Efficiency (Time)	Post Test Salinification (SUS Usability Test)

5 Results

The findings are presented in the subsections that follow Demographic data analysis and usability testing data analysis; for the data analysis, MS Excel and SPSS 21.0 software are used.

5.1 Demographic data analysis

The study sample includes 107 elementary school teachers from Shaheed Benazir Abad. Table 2 shows sample demographics. The experimental group consists of 107 instructors based on a random selection process, with 63 (59% male teachers) and 44 (41% female teachers). According to the age categories of teachers, 25 (23%) are between the ages of 25 and 30, 70 (65%) are between the ages of 31 and 40, and 12 (11%) are between the ages of 40 and 50. According to data, 68 (64%) of the 107 teachers have bachelor's degrees, 36 (34%), have master's or MPhil degrees, and just 1% have a Doctoral degree Furthermore, 89 (83%), of teachers have a B.Ed. Professional degree, 10 (9%), has an M.Ed. Certification, and 6 (6%), have an associate degree in education. According to the length of teaching experience, 76 (71%) have between one and five years of teaching experience, 28 (26%) have between 6–10 years, and 3 (3%) teachers have more than ten years of teaching experience. Notably, 90 (84%) of teachers/respondents have already attended 1–5 CPD training sessions in the traditional professional development model. Notably, 103 (96%) of the teachers/respondents had prior face-to-face training experience. Only 2% of teachers have taken online courses, and 2% have taken both. However, none of the respondents had previous mobile-based training experience. When teachers were asked about the time limit on mobile use, 82 (79%) of teachers use more than 2–3-hour(s) mobile daily for internet surfing and other usage. When asked about their technology usage, 95 (88.8%) of teachers said they had used a smartphone for one to five years, while 12 (11.2%) said they had used it for more than six to ten years. Furthermore, 30 (28%) teachers used 3–5 apps, 40 (37.4%) teachers used 6–8 apps, and 37 (34.6%) teachers used more than nine apps on their smartphones.

Table 2 summarizes the demographic data in a nutshell.

Table 2. Demographic information of participants

Demographics	Description	Sample	%
No of Participants (M/F Ratio)	Male	63	59
	Female	44	41
No of participants (Age-wise groups)	25–30	25	23
	31–40	70	65
	41–50	12	11
	51–60	0	0

(Continued)

Table 2. Demographic information of participants (*Continued)*

Demographics	Description	Sample	%
Academic Qualification	Bachelor's degree	68	64
	Masters /M.Phil.	36	34
	Ph.D.	1	1
	Other	2	2
Professional Qualification	B.Ed.	89	83
	M.Ed.	10	9
	ADE	6	6
	Other	2	2
Experience in No of years	1–5	76	71
	6–10	28	26
	11–20	3	3
Training attended during service	1–5	90	84
	6–10	17	16
	11–20	0	0
Mode of training you received in the Past?	Online Training	103	96
	Face to face training	2	2
	Both online and F2F training	2	2
	Mobile based Training	0	0
If you have a mobile, then how much time do you spend on your mobile phone on average in a day	Less than 30 Minutes	1	1
	From 30 Minutes to 1 Hour	6	6
	from 1 hour to 2 hours	18	17
	from 2 Hours to 3 Hour	39	36
	more than 3 Hours	43	40
Smart phone use	1–5 yrs	95	88.8
	6–10 yrs	12	11.2
No of app usage	3–5 App	30	28.0
	6–8 App	40	37.4
	9 + App	37	34.6

5.2 Usability testing data analysis

Reliability analysis. The tool was piloted before the main study to guarantee reliability and usefulness. Cronbach's alpha values for this study's questionnaires were 0.81, which is greater than 0.7 [70].

Effectiveness & efficiency (in terms of task completion rate and time). For the study, eight different tasks were created. The time required to perform each task activity is shown in Table 3 below. Task completion speed indicated efficacy. Observers and timekeepers tracked participants' task times. Each task had a time limit. The application was so simple and effective that all participants completed all eight tasks.

The mobile app's efficiency was measured by how long a task took. The Table below gives performance times in seconds. All tasks average 5.8 seconds to finish.

Table 3. Summary of task completion and its total mean & std. deviation

No	Task	N	Task Completion	Average Time on Task (Sec)	Std. Deviation
Task 1	Log in to the App using PID and password.	107	107(100%)	4.9	1.3732
Task 2	Post Question on Discussion forum	107	107(100%)	2.6	0.6160
Task 3	Enroll in CPD Course	107	107(100%)	5.3	1.3927
Task 4	Search scheduled training/ Workshops	107	107(100%)	8.8	1.5850
Task 5	View FAQ by category.	107	104(97%)	5.5	1.7503
Task 6	Play course Video	107	107(100%)	5.1	1.1746
Task 7	Download Certificates and Result sheet	107	103(96%)	7.5	1.7819
Task 8	Take pretest before training session	107	105(98%)	6.8	2.1550

The results of the task completion time with the eight supplied usability tasks are shown in Tables 3 & 4. Participants' performance ratios are about equal between male and female participants. Participants took less time to finish Task No. 2 since it has a difficulty level of 1, whereas Task Nos. 1, 3, 5 & 6 have the same depth (difficulty level 2), which means that they required almost the same amount of time to complete them, as shown in Table 4. Task No. 4, 7 & 8 has a difficulty level of 3, which is why it took the participants longer to complete than the other tasks, demonstrating that the application is generally efficient. İn a nutshell, the table shows the gender-wise task completion time in terms of Mean, Std. Deviation and Std. Error means.

Table 4. Average time of tasks completion by gender wise

Gender		N	Mean	Std. Deviation	Std. Error Mean
Task 1	Male	63	4.952	1.2499	.1575
	Female	44	4.818	1.5443	.2328
Task 2	Male	63	2.635	.6792	.0856
	Female	44	2.477	.5053	.0762
Task 3	Male	63	5.095	1.6335	.2058
	Female	44	5.545	.9010	.1358
Task 4	Male	63	8.667	1.5964	.2011
	Female	44	9.091	1.5525	.2340
Task 5	Male	63	5.254	1.8834	.2373
	Female	44	5.841	1.4933	.2251
Task 6	Male	63	4.905	1.3163	.1658
	Female	44	5.341	.8877	.1338
Task 7	Male	63	7.651	1.8064	.2276
	Female	44	7.386	1.7549	.2646
Task 8	Male	63	6.683	2.1984	.2770
	Female	44	7.000	2.1020	.3169

5.3 Satisfaction (system usability scale)

To assess the application's usability, participants were asked to complete a post-task questionnaire based on ten SUS questions on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Table 5 shows post-task survey results.

Table 5. Usability questionnaire (SUS) results

SUS Items	SD	D	N	Agree	SA	Mean	SD
I think I would like to use this tool frequently.	0	0	2	42	63	4.1	1.093
I found the tool unnecessarily complex.	31	75	1	0	0	1.7	0.506
I thought the tool was easy to use.	0	0	0	43	64	4.3	0.480
I think that I would need the support of a technical person to be able to use this system.	18	82	4	3	0	2.2	0.841
I found the various functions in this tool were well integrated.	0	0	0	48	59	4.4	0.486
I thought there was too much inconsistency in this tool.	18	89	0	0	0	1.8	0.384

(Continued)

Table 5. Usability questionnaire (SUS) results *(Continued)*

SUS Items	SD	D	N	Agree	SA	Mean	SD
I would imagine that most people would learn to use this tool very quickly.	0	0	0	37	70	4.4	0.493
I found the tool very cumbersome to use.	26	81	0	0	0	1.8	0.431
I felt very confident using the tool.	0	0	0	36	71	4.6	0.486
I needed to learn a lot of things before I could get going with this tool.	13	80	0	14	0	2.3	0.938

According to the SUS question 1, 42 agree, and 63 strongly agree that they will use this training app most frequently when it is implemented in schools, indicating that teachers have a very positive attitude regarding app use for sustainable professional development. Question 3 of the SUS revealed that all teachers disagree with the assertion. This App is both essential and straightforward for them. Question 3 shows that all respondents agreed that the training software is simple and navigate. Question 4 illustrates that just 1% of participants believe they need technical support to operate this application.

In contrast, the rest of the participants had no trouble using it, as shown in Table 5. and had no inconsistencies. Question 7's mean and standard deviation values are 4.4 and 0. 493, respectively, indicating that most participants strongly agree that this training app is extremely straightforward to use and that most individuals could learn to use it fast; and also helpful in improving knowledge, skills, and dispositions and significantly impact their professional development. Whereas Question 9 reveals that all participants believe this App is not a complex tool. However, the final two questions are also more important. Question 9 shows that 100% of teachers are happy and confident using the application; however, 14 out of 107 participants believe they still need to learn things before getting started. The System Usability Measure (SUS) is the most extensively used usability scale in the human-computer interaction (HCI) sector. Figure 4 depicts the average SUS score of all participants on the graph, which shows that the minimum score is 75 and the highest score on the chart is 92.5, which is higher than the average SUS score (68) as highlighted in studies [64], [66]. It implies that the mobile-based training application is highly user-friendly for novice users. Additionally, this figure demonstrates that participants can utilize this application efficiently and that nearly all participants are delighted with it.

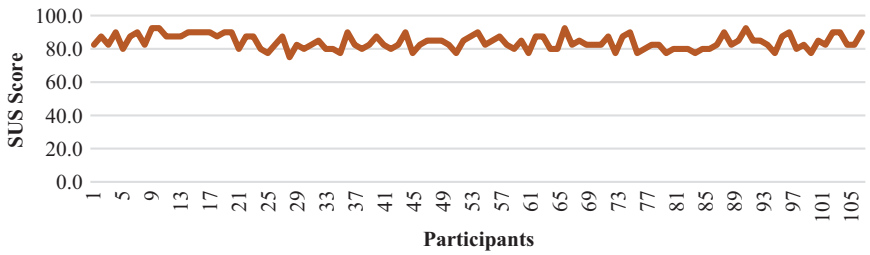


Fig. 4. Average SUS score of all participants

Table 6 shows that the average SUS score of a male participant is 84, while the average SUS score of a female is 83.9, and the overall SUS score of all participants is 84.1, which is higher than the average SUS score of 68. It shows that nearly all male and female participants are delighted with the usability of mobile-based training applications, and the overall rating score is acceptable. More information is mentioned in the plot graph see Figure 5, which is detailed below.

Table 6. Overall, SUS score rating summary (gender wise and overall satisfaction level)

SUS Items	Male (Avg SUS Score)	Female (Avg SUS Score)	Overall SM	Rating
10	84	83.9	84.1	Acceptable

Figure 5 shows the results on a plot graph, which shows the posterior mean and 95% credible interval for the population mean SUS score. The min 75.00 and max 92.50 bars offer the range of the single-participant SUS scores, and the circles in the bottom bar display the frequencies of the single-participant SUS scores, where larger circles denote a more significant number of scores. The estimates for the credible interval's bounds were found using a Bayesian method that is effective regardless of sample size. More information on the methodology is presented in Clark et al. (2021) [71].

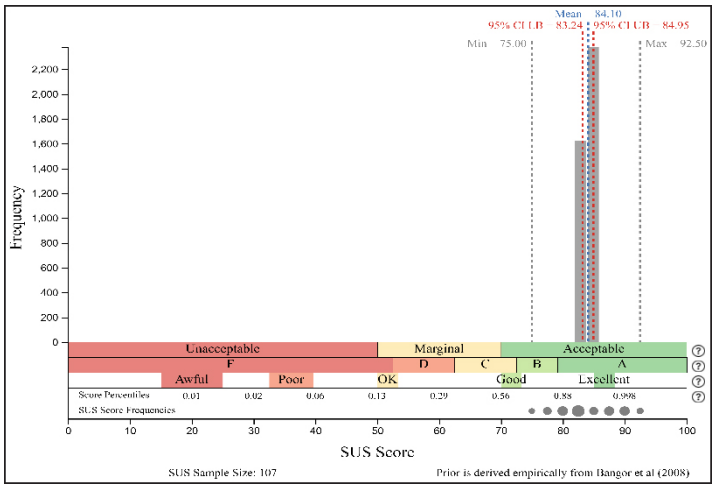


Fig. 5. Satisfaction rating

5.4 Statistical analysis

The findings of group differences in SUS scores that were extracted using SPSS V20 are presented in Table 7. The findings of statistical tests conducted on these demographic characteristics and system use are shown in Table 7. These tests were run with SUS serving as the dependent measure.

Table 7. Independent sample *t* test and one way ANOVA

Demographic	Category	M	SD	p-value
Gender	Male	83.968	4.1551	t=.473 p=.637
	Female	84.375	4.6732	
Age	25–30	84.231	4.1091	f=.301 p=.741
	31–40	83.949	4.6258	
	41–50	85.000	3.3710	
Education	Bachelors	84.118	4.4421	f=.369 p=.776
	Master	84.375	4.2835	
	Ph.D.	82.500	0	
	Others	81.250	5.3033	
Teaching Exp	1–5	84.079	4.5063	f=.612 p=.544
	6–10	84.554	4.0285	
	11–20	81.667	3.8188	
Smart phone use Exp	1–5 yrs.	84.079	4.4221	t=–.376 p=.708
	6–10 yrs.	84.583	3.9648	
No. App use	3–5 App	85.500	4.2243	f=3.750 p=.027
	6–8 App	84.438	3.8600	
	9 + App	82.703	4.6539	

According to the findings in Table 7, demographic factors do not substantially impact the sus score for perceived usability. The results indicate that gender, age, education, and teaching experience do not significantly affect the usability of mobile App. There was no significant difference between groups on SUS score, and recommended value is $p<0.001$, as indicated by [68]. Table 7 shows that years of smartphone use, and the number of apps used had no effect on perceived usefulness. SUS scores didn't differ between groups. Since the SUS mean across groups was 84.1, perceived usability is high.

5.5 The single ease question

After the test session, each participant receives a standardized questionnaire. They were asked to rate the system's overall usability. The goal is to determine their overall satisfaction with the system's ease of use and their plans based on its usability. Figures 6 and 7 show test findings. Figure 6 shows that 98% of teachers feel this system should be utilized to support teachers' professional growth. Figure 7 demonstrates that 104 (98%) teachers are happy with sustainable teacher training App.

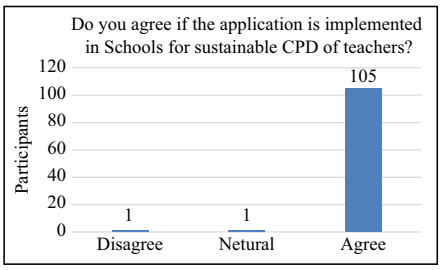


Fig. 6. Satisfaction question 1

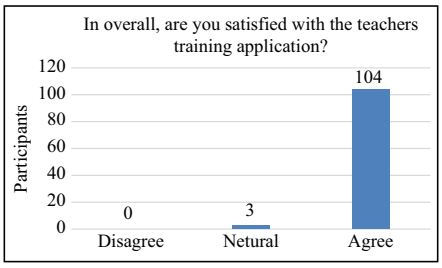


Fig. 7. Satisfaction question 2

6 Discussion and conclusion

Several training apps for teachers' training have been developed. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) is particularly interested in using mobile technology to sustain education in general. In particular, the educational environment promotes academic fairness, accessibility, and flexibility for learners everywhere and at any time [38]. But none of the projects is developed for sustainable continuous professional development of teachers in Pakistan, and neither the usability of such apps was evaluated for better and sustainable professional development programs. The purpose of this research was to improve the CPD model's sustainability for teachers' professional development. This research improved knowledge of using the CPD model as a source of educational sustainability by expanding the traditional CPD system through mobile technologies. This study evaluated a mobile-based training app's efficacy, efficiency, and overall satisfaction. This part discusses the study's findings and their relevance to other studies. This study tested a mobile app for teacher training in Sindh. This study examined the impact of demographics and system use on SUS final scores. 107 primary school teachers took part. Participants performed eight usability tasks utilizing the researcher's smartphones and internet bandwidth. Timing and completion rates were recorded. After completing usability tasks, users filled out a questionnaire. After completing usability activities, users submitted a System Usability Scale questionnaire to assess overall satisfaction with the training app and better understand the programme. 100% of participants successfully finish both tasks. All usability tasks and SUS scores show that the app is user-friendly, efficient, and effective.

The second research question investigated at demographics and system use and SUS outcomes. Gender, age, education, teaching experience, smart phone use, and app number were all investigated. The gender, and education feature had no effect on SUS results. Compared to past studies in a different situation, this conclusion is consistent with [72]–[74], Age doesn't seem to affect app usefulness. SUS scores were similar among groups. To our knowledge, teaching experience has never been evaluated in a mobile app setting. Table 7 shows that years of smartphone use, and the number of apps used had no effect on perceived usefulness. SUS scores didn't differ between groups. Since the SUS mean across groups was 84.1, perceived usability is high. Another study's findings [72]–[74]. Mobile apps' usability directly impacted teachers' usage of mobile learning for sustained professional development. Still, this effect was mediated

by learners' satisfaction with app ease, effectiveness, and learnability. This study supports the mobile-based training system as a sustainability factor due to its efficiency and effectiveness, acknowledging that it is simple to use an M-learning system for sustainable development and positively affects teachers' professional development for long-term education quality. Teachers were inspired to use a mobile app for training since they could access it anywhere. The model's mobility is suitable for mobile professional development that offers teachers real-time classroom help. It can be used for mobile-based teacher CPD without any problems. Peer contact and collaborative learning, teacher interaction, engagement, and training self-management in the training software have satisfied teachers overall. They promote group learning. Peer interaction, this app is simple and efficient. The 84.1 percent satisfaction percentage was satisfactory.

7 Limitations and future work

The research has some limitations: A convenience sample was drawn from a training centre. And only one type of teacher group was used for this study. Many future demographic factors can be considered, like urban and rural areas. Furthermore, we only examined the long-term benefits of a professional development program on teacher quality and retention. Still, it would be fascinating to see whether the program has a sustainable influence on student performance. This paradigm will be investigated further in the future and tested with larger groups of people of the target group. It may be regarded as the beginning point for pedagogical and technology design for a larger global audience in mobile learning courses.

Furthermore, the framework will serve as helpful assistance for instructional designers as they construct and design relevant mobile learning training. Likewise, in the future, various questions will need to be studied. What problems do educators and guide teachers have when deploying a sustainable CPD model through a school mobile app? What effect will it have in the long-term on the achievement of students and teachers? A Follow-up study is also required to look at the roles of all stakeholders' perceptions in mobile-based training, particularly in terms of adaptability and sustainability in teachers' continuous professional development.

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