Investigation on the Current Situation of Mobile Learning of Undergraduate Pre-service Teachers in China and Research on Promotion Strategies

Xingquan Zou[1,2], Mahizer bin Hamzah[1,*]
[1]*Faculty of Human Development, Universiti Pendidikan Sultan Idris (UPSI), Tanjung Malim, Perak, Malaysia*
[2]*School of Teacher Education, Ping Ding Shan Normal University, Pingdingshan, Henan, China*
**Corresponding Author.*

Abstract: The integration of technology into educational systems has brought about a transformation in the methods of obtaining information. This has given impetus to such ideas as mobile learning. Recent years have seen a significant increase in the use of mobile learning, or " M-learning" in remote education. This article investigates the current situation of mobile learning among students major in undergraduate pre-service teaching through questionnaires, interviews and other methods. It is found that pre-service teachers have the conditions to carry out mobile learning, but the awareness of mobile learning is insufficient, the knowledge absorption is fragmented, and the lack of information literacy, etc., and they are also affected by various external factors. Based on the above results, this study proposes corresponding strategies to promote pre-service teachers' mobile learning: instructors should actively carry out mobile learning to assist classroom-teaching practice, and increase the guidance for undergraduate pre-service teachers Learners need to be mobile learning awareness and improve their learning ability.

Keywords: Mobile Learning; Undergraduate Pre-service Teachers; Promotion Strategies

1. Introduction

In addition to benefiting from advancements in mobile network technology, M-learning has also been made possible by advances in instructional design. Mobile learning has evolved into a popular movement of classroom innovation and reform, bringing fresh energy and new challenges to the teaching profession. The advancement of teacher education is a key catalyst for ongoing innovation and progress in the field of education. In the age of information network technology, pre-service teachers have mobile learning devices, and smartphone-based mobile learning offers tremendous opportunities for pre-service teachers to learn[1]. Despite the fact that 80% of pre-service teachers actively try to use mobile devices for learning, they do not completely accept mobile learning as a comprehensive teaching strategy[2], this really reduces the effectiveness of mobile learning in the teaching and learning process. A survey shows that nearly half of the students still rely on teachers and peers when they encounter learning difficulties and are unable to use the Internet for independent learning[3].

As the preparatory force for future teachers, the learning ability of pre-service teachers will directly affect the quality of future education. Therefore, to understand the current situation of M-learning in the group of pre-service teachers, analyse the current situation and study the promotion strategies will be conducive to the better development of M-learning for pre-service teachers and the improvement of their learning ability.

2. Background

With the development of wireless networks and mobile communication technology, mobile devices are rapidly changing the face of the whole social life. In 2000, at the 40th anniversary of Shanghai Television University, Dr. Desmond Keegan, an international distance education authority, reported on " From d-learning to e-learning, to M-learning", introducing the concept of

mobile learning to China.

Mobile learning takes place in the context of the availability of mobility technologies [4]and is generally referred to as " learning across multiple environments through social and content interactions using personal electronic devices"[5]. The concept of mobile learning has evolved with the times and technological advancements, and its definition is centred on mobile technology devices. It focus on the learner and the learning process, and also emphasising the contextualisation, personalisation and interactivity of learning[6]. Combined with the idea of education, mobile learning refers to a new type of learning mode that uses wireless mobile communication network technology as well as wireless mobile communication devices to access educational information, educational resources and educational services[7].

With the increasing popularity of mobile smart devices represented by smartphones and the widespread use of mobile Internet represented by 5G transmission technology, various online e-learning resources have been enriched. As of June 2021, there were 1.007 billion mobile Internet users in China, according to the 47th China Internet Development Statistical Report. Of these users, 99.6% accessed the Internet via mobile phones, 25.6% via TV, and 0.6% via desktop computers. On laptops, tablets, the percentage of Internet users was 34.6% and 30.8% respectively.

In the context of the continuous promotion of the construction of " Digital China", mobile learning plays an increasingly important role in university students' learning, and compared with traditional education, mobile learning is outstanding in terms of mobility and universality[8]. Mobile technology allows learners to engage with authentic environments and to learn in both formal and informal settings[9], and mobile learning is a crucial mode of learning in the future model of university education.

3. Mobile Learning Impacts on Teacher Education

The majority of the research on mobile terminal equipment for mobile learning was done in its early stages. However, the intelligent mobile equipment is becoming more and more common, which has forced academics to focus more on how technology supports mobile learning with the research focusing on whether the mobile computing devices used are effective in presenting learning content and enabling two-way communication between teachers and learners.

Subsequently, a model of the influencing variables of mobile learning interaction intention was created by some scholars using the technology acceptance model and interaction theory[10]. In order to forecast and enhance learners' learning, research on mobile learning primarily focuses on analysing the learning outcomes and behaviours of learners.

The results of the current study indicate that higher education is now the primary market for mobile learning apps. It is also the most mobile device utilised across all educational levels, and the usage of mobile learning technology is becoming more and more popular. Lin Su Zhen (2020) used questionnaires and interviews to investigate the current status and expectations of students' mobile learning. It found that the gap between the current status and expectations, and analyzed the specific needs of students in five aspects: mobile learning equipment, mobile learning media resources, mobile learning methods, mobile learning communication objects, and attitudes. More scholars are focusing on pre-service teachers' attitudes and tendencies toward mobile learning, and analysing the survey data to explore the implications for subsequent research on mobile learning design, and to actively explore and promote the " mobile learning" (M-learning) teaching methodology, to make mobile phones a classroom teaching tool in colleges and universities [11].

In the context of information technology, education models and learning methods have gradually transformed into lifelong learning and personalized autonomous learning, in the field of mobile learning research, researchers have begun to devote themselves to the development of autonomous learning platforms to meet learners' learning needs and improve Educator competency level[12].In the future, we can focus on the deep integration of mobile terminals, resources, and applications, and develop more subject learning resources to suit innovative applications for different terminals and different courses, so that mobile

learning will have a broad prospect.

4. Methodology

First of all, through the questionnaire to investigate the current situation of pre-service teachers' mobile learning, the current situation of pre-service teachers' mobile learning is summarised and attributed on the basis of the analysis of the survey results; Then select some lecturers to be interviewed for certain issues to further understand how mobile learning is carried out in pre-service teachers' teaching in order to obtain corresponding strategies to promote the effect of mobile learning, and finally summarise this study.

Reviewing relevant literature in order to sort out M-learning research, on this basis, it was concluded that the current status of M-learning applications was investigated mainly in terms of the current use of M-learning, needs and attitudes. Qi Shao Xia's " Questionnaire on the Current Situation of Mobile Learning for Teachers and Students in Higher Vocational Education" (2019) and Liu Qian Ru's (2014) " Questionnaire on the Status Quo of Mobile Learning for College Students" could be as the reference for this study.

The questionnaire in this study, in addition to the necessary basic information, includes a survey on four aspects, namely, pre-service teachers' ownership of mobile learning devices, mobile learning behaviours, attitudes towards mobile learning and acceptance of mobile learning in teaching, with a total of 24 questions, includes single choice and multiple choice.

The teachers were interviewed using semi-structured interviews, this method seems to provide more useful data when the sample size is relatively small. It also allows thematic analysis of the qualitative data[13], and the outline of the interviews centred on teachers' perceptions of M-learning as well as their opinions and suggestions on the use of M-learning in teaching.

5. Analysis of the Questionnaire Survey Results

5.1 Subject of the Survey

The respondents of the survey were all the students in the pre-vocational education category at Ping Ding Shan Normal University. The Ping Ding Shan Normal University is a comprehensive general undergraduate institution, located in Henan Province, central China. This university was formerly a teacher training university. Its ranking is 93 in 2022's China's latest normal university ranking, and 160 undergraduate universities participated in the ranking.

The reliability and validity of the questionnaire need to be verified before the formal survey. Thirty-four students majoring in pre-service teaching at Ping Ding Shan Normal University were randomly sampled as the target of the questionnaire, and then the data were analysed by SPSS to collate the reliability and validity of this questionnaire. Cronbach's Alpha Reliability Coefficient method is used to test the reliability coefficient and the pre-test data reliability coefficient value of this questionnaire was greater than 0.8, which indicates that the data reliability is of high quality and can be used for further analysis. KMO and Bartlett's test are used as indicators of validity validation, the KMO value of this questionnaire was 0.749, which is between 0.7 ~ 0.8, and the research data is suitable for extracting information.

This questionnaire is issued based on the professional questionnaire website of Questionnaire Star, multiple choice and omission questionnaires can not be submitted, so there is no need to exclude non-compliant questionnaires. While a population between 1000 participants and 1100 participants is 278[14], so total of 278 questionnaires were distributed and 278 were returned. 240 female respondents accounted for 86.3% of the total number of respondents, and 38 male respondents; 222 respondents were from Arts and 56 from Science, which is in line with the fact that there are more female students in undergraduate teacher training colleges and universities.

5.2 Result

5.2.1 Mobile Learning Device Ownership by Undergraduate Pre-service teachers

As shown in Figure 1, all undergraduate Pre-service teachers own Smartphones, 58.6% own Laptops and 31.3% own tablets. A smaller percentage own e-book readers (5.0%) or other mobile devices (1.44%). Smartphones have become a ubiquitous mobile device for any student majoring in pre-service teaching, and most of them own laptops or desktops, which

provide a more convenient foundation for learning.

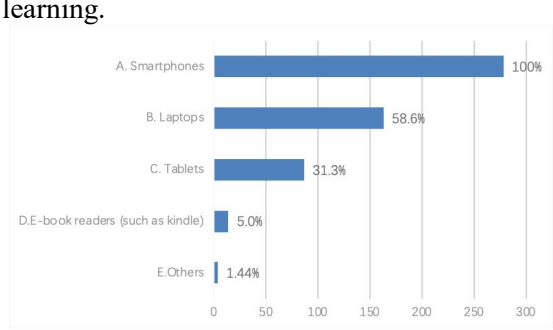

Figure 1. Basic Information Of Mobile Devices Held of Undergraduate Pre-service Teacher

5.2.2 Mobile Learning Behaviours and Habits of Undergraduate Pre-service Teachers

As shown in Figure 2, 67.20% indicated that they used mobile devices regularly, 27.2% of undergraduate Pre-service teachers indicated that they did so occasionally. Only 5.2% indicated that they seldom using mobile devices for learning or accessing learning content, and 0.2% of students indicated that they had never used mobile devices for learning.

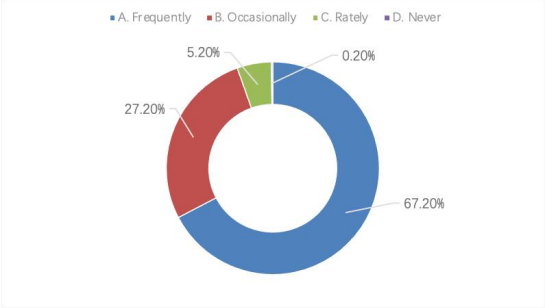

Figure 2. Frequency of Undergraduate Pre-Service Teacher Using Mobile Devices

When asked about their knowledge of M-learning, 92.1% of pre-service teachers were unfamiliar with the concept of M-learning, of which 56.12% had heard of M-learning, only 7.91% of respondents were familiar with M-learning. The data suggests that undergraduate pre-service teachers have little understanding of M-learning. Combined with the findings of the previous question, which showed that most of the Pre-service teachers had the experience of actively trying to use mobile devices for learning. Clearly, most of the students did not consider mobile learning as a way of learning.

The results show that 80% of undergraduate pre-service teachers chose M-learning mainly for " subject-specific" purposes, for " Qualification exam preparation" (68.8%) as much as for " General knowledge and life skills" (68%), 39.2% of the respondents would choose " News", 39.2% of the respondents would choose " News and current affairs" and " Language learning", more than a third, 34%, preferred " online open courses".

Figure 3 shows that 83.2% of the students preferred the mobile learning method of " Browsing websites for information, following relevant WeChat public accounts", which can be concluded that the application of Internet search function, learning software and social platforms through the device has become the main mobile learning method adopted by undergraduate pre-service teachers.

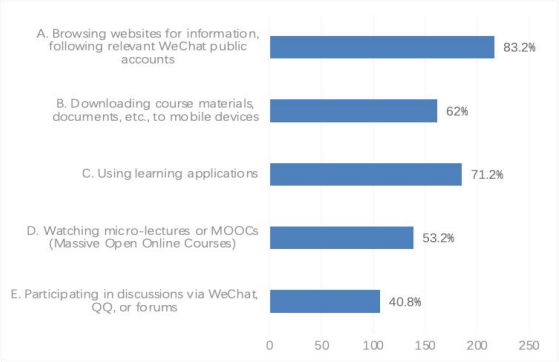

Figure 3. How Undergraduate Pre-service Teaches Performs Mobile Learning

5.2.3 Factors Influencing Mobile Learning for Undergraduate Preservice Teachers

When choosing the location or scenario for mobile learning, 73.2% of undergraduate Pre-service teachers chose When needing to quickly look up information., this shows that mobile learning has become the norm for undergraduate pre-service teachers, and a considerable proportion of them use fragmented time for mobile learning. More than 50% of undergraduate Pre-service teachers agreed with that the two categories of barriers were difficulty in learning resources and high fees. Additionally, 46.8% of them found the devices unfriendly and 41.2% reported a lack of guidance, as shown in Figure 4. Learning resources and the way they are presented are the main barriers to mobile learning for undergraduate Pre-service teachers, and the high cost of many resources also affects mobile learning.

During mobile learning, only 12.2% of students thought that attention was " Easily focused, learning without realising it", while the majority of students (58.6%) thought that attention " Depends on the learning content and environment", and 20% of undergraduate

pre-service teachers thought that it was difficult to get focused. It can be seen that the problem of attention during M-learning is affected by the content and environment, and how to help pre-service undergraduate teachers to focus their attention during M-learning needs to be further discussed.

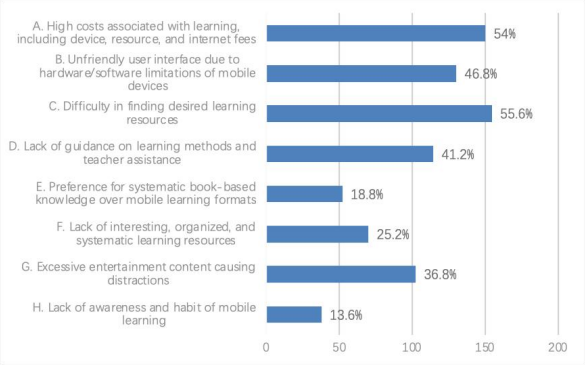

Figure 4. Major Obstacles to the Development of Undergraduate Pre-service Teachers Mobile Learning

The level of mastery of mobile learning skills by undergraduate pre-service teachers is that 65.2% of students are able to find relevant learning resources, 64% are able to assess the usefulness of the learning resources, 44% are able to integrate the acquired learning resources into their studies, and 4% are not able to achieve any of the above. In addition, only 24.8% of the students surveyed would read and take extracts. This shows that most of the undergraduate Pre-service teachers lack the basic information skills and literacy to process information.

5.2.4 Attitudes of Undergraduate Pre-service Teachers towards Mobile Learning

70% of undergraduate pre-service teachers believe that M-learning is conducive to learning; while only 4.8% believe that M-learning is inefficient, the vast majority of undergraduate pre-service teachers approve it as a method. 53.2% of them think that mobile learning resources are abundant but difficult to find, while 4% and 2.5% think that mobile learning resources are " Generally scarce" and " Unsure" respectively. This shows that the learning resources provided on mobile learning devices are relatively abundant. However, it is difficult to find these resources, which indicates that undergraduate pre-service teachers lack the ability to retrieve information. For the evaluation of the role of mobile learning, 49.6% of undergraduate Pre-service teachers think that mobile learning has great potential, and 33.5% think that the mobile learning method is just an aid, In general, there are still a lot of people who still have a one-sided understanding of mobile learning, and see mobile learning simply as a learning method. At the same time, almost all of them are willing to choose M-learning, but less than 30% of undergraduate pre-service teachers are "very willing" to do so, while nearly 20% of them have the mindset of trying, which means that a lot of undergraduate pre-service teachers are still not very interested in M-learning.

5.2.5 Undergraduate Pre-service Teachers' Willingness to Implement Mobile Learning in Teaching

In this section, a total of eight questions were asked in the form of a Likert scale to investigate attitudinal willingness, and the frequency statistics showed that the proportion of people who held a neutral or higher attitude for each question was close to or more than 85%, among them, the option of " applying M-learning in teaching" has the strongest willingness, with nearly 94.2% of them holding neutral or above attitudes.

The value of the mean in the Likert scale between 1.67 -3.33 indicates Moderate acceptance and between 3.34 - 5.00 indicates High acceptance. Analysing the mean values according to Table 1, it is found that (1) Item 17 is lower than 3.34, which means that the support of the network for mobile learning still needs to be improved; (2) The value of item 18 is equal to 3.34, while the number of people who chose neutral is 46.4%, which can be concluded that undergraduate Pre-service teachers think that the existing mobile devices are not yet able to fully meet the needs of mobile learning; (3) The mean values of items 19-24 are all greater than 3.34, indicating a high level of acceptance.

Undergraduate pre-service teachers support the use of mobile learning devices in the teaching and learning process. Undergraduate Pre-service teachers prefer mobile learning approaches when faced with problems. Especially when mobile learning resources and course content are closely linked undergraduate pre-service teachers are more willing to participate in mobile learning activities. Outside of class time, more than 60% of them are more likely to choose M-learning for learning if they are guided by teachers. Overall, undergraduate pre-service

teachers are willing to engage in M-learning on a regular basis in their future studies.

Table 1. Mean and Standard Deviation Statistics

Item	Mean	Standard deviation
17.The current internet connectivity is smooth and meets your needs for mobile learning.	3.29	0.86
18.The performance of your mobile device is sufficient for your mobile learning activities.	3.34	0.812
19.You strongly support the use of mobile devices for mobile learning during the teaching process.	3.47	0.759
20.You are very willing to use mobile leaning to find solutions when encountering learning problems.	3.51	0.771
21.If the teacher supports and advocates mobile learning in upcoming “Modern Educational Technology courses", you would be very willing to engage in it.	3.53	0.772
22. If the resources and course content are closely linked and rich in content, you would engage in mobile	3.68	0.661
23.If the instructor provides appropriate and clear guidance, you would be more inclined to use mobile learning for self-study outside of class.	3.59	0.717
24.You anticipate using mobile devices frequently for mobile learning in the future.	3.57	0.727

5.3 Discussion

(1) Conditions for the Implementation of Mobile Learning.

In the survey, it is found that all undergraduate pre-service teachers have smartphones, and each of them owns at least one mobile learning device that can be connected to the Internet, and all of them can meet the needs of mobile learning. In the survey on the scenarios of mobile learning carried out by undergraduate pre-service teachers, it is found that mobile learning is normalised among undergraduate pre-service teachers. In the statistics of the willingness to apply mobile learning, most undergraduate pre-service teachers are willing to carry out mobile learning. And the results of the evaluation of the role of mobile learning show that most undergraduate pre-service teachers believe that mobile learning is a viable way of learning.

(2) Fragmentation of Mobile Learning.

Undergraduate students' time for professional course learning is relatively fixed, and they have more discretionary time outside the classroom, and their independent learning time is more abundant, which provides the necessary time conditions for the development of mobile learning. Mobile learning can facilitate pre-service teachers to use fragmented time to carry out learning activities, but if there is no clear learning goal, mobile learning lacks planning and systematic, which is easy to cause fragmentation of learning results and affect the effect of mobile learning. At the same time, as mobile devices are installed with all kinds of other applications, they will push entertainment, news and other information according to the user's preference, which will also interfere with the mobile learning process.

(3) Multiple factors Influence Mobile Learning.

Many undergraduate pre-service teachers have M-learning behaviours but are not aware of themselves, they do not know enough about M-learning, which leads to the lack of awareness of most undergraduate pre-service teachers in guiding themselves to carry out M-learning in a targeted and planned manner. Due to the status of students, many high-quality online resources need to be charged, which also affects students' learning. In addition, teachers' insufficient guidance for mobile learning, students' weak awareness of active learning, lack of IT skills and lack of mobile learning skills also constrain the effectiveness of mobile learning.

6. Analysis of Teacher Interviews

6.1 Interview Design

This study used semi-structured interviews, developed semi-structured interview outlines, and followed up on research-worthy responses in the interviews to show the implementation of teaching and the application of mobile learning by university teachers, to obtain teachers' perspectives on mobile learning and application strategies, and to gain insights into mobile learning teaching for undergraduate

pre-service teachers.

The questions in the interview outline mainly focus on:

(1) How do you guide students in using smartphones or computers for learning?

(2) What are the problems or difficulties?

(3) How do you think mobile learning can be used for teaching process to pre-service teachers?

(4) What are the key strategies?

The interviews were conducted online and all interviewees were informed of the principles of voluntariness and confidentiality and signed an informed consent form prior to being interviewed. A total of seven university teachers were interviewed, all of whom teach teacher trainees.

6.2 Analysis of Interview Results

Table 2. Code of Teacher Interview Results

Primary node	Secondary nodes	Free nodes
Issues or Difficulties in using mobile devices	Increased workload of teachers	Classroom management is becoming more difficult
		Updating of teachers' skills
	Influence of external environment	Disturb from the entertainment information Network environment problems
	Attitude of students	overly rely on
		Lack of self-discipline
	Students' lack of competence	Resource and information Selection
		Skill Disparities
		technical difficulties
The measure used for mobile devices	learning method	Encouraging Blended Learning
		guide self-directed learning
	Provide Resources	Provide suitable online resources
		Providing Learning Resources
		recommend learning app
	Provide technical support	the appropriate and correct ways of using devices
		Technical Training
	Teaching progress	Immediate Feedback and Assessment
		Establishment of Classroom Policies
		guidance and support
		online management
The key strategies of mobile learning	Pay attention to practice	Combine information technology knowledge with educational practice
		Provide practical opportunities
	Enhance student's skills	Cultivate students' ability of teaching and design
		Foster pre-service teachers' communication and collaboration skills
		Improve students' information technology literacy
	Clearly the purposes for mobile learning	Define the purpose of mobile learning
		Define the purpose of utilizing learning tools

Interview data were analysed with the help of Nvivo11 software, the first software for qualitative and mixed-methods research, which analyses qualitative research data such as interviews, open-ended questionnaires, literature, policy texts, etc[15].

In this study, the interview texts were coded step by step using the method of rooted theory research, in the order of open coding, spindle coding and selective coding. The interview data were collated and analysed several times, resulting in 27 labels. The labels were then further analysed and categorised to identify 11 concepts, such as " Increased workload of teachers", which constituted the direct elements reflecting the M-learning pedagogical strategies based on teachers' perspectives. The main axis coding is to further focus the results of the open coding to form abstract categories, forming three main categories such as " Issues or Difficulties in using mobile devices", and " The measure used for mobile devices" which together constitute the necessary elements of teaching strategies for mobile learning based on teachers' perspectives, see Table 2. Free nodes correspond to labels, secondary nodes correspond to concepts, and primary nodes correspond to categories.

6.3 Finding

Based on the interviews, we can conclude that these factors are essential for effective mobile learning:

(1) Available technology: students should be able to easily access portable mobile tools.

(2) Resource support: Full, thoughtful and rich resources are essential.
(3) Integration: Successful M-learning programmes are not stand-alone, but are integrated with other learning activities and pay more attention to students' experiences and real-life scenarios.
(4) Students' attitudes: Students' recognition of and interest in M-learning is a prerequisite for independent M-learning.

7. Strategies and Recommendations

7.1 Strategies for Instructors to Apply Mobile Learning in the Teaching and Learning Process of Pre-service Teachers

(1) Strengthening mobile learning guidance for pre-service teachers. For example, setting clear learning objectives and progress to guide their learning direction and progress, stimulating pre-service teachers' learning motivation and initiative, implementing personalised learning guidance and advice, and improving the relevance and effectiveness of learning.
(2) Quality M-learning resources. Instructors provide Pre-service teachers with high-quality mobile learning content. The content should be relevant, interesting and adapted to mobile devices so that pre-service teachers can make full use of mobile devices for learning anytime, anywhere.
(3) Advocating independent and co-operative learning. Mobile learning platforms can provide opportunities and resources for independent learning and encourage Pre-service teachers to take the initiative in mobile learning, such as independent learning tasks and co-operative and exploratory learning activities, so that Pre-service teachers can learn according to their interests and goals.
(4) Provide feedback and support: Pre-service teachers may encounter problems or need counselling during the learning process, instructors can make use of the M-learning platform to provide timely learning support, such as online tutors, peer support, discussion forums, etc., to solve the confusions and problems faced by Pre-service teachers in their learning.

7.2 Strategies to Enhance Mobile Learning Skills for Pre-service Teachers

(1) To improve information literacy. Pre-service teachers should enhance their information awareness, enrich their information knowledge and improve their information skills by learning the theoretical knowledge of information literacy, to enhance the practical ability of mobile learning in an all-round way, and then improve the effect of mobile learning.
(2) To establish the awareness of identifying effective and safe information. Pre-service teachers should identify the authenticity of information obtained from the Internet and avoid spam, inaccurate information and undesirable information on the Internet; they should obtain professional knowledge from formal channels and authoritative websites, and should not blindly believe in the information on the top of search engines; and they should not readily disclose sensitive information such as personal identity card numbers and school numbers in the mobile learning process.
(3) Enhancement of self-management ability. Pre-service teachers can carry out M-learning scientifically and efficiently by making reasonable adjustments to the learning objectives in stages in order to improve the efficiency of the use of fragmented time and the efficiency of the implementation of M-learning programmes.
(4) Cultivate the habit of active learning. Good habits of active learning are conducive to improving mobile learning, and it is necessary to formulate a mobile learning strategy that meets the learning characteristics of the person concerned and make active use of fragmented time for mobile learning to improve the effectiveness of mobile learning.

8. Conclusion

After reading a lot of mobile learning-related literature, this paper combs through the theoretical basis and research direction of mobile learning and finds that mobile learning is an inevitable choice for college students to engage in informal learning, which is in line with the developmental needs of learning in the information age.
This article adopts survey methods such as questionnaires and interviews to investigate the current situation of mobile learning with undergraduate pre-service teachers as the target and puts forward strategies to promote mobile learning among undergraduate pre-service teachers.

Through summary and reflection, we found that this study has the following 2 deficiencies: (1) due to my limited knowledge of statistics, there are imperfections in questionnaire design and questionnaire analysis; (2) due to the time constraints, the practice session is in progress, and we have not yet been able to get the specific data after the practice to conduct the effect analysis.

The authors will address the weaknesses in terms of theoretical and research skills and other aspects of future work and learning, as well as carrying out more in-depth research in the teaching and learning work on the effectiveness of the application of M-learning aspects.

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