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ORIGINAL ARTICLE

A FRAME Model-based Investigation into the Implementation of M-Learning in Classrooms from the Perspectives of Vietnamese High School Teachers and Students in Southern Vietnam

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ABSTRACT
The current study aims to investigate how Vietnamese high school teachers and students perceive the implementation of mobile learning (M-learning) in classrooms. In this exploratory qualitative study, using a transcendental phenomenology approach, five teachers and six students were invited for semi-structured interviews. The data was then analysed using an analytic tool that was developed from the Framework for the Rational Analysis of Mobile Education (FRAME) model. The findings show that the key prerequisites for M-learning adoption in Vietnamese secondary schools were met, which potentially entail several benefits, including instant feedback, differentiated teaching, increased student involvement and 21st century competencies. Inadequate facilities, negative influences from external variables, instructor incapacity and a lack of student discipline were the barriers to the viability of M-learning in the classroom environment. The suggestions highlighted the responsibilities of the authorities, teachers and the autonomy of the students. Several theoretical and pedagogical implications for policymakers and future research are also discussed.

1. INTRODUCTION

The advancement of Information and Communication Technology (ICT) not only affects the industrial sector but also significantly influences education and training (Nguyen & Hoang, 2020). These advances have enhanced the application of mobile devices in the education field. Nuseir et al. (2022) found that M-learning has a beneficial influence on student academic achievement in educational institutions. In addition, various studies have assessed the factors affecting learners' implementation of M-learning (Almaiah & Alismaiel, 2019; Hamidi & Chavoshi, 2018). These studies show that although interactive technologies facilitate teaching and learning, they also pose many challenges.

Educational institutions are attempting to integrate technology into education, especially following the COVID-19 pandemic. E-learning is currently trending in emerging economies, such as Vietnam. Dao and Kim (2020) reported the growing trend of e-learning in Vietnam, especially because of the COVID-19 pandemic. Due to the increasing ownership of mobile devices amongst Vietnamese youths (Murphy et al., 2014), published studies that focus on M-learning in Vietnam are increasing, such as the work by Trinh (2014), Trinh and Nguyen (2014), Trinh et al. (2019). In Vietnam, the use of mobile phones was previously banned in formal contexts. However, in November 2020, the Vietnamese government amended its educational law to indicate that Vietnamese high school students

were allowed to use mobile phones in classrooms with the agreement of the teachers for the purpose of studying. This created the concern of how to incorporate conventional methods and M-learning by teachers and students to enable in-class lessons to flow smoothly. Therefore, unlike most previous studies, which emphasised the asynchronous feature of M-learning and how M-learning influences self-directed learning, the present research strongly emphasises classroom contexts with teachers' facilitation.

The efficacy of integrating innovative technology into the educational process hinges upon the willingness of instructors to embrace and use this technology (Esawe et al., 2024), and M-learning has emerged as an essential tool for both students and instructors (Almulla, 2024). Hence, this study enriches the existing literature on M-learning by offering a better comprehension of the viewpoints held by Vietnamese instructors and students from several high schools in southern Vietnam.

This study aims to ascertain the attitudes of Vietnamese high school instructors and students regarding M-learning. To do this, the study focused on three research questions: (1) How do Vietnamese high school teachers and students in Southern Vietnam perceive the opportunities regarding the implementation of M-learning in classrooms?; (2) How do Vietnamese high school teachers and students in Southern Vietnam perceive the challenges of the implementation of M-learning in classrooms?; (3) What suggestions do Vietnamese high school teachers and students in Southern Vietnam offer to mitigate the challenges and ameliorate the opportunities regarding M-learning deployment in classrooms?.

2. LITERATURE REVIEW

Mobile Learning

Pedro et al. (2018) state that M-learning has had various definitions since the 2000s and that M-learning was a natural consequence of the e-learning evolution (Georgiev et al., 2004). There are two lines of M-learning definitions (Baran, 2014). The first one focuses on the device and highlights the immediacy, convenience, access and mobility. In the second line, M-learning is defined as personal and social-driven, which emphasises location awareness, motion detection and augmented reality.

A plethora of previous studies report positive perceptions towards the use of M-learning. In general, M-learning helps learners to alter the current learning methods to flexibly manage their learning experiences (Ahmed et al., 2018). Previous research offers affirmative findings on positive perceptions of teachers and students towards M-learning (Nawi et al., 2015; Oz, 2015). These positive perceptions may derive from the advantages of M-learning. For example, Tran (2016) concluded that the use of the Quizzlet application on mobile devices could be fruitfully used to enhance students' informal learning of English vocabulary and grammar. In the same vein, the fact that M-learning can promote interactions when students use mobile phones to read books was detected (Charitonos et al., 2016). Similarly, M-learning enables students to assess the learning content themselves to choose suitable learning directions (Chang et al., 2018). Finally, collaboration skills and creative thinking can be ameliorated using M-learning for elementary school students (Chang et al., 2017).

Nevertheless, the challenges regarding the implementation of M-learning should also be taken into careful consideration. In education in general, Ahmed et al. (2018) list several challenges, namely management and institutional; design; technical; evaluation; and cultural and social challenges. Likewise, Bidin and Ziden (2013) depict various challenges regarding M-learning applications that are related to the characteristics of mobile gadgets and the expectations of users. Oz (2014) states that the mixture of devices, pedagogical justifications, administration, insufficient training, and financial burdens are barriers to prospective English teachers' application of M-learning. In addition, insufficient training is recorded as a major demolition of teachers' adoption of mobile technologies (Kukulska-Hulme et al., 2009; Schuck et al., 2013). Regarding formal contexts, Aamri and Suleiman (2011) found that the students had not been encouraged by the teachers to use mobile phones in classrooms as these tools were considered a big distraction. Not only can the digital devices distract students in the classroom but these learners can also be negatively influenced by the nature of multitasking when using these gadgets (Ahmed et al., 2018; Bowman et al., 2010; Fried, 2008; Lepp et al., 2015). Lastly, in a paper by Zakaria (2019), the integrity and privacy of data are reported as the constraints for M-learning implementation in formal contexts.

The Framework for the Rational Analysis of Mobile Education (FRAME) Model

The FRAME paradigm, developed by Koole (2009), incorporates mobile technology, human learning competence, and social interaction into the process of M-learning (Figure 1). It is suggested that this paradigm can address the present pedagogical challenges of information overload, knowledge navigation, and cooperation in learning. In this model, the device aspect (D), learner aspect (L) and social aspect (S) are represented by three circles. The intersections for each pair of the circles (DL, LS and DS) represent the attributes that belong to both aspects. The central intersection (DLS) of the Venn diagram, where the three circles overlap, symbolizes the optimal M-learning scenario.

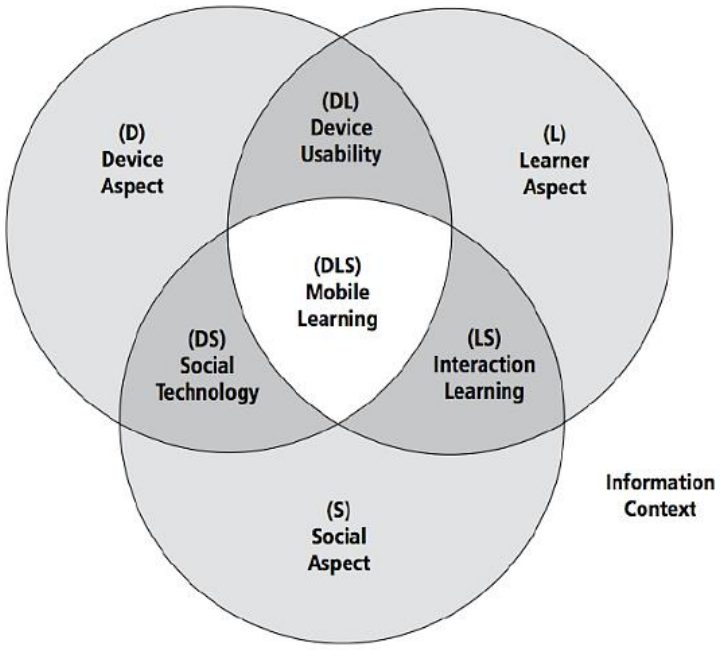

Figure 1. The FRAME model (Koole, 2009)

The D encompasses the tangible, technological, and operational characteristics of a mobile device. The L takes into account an individual's cognitive aptitude, memory, past knowledge, emotions, and motives, while the S incorporates social interaction and cooperative processes. The device usability intersection (DL) examines the connection between mobile devices and cognitive activities involving the processing and storage of information. The social technology intersection (DS) demonstrates the interaction and cooperation between many persons and systems facilitated by mobile devices. The term "interaction learning intersection (LS)" refers to the combination of learning and instructional theories. Finally, the primary focal point of the concept is the mobile learning process (DLS), which encourages cooperation among learners, facilitates access to information, and enhances the contextualization of learning.

The FRAME model has been widely used by researchers to examine M-learning in different educational contexts (Cheon et al., 2012; Lestary, 2020; Ozer and Kilic, 2018).

In summary, of all the models that were designed for M-learning, the FRAME model by Koole (2009) includes both the technical features of mobile devices and the social and personal learning processes (Kearney et al., 2012). Therefore, this model was employed as the theoretical framework of the current study.

3. MATERIALS AND METHODS

The current qualitative, explorative study employed a phenomenological approach, which helps the researcher to appropriately investigate participants' perceptions through in-depth interviews to trace certain common patterns (Fraenkel et al., 2014). This approach enabled the researchers to induce significant statements to create themes to describe what the participants underwent and how they experienced it (Creswell, 2017).

Participants and Implementation

Given the scope of the present study, the participants were purposively sampled Vietnamese high school teachers and students, who mostly came from the southern part of Vietnam. In addition, the interviews were conducted online, so only the teachers and students who had easy access to the Internet were approached. Although all the participants had experience in M-learning, some were tech-savvy, whereas some had limited digital competence.

The method of selecting participants for this study was purposive sampling, which allows researchers to subjectively judge the representativeness of the samples (Fraenkel et al., 2014). The pilot study involved two high school teachers and two high school students. For the main study, five high school teachers of five different subjects (maths, literature, foreign languages, social sciences and natural sciences) and six high school students from three grades (10, 11 and 12) were recruited for semi-structured interviews. The teachers and students came from different high schools in the southern part of Vietnam, and they had all used M-learning in the classroom. The demographic information of the participants is described in detail in Table 1 and Table 2 for the teachers and students, respectively.

Table 1. Demographic information of the teacher participants

Coded name	Major	Gender	Years of teaching experience	School location	Type of school
T1	Maths	Female	10	Urban	Public
T2	Literature	Female	9	Rural	Public
T3	English	Male	5	Rural	Public
T4	Social Sciences	Male	6	Urban	Private
T5	Natural Sciences	Male	9	Urban	Public

Table 2. Demographic information of the student participants

Coded name	Grade	Gender	School location	Type of school
S10-1	10	Female	Urban	Public
S10-2		Female	Urban	Private
S11-1	11	Female	Urban	Private
S11-2		Male	Rural	Public
S12-1	12	Male	Rural	Public
S12-2		Male	Urban	Public

The participants described how M-learning was implemented in classroom contexts. The teachers guided the students to use mobile devices, such as mobile phones or tablets, to engage in the lessons. M-learning could either only be employed during certain stages of a lesson or the whole lesson could be taught with the aid of mobile devices. For example, *Kahoot!* was mainly reported as being used individually during the warming-up or consolidation phase of the lesson, which took approximately ten minutes; however, M-learning was employed throughout the lesson when the teachers guided the students to work in groups to solve an important issue.

Research Instrument

To achieve the purposes of this study, a set of pre-defined interview questions was developed to elicit an insightful understanding of Vietnamese high school teachers' and students' perceptions towards the employment of M-learning in classroom contexts, focusing on the following three aspects: (1) the opportunities for the implementation of M-learning in classrooms; (2) the challenges for the implementation of M-learning in classrooms; and (3) the suggestions that Vietnamese high school teachers and students offer to mitigate the challenges and ameliorate the opportunities for M-learning deployment in classrooms. Based on the FRAME model (Koole, 2009), the semi-

structured interview questions were designed to elicit information on seven aspects, namely the D, L, S, DL, DS, LS and M-learning process.

Data Collection

Semi-structured interviews can help researchers to elicit deeper and more relevant information from interviewees (Longhurst, 2009). The semi-structured interview questions in this study were consulted by an expert in the field of education before they were used for the interviews. The semi-structured interviews for the pilot and main studies were conducted online via the Skype app. To avoid misinterpreting the information, the researcher conducted the interviews in Vietnamese with the Vietnamese participants. The interviewees agreed to sign a consent form. All personal information that was provided by the respondents was kept confidential.

Data Analysis

A thematic analysis is appropriate for coding a specific research question (Braun & Clarke, 2006), which makes it suitable for this study since the collected data was coded based on the three pre-determined research questions on the opportunities, challenges and suggestions. A data coding scheme with three main categories, namely the advantages of M-learning, challenges of M-learning and suggestions for M-learning implementation, was developed.

Data triangulation could be observed through the selection of diverse participants for the study. The data was triangulated between teachers and students of different demographic backgrounds.

Trustworthiness was conducted using a member-check technique. Member checks were operated orally directly after the interviews.

4. RESULTS AND DISCUSSION

4.1. Results

Research Question 1. Teachers' and Students' Perceptions of M-learning Advantages

Essential Prerequisites for M-learning Implementation

It is' an opportunity for the implementation of M-learning that the Vietnam Ministry of Education and Training legalised the use of mobile phones in classrooms. This policy highlights the openness of the authorities towards novel teaching and learning approaches, which in turn, encourages teachers to employ M-learning in their classes. Support from the Vietnam Ministry of Education and Training was reported by Hung and Tang (2020). These authors asserted that the Vietnam Ministry of Education and Training took several positive steps towards supporting the technology application. Likewise, teacher T2 revealed that despite not being born in the digital era, most teachers attempted to familiarise themselves with technology to provide their students with the most stimulating learning environment. This confirms that Vietnamese teachers have some autonomy in classroom-related matters (Nguyen & Walkinshaw, 2018).

I was born and grew up in a village where I hardly had the chance to work with high-tech devices. Therefore, I struggle with the development of technology, and I am afraid to apply it in teaching. However, due to the encouragement from the principals, I have tried to learn about educational apps and websites from various sources (T2).

Additionally, current high school students are digital natives. As most of them have access to high-technology devices every day, they can use them proficiently (Barbosa et al., 2020). Consequently, they excel at utilising mobile devices when the teacher implements M-learning, which corresponds to the psychological comfort of the device usability intersection in the FRAME model.

By the same token, a notable advantage of M-learning is its ubiquity, which aligns with the physical characteristic criterion of D in the FRAME model. A mobile device, such as a mobile phone, is small and portable. This means that both students and teachers do not need to prepare so many apparatuses for the class, as they only need to bring their own device with basic functions. This convenience helped to reduce the time-consuming preparation process for classes by integrating technology. The anytime-anywhere benefit of M-learning in this study is in accordance with the observations by Kukulska-Hulme et al. (2009), Herrador-Alcaide et al. (2020) and Fu et al. (2021).

The Facilitation of Instant Feedback and Differentiated Instruction

One notable advantage of M-learning implementation is that teachers could instantly assess students' performance without spending much time and effort grading their papers, as illustrated by participant T5. This finding is consistent

with that of Yagci (2015). For natural science subjects, in lieu of waiting for solutions to quizzes from teachers, which normally took quite a period of time, it is now more convenient for learners to receive instant feedback by uploading the questions on certain apps to get immediate responses. *Qanda* and *Solvee* apps on mobile phones were mentioned as good examples for maths and physics quizzes, respectively. However, M-learning was reported to not offer students any in-depth feedback in International English Language Testing System (IELTS) preparation (Lestary, 2020). Also, when both mobile devices and the teacher were present at the same time in the classroom context, online feedback was claimed to be more meaningful due to the teacher's immediate insightful explanation.

Instead of collecting students' answers to multiple-choice questions on paper and spending time grading them at home, I ask students to use their mobile phones to do the tasks on the Socrative website to collect immediate results in class and give feedback on the common mistakes that most students make. It is really quick and effective (T5).

Similarly, the students highly valued the up-to-date learning feature which was brought about through M-learning. Student S11-2 shared that due to rapid changes in technology, in some fields, information in textbooks became outdated after several years. Therefore, M-learning assists in providing authentic and up-to-date information in classrooms.

Some of the content in textbooks is too old. As it is strange to study that knowledge, updated information on the internet helps me to feel more engaged in the lesson (S11-2).

This characteristic is similar to the situated cognition criteria of the LS in the FRAME model. The participants in the study by Swanson (2018) were highly in favour of regularly updated course materials via m-devices. Moreover, the student interviewees of the current study confirmed the benefit of context sensitivity when M-learning was employed. This result is in accordance with those of Cheon et al. (2012).

Regarding the subjects that traditionally require students to frequently take notes, such as literature or history, teacher T2 said that M-learning helped to reduce the cognitive load by encouraging the students to use a camera to take pictures of the lectures. This finding is consistent with that described in the criterion of the input and output capabilities in the D of the FRAME model. The finding that M-learning could make the task of taking notes easier corresponds with the findings by Dold (2016).

In literature, traditionally, students need to write a lot in class, which makes them feel tired and bored. I allow them to take pictures of my writing on the blackboard so that they can focus more on my lectures (T2).

Additionally, a recurrent theme in the interviews related to the criteria of discovery learning in the L of the FRAME model was shared by both teacher and student interviewees. According to the teacher participants, students could learn how to filter information on the internet through the M-learning process. Likewise, the student respondents said that sometimes, even the teacher did not know everything related to an issue; therefore, they could search for the information on the internet. This finding is consistent with that of Swanson (2018), who stated that discovery learning was facilitated when learners used their mobile devices to look for further understanding or clarification.

As Vietnamese students were afraid of being exposed that they did not understand the lesson in front of their peers, they rarely asked questions during class. However, as shared by student S11-1, using a mobile phone helped them to overcome this as they could send a message directly to the teacher, and the teacher would keep the identity of the student confidential.

I felt much more secure in the M-learning class since I could privately communicate my queries to my teacher without being intimidated by my colleagues (S11-1).

The Enhancement of Students' Engagement and 21st Century Competencies

In the study, the criterion of knowledge navigation in the M-learning process based on the FRAME model was indicated. Through the M-learning process, the teacher's role of knowledge deliverer was transformed into a knowledge navigator. In other words, the tendency towards student-centred learning was more clearly observed. This can be observed via this excerpt by teacher T5: *I usually raise questions at the beginning of the lesson and ask students to use their phones to work in groups to search for the answers on the internet. After they have reached a consensus, each group will present their findings. Next, I guide them to identify the correct answers and explain why the others are not precise. By doing this, my students can develop their skills to filter unauthorized knowledge on the Internet* (T5).

The knowledge navigation advantage corroborates previous work on in-service teachers' conceptions of mobile technology-integrated instruction (Chen & Tsai, 2021). Through this process, both critical thinking and creativity skills were enhanced. It also resonates with that of Chang et al. (2017), who found that students' creativity improved significantly thanks to M-learning.

Another recorded advantage of M-learning demonstrated by all the teacher participants was its assistance in enhancing interactions in classrooms as clearly stated by teacher T2 and student S10-2. The interaction between students and knowledge significantly increased. This refers to the criterion of interaction in the LS of the FRAME model. Similar to the teacher participants, the students experienced an increase in learner-content interactions due to a rise in learner-learner interactions. Earlier observations by Smyth (2011) illustrated that the potential of online learner-content environments was extended through learner-learner dialogues.

In Literature, instead of the teachers presenting all the information about authors and literary trends, allowing students to use mobile phones to search for the target information helps them to not only broaden their knowledge beyond the textbook but also memorise the events more easily. In addition, knowledge of society, facts and true stories that are found using a phone are necessary materials and evidence for social discourse topics (T2).

I can use my phone to google information on the internet, discuss with my friends and jot down interesting facts that are not mentioned in the teacher's lesson (S10-2).

Research Question 2. Teachers' and Students' Perceptions of M-learning Challenges

Insufficient Facilities

Surprisingly, no matter what types of schools (public versus private) and locations (urban versus rural) the teacher interviewees were from, they all considered internet connection a major problem for M-learning implementation. As for the rural areas, it was understandable that a lack of infrastructure led to the issue of networking. In these regions, many schools did not support internet connection, which impeded the use of M-learning in classes. In urban areas, teacher T1 illuminated that although an internet connection was always available, it was not usable because of the low-speed connection.

I teach at the best high school in the province. Although a lot of money is invested in my school, I don't know why the internet connection is super slow. Even using Google is difficult, let alone other websites (T1).

Internet connection problems were also reported by Oz (2014) and Dinh et al. (2022). This outcome is contrary to that of Murphy et al. (2014), who found that most students considered the internet quality to be moderate or fair. This contradiction can be explained by the different demographic information of the participants of the two studies. While this study recruited Vietnamese high school teachers and students from various contexts, the study by Murphy et al. employed graduate students who were participating in a costly master's joint programme. These participants might be more able to afford a stable WiFi connection.

In the context of a developing country, although rare, a few students from the city and more students from the countryside came from families who could not afford a mobile phone or laptop for their children. Therefore, the teacher should take these learners into account when considering implementing M-learning.

Negative Impacts from External Factors

Comparatively, teacher T1 pointed out that the prejudices that mobile devices were only for entertainment were still popular in society.

When the policy on M-learning was first passed, opposing opinions were raised everywhere. I read them on Facebook and in newspapers. I am afraid that at this stage, if I allow students to use mobile phones at school and something negative happens, I will be on the news. You know, several months ago, there was widespread news that a student had used a mobile phone to secretly video-record the intimacy between two students at their school, and he used that clip to extort money from the couple (T1).

Additionally, the teachers were constrained by parents who insisted that their students should be taught traditionally so that they would not be affected by the adverse side effects of using mobile phones.

Parents will blame me for allowing their children to use mobile phones and blame me if their children get a low grade (T1).

Next, people are exposed daily to the negative impacts of mobile phones, which frequently go viral on the internet, rather than the positive side of using these devices for educational purposes. Hence, opposition to M-learning from the community is inevitable. It is probably due to cultural-social roles and the identity of Vietnamese high school teachers who are put under pressure of being too "noble" to make any mistakes. This result is in line with the social challenges that were found in the study by Ahmed et al. (2018). The opposition of parents to M-learning further supports Hadad et al.'s (2020) idea concerning parent resistance to the educational use of smartphones at school.

Correspondingly, the vague instruction of the Vietnam Ministry of Education and Training on M-learning implementation caused provincial educational managers and school principals to have different interpretations of M-learning implementation. Teacher T5 confirmed this inconsistent guidance. However, even when workshops were organised, the content of these trainings was normally either theoretical and almost impossible to apply in a classroom context or repetitive with nothing new being introduced.

Some departments of education and training in other provinces encourage schools to integrate technology into education, and they were complimented as good examples of school digitalisation. However, in my province, some principals stimulate this, while others do not. As some principals show neutral attitudes towards this, teachers do not know whether they should try to bring M-learning into their classroom (T5).

Although the vague guidance of the Vietnam Ministry of Education and Training regarding M-learning implementation was mentioned, caution must be involved as with a small sample size, the findings might not be representative. The management of teaching and learning is different for teachers from different provinces, which can be explained by the varied perceptions of provincial departments of education and training.

Teachers' Incapability and Students' Indiscipline

The challenge for M-learning implementation was traced from teachers' awareness. Student S12-1 believed that old teachers' resistance to change made it difficult for the thorough implementation of M-learning. These interviewees said that old teachers still held negative attitudes towards using mobile devices in classrooms, hence they preferred traditional teaching methods, such as the chalk and board method.

In my school, young teachers usually try new teaching methods, in which technology is integrated. However, old teachers never let us use mobile phones in class. The only thing that they use is slideshows. I think that this is because old teachers do not see the positive side of M-learning, and some of them cannot effectively use the technology (S12-1).

Likewise, the challenge for M-learning implementation due to the teachers' resistance to change was reported in a study on Saudi Arabian women teachers by Alfarani (2014). This can be partly explained by the teachers' tendency to resist school reform. Terhart (2013) found that most German teachers disregarded, misunderstood or misinterpreted feedback from regular performance exams for data-oriented teaching enhancement.

Next, due to insufficient training at college, as shared by teacher T2, teachers were not well-prepared with methodology and technical knowledge to adjust to rapid changes in a formal technology-integrated learning context. They found it hard to decide how to integrate technology into teaching and could not manage the classroom to prohibit learners from using mobile devices for personal affairs in classrooms.

I was not trained on how to use technology in teaching when I was at university. Therefore, despite being a young teacher, I don't know much about how to use educational apps and websites (T2).

This result agrees with the results obtained by Kukulska-Hulme et al. (2009) and Schuck et al. (2013). This outcome has various explanations. One reason is that the university's teacher training programme does not seem to efficiently include technology integration courses in teaching. The absence of frequent and efficient training could be another cause.

Similarly, the students thought that many teachers lacked the ability to employ M-learning. This insufficiency was mainly for classroom management skills and technical knowledge. According to these students, the inability to manage the class led to students' using mobile phones for purposes other than studying, and the incompetence in applying technology made teachers less eager to employ M-learning.

Another reported problem was that Vietnamese high school learners were more distracted during the M-learning process. The distraction mainly resulted from notifications from social networks on their phones. Facebook and Instagram were widely used for the ubiquitous social connection, even when these pupils were in class; consequently,

some students were reported to focus on replying to their friends' messages instead of concentrating on searching for information related to the lesson. In the same manner, the distraction of M-learning was reported by Fried (2008), Aamri and Suleiman (2011) and Lepp et al. (2015).

Research Question 3. Suggestions for M-learning Deployment

In the current study, both the teacher and student participants did not make many suggestions for this novel approach of teaching and learning. Based on the advantages and challenges of M-learning implementation in the classroom context, a few suggestions were provided.

The Roles of Authority

First, authorities should arrange workshops to train teachers on adequate teaching methodology comprising suitable teaching approaches combined with classroom management techniques since teacher training is vital in the successful implementation of M-learning (Qolamani et al., 2024). To make the training effective, the selection of the trainees is important. Nevertheless, studies on inequality regarding the selection of the teachers to participate in professional development activities are limited in the existing literature; therefore, more research should be conducted on this issue. Teacher T5 mentioned this matter as follows:

The difficulty of providing proper training to all teachers leads to the fact that one school will just send a few representatives to the workshop, who will then mentor other teachers when they return. However, the appointees are usually leaders of subject divisions or Information Technology teachers, rather than the teachers who are capable of and interested in educational technology (T5).

While the Vietnamese Ministry of Education and Training was expected to provide more professional development training, teacher T3 said that the content of these workshops should be practical. The idea of providing purposeful activities in teacher development training was also reported by Kukulska-Hulme et al. (2009) and Schuck et al. (2013).

Training workshops should be provided. Teachers need to be trained in teaching methodology, classroom management, practical technical skills, apps and websites that are useful for their specific subject. Additionally, teachers need to be trained in how to instruct students to study effectively in M-learning classes (T3).

Hence, it is noted that the role of education colleges in preparing pre-service teachers with essential knowledge of technology integration into education, including technical, pedagogical and sociological knowledge (Kukulska-Hulme et al., 2009), should be established. Pedro et al. (2018) expressed a similar idea.

To deal with the issue of device insufficiency, an ambitious suggestion of offering each student a device was considered. The school was suggested to have an IT technician to establish a stable internet connection with an ample bandwidth and control the internet access to allow only certain educational websites. The suggestion to provide mobile devices to learners is comparable with the proposal from Oz (2014). This idea has been reported to be operated in some countries globally, such as Kenya, which has bought and distributed tablets at a cost of 30 billion Kenyan Shillings to 21.637 state elementary schools (Oduor, 2020).

Interestingly, student S11-2 delineated that the community's attitude played an important role, and the media should take the responsibility of orienting people's attitudes. Therefore, the media could be used as a propaganda tool to mitigate the prejudices towards M-learning.

Newspapers, television channels and official government Facebook pages have an important role in raising people's awareness of educational technology's positive side. Hence, the Ministry of Education and Training should efficiently make use of these means (S11-2).

Yagci (2015) advised that social media should be used optimally. However, despite its role in the enactment of education policy, the use of social media as a propaganda weapon has not received much attention from the authorities. This could be investigated in future studies.

The Roles of Teachers

Depending on the objectives and stages of the lesson, teachers were advised to employ gamification using mobile phones. For example, teacher T5 explained, *Kahoot!* was mainly used to make quizzes to summarise the lesson or for summative assessment purposes. This is in line with the utilisation of M-learning and gamification to improve students' learner autonomy and modernise language learning classrooms in a technological context (Pham et al., 2021).

Students in social science major classes are normally not good at chemistry, and they do not raise their hands to answer my questions. Therefore, I designed Kahoot! Games and let them use their phones to play. Although sometimes they still cannot answer the questions correctly, they are more engaged in my lessons (T5).

When being asked about teaching methods, teacher T4 suggested the mind-mapping technique. This tendency to use the mind-mapping technique was reported in the study by Chang et al. (2018).

Using mind maps when teaching history allows students to visualise the flow of historical events. These maps also play the role of a navigator for students to look for information on mobile devices (T4).

To address the issue of mobile device insufficiency and a limited network connection, groupword activities can serve as a solution. However, the teacher needs to be careful when grouping students so that there is at least one device in each group. Regarding the obstacle of device networking, the teacher's subscription to an unlimited internet connection to share information with students during class was an efficient strategy. This can be explained by the collectivist culture of Vietnamese people (McCauley et al., 2020). Nevertheless, it was admitted that this method might not be applied widely because many Vietnamese teachers receive a low salary. Therefore, they struggled to make ends meet, let alone subscribe to an unlimited internet connection.

Other suggestions from students S11-2 and S11-1 included task- and project-based learning. Students collaborate with one another using mobile phones to investigate the assigned tasks, which corresponds to the FRAME model's DS, which points out the concepts of collaboration tools. There are similarities between this study and the study by Lai and Hwang (2015), which describes the interactive strategies that are used by Taiwanese teachers.

In a literature class, the teacher let us work in groups and search for information to solve a task. I felt really excited with this new experience (S11-2).

Project-based approaches should be employed more. Each group will be in charge of one issue. They design their presentation and share what they have found out with the other groups (S11-1).

Additionally, teacher T5 recommended that lesson plans should be designed using mobile online interactive tools and visual aids. These kinds of approaches might keep students interested in the lesson, and they would be less tempted by external factors.

If teachers want students to concentrate on their lesson, they have to make it interesting. Teachers should encourage students to interact with others to discuss the lesson by utilising appropriate mobile apps and websites (T5).

Teacher T4 reported that teachers should be able to design their own teaching materials by participating in relevant online microlearning courses.

History is notorious for its boring lessons. I don't want my students to sleep in my class, so I have taken different courses online to design my own teaching materials (T4).

Lastly, also pointed out by teacher T4, parents' resistance to M-learning may be due to their misunderstanding of mobile phones. Therefore, recording an M-learning class for parents to observe could raise their awareness of M-learning's advantages.

My students' parents do not let their children bring mobile phones to school because they think that mobile phones will spoil their children. Hence, teachers could video record an M-learning lesson and let students' parents watch it so that they can see the effectiveness of M-learning (T4).

Students' Autonomy

It seemed that students, as perceived by both instructors and learners (e.g., teacher T3 and student S10-2), did not play an active role in M-learning implementation. The passiveness of students was also reported by Tran et al. (2023). The only suggestion for these students that was elicited from the interviews was discipline. It was reported that students who were well-disciplined vitally attributed to the success of M-learning in classes because this trait mitigated the effects of the above-mentioned disturbance features. When being aware of the inappropriate use of mobile phones in class, the students thought that they should be more disciplined. This finding was also revealed in the study by Liu (2020), which recommended meticulous software selection to promote learners' self-control.

It is difficult for the teacher to manage the classroom when M-learning has been implemented. Students need to be well-disciplined (T3).

Students must control themselves so that they don't use mobile phones for personal purposes in class. They must respect their teacher by focusing on what the teacher is talking about (S10-2).

4.2. Discussion

The findings suggest that M-learning yields many benefits for the formal learning of students in Southern Vietnam, but it also implies challenges that need tackling through the support of the stakeholders at different levels.

Although the Vietnamese Ministry of Education plays a vital role in legalizing mobile phone use in the classroom, insufficient guidance constrains M-learning's full potential. To compensate for this lack, professional development programs should put an emphasis on practical and discipline-specific mobile applications to provide teachers with effective teaching strategies and classroom management. In addition, infrastructure issues create a barrier to M-learning implementation in formal learning environments, particularly in the context of rural schools in a developing country like Vietnam. A possible solution to this obstacle can be the investigation of IT facilities aiming for improving the internet bandwidth and offering necessary devices.

Teacher and student preparedness must also be addressed. Universities and teacher training programs should include courses on integrating technology into pedagogy. Regular workshops could help in-service teachers stay updated on effective M-learning practices. For students, fostering self-discipline and promoting responsible device use are critical for minimizing distractions and maximizing learning outcomes.

Also, community engagement is vital to overcoming societal resistance to M-learning. Media campaigns could highlight the benefits of educational technology and address common misconceptions. Schools could also record and share M-learning sessions with parents to build trust and demonstrate its effectiveness.

Strategic classroom practices, such as gamification and project-based learning, could further enhance student engagement. Teachers should design interactive lesson plans using mobile apps and visual aids to maintain student interest and counter external distractions. Encouraging collaboration through group activities and leveraging the collectivist culture of Vietnamese classrooms could also optimize the use of limited resources.

Lastly, socio-cultural factors are revealed to have an influence on resistance to M-learning and on equitable training opportunities for educators. Addressing these challenges holistically could unlock M-learning's potential to transform teaching and learning in Vietnam.

5. CONCLUSION

The purpose of this study is to investigate the perceptions and perspectives of Vietnamese high school teachers and students in Southern Vietnam towards the advantages, challenges and implications for M-learning implementation in the classroom context. Eleven participants, including five teachers and six students, from different high schools in various regions of Vietnam partook in online interviews. Some of the findings aligned with the criteria in the FRAME model, whereas others emerged as new themes. Several recommendations for M-learning implementation are put forward. The three conclusions that are compatible with the three research questions are as follows: (1) M-learning implementation in Vietnam can be promoted thanks to current advantageous conditions. Implementing M-learning in the classroom context results in effective assessments and differentiated instruction. It also facilitates the development of students' engagement and essential 21st-century competencies; (2) The challenges of M-learning implementation in the classroom context may come from insufficient facilities, external factors, incompetent teachers and students' indiscipline; (3) Implications for M-learning implementation emphasise the roles of the authorities and teachers, and students' autonomy.

Future research should include larger, diverse samples and use interviews and observations. It should also investigate community and parental influences on M-learning, develop assessment models, and compare perspectives from authorities with those of teachers and students. Policymakers should raise awareness about M-learning, provide guides, encourage digitalization, and use social media for promotion. Training workshops should be based on needs analysis. Teacher education programs need updated tech courses, and schools should invest in high-speed internet. Teachers should use educational apps flexibly and limit M-learning time to safeguard student health.

The most notable limitation of this study is that the participants were mostly from Southern Vietnam. Therefore, the results cannot be generalised to all Vietnamese high school teachers and students. Additionally, due to the nature

of online interviews, as the participants may have been worried about being recorded, they may not have shared their true opinions on the issue. Finally, more triangulation techniques should have been conducted to ensure the trustworthiness of the data.

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REFERENCES

Aamri, A., & Suleiman, K. (2011). The use of mobile phones in learning the English language by Sultan Qaboos university students: Practices, attitudes and challenges. *Canadian Journal on Scientific & Industrial Research*, *2*(3), 143-152.

Ahmed, A. H., Rana, A. A., & Salah, A. S. (2018). Perceptions and challenges of mobile learning in Kuwait. *Journal of King Saud University - Computer and Information Sciences*, *30*, 279-289. https://doi.org/10.1016/j.jksuci.2016.12.001

Alfarani, L. A. (2014). Influences on the adoption of mobile learning in Saudi women teachers in higher education. In *2014 International Conference on Interactive Mobile Communication Technologies and Learning* (pp. 30-34). IEEE. https://doi.org/10.3991/ijim.v9i2.4411

Almaiah, M. A., & Alismaiel, O. A. (2019). Examination of factors influencing the use of mobile learning systems: An empirical study. *Education and Information Technologies*, *24*, 885-909. https://doi.org/10.1007/s10639-018-9810-7

Almulla, M. A. (2024). Investigating students' intention to use M-learning: The mediating role of mobile usefulness and intention to use. *International Journal of Information and Communication Technology Education*, *20*(1), 1-26. http://doi.org/10.4018/IJICTE.337136

Baran, E. (2014). A review of research on mobile learning in teacher education. *Educational Technology & Society*, *17*(4), 17-32.

Barbosa, D., Schneider, G., Mossmann, J., & dos Santos, P. (2020). Usability and gameplay evaluation on mobile games: A user-centred application proposal. *International Journal of Learning Technology*, *15*(2), 107-129. https://doi.org/10.1504/IJLT.2020.109570

Bidin, S., & Ziden, A. A. (2013). Adoption and application of mobile learning in the education industry. *Procedia - Social and Behavioral Sciences*, *90*, 720-729. https://doi.org/10.1016/j.sbspro.2013.07.145

Bowman, L. L., Levine, L. E., Waite, B. M., & Gendron, M. (2010). Can students really multitask? An experimental study of instant messaging while reading. *Computers & Education*, *54*(4), 927-931. https://doi.org/10.1016/j.compedu.2009.09.024

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*, 77-101. https://doi.org/10.1191/1478088706qp063oa

Cavus, N. (2011). Investigating mobile devices and LMS integration in higher education: Student perspectives. *Procedia Computer Science*, *3*, 1469-1474. https://doi.org/10.1016/j.procs.2011.01.033

Chang, J. H., Chiu, P. S., & Huang, Y. M. (2018). A sharing mind map-oriented approach to enhance collaborative mobile learning with digital archiving systems. *The International Review of Research in Open and Distributed Learning*, *19*(1). https://doi.org/10.19173/irrodl.v19i1.3168

Chang, W. H., Liu, Y. C., & Huang, T. H. (2017). Perceptions of learning effectiveness in M-learning: Scale development and student awareness. *Journal of Computer Assisted Learning*, *33*(5), 461-472. https://doi.org/10.1111/jcal.12192

Charitonos, K., Morini, L., Arnab, S., Cervi-Wilson, T., & Brick, B. (2016). Urban explorations for language learning: A gamified approach to teaching Italian in a university context. In P. S. Salomi, L. Bradley, & S. Thorne (Eds.), *CALL communities and culture - short papers from EUROCALL 2016* (pp. 94-99). Research-publishing.net. https://doi.org/10.14705/rpnet.2016.eurocall2016.544

Chen, C. H., & Tsai, C. C. (2021). In-service teachers' conceptions of mobile technology-integrated instruction. *Computers & Education*, *170*, 104-224. https://doi.org/10.1016/j.compedu.2021.104224

Cheon, J., Lee, S., Crooks, S., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & Education*, *59*, 1054-1064. https://doi.org/10.1016/j.compedu.2012.04.015

Creswell, J. W. (2017). Five qualitative approaches to inquiry. In J. W. Cresswell & C. N. Poth (Eds.), *Qualitative inquiry and research design* (pp. 53-84). SAGE.

Dao, H. T. T., & Kim, L. T. T. (2020). Transitioning from traditional learning to blended learning at some public universities in Vietnam after the Covid-19 pandemic. In *2020 The 4th International Conference on Advances in Artificial Intelligence* (pp. 85-91). Association for Computing Machinery. https://doi.org/10.1145/3441417.3441429

Dinh, M. P. T., Le, P. T., & Tran, A. T. P. (2022). How to create, maintain, and reinforce students' motivation and engagement in online education: A discussion. *Vietnam Journal of Education*, *6*(1), 53-61. https://doi.org/10.52296/vje.2022.133

Dold, C. J. (2016). Rethinking mobile learning in light of current theories and studies. *The Journal of Academic Librarianship*, *42*, 679-686. https://doi.org/10.1016/j.acalib.2016.08.004

Esawe, A., Esawe, K., & Esawe, N. (2024). Evaluating schoolteachers' acceptance of M-learning during Covid-19 using the Technology Acceptance Model: The moderating role of gender and age. *SN Social Sciences*, *4*(43). https://doi.org/10.1007/s43545-024-00830-y

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2014). *How to design and evaluate research in education* (9th ed.). McGraw Hill Education.

Fried, C. (2008). In-class laptop use and its effects on student learning. *Computers & Education*, *50*, 906-914. https://doi.org/10.1016/j.compedu.2006.09.006

Fu, J. S., Yeh, H. C., Liang, P. C., & Heng, L. (2021). Exploring adult learners' perceptions towards learning English via mobile applications. *International Journal of Learning Technology*, *36*(3), 181-196. https://doi.org/10.1504/IJLT.2021.119471

Georgiev, T., Georgieva, E., & Smrikarov, A. (2004). *M-learning - A new stage of E-learning*. Paper presented at the International Conference on Computer Systems and Technologies CompSysTech'2004, Rousse, Bulgaria, June 17-18. https://doi.org/10.1145/1050330.1050437

Hadad, S., Meishar-Tal, H., & Blau, I. (2020). The parents' tale: Why parents resist the educational use of smartphones at schools?. *Computers & Education*, *157*. https://doi.org/10.1016/j.compedu.2020.103984

Hamidi, H., & Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of students of the University of Technology. *Telematics and Informatics*, *35*(4), 1053-1070. https://doi.org/10.1016/j.tele.2017.09.016

Herrador-Alcaide, T. C., Hernández-Solís, M., & Hontario, J. F. (2020). Online learning tools in the era of M-learning: Utility and attitudes in accounting college students. *Sustainability*, *12*(12), 5171. https://doi.org/10.3390/su12125171

Hung, N. T., & Tang, M. S. (2020). Digital transformation trend in Vietnam higher education: Blended learning model. *International Journal of Social Science and Economics Invention*, *6*(7), 304-309. https://doi.org/10.23958/ijssei/vol06-i07/218

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology*, *20*(1). https://doi.org/10.3402/rlt.v20i0/14406

Koole, M. L. (2009). A model for framing mobile learning. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education and training* (pp. 25-47). Athabasca University Press.

Kukulska-Hulme, A., Sharples, M., Milrad, M., Arnedillo-Sánchez, I., & Vavoula, G. (2009). Innovation in mobile learning: A European perspective. *International Journal of Mobile and Blended Learning*, *1*(1), 13-35. https://doi.org/10.4018/jmbl.2009010102

Lai, C. L., & Hwang, G. J. (2015). High school teachers' perspectives on applying different mobile learning strategies to science courses: The national mobile learning program in Taiwan. *International Journal of Mobile Learning and Organisation*, *9*(2), 124-145. https://doi.org/10.1504/IJMLO.2015.070704

Lepp, A., Barkley, J., & Karpinski, A. (2015). The relationship between cell phone use and academic performance in a sample of U.S. college students. *Sage Open*, *5*(1), 1-9. https://doi.org/10.1177/2158244015573169

Lestary, S. (2020). Perceptions and experiences of mobile-assisted language learning for IELTS preparation: A case study of Indonesian learners. *International Journal of Information Technology*, *10*(1), 67-73. https://doi.org/10.18178/ijiet.2020.10.1.1341

Liu, Y. (2020). Use of mobile phones in the classroom by college students and their perceptions in relation to gender: A case study in China. *International Journal of Information Technology*, *10*(4), 320-326. https://doi.org/10.18178/ijiet.2020.10.4.1383

Longhurst, R. (2009). Interviews: In-depth, semi-structured. In R. Kitchin & N. Thrift (Eds.), *International encyclopedia of human geography* (pp. 580-584). Elsevier Science. https://doi.org/10.1016/B978-008044910-4.00458-2

McCauley, B., Nguyen, T. H. T., McDonald, M., & Wearing, S. (2020). Digital gaming culture in Vietnam: An exploratory study. *Leisure Studies*, *39*(3), 372-386. https://doi.org/10.1080/02614367.2020.1731842

Murphy, A., Midgley, W., & Farley, H. (2014). Mobile learning trends among students in Vietnam. In M. Kalz, Y. Bayyurt, & M. Specht (Eds.), *Mobile as Mainstream Towards Future Challenges in Mobile Learning* (pp. 197-204). Springer. https://doi.org/10.1007/978-3-319-13416-1_18

Nawi, A., Hamzah, M. I., & Rahim, A. A. A. (2015). Teachers Acceptance of Mobile Learning for Teaching and Learning in Islamic Education: A Preliminary Study. *Turkish Online Journal of Distance Education*, *16*, 184-192. https://doi.org/10.17718/tojde.30611

Nguyen, L. M. T., & Hoang, T. S. (2020). Mobile technology to promote education 4.0 in Vietnam. *Vietnam Journal of Education*, *4*(4), 1-6. https://doi.org/10.52296/vje.2020.73

Nguyen, X. N. C. M., & Walkinshaw, I. (2018). Autonomy in teaching practice: Insights from Vietnamese English language teachers trained in Inner-Circle countries. *Teaching and Teacher Education*, *69*, 21-32. https://doi.org/10.1016/j.tate.2017.08.015

Nuseir, M. T., Aljumah, A. I., & El Refae, G. A. (2022). The influence of e-learning, M-learning, and d-learning on the student performance: Moderating role of institutional support. *International Arab Conference on Information Technology (ACIT)*, 1-9. https://doi.org/10.1109/ACIT57182.2022.9994193

Oduor, A. (2020). 1.2 million tablets delivered to schools. *The Standard*. https://www.standardmedia.co.ke/education/article/2001383341/12-million-tablets-delivered-to-schools

Oz, H. (2014). Prospective English teachers' ownership and usage of mobile devices as M-learning tools. *Procedia - Social and Behavioral Sciences*, *141*, 1031-1041. https://doi.org/10.1016/j.sbspro.2014.05.173

Oz, H. (2015). An investigation of pre-service English teachers' perceptions of mobile-assisted language learning. *English Language Teaching*, *8*(2), 22-34. https://doi.org/10.5539/elt.v8n2p22

Ozer, O., & Kilic, F. (2018). The effect of a mobile-assisted language learning environment on EFL students' academic achievement, cognitive load and acceptance of mobile learning tools. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(7), 2915-2928. https://doi.org/10.29333/ejmste/90992

Pedro, L. F. M. G., Barbosa, C. M. M. d. O., & Santos, C. M. d. N. (2018). A critical review of mobile learning integration in formal educational contexts. *International Journal of Educational Technology in Higher Education*, *15*, 1-15. https://doi.org/10.1186/s41239-018-0091-4

Pham, L. L. N., Nguyen, H. T., & Le, V. T. K. (2021). Triggering students' learning autonomy using the combination of M-learning and gamification: A case study at Nguyen Tat Thanh university. *The Journal of Teaching English with Technology*, *2*, 66-91.

Qolamani, K., Abdullah, S., & Rajab Rekani, M. (2024). Empowering social studies education: The role of M-learning in fostering motivation and well-being. *Amalee: Indonesian Journal of Community Research and Engagement*, *5*(1), 129-142. https://doi.org/10.37680/amalee.v5i1.3983

Schuck, S., Aubusson, P., Kearney, M., & Burden, K. (2013). Mobilising teacher education: A study of a professional learning community. *Teacher Development*, *17*(1), 1-18. https://doi.org/10.1080/13664530.2012.752671

Smyth, R. (2011). Enhancing learner-learner interaction using video communications in higher education: Implications from theorising about a new model. *British Journal of Educational Technology*, *42*, 113-127. https://doi.org/10.1111/j.1467-8535.2009.00990.x

Swanson, J. A. (2018). Assessing the effectiveness of the use of mobile technology in a collegiate course: A case study in M-learning. *Technology, Knowledge and Learning*, *25*, 389-408. https://doi.org/10.1007/s10758-018-9372-1

Terhart, E. (2013). Teacher resistance against school reform: Reflecting an inconvenient truth. *School Leadership & Management*, *33*(5), 486-500. https://doi.org/10.1080/13632434.2013.793494

Tran, L. T. T., Cao, T. T., & Vo, V. L. H. (2023). Pedagogical challenges in online teaching: A qualitative study on Vietnamese university teachers of social sciences. *Vietnam Journal of Education*, *7*(3), 227-239. https://doi.org/10.52296/vje.2023.300

Tran, P. (2016). Training learners to use Quizlet vocabulary activities on mobile phones in Vietnam with Facebook. *JALT CALL Journal*, *12*, 43-56. https://doi.org/10.29140/jaltcall.v12n1.201

Trinh, T. P. T. (2014). *Exploitation of applications on mobile phones to support grade 12 students in high schools in Mathematics self-study* [Unpublished doctoral dissertation]. The Vietnam Institute of Educational Sciences.

Trinh, T. P. T., & Nguyen, D. N. (2014). A model for using mobile phones in teaching and learning Mathematics. *American Research Journal of Humanities & Social Science*, *2*(7), 8-12.

Trinh, T. P. T., Lai, D. T., Hai, T. T., Tran, T., Le, T. T. T., & Hoang, V. Q. (2019). Mobile learning for high-school mathematics as a path to better sustainability in a fast-changing society: An exploratory study from Vietnam. *Problems and Perspectives Management*, *17*, 392-403. https://doi.org/10.31219/osf.io/nvqea

Yagci, T. (2015). Blended learning via mobile social media & implementation of "EDMODO" in reading classes. *Advances in Language and Literary Studies*, *6*(4), 41-47. https://doi.org/10.7575/aiac.alls.v.6n.4p.41

Zakaria, I., Mustapha, H., & Ahmed, B. (2019). A data confidentiality system based on trusted platform module in a cloud storage environment. *Journal of Theoretical and Applied Information Technology*, *97*(23), 3520-3528.