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The effects of mobile-assisted concept mapping on EFL learners' writing fluency and motivation

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Writing and its role in English as a foreign language (EFL) context has been one of the primary areas of focus for many years. The present study examined the effects of mobile-based concept mapping on EFL learners' writing fluency and motivation. To fulfill the objective, 70 upper-intermediate level Persian EFL learners were assigned into one experimental and one control conditions, each including 35 participants. The experimental condition's participants received instruction through mobile-based concept mapping while the students of the control condition did not receive any instruction and were just required to discuss the topics and write about them traditionally. The findings of the study revealed that mobile-mediated concept mapping was effective for EFL students' writing fluency. Moreover, the results indicated that mobile-based concept mapping was beneficial for learners' writing motivation.

Keywords: concept mapping; writing fluency; motivation; mobile-assisted language learning (MALL); ubiquitous learning (U-learning)

Introduction

The importance of writing has been highly emphasized in English as a foreign language (EFL) context (Bhowmik, 2021; Kaveh & Rassaei, 2022; Lee et al., 2016). It is generally believed that people are not considered as "educated" unless they

become able to read and write in that language (Chastain, 1998). A growing body of research has indicated that writing is an important skill and should be taken into consideration, especially in second language (L2) classrooms (e.g., Barkaoui, 2007; Harklau, 2002; Nasser, 2016; Vedpoel & Gasiorek, 2012; Welsh et al., 2017). However, the value of writing is often ignored in EFL settings, and many learners seem to have difficulties with the writing process (Kumaran et al., 2017; Monaghan, 2007; Okasha & Hamdi, 2014). In fact, because of inadequate writing techniques, many EFL learners have difficulties with the writing process (Okasha & Hamdi, 2014). Therefore, investigating innovative techniques for improving L2 learners' writing merits further attention.

One technique that has attracted researchers' attention in the context of L2 writing research is mobile-based concept mapping. Mobile-mediated concept mapping as a kind of technology-mediated concept map differs from traditional concept mapping in several ways. For instance, mobile-based concept mapping can be used synchronously or asynchronously (at a later time). Further, mobile-mediated concept mapping can be employed without the constraints of time and place which can be effective for some specific instructional settings and purposes, including virtual learning environments. Asynchronous mobile-mediated concept mapping can also provide students with more time to think and reflect on their writing assignments.

As Dörnyei (2013) stated, motivation is an important factor for EFL learners. It is considered an integral part of students' learning process which helps them learn subject matter much better (Kholifah et al., 2021). According to Widayanti et al. (2020), motivated learners become more interested in classroom topics and give them much attention. York (1970) claimed that motivation refers to the need or desire to assist students in reaching a particular goal and also makes the distinction between success and failure.

Writing fluency can be defined as an ability that writers employ automatically to provide the readers with intended meaning (Brand & Brand, 2006; Schmidt, 1992). As Chenowith and Hayes (2001) stated, writing fluency is important for second language (L2) learners because it influences the quality of their study. Some language researchers (e.g., Fathman & Whalley, 1990; Skehan, 2009) believe that teachers evaluate learners' writing fluency by analyzing the length of the text, the amount of time, and the number of words they devote to their writing assignments in classrooms.

Regarding concept maps, Novak and Canas (2006) defined them as graphical tools which are used to arrange and indicate the relations among the ideas or concepts. Duston (1992) and Readence et al. (1989) stated that concept maps are beneficial for students' learning because they can serve as visual organizers. Several previous studies have provided evidence for the importance and effectiveness of concept mapping in different areas of education (e.g., Chulaurt & Decbacker, 2004; Liu & Lee, 2013; Kazemi & Moradi, 2019; Kaveh & Rassaei, 2016; Rassaei, 2019) however, to the best of the researchers' knowledge, little is known about the effects of mobile-mediated concept mapping on EFL learners' writing fluency and motivation.

Consequently, the main goal of this study is to examine the effects of

mobile-based concept mapping on EFL learners' writing fluency. That is, the present study researchers want to find out whether mobile-based concept mapping enhances EFL learners' writing fluency. Moreover, the present study intends to see if the use of mobile-based concept mapping improves students' motivation in EFL classrooms.

Literature review

Concept mapping

Concept maps are known as graphic organizers which are used to show the relationships among the concepts or ideas (Guastello et al., 2000). The notion of concept maps was first developed by Novak to enhance learners' understanding (Richardson & Fox, 2005). Liu et al. (2010) stated that concept maps are effective enough to help learners deal with reviewing and recalling information much better. Asiksoy (2019) also claimed that teachers can use concept maps to eliminate the students' misconceptions in various areas of education. In general, concept maps are considered important educational techniques or strategies that help students to understand the materials and cope with them better.

Concept mapping has its origin in Ausubel's assimilation theory (Brown, 2000). According to this theory, meaningful learning takes place as a result of connecting new information to existing knowledge (Khoshsima et al., 2015). As noted by Novak and Canas (2006), concept maps involve different shapes, including triangles, circles, and boxes to show the relationships among the concepts in a hierarchical order resulting in meaningful learning. That is, concept maps are used to indicate the connections among the ideas hierarchically that lead to meaningful learning. Nesbit and Adescope (2006) remarked that concept maps are used in different educational settings and have an encouraging effect on learning knowledge and improving attitudes.

One important characteristic that distinguishes concept mapping from other techniques is the minimum number of words that learners use to indicate the connections among the concepts. In fact, since concept maps take up less space in learners' minds, they can provide learners with meaningful learning which leads to the retention of the learned materials much better (Erdem et al., 2009; Chang et al., 2017). Moreover, learners do not need to invest too much time in learning the materials. As Novak (2010) stated, concept maps are beneficial for learners because they allow them to use their previous information to understand novel ideas and relate new information with existing knowledge.

Some previous studies examined the effects of conventional concept mapping on L2 development (e.g., Al Aqtash & Musleh, 2020; Dilek & Yurk, 2013; Kazemi & Moradi, 2019; Machida & Dalsky, 2014; Rassaei, 2019; Tajeddin & Tabatabaei, 2016). All these studies provided positive evidence regarding paper and pencil concept mapping. To the researchers' knowledge, few studies if any have examined the effects of mobile-based concept mapping on EFL learners' writing fluency and motivation. Consequently, the current study contributes

to the present body of literature by investigating the effects of mobile-based concept mapping on EFL students' writing fluency and motivation.



Writing fluency and motivation

In today's modern world, the ability to write fluently has received increased attention (Biria & Jafari, 2013). Students who are not able to write fluently are usually faced with some problems such as cognitive demands because they need to spend much time and energy on both spelling words and individual letters (Gillespie & Graham, 2014). Several studies (e.g., Armstrong, 2010; Atasoy & Temizkan, 2016; Fellner & Apple, 2009; Pham & Tran, 2021) have indicated that fluent writers are able to go over the topics more easily while non-fluent writers have difficulties with their writing assignments. Language learners' knowledge affects fluency and fluency is improved when students enhance their knowledge of vocabulary and grammar (Atasoy & Temizkan, 2016).

Generally, there are two approaches to writing fluency: automaticity and ratio/time [42]. The advocates of "automaticity" claimed that fluent writers try to do their written assignments automatically, meaning without delay (e.g., Brand & Brand, 2006; Schmidt, 1992). The proponents of the "ratio/time" on the other hand, stated that quantity and time are primary elements besides automaticity for fluent writers to write effectively (Atsoy & Temizkan, 2016). According to MacArthur et al. (2008), writing fluency refers to short pausing times, few revisions, and also a high production rate that helps writers become fluent and write assigned work better.

With respect to motivation, Pintrich and Schunk (2002) defined it as "the process whereby goal-directed activity is instigated and sustained" (p. 5). Yorkey (1970) claimed that people's success depends on their motivation while Dörnyei (2013) argued that motivation is an effective factor to enhance students' learning. Several studies (e.g., Cheng & Yeh, 2009; Keller, 1993; Pintrich & Schunk, 2002) have indicated that motivation is beneficial for learners and helps them deal with the materials much better. Moreover, it is commonly believed that motivation is a type of goal-directed behavior. That is, although motivation is not observable, it can be easily recognized from learners' behaviors, including effort, persistence, and also the choice of tasks (Bures et al., 2009; Maslow, 1970; Pintrich & Schunk, 2002).

Several researchers (e.g., Harter, 1981; Lepper et al., 1997; Ryan & Deci, 2000) have remarked that motivation, especially intrinsic one begins as early as preadolescence and decreases with age. However, the role of educators should not be overlooked in stopping the decline of motivation in academic settings (Lepper & Hoddel, 1989; Pintrich & Schunk, 2002). Many scholars (e.g., Lepper & Hoddel, 1989; Ryan & Deci, 2000; Pintrich & Schunk, 2002) have stated that learners' motivations can be easily increased by meeting their basic needs of competence and also autonomy.

Usher and Kober (2012) stated that learners that are not motivated in classrooms experience difficulties and cannot understand subject matters very well. Kim (2010) identified two different kinds of motivation: intrinsic and extrinsic.

Deci and Ryan (2006) stated that extrinsic motivation refers to individuals' outside factors to act better while intrinsic motivation comes from individuals' eagerness or inner desires for doing a task. Deci and Ryan (2000) also claimed that all those learners who are intrinsically motivated are more eager for classroom activities. Losing motivation in educational settings may have some bad consequences. Bridgeland et al. (2006) stated that many high school students dropped out of school because they were completely unmotivated.

Technology-mediated concept mapping

With the emergence of technology in various areas of education and language learning and teaching as well, a growing body of research has been done to investigate how different kinds of technology-based tools can assist L2 development (e.g., Becirovic et al., 2021; Lee et al., 2020; Mosavi Minagh, & Nezarat, 2012; Rassaei, 2018; 2019; Shintani & Aubrey, 2016; Wang & Han, 2021). Among different types of technology, MALL has received much attention. Concerning MALL, Kukulska-Hulme (2018) defined it as the use of mobile phones in language learning and teaching classrooms. Klopfer et al. (2012) stated that MALL is popular because it has some unique characteristics such as interactivity, internet connectivity, multimedia capabilities, portability, ubiquity, cost-effectiveness, and accessibility.

McQuiggan (2012) claimed that mobile learning (M-learning) is effective for learners because it helps them deal with the subject matters better as well as do their assignments without the limitation of time and place. Moreover, instructors can use mobile phones to enhance their instructional process (Hashim et al., 2017). As Saleem and Bakhsh (2017) stated, mobile phones have positive effects on learners' peer and family relationships. Several studies have investigated the effects of technology-mediated concept mapping on different aspects of language learning and teaching.

In one study, Liu et al. (2010) examined the influence of the computer-assisted concept mapping learning strategy on EFL college learners' English reading comprehension. The findings revealed that computer-based concept mapping was beneficial for the experimental group students. In addition, the results of the study indicated that computer-based concept mapping learning strategy enhanced students' other English reading strategies-listing, enforcing, and also reviewing. Adescope et al. (2016) examined the comparative effects of computer-based concept maps, refutational text, and expository texts on social learning. The findings showed that the concept mapping group outperformed both refutational and scientific text groups.

In another study, Chang et al. (2017) investigated the effects of collaborative computer-based strategy on geographic science performance in junior high school learners. The study analysis indicated that collaborative computer-assisted concept mapping was effective for junior high school students. Asiksoy (2019) also conducted a study regarding computer-based concept mapping as a method for improving the effectiveness of concept learning in technology-enhanced learning. The results of the study indicated that computer-mediated

concept mapping was beneficial for students' learning. Moreover, the study showed a significant increase in the problem-solving skills of the experimental condition compared to the control condition.

Despite previous studies have shown the effectiveness of technology-based concept mapping on students' learning in various areas of education, to the researchers' knowledge, few studies have examined the impact of mobile-based concept mapping on EFL students' writing fluency and motivation. Accordingly, the primary aim of the study is to investigate the effects of mobile-based concept mapping on EFL learners' writing fluency. In other words, the researchers of the current study want to realize if mobile-based concept mapping has a positive effect on enhancing EFL students' writing fluency. Moreover, it is within the study scope to see whether mobile-assisted concept mapping influences EFL learners' writing motivation. To this end, the following questions were formulated for the present study:

1. To what extent is mobile-based concept mapping effective for EFL learners' writing fluency?
2. Does mobile-based concept mapping improve EFL learners' writing motivation?

Method

Design

The present study design is considered quasi-experimental since the researchers used two intact classes involving one experimental condition and one control group. The placement test was administered to learners one week prior to the investigation while the pre-test and also writing motivation questionnaire were held two days before the first treatment session. The purpose of administering the pre-test was to see if learners were able to write fluently. The experimental group's participants were required to attend an instruction session (about 45 minutes) which was held two days before the treatment sessions to understand how to install a concept map application on their mobile phones and work with it. Then, eight treatment sessions were conducted for four weeks. Each treatment session lasted about an hour. The experimental condition was then designated as the mobile-mediated concept mapping group. A post-test was administered to all the participants of both groups, namely experimental and control groups in the last treatment session. Moreover, the learners were asked to take part in a delayed post-test which was similar to the post-test three weeks after the last treatment session. Also, the mobile-mediated group's participants were interviewed on the effectiveness and usefulness of mobile-assisted concept mapping to find out if it had any effects on their motivation. Figure 1 shows the design of the present study.

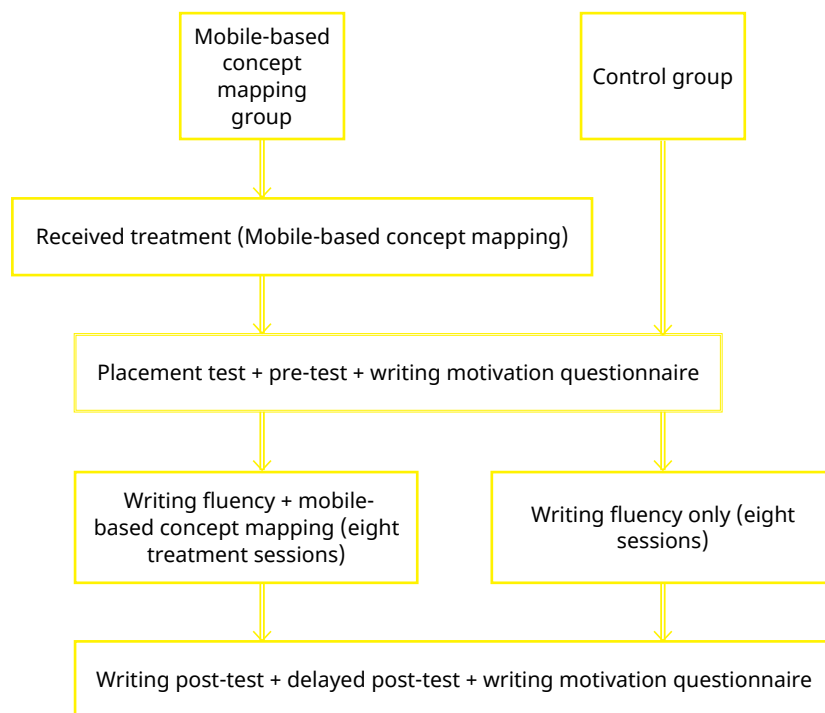


Figure 1. Design of the study

Participants

The participants in the study were 70 Persian upper intermediate level EFL students enrolled in two intact EFL classrooms, all university students and ranged in age from 21 to 37. They were 40 females and 30 males who were studying English in one language institute which was located in Shiraz, Iran. The focus of the learners' program was primarily on improving spoken communication and with less attention to students' written communication. All the learners stated that they were fully familiar with mobile technology and reported studying English for 5 years on average. The students' participation was voluntary in the study and unrelated to their institute issues. All the learners were asked to participate in the treatment sessions out of their regular classroom hours because they were busy with scheduled activities at school.

Instrumentation

To achieve the objectives of the current study, the following instruments were used.

Michigan Language Proficiency Test

In order to make sure whether learners were homogeneous in terms of English language knowledge, The Michigan language proficiency test was administered

to all the participants. The test comprised three sections. The first section was in a conversational format consisted of 40 grammar items. The second section was 40 vocabulary items which required the learners to select the synonyms of the words or complete the sentences. The third section of the test included 20 comprehension questions based on the reading passages.

Mind mapping application

The application used for the objectives of the present study was mind mapping. It includes some options which help learners create and store concept maps without limitation of time and place. This application enables learners to share and edit the concepts without any difficulties and can be easily downloaded and installed on smartphones, tablets, and computers. All the learners were provided with rectangular-shaped parts for writing fluency in this study.

Writing pre-test, post-test, and delayed posttest

To measure EFL students' writing fluency as a result of mobile-based concept mapping, three writing tasks were used as a pre-test, post-test, and also delayed post-test in this study. The researchers provided the learners with a topic for each of the above tests and asked them to write a paragraph (100–160 words) about them. Therefore, all the writing tests were quite similar but completely different from one another. Concerning the topics, they were extracted from the book *Essay Writing* by Kasraeian and Fakh-Rohani, (2006). As mentioned before, the post-test was given to learners in the last treatment session and the delayed post-test was administered three weeks after the last treatment session.

Interview

To find out if mobile-mediated concept mapping had any impacts on EFL learners' motivation, the researcher asked the participants of the mobile-mediated concept mapping group to attend an interview at the end of the treatment sessions. During this session, the researcher interviewed each mobile-assisted group's participant separately for about five minutes, and asked them the following question:

“Do you find mobile-assisted concept mapping effective for improving writing fluency? If so, how?”

Academic Writing Motivation Questionnaire (AWMQ)

As already mentioned, one of the objectives of the current study is to investigate whether using mobile-mediated concept mapping improves learners' writing motivation. To this end, the academic writing motivation questionnaire developed by Payane (2012) was used in the study. Before distributing the questionnaires among the learners, the researchers started explaining all the items of the questionnaire to avoid the risk of misinterpretation. Moreover, two

experienced writing instructors who were MAs in TEFL were invited to check the questionnaire in order to find out if it needed some changes or instruction clarity, which did not lead to reformulations. Some researchers (e.g., Rezvani & Saeidi, 2019; Surastina & Dedi, 2017) employed this questionnaire in their studies to measure learners' writing motivation. Payane [76] reported .95 internal consistency (Cronbach Alpha) for the overall questionnaire. The items in this questionnaire indicated a 5-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). It was once administered to learners two days before the first treatment session and once at the end of the eight treatment sessions.

Writing scoring rubric

The grading rubric for writing assignments was used to rate the learners' pre-test, post-test, and delayed post-test in this study. The rubric assignment includes 10 sections, including focus, main idea, organization (overall), organization (paragraphs), content, research, style (sentence structure), style (word choice), tone, style (details and examples), and grammar and mechanics. All the rating scales were based on criteria ranging from 0 to 4, which was then converted to 20. Accordingly, every criterion was assigned from 0 to 4, which was then added up and divided by 2 to have a single score out of 20. Inter-rater reliability was performed to ensure the test reliability. To do this, the researchers invited two experienced writing instructors that held MAs in TEFL to rate the learners' writing pre-test, post-test, and delayed post-test. In order to avoid the raters' subjectivity, all the learners' names were erased before giving the papers to the markers. After each of the above-mentioned test, both raters started going over each student's writing assignments taking analyzing of text, the amount of time, the number of words, writing scoring rubric and so forth into consideration. Also, Pearson Correlation was performed on the learners' pre-test (Pearson's correlation coefficient = .89), post-test (Pearson's coefficient = .93), and delayed post-test (Pearson's correlation coefficient = .91) after the scoring process by the markers. Moreover, the validity of the above tests was checked by two writing experts.

Procedure

Concept mapping instruction

As previously mentioned, the researchers asked the experimental group's participants to attend a 45 instructional session to see how to install and work with the mind mapping application. To do this strategy, the researcher first asked the participants to install the above-mentioned application on their mobile phones. After making sure that all the participants installed the application, the researcher started talking about the application and showed the learners how to work with it. The researcher then wrote a topic that included seven words on the whiteboard and asked the students to talk about it. Next, the researcher

started writing about the topic in form of topic sentence, development, and also concluding sentence via mind mapping application. The researcher then provided the learners with another topic and asked them to write about it through mind mapping. Figure 2 illustrates the concept map used by the experimental condition's participants.

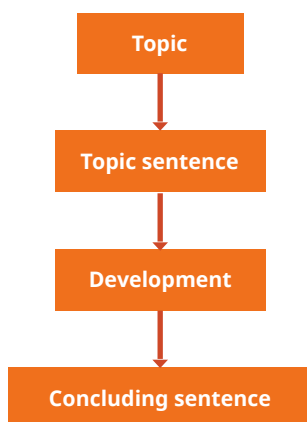


Figure 2. Concept map of experimental condition's participants.

Treatment sessions

For the learners of the experimental group, the instructor asked them to install the mind mapping application on their smartphones. After making certain that all the participants installed the mind mapping application, the researcher created a group on WhatsApp and shared the link with the participants to join. Before every treatment session, the mobile-mediated condition's participants were ensured to have mobile data or Wi-Fi in their mobile connection. As mentioned previously, all the treatment sessions were held outside of the learners' classroom in a scheduled pattern of twice a week on Saturdays and Tuesdays at 5:00 pm.

For each treatment session which usually was about 45 minutes, the instructor first sent a text message to the experimental group through WhatsApp to let the participants know that the treatment session was going to start. Once the researchers made sure that all the participants were ready, they provided the learners with a topic and required them to go over it and say whatever comes to their minds. After the brainstorming, the researcher started going through all the words sent by the learners to choose the ideas that were related to the topic and good enough to be included in the learners' writing assignments. The researcher then asked the students to write a paragraph about the topic, including a topic sentence, development, and a concluding sentence via the mind mapping application and send their writing pdf files to the group. Next, the instructor started going over each learner's writing assignment separately and informed them of any errors or mistakes. The error correction process was continued till the students could revise their assignments. For example, if one participant had difficulties with his/her assignment such as the length of

the text, the amount of time, the number of words they devote to writing, sentence structure, word choice, main idea(s), spelling, and so forth, the instructor stepped in and helped him/her find out the problems and apply the correct form in their assignments. On the other hand, the participants of the control group did not receive any treatment and were just required to write about the topics given to the experimental group traditionally. That is, the researchers just provided the participants of the control group with the writing topics given to the mobile-mediated condition and asked them to both discuss them and write about them traditionally, without receiving the treatment. Figure 3 indicates one screenshot of the treatment sessions.

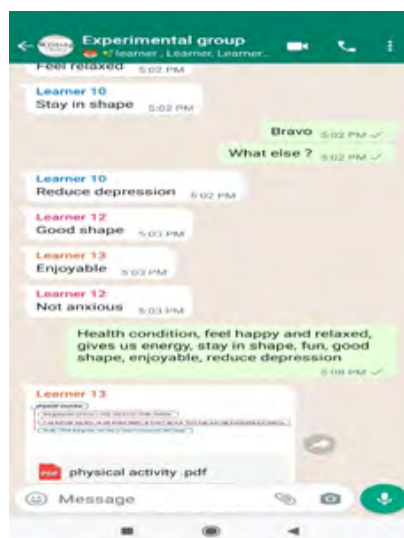


Figure 3. One screenshot of the treatment sessions.

Analysis

To investigate the effects of mobile-based concept mapping on EFL learners' writing fluency and motivation, learners' raw scores in the writing pre-test, post-test, and delayed post-test were first calculated. Descriptive statistics were then calculated for the learners. Independent sample *t*-test was performed on participants' pre-test, post-test, and delayed post-test to see whether (I) mobile-mediated concept mapping was effective for EFL learners' writing fluency, and (II) if mobile-based concept mapping improved learners' writing motivation. With respect to the writing motivation questionnaire, students' answers to all the questions were first added up. The total score for each student was then divided by the total number of questions in the questionnaire to receive an average writing motivation score for each participant.

Results

Table 1. Descriptive statistics for the two condition’s pre-test, post-test, and also the delayed post-test

Condition	N	Pre-test		Post-test		Delayed post-test	
		Mean	SD	Mean	SD	Mean	SD
Mobile-based concept mapping	35	12.07	.46	18.54	.32	18.41	.35
Control	35	12.17	.45	12.51	.28	12.48	.35

As is evident from Table 1, the mean scores on writing fluency between the two conditions were similar to each other. The mean score for the experimental condition was ($M = 12.07$), and the mean score for the control condition was ($M = 12.17$). To find out whether there was any statistically significant difference between the conditions, an independent sample t -test was performed on the participants’ pre-test scores. The results showed no significant difference between the conditions’ means on the writing fluency measure ($t = .847$, $P = .400$) at the 0.5 level. In short, the results of the statistical analysis on participants’ pre-test revealed that there was no statistically significant difference between the mobile-mediated concept mapping and the control conditions. Consequently, the results indicated that the conditions were comparable regarding writing fluency before the treatment.

As can be seen in Table 2, the participants of the mobile-mediated concept mapping group obtained the highest scores in writing fluency for post-test and the delayed post-test. To ensure if the difference between the groups were statistically significant, an independent sample t -test was performed on learners’ scores. The results showed significant difference between the conditions ($t = 82$, $P = .000$). In other words, the results of the independent sample t -test indicated that the difference between two conditions in terms of writing fluency was meaningful since $P = .000$ less than 0.5.

With respect to the delayed post-test, independent sample t -test was used to find out if observed as a consequence of mobile-based concept mapping on L2 students’ writing fluency was statistically significant. Like the post-test, the results of the independent sample t -test showed that the experimental group significantly outperformed the control group ($t = 69$, $P = .000$). These results indicate that mobile-mediated concept mapping can be known as a useful technological strategy to improve EFL learners’ writing fluency.

Table 2. Descriptive statistics for learners’ writing motivation questionnaire

Group	Pre-test			Post-test	
	N	Mean	SD	Mean	SD
Mobile-mediated concept mapping	35	2.25	.11	3.57	.12
Control	35	2.29	.08	2.36	.11

Based on Table 2, learners’ writing motivation mean scores improved from the pre-test to post-test. Independent sample *t*-test on participants’ scores indicated no statistically significant difference between the groups ($t = 1.55$, $P = .125$). Regarding the post-test scores, independent sample *t*-test on learners’ post-test scores revealed statistically significant difference between the two conditions ($t = 41$, $P = 000$).

As mentioned before, all the participants of the mobile-assisted condition were interviewed on the effectiveness of the mobile-assisted concept mapping technique. During this session, 32 EFL learners out of 35 claimed that they were happy with the use of mobile-assisted concept mapping for writing fluency, and it motivated and also interested them to start writing fluently and eagerly. They also believed that the mobile-assisted concept mapping technique helped them get a new impression on writing, especially writing fluency. All these 32 learners stated that mobile-assisted concept mapping triggered their reflective learning because it allowed them to reflect on their writing assignments without constraints of time and location. They claimed that since mobile-mediated concept mapping provided them with opportunities to go over the assignments at a later time, they were able to refer back to what they learned in educational settings. Two of 35 stated that they never liked writing and they considered it a difficult and boring task because they always got embarrassed when it came to writing. Only one participant out of thirty-five claimed that mobile-assisted concept mapping did not have any effects on his motivation because he did not agree with the use of technology for education. Based on the results of the in-depth interview and writing motivation questionnaire, we can claim that mobile-assisted concept mapping was an effective technique for improving EFL learners’ writing fluency and also motivation.

Discussion

The current study examined the effects of mobile-based concept mapping on EFL learners’ writing fluency and motivation. The findings indicated that mobile-mediated concept mapping was effective for EFL students’ writing fluency. The results of the study also revealed that mobile-mediated concept mapping was beneficial for learners’ writing motivation. In other words, the findings of the study showed that mobile-mediated concept mapping motivated EFL learners to write the English tasks very well. The first important finding of the study was that the mobile-based concept mapping strategy helped the experimental group’s participants to enhance their writing fluency and performed

better than the control group. Accordingly, concerning the first research question, we can state that mobile-mediated concept mapping was beneficial for EFL learners' writing fluency.

In other words, the answer to the first research question that asked to what extent mobile-based concept mapping was effective for EFL students' writing fluency is that L2 learners can write fluently through mobile-based concept mapping and thus we can claim that the mobile-based concept mapping is really effective for EFL learners' writing fluency. Consequently, the results of the study corroborate previous research findings (e.g., Asiksoy, 2019; Chang et al., 2017; Chen et al., 2015; Hwang et al., 2013; Khamesan & Hammond, 2004; Kwon & Cifunetes, 2009; Liu, 2016) that showed employing technology-mediated concept mapping was effective for learners in different fields of education.

The second research question was whether mobile-mediated concept mapping improved EFL learners' writing motivation, the findings of the study indicated that mobile-based concept mapping strategy enhanced EFL learners' writing motivation. Therefore, the answer to the second research question is also affirmative. This is an important finding because a number of previous studies (e.g., Almulla & Almari, 2021; Hasnah & Mada Ali, 2020; Nowruzhi Khiabani & Naffisi, 2010; Sahraee et al., 2022) provided evidence regarding the effectiveness of classroom concept mapping on language learners' motivation. In other words, the effect of mobile-mediated concept mapping that turned out to be effective for EFL learners' writing motivation was mostly ignored by previous studies.

To the researchers' knowledge, no previous study has investigated the impact of mobile-based concept mapping on EFL students' writing fluency. So, why was mobile-mediated concept mapping effective for the experimental group's participants in this study? One possible reason for such findings is the integration of mobile technology with concept mapping strategy that may enable students to learn better and lead to meaningful learning. That is to say, for the mobile-mediated group, mobile technology, and concept mapping strategy were mixed which could result in meaningful learning much better.

The other possible reason for such results could be the unique characteristics of MALL such as easy connectivity, portability, synchronous and asynchronous learning. The findings of the current study are in line with the findings of previous research which reported the usefulness of MALL in EFL learning environment (e.g., Hassan & Shafiqul Islam, 2020; Morshedi Tonekabani, 2019; Nalliveetil & Khaled Alenazi, 2016). As Ally and Samaka (2016) stated, MALL has some benefits for both teachers and students which result in enhancing EFL learners' learning. Moreover, they claimed that mobile phones are small enough to be employed everywhere without the limitation of time and place which helps learners to share information and expertise, complete a task, or work collaboratively on a project (Ally & Samaka, 2016). Students can also employ their mobile phones to communicate with their teachers or other experts in the same field.

Using concept mapping based on the design of the current study has some benefits for language learners. First, it helps them create concept maps actively

to write about the topics much better. Compared to traditional or classroom concept mapping which took the learners much time to draw the concept maps and to connect the ideas, mobile-mediated concept mapping can be made quickly and allows students to construct the ideas in a stress-free learning environment. Second, the mobile-mediated concept mapping provides all the learners with some unique opportunities, including online group feedback which may result in better understanding. Third, it enhances learners' motivation which helps them deal with writing fluency very well.

The outcome of the present study was different from the studies (e.g., Alemi et al., 2012; Dehghan et al., 2017; Saleem & Bakhsh, 2017) that reported mobile assisted language learning (MALL) was not effective for EFL learners and did not lead to better understanding. This could be because of the limitations of these research studies. For instance, Alemi et al. (2017) stated that the limited number of students and questions in the post-test might have influenced the outcome of their study. Similarly, Dehghan et al. (2017) claimed that lack of treatment could affect mobile-mediated condition participants' performance.

Conclusion, implications and suggestions for further study

Some primary conclusions can be drawn from the findings of the current study. First, the outcome of the study showed that mobile-based concept mapping was effective for EFL learners' writing fluency. Second, it was also found that mobile-based concept mapping was beneficial for learners writing motivation. Moreover, the findings of the study provided evidence for the effectiveness and usefulness of technology-mediated, especially mobile-mediated concept mapping in writing courses. Several pedagogical implications can be inferred based on these results.

One important implication is that language teachers can employ mobile-mediated concept mapping to help students improve their writing fluency outside of the classroom. The current study provided more evidence on the use of smartphones in language learning settings, particularly in writing classes. Another implication of this study is that second language (L2) teachers need to consider mobile technology as a useful strategy through which the students will not be pushed on in classrooms. The findings of the study may also provide all those syllabus designers who are interested in the use of mobile-mediated concept mapping technique with insightful implications because it results in better learning outcome. Currently, increasing written communication among both EFL and ESL learners is of great importance and under investigation in the field of language learning and teaching.

To enhance learners' writing fluency, some effective and helpful strategies as well as supportive techniques need to be considered. Previous studies (e.g., Fahim & Rahimi, 2011; Jafari & Zarei, 2015; Machida & Dalsky, 2014; Mashhadi et al., 2021) have indicated that traditional concept mapping can help L2 learners improve their writing skill. However, there are two important limitations concerning the conventional classroom concept mapping technique. First, traditional concept mapping consists of a number of concepts which may be

confusing for learners (Anderson-Inman & Zeitz, 1993; Reader & Hammond, 1994). Second, teachers are not able to provide learners with immediate feedback through the conventional concept mapping technique (Liu et al., 2010). Therefore, one advantage of using the mobile-based concept mapping based on the design of the present study is solving the aforementioned problems regarding the traditional concept mapping technique.

Despite the present study having reached its objectives regarding the effectiveness and usefulness of mobile-based concept mapping, there are some limitations. First, the number of participants was small. It is recommended that future studies be implemented with more participants. Second, all the learners in this study were adults. Future studies are needed to choose and include teenage learners to see if the outcome can be generalized to teenage EFL students. Third, the present study only investigated the effects of mobile-based concept mapping on EFL learners' writing fluency and does not report on other types of writing such as general writing, essay writing, letter writing, descriptive writing, narrative, and persuasive writing. Accordingly, other researchers can implement future studies to examine the effects of mobile-based concept mapping on other types of writing.

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Appendix A

Topics of the pre-test, post-test, and delayed post-test

1. Write a paragraph (about 8–9 sentences) on knowledge and wisdom.
2. Write a paragraph (7–8 sentences) on thinking and reasoning.
3. Write a paragraph (about 160 words) about sympathy and consideration for others.

Appendix B

Grading rubric for writing assignment



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	A (4)	B (3)	C (2)	D/F (1/0)
Focus: Purpose	Purpose is clear	Shows awareness of purpose	Shows limited awareness of purpose	No awareness
Main idea	Clearly presents a main idea and supports it throughout the paper.	There is a main idea supported throughout most of the paper.	Vague sense of a main idea, weakly supported throughout the paper.	No main idea
Organization: Overall	Well-planned and well-thought out. Includes title, introduction, statement of main idea, transitions and conclusion.	Good overall organization, includes the main organizational tools.	There is a sense of organization, although some of the organizational tools are used weakly or missing	No sense of organization
Organization: Paragraphs	All paragraphs have clear ideas, are supported with examples and have smooth transitions.	Most paragraphs have clear ideas, are supported with some examples and have transitions.	Some paragraphs have clear ideas, support from examples may be missing and transitions are weak.	Para. lack clear ideas
Content	Exceptionally well- presented and argued; ideas are detailed, well-developed, supported with specific evidence & facts, as well as examples and specific details.	Well-presented and argued; ideas are detailed, developed and supported with evidence and details, mostly specific.	Content is sound and solid; ideas are present but not particularly developed or supported; some evidence, but usually of a generalized nature.	Content is not sound
Research (if assignment includes a research component)	Sources are exceptionally well-integrated and they support claims argued in the paper very effectively. Quotations and Works Cited conform to MLA style sheet.	Sources are well integrated and support the paper's claims. There may be occasional errors, but the sources and Works Cited conform to MLA style sheet.	Sources support some claims made in the paper, but might not be integrated well within the paper's argument. There may be a few errors in MLA style.	The paper does not use adequate research or if it does, the sources are not integrated well. They are not cited correctly according to MLA style, nor listed correctly on the Works Cited page.

Style: Sentence structure	Sentences are clear and varied in pattern, from simple to complex, with excellent use of punctuation.	Sentences are clear but may lack variation; a few may be awkward and there may be a few punctuation errors.	Sentences are generally clear but may have awkward structure or unclear content; there may be patterns of punctuation errors.	Sentences aren't clear
Style: Word choice, Tone	There is clear use of a personal and unique style of writing, suited to audience and purpose; the paper holds the reader's interest with ease.	There is an attempt at a personal style but style of writing may be awkward or unsuited to audience and purpose; the reader may lose interest in some sections of the paper.	There is little attempt at style; reads as flat and perhaps uninteresting in content, which is usually generalized and cliched.	No attempt at style
Style: Details and Examples	Large amounts of specific examples and detailed descriptions.	Some use of specific examples and detailed descriptions. May have extended examples that go on for too long.	Little use of specific examples and details; mostly generalized examples and little description.	No use of examples
Grammar & Mechanics	Excellent grammar, spelling, syntax and punctuation.	A few errors in grammar, spelling, syntax and punctuation, but not many.	Shows a pattern of errors in spelling, grammar, syntax and/or punctuation. Could also be a sign of lack of proof-reading.	Continuous errors

ACADEMIC WRITING MOTIVATION QUESTIONNAIRE (AWMQ)

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In order to better understand what you think and how you feel about the writing you do in your courses, please respond to each of the following statements by circling the number in one of the boxes or providing the requested information. Thank you!

Statements	Strongly Disagree 0	Disagree 1	Uncertain 2	Agree 3	Strongly Agree 4
01. I enjoy writing.	0	1	2	3	4
02. I like to write down my thoughts.	0	1	2	3	4
03. I use correct grammar in my writing.	0	1	2	3	4
04. I complete a writing assignment even when it is difficult.	0	1	2	3	4
05. Being a good writer will help me do well academically.	0	1	2	3	4
06. I write as well as other students.	0	1	2	3	4
07. I write more than the minimum on writing assignments.	0	1	2	3	4
08. I put a lot of effort into my writing.	0	1	2	3	4
09. I like to participate in written online discussions.	0	1	2	3	4
10. I like to get feedback from an instructor on my writing.	0	1	2	3	4
11. I am able to clearly express my ideas in writing.	0	1	2	3	4
12. I easily focus on what I am writing.	0	1	2	3	4
13. I like my writing to be graded.	0	1	2	3	4
14. I am more likely to succeed if I can write well.	0	1	2	3	4
15. It is easy for me to write good essays.	0	1	2	3	4
16. I enjoy creative writing assignments.	0	1	2	3	4
17. I like classes that require a lot of writing.	0	1	2	3	4
18. I plan how I am going to write something before I write it.	0	1	2	3	4
19. Becoming a better writer is important to me.	0	1	2	3	4
20. Being a better writer will help me in my career.	0	1	2	3	4
21. It is important to me that I make an A on a writing assignment.	0	1	2	3	4
22. I enjoy writing assignments that challenge me.	0	1	2	3	4
23. I revise my writing before submitting an assignment.	0	1	2	3	4
24. Punctuation is easy for me.	0	1	2	3	4
25. I enjoy writing literary analysis papers.	0	1	2	3	4
26. I like to write even if my writing will not be graded.	0	1	2	3	4
27. I like others to read what I have written.	0	1	2	3	4
28. I enjoy writing research papers.	0	1	2	3	4
29. I would like to have more opportunities to write in classes.	0	1	2	3	4
30. Being a good writer is important in getting a good job.	0	1	2	3	4
31. I practice writing in order to improve my skills.	0	1	2	3	4
32. I want the highest grade in the class on a writing assignment.	0	1	2	3	4
33. I would rather write an essay than answer multiple-choice questions.	0	1	2	3	4
34. I want others to recognize me as a good writer.	0	1	2	3	4
35. Spelling is easy for me.	0	1	2	3	4
36. Choosing the right word is easy for me.	0	1	2	3	4
37. I am motivated to write in my classes.	0	1	2	3	4

General Background Information

I am a ☐ female ☐ male (please check)

The number of non-required books I read for pleasure each year is about (please estimate)

My academic major (or intended major) is