MODESTUM
OPEN ACCESS

EURASIA Journal of Mathematics, Science and Technology Education, 2018, 14(5), 1719-1729
ISSN:1305-8223 (online) 1305-8215 (print)
Research Paper https://doi.org/10.29333/ejmste/85110

Effects of the Visual/Verbal Learning Style on Concentration and Achievement in Mobile Learning

Ting Lu [1], Xianmin Yang [1*]

[1] Research Center of Smart Education, Jiangsu Normal University, Xuzhou, CHINA

Received 29 August 2017 ▪ Revised 2 January 2018 ▪ Accepted 10 January 2018

ABSTRACT

This study investigated the relationship between the style, concentration, and achievement of students in terms of visual/verbal learning when learning conceptual knowledge with the use of mobile phones in the classroom. A total of 93 Chinese college students who majored in education participated in this study. Two major results were identified by combining the methods of correlation analysis and ANOVA (one-way, two-way): A significant correlation was found to exist between concentration and the delayed post-test. Moreover, a significant interaction effects on learning achievement was found in visual/verbal learning style and concentration. The implications, limitations, and future research plans were presented.

Keywords: learning concentration, learning style, mobile learning, conceptual knowledge, learning achievement

INTRODUCTION

In view of the development of wireless and mobile technologies, mobile phones constitute a technology that has become part of everyday use (Shuib, Shamshirband, & Ismail, 2015).

In recent years, mobile learning (m-learning) has become increasingly popular in universities, and more college students have access to smartphones, tablets, and other mobile devices (Oz, 2014). Mobile technology deployment offers students new opportunities to increase their engagement, motivation, and learning outcome (Lin, Fulford, Ho, Iyoda, & Ackerman, 2012); it is also helpful in developing students' exploratory and critical thinking abilities (Kissinger, 2011). The characteristics of mobile devices are portability, instant connectivity, and context sensitivity (Sharples, 2000); thus, m-learning has a greater potential in facilitating collaborative inquiry processes, promoting students' interest and engagement (Rogers & Price, 2008), strengthening students' interactions (Ting, 2013), and improving students' learning performance (Lin, Huang, & Cheng, 2010) compared with traditional lecture-based learning in classroom settings. A review of selected journals from 2001 to 2010 showed that most m-learning studies focused on the students' learning motivation and attitudes (Hwang & Tsai, 2011).

Several studies (Sharples, Taylor, & Vavoula, 2010; Hockly, 2013) have also considered the shortcomings of m-learning. The disadvantages include limited memory, small screen, possible disconnection, and limited battery life of devices (Kutluk & Gülmez, 2014). Furthermore, the limitations of mobile devices also affect students' learning concentration and cognitive load (Hwang & Wu, 2014). Solving issues of concentration is a worthwhile topic in m-learning, especially given the lack of research on this critical issue. Contemporary studies on m-learning focus less on concentration and the relationships between concentration and other factors (e.g., learning style and achievement). This study focuses on the learning concentration and outcome of college students in terms of visual/verbal learning styles using m-learning graphical courseware.

✉ ltmail131203@163.com ✉ yangxianmin8888@163.com **(*Correspondence)**

Contribution of this paper to the literature

- A significant correlation exists between concentration and delayed post-test, while no correlation exists between concentration and immediate post-test.
- Significant interaction effects on achievement occur from learning style and concentration.
- The concentration issue should be taken into consideration while developing m-learning resources. And individual preference, such as learning style, should be comprehensively considered in m-learning.

LITERATURE REVIEW

Learning Concentration in E-learning and M-learning

Concentration is the ability to direct one's thinking in whatever direction one would intend (Paget, 2010). Concentration is important in learning, and is especially critical for efficient learning (Liu, Liao, & Peng, 2005) to improving students' academic achievement (Delgado, Phelps, & Robbins, 2011).

In the traditional face-to-face classroom setting, teachers observe students' expressions to determine whether or not they are attentively learning. In recent years, several studies began to carry out empirical research with the use of eye tracking technologies in the classroom (Liu, 2014; van Gog & Scheiter, 2010) as well as electroencephalography detection tools (Li et al., 2010) in the laboratory to measure and analyze students' attention. Studies on concentration during multimedia learning have also been conducted, and these studies involved split-attention (Mayer & Moreno, 1998), split visual attention (Schmidt-Weigand, Kohnert, & Glowalla, 2010), and attention-guiding means (Jamet, Gavota, & Quaireau, 2008).

Given a lack of time and space limitations of e-learning (Kydd & Ferry, 1994) and the small screen size and representation of mobile devices of m-learning (Sharples, 2006), concentration also is an important issue in the field of e-learning and m-learning. To improve students' learning concentration in e-learning and m-learning, researchers have conducted further research in addition to studies that use eye tracking technologies (Mason, Pluchino, Tornatora, & Ariasi, 2013). Chen, Kao, and Sheu (2003) developed an m-learning system to arouse learners' attention and interest as students learn about bird watching.

Existing studies on m-learning include less research on learning substantive knowledge with mobile phones. This study aims to investigate the interaction effects of learning style on learning concentration and achievement when college students use mobile phones to learn conceptual knowledge.

Effects of Learning Style on M-learning

Learning style is the natural or habitual patterns of learners when acquiring and processing information in learning situations (Borich, 1988). Akkoyunlu (1995) claimed that determining the learners' learning style is beneficial to the learners themselves and can assist teachers in developing their teaching process. Another study (Babadoğan, 2000) showed a positive influence between learning style and learning environments on the academic achievement of learners. Thus far, studies on learning style have developed several learning style models, some of which have been proposed by Myers–Briggs (Briggs, 1976), Kolb and Kolb (2012), and Felder–Silverman (Felder & Silverman, 1988).

In many ways, learning styles affect traditional classroom learning and e-learning. Learning style affects the teaching of many courses and learning achievement (Biçer, 2014). Moreover, learning is a factor that affects the quality of e-learning (Marković & Jovanović, 2012) and has significantly affected the academic achievements of learners (Dağ & Geçer, 2009).

Learning style also affects m-learning, such that researchers have focused on the learning style in m-learning via empirical research. These studies can be divided into two aspects. One aspect is building a relevant model to explore the problems between m-learning and learning styles, such as constructed adaptive m-learning system (Cruz, 2013) and the modified Dunn and Dunn learning style model (Dunn & Dunn, 1978), which incorporated learning styles in m-learning (Yau & Joy, 2006). Another aspect is the relationship between learning style and m-learning. The experiments of Wyatt et al. (2010) indicated that m-learning can better enhance learning for visual/nonverbal and tactile/kinesthetic students than for visual/verbal students. The findings of the empirical study of Norazah, Ridzwan, and Arif (2013) show a positive and significant relationship between learning style and the level of acceptance of m-learning for an AutoCAD course.

However, empirical studies on the interrelationship among visual/verbal learning style, m-learning, and other factors are limited.

Purpose and Research Questions

This study aims to investigate the relationship among visual/verbal learning style, learning concentration, and achievement when college students use mobile phones to learn conceptual knowledge. This study attempts to answer the following questions:

1) What is the relationship between concentration and learning achievement?
2) Does an interaction effect on learning achievement exist from visual/verbal learning style and concentration?

METHOD

Participants

The participants in this study were 93 freshmen who majored in education and attended two classes at Jiangsu Normal University. Their average age was 18.73 (SD = 0.80). After the survey of learning style, the participants were found to be 79 visual learners (84.95%) and 14 verbal learners (15.05%). Then the participants were randomly divided into two groups. Each participant had a smartphone and had experience in using them for m-learning. Thus, the participants were familiar with smartphone operation.

Instruments

This study adopted a quasi-experimental design with the following instruments: Index of Learning Styles (ILS) questionnaire (Felder & Soloman, 1997), learning concentration questionnaire, m-learning questionnaire, and post-tests.

Concentration questionnaire

The aim of the concentration questionnaire was to examine the participants' learning concentration while studying. The original questionnaire was adopted from Chen, Yang, and Hsu (2013), as well as the Concentration Questionnaire of California State University, which was used for the general classroom and not specifically for m-learning. For the present work, the original questionnaire was modified to include 10 items to meet the requirements of m-learning. The integral questionnaire consisted of two parts, namely, forward items (represented by a negative tone) and reverse items (expressed in a positive tone). The questions in the modified questionnaire were evaluated on a five-point Likert-type scale with a Cronbach's α of 0.83.

Table 1. The concentration questionnaire for mobile learning

Item	Description
1	In the m-learning activity, I try my best not to be absent-minded.
2	In the m-learning activity, I can ignore the noise of the surrounding environment and focus on learning content.
3	In the m-learning activity, it is easy for me to lose my concentration. *
4	In the m-learning activity, even if the contents are not interesting, I can still concentrate on them.
5	In the m-learning activity, it is hard for me to keep concentration for 15 minutes. *
6	In the m-learning activity, my mind wandered. *
7	In the m-learning activity, I often forget what I just learn. *
8	In the m-learning activity, it is difficult for me to pay attention to the details. *
9	In the m-learning activity, I can notice the key points of learning contents.
10	In the m-learning activity, I can grasp the main points and fully understand.

*Note. * represents the reverse item*

M-learning questionnaire

The questionnaire of m-learning involved participants' basic personal information, such as their name, gender, major, age, grade, m-learning situation during the study period, and m-learning frequency.

Learning style scale

In this study, the ILS questionnaire was used to distinguish the participants' dominant learning styles. The ILS comprises four dimensions, each with 11 items: perception (sensing/intuitive), input (visual/verbal), process (active/reflective), and understanding (sequential/global). Scholars have found that individual preferences for

multimedia materials based on visual and verbal cognitive styles may affect learners' emotions and performance (Chen & Sun, 2012). Therefore, the visual/verbal dimension was selected to measure students' preferred input mode in the present study.

Post-tests

Two post-tests, namely, immediate and delayed post-tests, were conducted. The researchers in this study followed the learning materials and used the post-tests to evaluate the participants' learning outcomes of eight concepts. The same paper was used as the immediate post-test and the delayed post-test. The only difference was the order of the items to eliminate the participants' previous memories. The full mark of post-tests was 100. All the questions were objective items. After one researcher marked all the test papers, another researcher randomly selected 30 papers to check to ensure accuracy.

Group interviews

After the delayed post-test, 10 participants (two groups) were selected for the focus group interview. Group A consisted of three high-concentration participants and two low-concentration participants, whereas Group B consisted of three high-achievement participants and two low-achievement participants. All interviews were recorded using a recording pen. Each group interview lasted approximately 30 minutes. The researcher then transcribed the audio of each interview into text. The interview outline was as follows:

(1) Rate the difficulty of these concepts. Kindly explain.

(2) Please provide a brief description of your concentration level in the process of m-learning.

(3) Do you have any suggestions for this graphical courseware?

The learning achievement and learning concentration of the interviewees were not disclosed. The interviews were conducted in a quiet and undisturbed classroom. Before the questions were asked, the interviewees described their individual situations and expressed their feelings about the learning process.

More than 95% of the interviewees said that the content of the concept knowledge had moderate difficulty. They proposed how the learning materials could improve.

Materials

The participants were education majors. In educational experiments, selecting unfamiliar knowledge for participants is an effective strategy to guarantee their equal pre-knowledge level and avoid the effect of pre-test on subsequent tests (Kang & Zhou, 2009). Eight concepts from other majors (including biology, geography, and chemistry) were selected to ensure that the participants had similar levels of knowledge before the experiment. The eight concepts were aerobic respiration, golgiosome, cold front, metamorphic rock, equatorial plate, covalent bond, brine electrolysis, and redox reaction. Moreover, six students from other classes and those who were not involved in this experiment were randomly selected to investigate their levels of understanding of the eight concepts. Results showed that they had now almost forgotten these concepts although they were included in their middle school curricula.

After determining the concepts, a graphical courseware was developed in PDF format. In the courseware, the text on the left side of the screen was the concept explanation, and the image on the right side was the schematic of concepts (**Figure 1**). In view of the concept of metamorphic rock by graphical courseware for example, the concept explanation of metamorphic rock describes its formation process and various types. In addition, the diagram shows its formation process with pictures and arrows.

Before the experiment, the courseware was installed in different types of mobile phones (e.g., Android and iOS) to test its usability. The graphical courseware could run smoothly on mobile phones with different operating systems.

Figure 1. Graphical courseware

Procedure

The experiment was conducted in a classroom setting. Each participant completed learning of the eight concepts using their own mobile phones within the required time. **Figure 2** outlines the overall research procedure.

Before the experiment, informed written consent was obtained from the participants, which indicated that they were willing to participate in this experiment and that their personal information would not be revealed. Subsequently, the participants were provided a brief description of this research, including its aims, procedure, and privacy protection measures. Each student was asked to fill in the survey of learning style and personal information with regard to m-learning supported by mobile phones.

During the experiment, students downloaded the graphical courseware via the download links written by the researchers on the blackboard. Then, they were given the security codes to open the graphical courseware simultaneously and learn the eight concepts individually in 20 minutes.

After the concept learning, a post-test was conducted immediately for 15 minutes. Then, the participants filled in the concentration questionnaire for three minutes. One week after the experiment, the delayed post-test was conducted for 15 minutes.

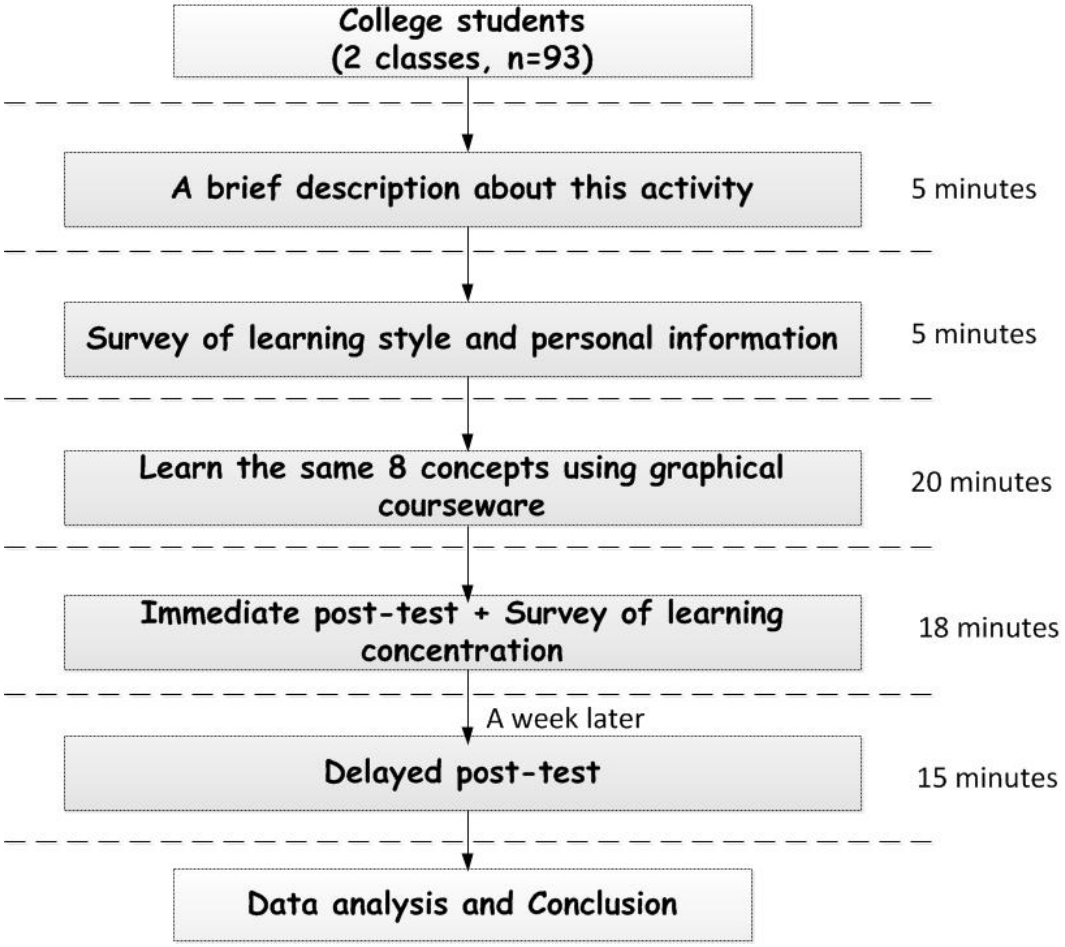

Figure 2. Research procedure

Table 2. Results of correlation analysis

	Concentration	Immediate post-test	Delayed post-test
Concentration	-	-	-
Immediate post-test	0.141	-	-
Delayed post-test	0.267**	0.590**	-

***p<0.01*

RESULTS AND DISCUSSION

Relationship between Concentration and Learning Achievement

Statistical analysis of data indicated that the average scores of concentration when using mobile phones to learn conceptual knowledge was 3.06 (SD = 0.56). The average scores of the immediate and delayed post-tests were 64.31 (SD = 16.06) and 55.23 (SD = 16.05), respectively.

In this experiment, post-test scores were set as the indicator of learning achievement. **Table 2** indicates a significant but weak correlation between concentration and delayed post-test (Pearson's r = 0.267, p < 0.05). Meanwhile, a significant but medium correlation was found between immediate and delayed post-tests (Pearson's r = 0.590, p < 0.01). No correlation was found between concentration and the immediate post-test.

Table 2 indicates three interesting experimental results. Firstly, there is a significant but medium correlation between the immediate and delayed post-tests. During this experiment, we have administered the same paper to test the participants' learning effects. The only difference was the order of the items. So it is reasonable that there was correlation between immediate and delayed post-tests. Secondly, there is a significant but weak correlation between concentration and the delayed post-test. Several studies have demonstrated that learning concentration is associated with learning achievement (Lin, Huang, & Cheng, 2010; Lin, Huang, & Liu, 2010) and that learning

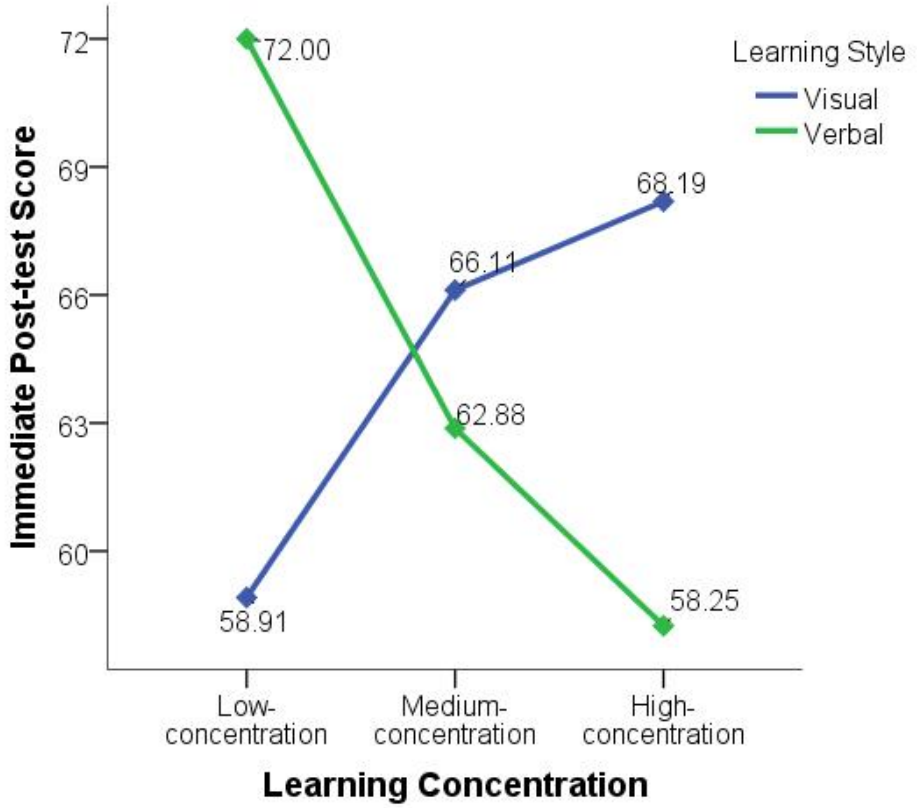

Figure 3. Interaction effect of learning style and concentration on learning achievement

concentration can improve students' achievement (Delgado, Phelps, & Robbins, 2011). The significant correlation between concentration and the delayed post-test achievement is consistent with the above conclusions. Conversely, the absence of a relationship between concentration and immediate post-test achievement is incongruent with the above conclusions, which is the third interesting results. The post-tests consistently assessed memory retention and analytical skill (Kalpana et al., 1998). In this study, the participants' immediate comprehension and memory about the eight concepts was examined during the immediate post-test. The absence of a relationship between concentration and immediate post-test indicated that the participants' concentration during the experiment did not affect their memory of the learning content. Stipek (2014) conducted an experiment on childhood memory and attention. One of the results of the experiment demonstrated a strong relationship between working memory and attention with academic outcomes. Ebbinghaus' forgetting curve shows that the memory of knowledge reduced by approximately three-fourths after six days (Murre & Joeri, 2015). The one-fourth that was retained in the memory of the participants showed the concentration level. However, the effect of anxiety on concentration cannot be ignored. Students who participated in group interviews expressed that anxiety reduced their concentration when learning. One student said, "*When I found out that I had forgotten what I learned, I felt very anxious which made it harder for me to concentrate.*" Other students gave similar feedback. Thus, memory and anxiety (one or more factors) may be the main factors that affect the relationship between concentration and the immediate post-test.

Interaction Effect of Learning Style and Concentration on Learning Achievement

In the study, the visual/verbal learning style was selected as an independent variable, which was one dimension of learning style. One-way ANOVA revealed no effects of visual/verbal learning styles on learning concentration or learning achievement. Two-way ANOVA revealed significant interaction effects between visual/verbal learning style and concentration on immediate post-test ($F(3, 89) = 2.814$, $p < 0.05$; **Figure 3**). The visual learners achieved higher scores with high concentration ($M = 68.19$, $SD = 13.40$) and medium concentration ($M = 66.11$, $SD = 15.18$) than those with the scores with low concentration ($M = 58.91$, $SD = 14.72$). The verbal learners obtained better scores with low concentration ($M = 72$, $SD = 26.87$) than those with the scores with medium concentration ($M = 62.88$, $SD = 22.76$) and high concentration ($M = 58.25$, $SD = 24.57$). No interaction effects of visual/verbal learning style and concentration were observed on the delayed post-test in learning concepts using mobile phones.

Visual/verbal learning styles were not significantly effective on students' achievement which is consistent with the findings of Yilmazsoylu and Akkoyunlu (2009). Li and Yang (2016) also found no effects between learning styles and concentration in m-learning. When learning conceptual knowledge with graphical courseware, the participants with different learning styles (visual/verbal) in m-learning had different performances under the three states of learning concentration. The visual learners attained the highest scores with high concentration, whereas the verbal learners attained the best learning outcome with low concentration. Generally, students often achieve better performance when they focus highly on the learning contents and activities. However, this situation is different between visual and verbal learners who are learning conceptual knowledge with graphical courseware; such difference may be attributed to the preference of different learning styles and the graphical courseware. Visual learners prefer pictures, diagrams, and sketches (Felder, 1993). They are interested in learning contents with graphics and best remember the details of what they learn via images and illustrations (Gappi, 2013). Conversely, verbal learners obtain considerable information from what they have heard or said (Gomes et al., 2007). They prefer explanations with words. The graphical courseware contains two media elements, namely, text and graphics. In the courseware used in the present study, the text was the concept explanation that explained the conceptual knowledge; whereas the graphics was the schematic of concepts that showed the content of conceptual knowledge or its formation process. In comparison with the preference of the verbal learners, the graphical courseware was more likely to meet the visual learners' demands. Moreover, learning preferences and learning interest have the same meaning to some extent (Arikpo & Domike, 2015). Ge (2006) found that interest is a significant factor that affects student concentration. Therefore, the visual learners with high concentration attained better performance, whereas the verbal learners obtained high scores with low concentration. In addition to the above results, another phenomenon deserves attention, in which the verbal students did not perform poorer than the visual students did on concentration. The verbal learners obtained the best scores with low concentration; these scores were higher than those of the visual learners. One possible reason might be that undue attention had caused anxiety, which is congruent with the findings of Wine (1971). The verbal students obtained the best learning experience with low concentration. However, they were unable to attain better performance with high concentration, which caused anxiety.

CONCLUSION

This study investigated the interaction effects of learning style on learning concentration and achievement when college students used mobile phones in the classroom setting to learn concepts using a graphical courseware. The major findings are as follows. 1) A significant correlation exists between concentration and the delayed post-test, and no correlation exists between concentration and the immediate post-test. 2) Significant interaction effects on achievement occurred from visual/verbal learning style and concentration.

These findings could serve as a guideline in promoting m-learning, particularly for concept learning in the classroom. The results also provided the following research implications. 1) Individual preference, such as learning style, should be comprehensively considered in m-learning. M-learning emphasizes individuation and allows truly personalized learning (Attewell, 2005). Designers should consider learning style as the most important feature of the individual when designing m-learning materials. Teachers should provide suitable learning materials for learners in m-learning. Furthermore, they are recommended to adopt different teaching strategies for visual and verbal learners in m-learning. For instance, teachers can encourage visual learners to use imagery strategies and guide verbal learners to use verbal associative or elaborative strategies (Kirby, Moore, & Schofield, 1988). In addition, teachers should train learners in the skills of other learning styles through their teaching. A learning style is value-neutral and has no indication of intelligence or individual worth (Felder & Brent, 2005). Students, equipped with the skills associated with every learning style, can learn concepts quickly because they will need all of those skills to function effectively as professionals (Felder & Brent, 2005). 2) The improvement of learners' concentration in m-learning should be given focus. Generally, concentration may depend on several other factors, such as learning motivation and self-efficacy. Some studies have also indicated difficulties in focusing concentration on the learning contents in m-learning (Denk, Weber & Belfin, 2007; Sharples et al., 2009).

The results of this study can provide a reference for the development of m-learning resources. However, as with all empirical research, this study has certain limitations. First, the influence of the participants' a priori knowledge is unavoidable without pre-tests. Second, participants measured their concentration by self-reporting without objectivity. Future research may incorporate the use of eye tracking and brain wave monitoring to record participants' concentration. Moreover, the research scope will be expanded by including students with different majors and types of knowledge.

ACKNOWLEDGEMENTS

This work was supported by a project funded by the Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD) and the 333 project of Jiangsu Province.

REFERENCES

Akkoyunlu, B. (1995). Bilgi Teknolojilerinin Okullarda Kullanımı ve Öğretmenlerin Rolü (in Turkish). *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 11*(11), 105-109.

Arikpo, O. U., & Domike, G. (2015). Pupils learning preferences and interest development in learning. *Journal of Education & Practice*, *6*(21), 31–38.

Attewell, J. (2005). Mobile technologies and learning. *London: Learning and Skills Development Agency, 2*(4).

Babadoğan, C. (2000). Öğretim Stili Odakı Ders Tasarımı Geliştirme (in Turkish). *Milli Eğitim Dergisi, 147*, 61-63.

Biçer, D. (2014). The effect of students' and instructors' learning styles on achievement of foreign language preparatory school students. *Social and Behavioral Sciences, 141,* 382-386.

Borich, G. D. (1988). *Effective teaching methods*. India: Pearson Education India.

Briggs, K. C. (1976). *Myers-Briggs type indicator*. Palo Alto, CA: Consulting Psychologists Press.

Chen, C. M., & Sun, Y. C. (2012). Assessing the effects of different multimedia materials on emotions and learning performance for visual and verbal style learners. *Computers & Education*, *59*(4), 1273-1285.

Chen, I. H., Yang, Y. T. C., & Hsu, S. W. (2013, March). Development and evaluation of a concentration questionnaire for students in classroom. In *Society for Information Technology & Teacher Education International Conference,* No. 1, pp. 4226-4230.

Chen, Y. S., Kao, T. C., & Sheu, J. P. (2003). A mobile learning system for scaffolding bird watching learning. *Journal of Computer Assisted Learning, 19*(3), 347-359.

Cruz, Y. (2013, July). Examining the effect of learning styles on mobile learning adoption. In *Advanced Learning Technologies (ICALT), 13th International Conference on* (pp. 510-511). IEEE.

Dağ, F., & Geçer, A. 2009). Relations between online learning and learning styles. *Social and Behavioral Sciences, 1,* 862–871.

Delgado, M. R., Phelps, E. A., & Robbins, T. W. (Eds.). (2011). *Decision making, affect, and learning: Attention and performance XXIII* (Vol. 23). Oxford: Oxford University Press.

Denk, M., Weber, M., & Belfin, R. (2007). Mobile learning–challenges and potentials. *International Journal of Mobile Learning and Organisation, 1*(2), 122-139.

Dunn, R. S., & Dunn, K. J. (1978). *Teaching students through their individual learning styles: A practical approach*. Englewood Cliffs, NJ: Prentice Hall.

Dunn, R., & Dunn, K. (1978). Teaching students through their individual learning styles: a practical approach. *International Journal of Science Education* - INT J SCI EDUC.

Felder, R. M. (1993). Reaching the second tire - learning styles and teaching styles in college science education. *Journal of College Science Teaching, 23*(5), 286- 290.

Felder, R. M., & Brent, R. (2005). Understanding student differences. *Journal of Engineering Education*, *94*(1), 57-72.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering education, 78*(7), 674-681.

Felder, R. M., & Soloman, B. A. (1997). *Index of learning styles*. Raleigh.

Gappi, L. L. (2013). Relationships between learning style preferences and academic performance of students. *International Journal of Educational Research and Technology, 4*(2), 7.

Ge, X. S. (2006). The top ten factors of influencing learning attention. *Instructional Research, 6*, 555-557.

Gomes, A., Santos, Á., Carmo, L., & Mendes, A. J. (2007, September). Learning styles in an e-learning tool. Paper presented at *the meeting of ICEE*, Coimbra, Portugal.

Hockly, N. (2013). Technology for the language teacher: Mobile learning. *Elt Journal, 67(1)*, 80-84

Hwang, G. J., & Wu, P. H. (2014). Applications, impacts and trends of mobile technology–enhanced learning: a review of 2008–2012 publications in selected SSCI journals. *International Journal of Mobile Learning and Organisation, 8*(2), 83-95.

Hwang, G.-J., & Tsai, C.-C. (2011). Research trends in mobile and ubiquitous learning: A review of publications in selected journals from 2001 to 2010. *British Journal of Educational Technology*, *42*(4), E65-E70.

Jamet, E., Gavota, M., & Quaireau, C. (2008). Attention guiding in multimedia learning. *Learning and instruction*, *18*(2), 135-145.

Kalpana, E., Anand, K. N., Nalini, K., Sujith, C. J., Alice, K., & Molly, T. (1998). Patient oriented problem solving (POPS) approach and audiovisual aided (AVA) lectures in teaching pharmacology-A comparative study. *Indian Journal of Pharmacology*, *30*(2), 97.

Kang, C., & Zhou, A. B. (2009). The effect of representational mode of information and personality traits of learners on the learning in multimedia environment. *Psychological Development and Education, 25*(1), 81-90.

Kirby, J. R., Moore, P. J., & Schofield, N. J. (1988). Verbal and visual learning styles. *Contemporary Educational Psychology*, *13*(2), 169-184.

Kissinger, J. S. (2011). *A collective case study of mobile e-book learning experiences* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database. (UMI No. AAT 3458925).

Kolb, A., & Kolb, D. A. (2012). Kolb's learning styles. In *Encyclopedia of the Sciences of Learning* (pp. 1698-1703). NY, US: Springer.

Kutluk, F. A., & Gülmez, M. (2014). A research about mobile learning perspectives of university students who have accounting lessons. *Social and Behavioral Sciences, 116*(2014), 291-297.

Kydd, C. T., & Ferry, D. L. (1994). Managerial use of video conferencing. *Information & Management, 27*(6), 369-375.

Li, X., & Yang, X. (2016). Effects of learning styles and interest on concentration and achievement of students in mobile learning. *Journal of Educational Computing Research*, *54*(7), 922-945.

Li, X., Zhao, Q., Liu, L., Peng, H., Qi, Y., Mao, C., ... Hu, B. (2010). Improve affective learning with EEG approach. *Computing & Informatics, 29*(4), 557-570.

Lin, M. F., Fulford, C. P., Ho, C. P., Iyoda, R., & Ackerman, L. K. (2012, March). Possibilities and challenges in mobile learning for K-12 teachers: a pilot retrospective survey study. In *2012 IEEE Seventh International Conference on Wireless, Mobile and Ubiquitous Technology in Education* (pp. 132–136).

Lin, Y. T., Huang, Y. M., & Cheng, S. C. (2010). An automatic group composition system for composing collaborative learning groups using enhanced particle swarm optimization. *Computers & Education, 55*(4), 1483-1493.

Lin, Y. W., Huang, T. C., & Liu, C. J. (2010). The development and application of the concentration questionnaire in science classroom. *Chinese Journal of Science Education, 18*(2), 107-129.

Liu, P. L. (2014). Using eye tracking to understand the responses of learners to vocabulary learning strategy instruction and use. *Computer Assisted Language Learning*, (ahead-of-print), 1-14.

Liu, S. H., Liao, H. L., & Peng, C. J. (2005). Applying the technology acceptance model and flow theory to online e-learning users' acceptance behavior. *E-learning*, *6*(2), 4-8.

Marković, S., & Jovanović, N. (2012). Learning style as a factor which affects the quality of e-learning. *Artificial Intelligence Review*, *38*(4), 303-312.

Mason, L., Pluchino, P., Tornatora, M. C., & Ariasi, N. (2013). An eye-tracking study of learning from science text with concrete and abstract illustrations. *The Journal of Experimental Education, 81*(3), 356-384.

Mayer, R. E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology*, *90*(2), 312.

Murre, J. M. J., & Joeri, D. (2015). Replication and analysis of Ebbinghaus' forgetting curve. *Plos One, 10*(7), e0120644.

Norazah, M. N., Ridzwan, C. R., & Arif, A. A. (2013). Relationship between the acceptance of mobile learning for AutoCAD course and learning style in polytechnic. *Procedia-Social and Behavioral Sciences*, *102*, 177-187.

Oz, H. (2014). Prospective English teachers' ownership and usage of mobile devices as m-learning tools. *Social and Behavioral Sciences, 141,* 1031-1041.

Paget, R. (2010). *A Guide to Study and Revision*. Lulu.com.

Rogers, Y., & Price, S. (2008). The role of mobile devices in facilitating collaborative inquiry in situ. *Research and Practice in Technology Enhanced Learning*, *3*(03), 209-229.

Schmidt-Weigand, F., Kohnert, A., & Glowalla, U. (2010). A closer look at split visual attention in system-and self-paced instruction in multimedia learning. *Learning and Instruction*, *20*(2), 100-110.

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education, 34*(3-4), 177-193.

Sharples, M. (2006). *Big issues in mobile learning*. Nottingham: University of Nottingham.

Sharples, M., Arnedillo-Sánchez, I., Milrad, M., & Vavoula, G. (2009). *Mobile learning* (pp. 233-249). The Netherlands: Springer.

Sharples, M., Taylor, J., & Vavoula, G. (2006). *A theory of learning for the mobile age*. 87-99.

Sharples, M., Taylor, J., & Vavoula, G. (2010). A theory of learning for the mobile age. *Medienbildung in Neuen Kulturräumen,* 87-99.

Shuib, L., Shamshirband, S., & Ismail, M. H. (2015). A review of mobile pervasive learning: Applications and issues. *Computers in Human Behavior*, *46*, 239-244.

Stipek, D., & Valentino, R. A. (2014). Early childhood memory and attention as predictors of academic growth trajectories. *Journal of Educational Psychology, 107*(3), 771–788.

Ting, Y. L. (2013). Using mobile technologies to create interwoven learning interactions: An intuitive design and its evaluation. *Computers & Education, 60*(1), 1-13.

van Gog, T., & Scheiter, K. (2010). Eye tracking as a tool to study and enhance multimedia learning. *Learning and Instruction, 20*(2), 95-99.

Wine, J. (1971). Test anxiety and direction of attention. *Psychological bulletin, 76*(2), 92.

Wyatt, T. H., Krauskopf, P. B., Gaylord, N. M., Ward, A., Huffstutler-Hawkins, S., & Goodwin, L. (2010). Cooperative m-learning with nurse practitioner students. *Nursing Education Perspectives*, *31*(2), 109-113.

Yau, J. Y.-K., & Joy, M. (2006). Application of learning styles for effective mobile learning. In *Mobile Learning*. Dublin, Eire, 16-21.

Yilmazsoylu, M., & Akkoyunlu, B. (2009). The effect of learning styles on achievement in different learning environments. *Turkish Online Journal of Educational Technology, 8*(4), 43-50.