THE EFFECT OF MOBILE LEARNING AND LEARNING STYLES ON STUDENTS' SCIENTIFIC LITERACY IN SALT HYDROLYSIS CONCEPT

Ucu Cahyana[1]*, Irwanto Septian[1] and Erdawati[1]
[1]*Department of Chemistry Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Jakarta, Jl. Rawamangun Muka, Jakarta, 13220, Indonesia*
*E-mail: ucahyana@unj.ac.id

───

ABSTRACT

This study aimed to determine the effect of mobile learning and learning style on students' scientific literacy in the salt hydrolysis concept. This research was conducted at Senior High School 42 Jakarta with a sample of 56 students consisting of 28 students with visual learning style and 28 students with auditory learning style. The sample in the study was randomly selected. The research method used was experimental with 2x2 design level treatment and analyzed by Two-Way ANOVA. The results showed that there were differences in scientific literacy between groups of students who used mobile and traditional learning (without considering learning styles) and groups of students who used a combination of consideration of learning styles and mobile learning. The use of mobile learning has a positive effect on scientific literacy outcomes when applied to group visual learning styles. Whereas, in the audio learning style group, the use of mobile learning media provided lower scientific literacy results compared to traditional learning media.

Keywords: learning style, mobile learning, scientific literacy

───

1. INTRODUCTION

The achievement result of scientific literacy in the Programme for International Student Assessment (PISA) survey at 2015 placed Indonesia at 62th place out of 69 participating countries with an average score for scientific competence of 403. The average score is below the average score of all participants in the PISA 2015 survey, it was 493. In the analysis of the PISA 2015 results, 42.3% of Indonesian students had the thinking ability below level 2 and only 0.8% were at levels 5 and 6. This shows that most Indonesian students only able to use scientific knowledge in several life situations that require a low cognitive level and have not been able to use scientific knowledge in various complex life situations that require a high cognitive level (OECD, 2015). Therefore, these results illustrate the low level of scientific literacy in Indonesian education.

The low level of scientific literacy is related to learning patterns in the classroom that have not provided room for developing students' critical thinking and analytical skills. Science learning is still limited to the transfer of science as a product (facts, laws and theories) that must be memorized (Istyadji, 2007). Learning rarely starts from actual problems and is less connected to the real-life context, and also the goals of science education tend to be oriented towards test results (Suroso, 2012). Students are not used to solving test questions or problems related to science skills also (Abdul & Citron, 2014). Therefore, science learning still uses conventional learning patterns which have an impact on the low level of scientific literacy of Indonesian students.

Scientific literacy is defined as the capacity to use scientific knowledge, to identify questions, to conclude based on facts in understanding the universe, and to make decisions from

changes that occur due to human activities (OECD, 2015). Scientific literacy can be interpreted as an understanding of science and its application for society needs. Scientific literacy is important for students to master in understanding the environment, health, economy, and other problems faced by modern societies that depend heavily on technology and the progress and development of science. Scientific literacy is a key competency that students must possess in facing today's modern society. So, it is very necessary to improve scientific literacy skills in learning.

The use of ICT technology in learning is very needed to form quality learning. The use of ICT that has been widely used in learning is Power Point for presentations and the internet (blog, email, website) (Husain, 2014). The results of research on the use of ICT in learning on acid-base concepts can improve the ability to interconnect multiple levels of representation (IMLR) (Farida et al., 2011), can provide educators and students with new experiences that are not obtained in traditional learning (Hadjerrouit, 2010), can increase students' self-confidence and motivation (Koc, 2005), enabling students to learn anywhere and anytime and fostering independence (Cook, 2007), and enabling students to build their own knowledge (Faizal & Rahman, 2013).

Current developments in technology and information have developed mobile phones into smartphones. One of the uses of smartphones in education is mobile learning. Smartphones can be used in learning content that is packaged in a more fun form so it can motivate student for better learning outcomes. Learning with Mobile Learning (M-Learning) can also increase student independence (Yao et al., 2016). M-Learning is learning with certain devices, which can be used any time and any place (Boyinbode & Akinyede, 2008). This is in line with the results of research by Buchari et al. (2015) stated that learning using mobile learning media provides better results than students who learn conventionally.

Using mobile learning appropriately must consider several factors, one of which is learning style. Learning style is a person's style in processing and absorbing information or learning something from his experience so he can easily accept the information received either through hearing, seeing or doing it, who can finally understand the information that he got. The introduction of learning styles will provide appropriate services for what and how should be provided and done so that learning can take place optimally (Agustina & Sitompul, 2015).

Learning style is one aspect that affects student learning outcomes. Based on the results of research conducted by Gunawan (2012), it shows that students who learn using their dominant learning style, they got higher test result compared with learning styles that don't suit with them. According to Masrimuna (2014) research shows that students' learning style have an effect on students' scientific literacy skills because it is one of the students' learning achievements.

Salt Hydrolysis is a chemical concept that has an abstract and complex characteristic. Understanding it requires an integration of macroscopic, microscopic and symbolic aspects. The microscopic aspect of a solution is something beyond from students' daily experiences because they cannot see the reactions that occur in a solution and how the ions or molecules in the solution move and interact with each other. The existence of videos and animations in mobile learning can help to visualize the microscopic aspects of the reactions in solution and to minimize learning difficulties and misconceptions caused by the characteristics of Salt Hydrolysis concept.

Based on the description above, learning using mobile learning can streamline inquiry learning and foster critical thinking skills, and independent student learning that can develop students' scientific literacy. It is just that as a learning medium, in using mobile learning, you must notice to students' learning styles. There has been no research that links mobile learning and students' learning styles

toward scientific literacy. Based on this background, it is necessary to conduct a research to see the effect of using Mobile Learning media and students' learning styles toward scientific literacy on Salt Hydrolysis concepts.

2. RESEARCH METHOD

The population in this study were all students of 11th Grade in Senior High School 42 East Jakarta. This research was conducted from April until May. In this study, the sampling technique used was simple random sampling which included probability sampling. The sample in this study amounted to 56 students consisting of 28 students who have visual learning styles (14 students from classes with mobile learning media and 14 students from classes with traditional learning) and 28 students who have audio learning styles (14 students from classes with mobile media learning and 14 students from classes with traditional learning).

The research method used in this study is true experiment with a 2x2 treatment by level design. In this study, mobile learning is a treatment variable, while the learning style used in this study consists of visual and audio learning styles which are moderate variables. The dependent variable in this study is scientific literacy. The research design is presented in Table 1.

Table 1. Research Design

Learning Styles (B)	Learning Media (A)	
	Mobile Learning (A_1)	Conventional (A_2)
Visual (B_1)	A_1B_1	A_2B_1
Audio (B_2)	A_1B_2	A_2B_2

Information:
A_1= Using Mobile Learning Media
A_2= Using Traditional Learning Media
B_1= Students who have a visual learning style
B_2= Students who have an audio learning style
A_1B_1= Groups that have a visual learning style using mobile learning media

A_2B_1= Groups that have a visual learning style using traditional learning media
A_1B_2= Groups that have an audio learning style using mobile learning media
A_2B_2= Groups that have an audio learning style using traditional learning media

Measuring Learning Styles to determine the type of learning style (Visual or Auditory) uses instruments that refer to the VAK Quantum Teaching learning style instrument compiled by DePorter and Hernacki (2002) in the form of 24 statements. This instrument has been tested for validity and reliability with Alpha Cronbach formula which obtained a value of r = 0.91.

Measurement of scientific literacy on Salt Hydrolysis concept uses the instrument of scientific literacy which refers to the three aspects of scientific literacy according to PISA that includes context, knowledge and competence (OECD, 2009). The instrument of scientific literacy ability consists of twenty descriptive questions that have been tested for validity and reliability with the r value obtained of 0.92.

The data obtained from the scientific literacy test was carried out by the prerequisite analysis test, that is the normality test with the Lilierfors test (L_0 = 0.1243 in the A_1 student group, L_0 = 0.1587 in the A_2 student group with L_{table} = 0.167 and L_0 = 0.1429 in the A_1B_1 student group, L_0 = 0.2026 in the A_1B_2 student group, L_0 = 0.1475 in the A_2B_1 group, L_0 = 0.1957 in the A_2B_2 group with L_{table} = 0.227) and the homogeneity test using the Fisher test (f_{count} = 1.653 with f_{table} = 1.87) followed by the Bartlett test (x^2_{count} = 6.955 with x^2_{table} = 7.815). The first hypothesis test (main effect) and the second hypothesis test (interaction effect) used two-way analysis of variance (ANOVA) techniques, while the third hypothesis test (simple effect) and the fourth hypothesis test (simple effect) used the Tukey test.

3. RESULT AND DISCUSSION

The results of testing the hypothesis on this study with the ANOVA test are given in Table 2.

Table 2. Two-Way ANOVA Calculation Results

Varian Source	db	JK	RJK	F_h
Between columns (BC)	1	492,071	492,071	4,172
Between rows (BR)	1	185,786	185,786	1,575
Interaction	1	5680,286	5680,286	48,159
Between groups (B)	3	6358, 143	2119,381	
In group (I)	52	6133, 286	117,948	
Reduced total (RT)	55	12491, 429		
Mean/ correction (M)	1	2383012, 571	2383012, 571	
Total	56	2395504		

While the Tukey test is given in Table 3.

Table 3. Tukey Test Results

Group	N	Q_{count}	Q_{table}
A_1B_1	14	8,98	4.11
A_2B_1	14		
A_1B_2	14	4.90	4.11
A_2B_2	14		

3.1 The Differences Scientific Literacy Ability on Salt Hydrolysis Concept between Students Using Mobile Learning Media and Students Using Traditional Learning

Hypothesis testing between groups of students using mobile learning media and groups of students using traditional learning obtained F_{count} of 4.712, which means greater than F_{table} of 4.03. Therefore, H_0 is rejected, so it can be concluded that there are differences in students' scientific literacy abilities between students who use mobile learning media and students who use traditional learning.

In the group of students who used mobile learning media, an average score of science literacy skills was 209.25 with a standard deviation of 16.6, while in the control class, students who used traditional learning had the average score for science process skills of 203.32 with a standard deviation 12.9.

The use of mobile learning media in the learning process provides a different learning experience and helps students to access learning materials or information anywhere so that created a cooperative and collaborative learning process. Presentation in the form of text, animation, video also helps students to find their own answers to the problems given, this will encourage students to build their own knowledge (Sharma et al., 2017) and also develop problem solving skills and critical thinking skills. The use of mobile learning in learning also makes learning more effective because the time it takes for teachers to explain subject matter can be reduced and can be filled with active and in-depth learning activities such as discussion and problem solving, especially the problems in the surrounding environment so it has an impact on high scientific literacy.

Unlike the case with students who were taught using traditional media, PowerPoint media does not support the formation of meaningful learning because it does not stimulate students' audio and visually (Penciner, 2013). Generally, PowerPoint media is only a show combined with the lecture method that the teacher gives when explaining learning concept in class so students tend to receive information passively. This causes students to become bored and sleepy because students are not actively involved (Boumová, 2008). As a result, students do not have a deep understanding of the problems given and it results in low literacy.

Based on this explanation, learning in the classroom with traditional media becomes less effective because it tends to focus on the teacher in delivering learning concept and does not involve students in the learning activities.

3.2 The Effect of the Interaction between the Use of Mobile Learning Media and Learning Styles on Students' Scientific Literacy Ability on Salt Hydrolysis Concept

The results of hypothesis testing obtained that the F_{count} (F_c) value of 48.159 was greater than the F_{table} value at the 0.05 significance level of 4.03. Therefore, H_0 is rejected, so it can be concluded that there is an interaction effect between the use of mobile learning media and learning styles on students' scientific literacy skills on salt hydrolysis concept.

The interaction proves that the use of mobile learning media and traditional media each has a different effect on students' scientific literacy skills when applied to groups of students with different learning styles. Groups of students with visual learning styles who were given learning treatment using mobile learning media had a higher tendency for scientific literacy than groups of students with audio learning styles. In contrast, groups of students with visual learning styles who were given learning treatment using traditional media had a lower tendency for scientific literacy than groups of students with audio learning styles (see Figure 1).
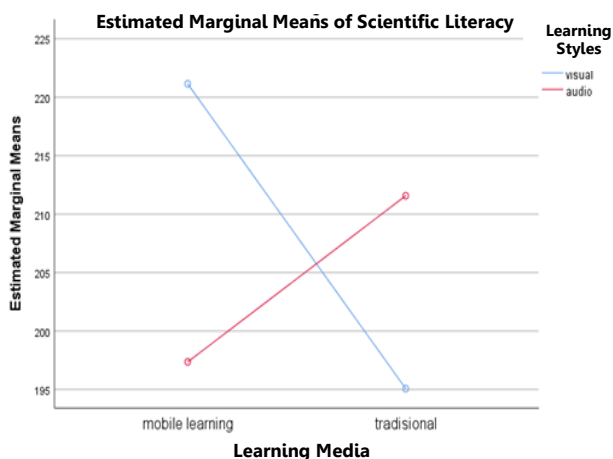

Figure 1. The Average Score Graph of Scientific Literacy in Each Group of Students

Learning style is a person's style in processing and absorbing information or learning something from his experience so he can easily accept the information that he receives either through hearing, seeing or doing it, who can finally understand the information that he got. The introduction of learning styles will provide appropriate services for what and how should be provided and done so that learning can take place optimally (Agustina & Sitompul, 2015).

Learning that is in accordance with student learning styles will provide a pleasant learning experience so students will be more interested. Therefore, the use of learning media will be very effective if it is in accordance with student learning styles. Based on the results of the research conducted by Gunawan (2012), it shows that students who learn by using their dominant learning style, while doing tests they will get higher results than those are not in accordance with their learning style. According to Ikitde & Edet (2013) research, it shows that the application of a learning model that considers learning styles can improve student academic achievement. Based on this description, it can be concluded that there is an interaction between the use of learning media and learning styles on student learning outcomes.

3.3 The Differences in Scientific Literacy Ability on Salt Hydrolysis Concept between Students that Using Mobile Learning Media and Students that Not Using Mobile Learning Media in Groups of Students with Visual Learning Styles

Based on the results of the hypothesis, the Q_{count} value is 8.98 with the Q_{table} value at the 0.05 significance level of 4.11. Because the value of $Q_{count} > Q_{table}$, then H_0 is rejected so it can be concluded that there is a difference in the scientific literacy ability on Salt Hydrolysis concept between students that using mobile learning media and students that using traditional learning in groups of students who have visual learning styles.

The average score of scientific literacy in the group of students with visual learning styles treated by using mobile learning in their learning was obtained by 221.14 with a standard deviation of 13.184, while the group of students with visual learning styles who treated by using traditional media had an

average scientific literacy score of 195.07 with a standard deviation of 5.993.

The average value of scientific literacy using mobile learning media with visual learning styles has higher results than the group of students who use traditional learning with visual learning styles. These results are related to the use of mobile learning media with visual media stimuli. The content in mobile learning media dominated by images, graphics, illustrations and videos causes the use of mobile learning media to be preferred by groups of students with visual learning styles. Groups of students with visual learning styles are more interested in learning concept through graphics and remembering well what they learn through pictures and illustrations (Gappi, 2013).

This is different with the traditional learning media group, in this case using PowerPoint media combined with the lecture method that the teacher provides when explaining concept in the class. Although in the PowerPoint media there are various visual stimulus content, learning using PowerPoint media is more dominated by the teacher explanations. This creates a non-attractive learning situation and tends to be boring for groups of students with a visual learning style.

From this explanation, it can be concluded that the use of mobile learning media in groups of students with visual learning styles gave better results of scientific literacy skills than the use of traditional media in groups of students with visual learning styles.

3.4 The Differences in Scientific Literacy Ability on Salt Hydrolysis Concept between Students that Using Mobile Learning Media and Students That Not Using Mobile Learning Media in Groups of Students with Audio Learning Styles

Based on the results of hypothesis testing, the Q_{count} value was 4.67 with the Q_{table} value at the 0.05 significance level of 4.11. Because $Q_{count} > Q_{table}$ then H_0 is rejected, so it can be concluded that there is a difference in the scientific literacy ability on Salt Hydrolysis concept between students using mobile learning media and students using traditional learning in groups of students with audio learning styles.

In the group of students with audio learning styles treated by using mobile learning media was obtained an average score of 197.36 scientific literacy with a standard deviation of 9.83, while the group of students with audio learning styles who treated by using traditional media had an average scientific literacy score of 211.57 with a standard deviation of 12.858.

Students who have an audio learning style get more information from what they hear or say (Gomes et al., 2007). Therefore, the group of students with an audio learning style prefers explanation through words.

The use of traditional learning media, in this case using PowerPoint media combined with the lecture method that the teacher provides when explaining the concept, provides plenty of space for the teacher to give verbal explanations during the learning process. Learning situations like this are more suitable and preferred by groups of students with audio learning styles, so they can be more interested and absorb more information in the learning process. This allows students to have a deeper understanding of the concept which has an impact on the high level of scientific literacy.

A different thing happened to a group of students with an audio learning style that given mobile learning media. Learning content that tends to be more visualized, does not accommodate audio learning styles to obtain optimal learning information. This causes the learning process to be less than optimal so the understanding of the concept is less comprehensive which results in low scientific literacy.

From this explanation, it can be concluded that the use of mobile learning media in groups of students with audio learning styles provides lower scientific literacy results than the traditional media in groups of students with audio learning styles.

4. CONCLUSION

Mobile learning media has a positive influence on scientific literacy compared to traditional media. The use of mobile learning media provides opportunities for students to learn at their own pace and encourages students to build their own knowledge so students will acquire comprehensive knowledge and improve their scientific literacy.

The interaction between the use of mobile learning media and student learning styles shows that the use of mobile learning media has a different effect on groups of students who have different learning styles.

The use of mobile learning media in the learning process must regard to student learning styles so its use can be effective. Based on the results obtained, the use of mobile learning has a positive effect on scientific literacy outcomes when applied to visual learning style groups. While in the audio learning style group the use of mobile learning media gave a lower scientific literacy results compared to traditional learning media.

REFERENCES

Abdul, H. & Citron, S. P. (2014). Analisis Kemampuan Awal Literasi Sains Siswa pada Konsep IPA. *Prosiding Seminar Nasional Kimia*, 40-67, Surabaya: Jurusan Kimia FMIPA Universitas Negeri Surabaya. Retrieved from https://repository.ung.ac.id/karyailmia h/show/2750/analisis-kemampuan-awal-literasi-sains-siswa-pada-konsep-ipa-oleh-abdul-haris-odja-citron-payu.html

Agustina, R., & Sitompul, H. (2015). Pengaruh Media Pembelajaran dan Gaya Belajar Terhadap Hasil Belajar Biologi. *Jurnal Teknologi Informasi & Komunikasi dalam Pendidikan*, *2*(1), 1-14. https://doi.org/10.24114/jtikp.v2i1.327 3

Boumová, V. (2008). *Traditional vs. Modern Teaching Methods: Advantages and Disadvantages of Each*. Ceko: Masaryk University Faculty of Arts.

Boyinbode, O. K., & Akinyede, R. O. (2008). Mobile Learning: An Application of Mobile and Wireless Technologies in Nigerian Learning System. *International Journal of Computer Science and Network Security*, *8*(11), 386–392. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/d ownload?doi=10.1.1.460.4453&rep=re p1&type=pdf

Buchari, A., Rahmawati, N. D., & Baedow, S. (2015). Pengembangan Mobile Learning dengan Model TAPPS pada Materi Barisan dan Deret Kelas X Semester I di SMA Nasima Semarang. *JKPM*, *2*(2), 1-7. https://doi.org/10.26714/jkpm.2.2.201 5.%25p

Cook, D. A. (2007). Web-Based Learning: Pro, Cons and Controversies. *Clinical Medicine*, *7*(1), 37–42. Retrieved from 10.7861/clinmedicine.7-1-37

DePorter, B., & M. Hernacki. (2002). *Quantum Learning: Membiasakan Belajar Nyaman dan Menyenangkan*. Bandung: Kaifa.

Faizal, M., & Rahman, A. (2013). The Effectiveness of Web-based Multimedia Applications Simulation in Teaching and Learning. *International Journal of Instruction*, *6*(2). Retrieved from https://eric.ed.gov/?id=EJ1085400

Farida, I., Liliasari, & Sopandi, W. (2013). Pembelajaran Berbasis Web untuk Meningkatkan Kemampuan Interkoneksi Multipel Level Representasi Mahasiswa Calon Guru pada Topik Kesetimbangan Larutan Asam-Basa. *Chemica, Jurnal Ilmiah Kimia dan Pendidikan Kimia*, *12*(1). https://doi.org/10.35580/chemica.v12i 1.131

Gappi, L. L. (2013). Relationships Between Learning Style Preferences and Academic Performance of Students. *International Journal of Educational Research and Technology*, *4*(2), 7. Retrieved from http://soeagra.com/ijert/ijertjune2013 /11.pdf

Gomes, A., Santos, Á., Carmo, L., & Mendes, A. J. (2007). Learning Styles in an E-Learning Tool. *Paper presented at the meeting of ICEE*, Coimbra: Portugal. Retrieved from https://www.researchgate.net/publicat ion/243962007_Learning_styles_in_an_ e-learning_tool

Gunawan, Adi W. (2012). *Petunjuk Praktis untuk Menerapkan Accelerated Learning*. Jakarta: Gramedia Pustaka Utama.

Hadjerrouit, S. (2010). Developing Web-Based Learning Resources in School Education: A User-Centered Approach. *Interdiciplinary Journal of E-Learning*

and Learning Object, 6. Retrieved from https://www.learntechlib.org/p/44777/

Husain, C. (2014). Pemanfaatan Teknologi Informasi dan Komunikasi dalam Pembelajaran di SMA Muhammadiyah Tarakan. Jurnal Kebijakan dan Pengembangan Pendidikan, 2(2), 184–192.https://doi.org/10.22219/jkpp.v2i2.1917

Ikitde G. A., & Edet, U. B. (2013). Influence of Learning Styles and Teaching Strategies on Students' Achievement in Biology. Voice of Research, 1(4), 5-13. Retrieved from https://ideas.repec.org/p/vor/issues/2013-5-2.html

Istyadji, M. (2007). Penerapan Paduan Model Pembelajaran Siklus Belajar dengan Kooperatif GI untuk Meningkatkan Kualitas Proses dan Hasil Belajar Siswa SMA. Tesis, PPS Universitas Negeri Malang.

Koc, M. (2005). Individual Learner Differences in Web-based Learning Environments: From Cognitive, Affective and Social-cultural Perspectives. Turkish Online Journal of Distance Education, 6(4), 12–22. Retrieved from https://eric.ed.gov/?id=ED494748

Masrimuna, Esihana. (2014). Pengaruh Gaya Belajar Menurut Kolb Terhadap Kemampuan Literasi Sains Siswa. Skripsi, Universitas Negeri Jakarta.

OECD. (2009). PISA 2009 Assessment Framework: Key Competencies in Reading, Mathematics, and Science. Paris: OECD Publishing.

OECD. (2015). PISA 2015 Results in Focus. Paris: OECD Publishing.

Penciner, R. (2013). Does Powerpoint Enhance Learning?. Canadian Journal of Emergency Medicine, 15(2), 109 - 112. https://doi.org/10.2310/8000.2013.130756

Sharma, A., Ghandar, K., Sharma, S., & Seema. (2011). Role of ICT in the Process of Teaching and Learning. Journal of Education and Practice, 2(5), 1 - 5. Retrieved from https://www.iiste.org/Journals/index.php/JEP/article/view/489/374

Suroso. (2012). Penerapan Model Pembelajaran Kontekstual dalam Meningkatkan Keterampilan Proses dan Hasil Belajar Sains Siswa Kelas V SD No 5 Bandung. Skripsi, Universitas Pendidikan Indonesia.

Yao, T. S., Chan K. S., & Chien, T. L. (2016). The Effects of Integrating Mobile Devices with Teaching and Learning on Students' Learning Performance: A Meta-Analysis and Research Synthesis. Elsevier Computers & Education, 94, 252-275. https://doi.org/10.1016/j.compedu.2015.11.008