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Development of Mobile Learning Applications to Improve High School Students' Independent Learning and Computational Thinking in Mathematics

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Abstract. *The purpose of this study is (1) to describe the characteristics of a good mobile learning application to improve computational thinking and learning independence of high school students. (2) to produce a mobile learning application that is oriented towards computational thinking skills and student learning independence with good quality. The quality of the development results is determined based on Nieveen's criteria, namely valid, practical, and effective. This study is a research and development (R&D) that uses the Borg & Gall development model with 8 development steps, namely preliminary study, planning, initial product development, small group trials, main product revision, limited scale trials, operational product revisions and large-scale trials. The subjects in this study were 36 students from one class at SMA Negeri 1 Gamping, Sleman Regency. The instrument used to measure the validity of the mobile learning application is the expert validation sheet. The instrument to measure the practicality of the mobile learning application is the student response questionnaire. The instrument to measure the effectiveness of the application is the computational thinking test and the student learning independence questionnaire. Validity and practicality data analysis was conducted by converting quantitative data into qualitative form in the form of four standard scale values, while effectiveness data analysis based on test and questionnaire results was conducted using paired sample t-test. The results of the study showed that (1) Mobile learning applications have the characteristics of being easy to apply, flexible to time, lightweight and easy to carry anywhere and also implementing each computational thinking indicator in each stage of the material. (2) The results of expert validation showed that the developed mobile learning application met the valid criteria as seen by the Aiken's validity test score for media experts of 0.83 and 0.68 for material experts. The practicality of the mobile learning application is included in the very good category as seen from the average results with an average percentage of student responses of 87.17%. The effectiveness of the computational thinking test obtained a t-value of 47.22 greater than t (35,0.05) with a score of 1.69, the effectiveness of the learning independence test based on the t test obtained a t-value of 4.85 greater than t (35,0.05) with a score of 1.69. Based on the results obtained, it can be concluded that the developed mobile learning application meets the criteria of validity, practicality and effectiveness.*

Keywords: *Development, Mobile learning, Computational Thinking, Learning Independence*

1. INTRODUCTION

Educational technology can change conventional ways of learning to non-conventional (Nurdyansyah, 2017). With digital learning media, students can learn in new ways all the time. Nurdyansyah (2017) stated that students can still learn based on their portion even without a teacher teaching. Students can learn independently when there is a teacher or when there is no teacher, which is independent learning (Alperi, 2019). Fajriyah et al. (2019) Learning independence is a student's ability to work independently in exploring learning information from learning sources other than the teacher.

Learning independence is very important to develop because according to Laksana and Hadijah (2019) with learning independence students are able to take the initiative and have self-confidence without needing help from other people in overcoming obstacles or problems.

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The results of the Program for International Student Assessment (PISA, 2018) survey regarding reading, science and mathematics abilities, Indonesia has a relatively low score. Indonesia ranks 73rd out of 79 countries with an average score of 379 (OECD, 2019), and experienced a decrease from the previous score, namely 63rd with an average score of 386 points (OECD, 2016).

Mobile learning is a learning application using mobile devices. White and Martin in (Borba et al., 2016) argue that the characteristics of mobile devices such as capturing and collecting information, communicating and collaborating with others, consuming and critiquing media, building and creating forms of representation and personal expression can be mapped onto mathematical practices.

Based on the results of interviews with mathematics education teachers at SMA N 1 Gamping, Sleman, Yogyakarta, students still tend to have difficulty solving problems, if they are given questions that are different from the examples, students have difficulty solving the problem. This difficulty can be seen that students have difficulty in pattern recognition (the ability to adapt problem patterns based on patterns they have previously done). Teachers also stated that the use of technology-based media was still underused at SMA N 1 Gamping. The use of learning media still uses conventional learning media. Hooshyar, (2022) Conventional learning media can foster conceptual knowledge but have difficulty improving computational thinking.

2. LITERATURE REVIEW

Learning is a series of activities designed to enable the student learning process to occur (Winataputra, 2008). Erman (2003) states that learning is an effort to organize an environment that provides nuances so that learning programs grow and develop optimally. Hamzah & Muhlisyarini (2014) stated that mathematics is generally known as abstract science. Mathematics as an abstract science is so broad in its meaning that it is not enough to describe it with just one definition. Hamzah & Muhlisyarini (2014) stated that if there is a definition of mathematics then it is tentative (meaning many things) depending on the person who defines it. So it can be concluded that mathematics learning is a set of basic knowledge that constitutes tools, shapes, arrangements of quantities, and other relationship concepts that contain the artistic value of symmetry which is symbolized by numbers and can be understood by many people.

Meanwhile, according to Richey & Klein (2007) states a systematic study of the design, development and evaluation process with the aim of establishing an empirical basis for the

creation of instructional and non-instructional products and tools and new or improved models that govern their development.

Computational thinking is a set of problem-solving thought processes like the way computer scientists think (Grover & Pea, 2013) and can be used comprehensively, by everyone, not just computer scientists (Wing, 2006) and can be applied in any domain and in other scientific disciplines through problem-solving processes (Cahdriyana & Richardo, 2020). This means that computational thinking is not limited to the skills of writing computer software and coding, but rather how students connect concepts with patterns in order to solve problems.

Learning independence is a process of designing and self-monitoring the learning process. Bandura in Daulay (2021) states that self-regulated learning is a process of careful design and self-monitoring of cognitive processes and is effective in completing an academic task.

3. METHODS

This research uses a type of development research or R&D (Research and Development) with a development model (Borg & Gall, 1989). The first step in this research is to seek initial information through a preliminary study. Initial information was obtained through interviews, observation and documentation. Interviews were conducted with teachers and students based on interview guidelines. By determining the experimental class, namely class XI IPA 1 SMA N 1 Gamping, and determining achievement targets and designing mobile learning application product designs.

The product design carried out at this stage is designing the theme, determining the type of color, type of font, font size, as well as determining additional requirements in the form of navigation buttons, images, animations and determining the order of material in accordance with the RPP, validation will be carried out by material experts and media experts. After conducting a product trial, the next stage is conducting an actual media test on a wider scale. A wide-scale test was carried out on 36 students of class XI Science 1 SMA N Gamping. Wide-scale tests were carried out to obtain pre-tests and post-tests to assess the effectiveness of mobile learning applications in increasing students' learning independence and computational thinking.

In conducting this research, researchers used several methods including documentation, observation, interviews, questionnaires and learning outcomes tests. Nieveen (1999) states that a product is said to be of quality if it meets the criteria of Valid, Practical and Effective (Subekti,

2010). The data analysis is used to assess the validity, practicality and effectiveness of the media.

4. RESULTS

Based on the results of interviews with teachers and several students, the learning process carried out at SMA N 1 Gamping still looks stiff and monotonous. The learning process carried out by teachers still uses conventional learning models and methods. Conventional learning models and methods are prone to making students bored while learning. Based on the results of interviews with teachers and several students, the learning resources used at SMA N 1 Gamping are still limited to books and LKS (student worksheets). Visual learning media, such as cubes and blocks, as well as ICT media, are still rarely used.

This learning media is easy to apply, can be moved around, is light and easy to carry anywhere and can encourage students to learn more actively. so that it can improve students' computational thinking, both independently and under teacher supervision. Apart from interesting learning media, students also need material that is easy to understand.

Based on observations and interviews conducted by researchers, the problem was that students had difficulty learning linear program material because the learning media used by teachers still used conventional media (LKS) so that the material presented was boring. Therefore, researchers conclude that there is a need for supporting media that can be used in real life, such as material supported by audio-visuals, animations, pictures and quizzes. So that students become motivated and want to learn the learning material.

After all the supporting materials for making media are collected, the next step is making media. This media was created using the PowerPoint application or software as the main software which was then assisted by using iSpring Suite 11 software as an additional application which will be used to convert SWF files into HTML files.

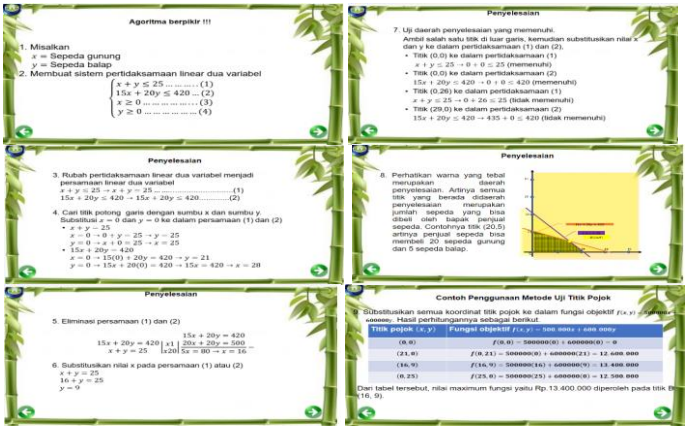

Figure 1. Thinking algorithm

Quizzes contain problems that users must answer by directly selecting the answer in the box provided. Answers can be selected directly in the story question or in the selection box provided. Quis applies computational thinking indicators. Here's what the quiz looks like:

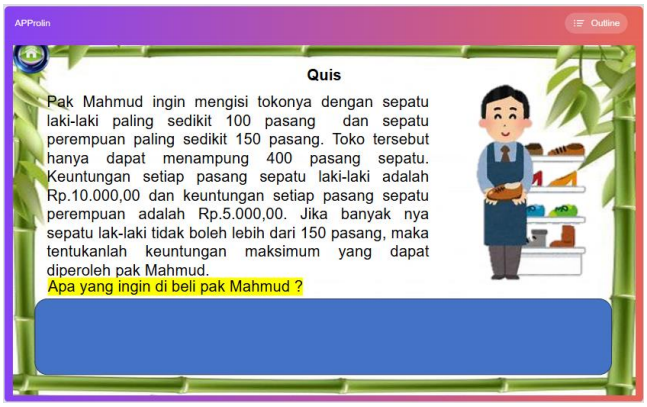

Figure 2. Quis

5. DISCUSSION

Based on the results of trials carried out on 5 respondents, the results obtained were that the Aiken's validity value was 0.73 with a total s value (the respondent's answer score minus the lowest score) 60 and an n(c-1) value of 60. These results showed that the mobile learning application was declared valid with high validity criteria, based on the criteria for drawing conclusions in the interval 0.40-0.80, it was declared with high validity.

Based on the results of trials conducted on 10 respondents, the results obtained were that learning media was declared practical with an average percentage/respondent of 87.17% being in the practical category with the average student answer score being 80% and the highest number of answers being 92%. Based on the results of data processing, mobile learning media is suitable for use in the next stage of research.

Based on the results of the normality test carried out, it can be concluded that the data is found in a normal population, as can be seen in table 14 above, namely that the Shapiro-Wilk significance value is greater than the significance level, namely 0.589> 0.05 for student pre-test data and 0.435> 0.05 for student post-test data.Berdasarkan tabel diatas, maka data dinyatakan berada pada populasi berdistribusi normal. Dengan nilai nilai asymp.sig.one-tiled untuk data pretest dan postest lebih dari sig α yaitu 0,148 > 0,05 dan 0,193 > 0,05.

Based on the data above, it can be seen that the results of the product feasibility test assessment of 5 students were 0.73. The validity criteria were in the interval 0.40-0.80, which was declared valid. Based on the results of this analysis, it can be concluded that the mobile

learning application product is included in the "suitable" category for use as learning material and understanding linear program material.

Based on the results of trials conducted on 10 respondents, the results were obtained that learning media was declared practical with an average percentage/respondent of 87.17 in the practical category. Based on the results of data processing, mobile learning media is suitable for use in the next stage of research.

Based on the normality assumption test on pretest and posttest computational thinking data, it was stated that the data was in a normally distributed population with the Shapiro-Wilk significance value being greater than the significance level, namely 0.589> 0.05 and 0.435> 0.05. Meanwhile, the normality assumption test for the pretest and posttest of learning independence stated that the data was in a normally distributed population with the one-tiled Kolmogorov-Smirnov asymp.significance value greater than the significance level, namely 0.148> 0.05 and 0.193> 0.05

Based on the results of the effectiveness test using IBM SPSS Statistics 27, the result was that the one-tailed t-test significance value for computational thinking ability was smaller than the significance value α, namely 0.00 < 0.05, meaning that H0 was rejected. The results of the effectiveness test using IBM SPSS Statistics 27 for student learning independence showed that the one-tailed t-test significance value was smaller than the α significance value, namely 0.00 < 0.05, meaning that H0 was rejected. So it can be concluded that there is a difference in the average computational thinking and student learning independence before learning using the mobile learning application and after learning using the mobile learning application.

6. CONCLUSION

The results of the feasibility/validity test of Android-based mobile learning media for mathematics learning carried out by material experts obtained a very high level of validity for all statements, with a score of 0.83. Meanwhile, based on the validation results from media experts, the level of validity of all statements was high, with a score of 0.68. The results of the small group trial showed that all items were declared valid with 0.73. The validity criteria were in the interval 0.40-0.80.

The results of a limited scale trial as a practicality trial, the mobile learning application was declared practical with an average percentage/respondent of 87.17 in the practical category. The average percentage/item is 87.17 in the practical category.

The effectiveness test to see the effect of mobile learning applications on students' Computational Thinking was carried out using the t test. Using the help of IBM Statistics SPSS 27, the results obtained were that the 2-tailed significance value was smaller than the α significance value, namely 0.00 < 0.05. So learning using mobile learning applications is declared effective in improving students' computational thinking

The results of testing the effectiveness of mobile learning applications on student learning independence using the t test show that the 2-tailed significance value is smaller than the α significance value, namely 0.00 < 0.05. So learning using mobile learning applications is declared effective in increasing student learning independence. Based on these results it can be concluded that the media is in the valid, practical and effective category.

7. LIMITATION

When developing applications using PPT and iSpring, researchers did not find a way to combine PPT macro functions. This results in feedback in the form of typing that students cannot do. The lack of tools in Ispring makes it difficult to equate the design in PPT with the design in Ispring, so we can only focus on developing our apk on one software, so that the apk we develop can be consistent in terms of design and appearance. The tools function in ppt cannot be used optimally.

REFERENCES

Alperi, M. (2019). Peran bahan ajar digital Sigil dalam mempersiapkan kemandirian belajar peserta didik. *Jurnal TEKNODIK, 23*(2).

Borba, M. C., Askar, P., Engelbrecht, J., Gadanidis, G., Llinares, S., & Sánchez, M. (2016). Blended learning, e-learning, and mobile learning in mathematics education. *ZDM – Mathematics Education.* https://doi.org/10.1007/s11858-016-0798-4

Cahdriyana, R. A., & Richardo, R. (2020). Berpikir komputasi dalam pembelajaran matematika. *LITERASI (Jurnal Ilmu Pendidikan), 11*(1), 50. https://doi.org/10.21927/literasi.2020.11(1).50-56

Daulay, N. (2021). Motivasi dan kemandirian belajar pada mahasiswa baru. *Al-Hikmah: Jurnal Agama dan Ilmu Pengetahuan, 18*(1).

Erman, S. (2003). *Strategi pembelajaran matematika kontemporer.* Bandung: UPI JICA.

Fajriyah, L., Nugraha, Y., Akbar, P., & Bernard, M. (2019). Pengaruh kemandirian belajar siswa SMP terhadap kemampuan penalaran matematis. *Journal On Education, 1*(2), 288–296.

Gall, M., Gall, J. P., & Borg, W. R. (2003). *Educational research: An introduction.* Longman.

Grover, S., & Pea, R. (2013). Computational thinking in K-12: A review of the state of the field. *AERA, 20*(20), 1–6. https://doi.org/10.3102/0013189X12463051

Hamzah, A., & Muhlisyarini. (2014). *Matematika.* Rajagrafindo.

Hooshyar, D. (2022). Effects of technology-enhanced learning approaches on learners with different prior learning attitudes and knowledge in computational thinking. *Computer Applications in Engineering Education, 30*(1), 64–76.

Laksana, A. P., & Hadijah, H. S. (2019). Kemandirian belajar sebagai determinan hasil belajar siswa. *Jurnal Pendidikan Manajemen Perkantoran, 4*(1), 1–7. https://doi.org/10.17509/jpm.v4i1.14949

Nurdyansyah, N. (2017). Sumber daya dalam teknologi pendidikan. *Eprints UMSIDA*, 1–22. http://eprints.umsida.ac.id/1625/1/Sumber%20Daya%20dalam%20Teknologi%20Pendidikan.pdf

Organisation for Economic Co-operation and Development (OECD). (2016). *Country note – Results from PISA 2015: Indonesia.* OECD.

Organisation for Economic Co-operation and Development (OECD). (2019). *PISA 2018 results: Combined executive summaries (Volume I, II & III).* https://doi.org/10.1787/g222d18af-en

Richey, R. C., & Klein, J. D. (2007). *Design and development research: Methods, strategies, and issues.* Routledge.

Subekti, H. (2010). Pengembangan perangkat pembelajaran sains SMP berorientasi pendidikan berkarakter dengan model kooperatif pada materi sensitivitas indera peraba. *Proceedings of the 4th International Conference on Teacher Education,* 1–11.

Winataputra, U. S. (2008). *Teori belajar dan pembelajaran.* Universitas Terbuka.

Wing, J. M. (2006). Pemikiran komputasi. *Komunikasi ACM, 3,* 33–35.