Advances in Engineering Research, volume 196
International Joint Conference on Science and Engineering (IJCSE 2020)

Developing Android-Based Comic for Learning Quadrilateral to Improve Seventh-graders' Geometric Thinking

Dany Samsurya Kurniawan[1,*] Mega Teguh Budiarto[2,] Atik Wintarti[3]

[1] *Universitas Negeri Surabaya, Surabaya 60213, Indonesia*
[*] *Corresponding author. Email: danysamsuryakurniawan@gmail.com*

ABSTRACT
This research was conducted to develop android-based comic learning media and describe the increase in geometric thinking skills after learning to use android-based comic learning media. This comic development process uses the Gall and Borg development model. The stages were needs analysis; product planning and design; developing products; initial testing; product revision; main testing; revision and application of the final product. The result of this research was comic software that could be run on an android smart phone. In this software, quadrilateral learning materials were presented in comic form followed by practice questions. After learning using comics learning media based on android, out of 30 students in seventh grade, 17 students were at level 0, 10 students were at level 1 and 3 students were at level 2. After learning, their level of thinking had increased.

Keywords: *Media, comic, geometric thinking*

1. INTRODUCTION

Learning media functions as teaching aids that can participate in influencing the situations and conditions of the learning environment that have been conditioned by educators [1]. In the conditions of the 4.0 era, technology is developing rapidly so that the learning process does not have to be done traditionally where students and teachers must be in the same time and space, but the learning process must participate in transforming by utilizing technology such as smart phones.

Smartphones are part of the progress of technological developments that are owned by most of the citizens of the Republic of Indonesia. The number of smart phone users in Indonesia in 2017 reached 86.6 million [2]. In 2016 there were 132.7 million internet users, of which 24.4 million were people aged 10-24 years. Of the 132.7 million internet users, 63.1 million of them use the internet on smartphones for browsing purposes [3]. This means that the number of smartphones used by students is high. Based on preliminary research conducted by researchers, the majority of students used smartphones with the Android operating system.

Android is a basic operating system based on the Linux kernel developed by google [4]. People in the republic of Indonesia like the use of the android system operation because it is easy to operate. Software that can be run on a smartphone with the Android operating system is software with the APK type (Android package kit). Even though the Android smartphone can distal various software, most students only install social media software, not software to help the learning process. Even though learning using an Android smartphone is part of digital learning, which can be implemented for the learning process where the goal is according to experts as part of e-learning [5].

Learning using smartphones is a way to increase learning motivation where students can practice responsibility and independence [6]. Likewise, learning using this smartphone can make it easier for teachers to deliver learning content so that learning can become meaningful learning [7].

Mathematics is the key to various disciplines, including technological advances, including the development of smartphones. To learn mathematics, of course, requires special stages in order, including the field of geometry. To find out the development of

students in the geometry learning process, at least based on the theory put forward by van Hiele, namely through five levels of understanding. The level of understanding includes level 0 (visualization), level 1 (analysis), level 2 (formal deductive), level 3 (deduction), and level 4 (rigor). In the process of understanding, a person cannot rise to a higher level of thinking if previously he did not go through a lower level of thinking [8].

In general, junior high school students in the Republic of Indonesia were between stage 0 (visualization) and stage 1 (formal deductive) [9]. In previous research, using the Skeetpad software, 94 students were divided into two groups, of which 47 students were the control group and the other 47 students were the experimental group. The results obtained in the control class, the majority of students are at level 0 (visualization) and a few students are at level 1 (analysis) but in the experimental class the majority of students are at level 1 (analysis) and a few are at level 0 (visualization) [10]. Other research to increase geometric ability did not have a significant difference between conventional learning and learning using sketchpad, instead students were very active in the learning process [11].

At the level of the ability to think geometry at level 0 students are able to name and recognize shapes with the appearance of shapes, but they cannot clearly explain the properties of shapes. Even though they have recognized the characteristics, they are not used for logic. At level 1 they are able to analyze the concept and its parts and can determine the properties of a shape by observing, measuring, experimenting, drawing and modeling. However, students do not fully understand the relationship between characteristics and cannot yet understand the definition. Next, at level 2 they can see the relationship between the properties of a geometric shape and the properties between several geometric shapes. Students can define abstractly, find the properties of several shapes by using informal deduction [12].

On average, students in the Republic of Indonesia have low geometric thinking skills, as evidenced by the results of Trends in International Mathematics and Science Study (TIMSS). In a study conducted in Makassar, Indonesia, from 289 respondents to seventh grade students, most of them were at level 0 [13].

One of the geometry materials in seventh grade junior high school students in the Republic of Indonesia is a rectangle. Quadrilateral is one of the main materials in mathematics, this material contains facts, concepts, operations and principles so that the rectangular material can be said to be an important part of mathematics.

In the industrial era 4.0, teachers must have creativity in spurring increased geometric thinking skills. One of the efforts that can be made in the industrial era 4.0 is that teachers can make learning media relevant to the needs of increasing students' geometric thinking skills. One of the new breakthroughs is to create an Android-based comic learning media that can be used to convey rectangular material while still referring to increasing learning motivation. Comics allow a student not only to learn to use text but also to use pictures, so it can be interpreted that comic learning media can increase students' interest in learning [14]. In the learning process comic learning media is a good medium and is suitable for the learning process [15]. However, in this modern era, new breakthroughs are needed to innovate so that comics which are used as learning media are more practical and interesting and can be used anywhere.

Previous studies in line with this research on the development of learning tools to improve geometric thinking skills with valid results and students' geometric thinking skills increase classically [16]. Development of Android-based M-Learning learning media for mirroring material for seventh grade junior high school students resulted of quality learning media met 3 criteria, namely valid, practical, and effective [17]. Learning media based on Toondoo online comics was found to be valid and more effective than student learning outcomes who did not use Toondoo online comics in terms of student learning outcomes [18].

From the three previous studies, the concept of geometric thinking, Android-based learning media and comic learning media were combined in this study. The purpose of this study was to describe the process and results of the development of Android-based comic learning media on rectangular material in seventh grade and to describe the improvement of students' geometric thinking skills through its application.

2. METHOD

In this study, an Android-based comic learning media was developed on rectangular material and described its benefits in increasing the ability to think geometry. The development model used in this study was adaptation of the Borg & Gall (2003) model. The results of the adaptation model resulted in several stages of development; (1) needs analysis (literature study, field survey, needs analysis, curriculum analysis), (2) product design and planning (making flowcharts, story boards, material texts, evaluation questions, voice , and music) the media design process is carried out using the Pixton application, (3) product development, the media preparation process uses a web-based application http://ai2.appinventor.mit.edu (4) initial field testing (material experts, media experts and educators mathematics), (5) product revision, (6) main field testing (individual experiment, limited trial, field trial), (7) final product revision and dissemination. Meanwhile, to determine the increase in geometric

thinking skills using a test developed by The Cognitive Development and Achievement in Secondary School Geometry Projet (CDASSG). The data collection process in this study used a validation sheet for material experts, media experts and student responses in the form of a Likert scale. The formula for calculating the percentage of idealism is as follows.

$$P = \frac{S}{N} \times 100\% \quad (1)$$

P = Ideal percentage

S = The number of components of the research results

N = Total maximum score

Questionnaire responses to the use of 5 choices of products were in accord to the content of the question. Results of the assessment of media experts, material experts, educators and student responses were converted into criteria as presented in Table 1.

Table 1. Likert scale of validity sheet

Interval	Criteria
5	Excellent
4	Good
3	Fair
2	Poor
1	Very Poor

The validator questionnaire was used to determine the feasibility of the media being developed. So that the final value was obtained using the average analysis of the items in question in the questionnaire, namely by calculating the value of the eligibility of the questionnaire for each aspect divided by the number of statements. The conversion of the score into a statement of this assessment is as presented in Table 2. Based on these criteria, the media was said to be feasible if the percentage is ≥60% from all aspects.

Table 2. Criteria validity

Percentage (%)	Criteria
0 - 20	Very Weak
20< - ≤40	Weak
40< - ≤60	Enough
60< - ≤80	Well Worth
80 < - ≤100	Very Worth

The subjects in this study were media validators including one material expert and one media expert. Product trials consist of individual trials, limited trials, and field trials. Individual test subjects consisted of 3 seventh grade students, while the limited trial subjects included 10 seventh grade students while the field trial subjects included 30 seventh grade students of Daarul Muttaqien Surabaya Junior High School. Before and after the Android-based comic application was tested on field trial participants, they were first tested for their geometric thinking skills.

3. RESULT AND DISCUSSION

At the observation stage, the researcher obtained data from interviews and distributing questionnaire, resulted in that many students did not like mathematics, especially geometric because it was considered difficult and boring. In addition, the media used by the teacher during the learning process was very limited because only manuals and worksheets were used. From several schools observed, it was revealed that the learning media used were still limited due to inadequate time and costs in updating learning media. One teacher stated that he had never used the media because of limitations in technology.

After obtaining problems and collecting data during field observations, we began to design a medium that could help students' difficulties in the learning process of physics material, namely by developing learning media in the form of android-based comics to improve seventh grade geometric thinking skills.

The results of this development research were comics based on Android with rectangular material. Comics created were designed digitally using a web-based application at www.pixton.com. Comic character was designed using Pixton (Figure 1).

Figure 1 Comic characters

After characters were designed, a flowchart was made to assist in making program (Fig. 2). The purpose of the flowchart above was that when opening the software installed on the smartphone, it would go directly to the main menu where KI/KD menu (core competence/basic competence, material, profile, instructions, and exit button could be found. There was also practice question followed by the results of a practice question work. After arriving at the next result, students could choose to return to main menu to exit.

The process for making the comic application into an Android application was made online on the web http://ai2.appinventor.mit.edu. Appearance of comic learning media when on smartphone is presented in Figure 3-7

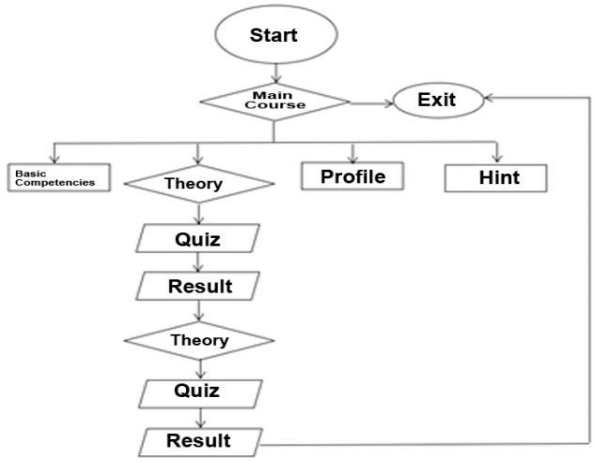

Figure 2 Flowchart

3(a) **3**(b) **3**(c)

3(d) **3**(e)

Figure 3 (a) Menu display; (b) display instruction for use; (c) dicplat core competences; (d) example of comic display; (e) profile display

After android-based comic media was designed, then the media was validated by material and media experts to obtain revisions or suggestions to improve the media so that it was feasible and could be used in the learning process. After the comic media was validated and obtained the percentage value of feasibility, then the android-based comic media was tested on students (Table 3).

Table 3. Trial result for android-based comic media

No	Result	Total (%)
1	Media Expert	80,00
2	Material Expert	85,00
3	Small Group	86,00
4	Large Group	88,00
Average		84,75

The test results show that the percentage of feasibility for the comic was 84.75%, or categorized as good category. Thus, it was suitable for use in the mathematics learning process. Meanwhile, the results of field trials proved that students were very enthusiastic in participating in learning with an Android-based comic book application.

Table 4. Result of the ability to think geometry

Level	Beginning	End
0 (visualization	17	5
1 (analysis)	10	16
2 (formal deductive)	3	9

Based on the initial geometric ability test of 30 students in seventh grade, 17 students were at level 0, 10 students were at level 1 and 3 students were at level 2 (Table 4). While the geometric ability test results after learning using an Android-based comic application on rectangular material were obtained, 5 students were at level 0, 16 students were at level 1 and 9 students were at level 2. This means that there was an increase in geometrical abilities, which was originally at level 2 where 3 students increased to 9 students, while those at level 1 were originally 10 students increased to 16 students, while those at level 0 were originally 17 students reduced to 5 students.

4. CONCLUSION

In this research and development, Android-based comic application on rectangular material was developed. This application used APK (Android Package Kit) format and could be run on smartphones with the Android platform. From the results of field trials, it was proven that this Android-based comic application could improve geometric thinking skills and increase enthusiasm of students. The Android-based comic application is published on the matematikacantik.worpress.com website.

REFERENCES

[1] A. Arsyad, Media Pembelajaran, Jakarta: Raja Grafindo Persada, 2016. https://id.techinasia.com/jumlah-pengguna-smartphone-di-indonesia-2018

[2] Survei APJII. Penetrasi internet di Indonesia capai 143 juta jiwa. Buletin APJII 2018. Available from: https://apjii.or.id/downfile/file/. Bulletinapjiiedisi2. Maret 2018.

[3] S. Mukherjee, J. Prakash, and D. Kumar, "Android Application Development & Its Security," IJCSMC, vol. 4, Issue. 3, March 2015, pg.714 – 719.

[4] G. Jengathe, and D. Rojatkar, "Use of android in education system,". Int. J. Elec. Electron. Res., vol. 3, 2015, pp. 133- 137.

[5] E. Backer, "Using smartphones and Facebook in a major assessment: the student experience", J. Bus. Edu. Scholarship of Teach., vol. 4, 2010, pp: 19-31.

[6] G. M. Jeong, C.W. Park, S. You, and S.H. Ji, "A study on the education assistant system using smartphones and service robots for children," Int. J. Adv. Robot. Syst., vol. 11, 2014.

[7] A. Van De, W. John, Elementary and Middle School Mathematics, Sixth Edition, Translation by Suyono. Jakarta: Erlangga, 2008.

[8] D. H. Clements, and M.T. Battista, Penalaran geometri dan spasial. Dalam DA Grouws (ed.), Handbook of Research on Mathematics Teaching and Learning. New York: Macmillan, 1992.

[9] A.H. Abdullah, and E. Zakaria, "Enhancing students' level of geometric thinking through van Hiele's phase-based learning," Indian J. Sci. Tech., vol. 6, 2013, pp. 4432-4446.

[10] P. G. Tieng, K.E. Leong, "Improving Students' Van Hiele Level Of Geometric Thinking Using Geometer's Sketchpad", Malaysian Online J. Edu. Tech., vol. 2, 2013, pp. 20-31.

[11] M. T. Budiarto, "Learning geometry and thinking geometry," Proceedings of the National Mathematics Seminar, ITS Surabaya, November 2000.

[12] A. D. Baiduri, Ismail, and R. Sulfiyah, "Understanding The Concept Of Visualization Phase Student In Geometry Learning," Int. J. Sci. Tech. Res., vol. 9, February 2020.

[13] F. D. Arini, A. S. Choiri, and Sunardi, "The Use of Comic As a Learning Aid To Improve Learning Interest of Slow Learner Student," European J. Spec. Edu. Res., vol. 2, 2017, pp. 71–78.

[14] Indaryati and Jailani, "Developing Comic Media For The Teaching Of Mathematics To Enchance The Motivation And Mathematics Learning Outcomes Grade V," Jurnal Prima Edukasia, vol. 3, 2015, p. 84.

[15] I. A. Sari, "Development of learning tools based on van Hiele's theory to improve the geometric thinking skills of seventh grade students of junior high school," Universitas Negeri Surabaya, unpublished thesis, 2016.

[16] E.P. Lusiyanto, "Development of Android-Based M-Learning Learning Media for Mirroring Material for Class VII SMP," Universitas Negeri Surabaya, unpublished thesis, 2016.

[17] P. D. Widyastuti, Rasiman, and R. D. Setyowati, "The Development of Learning Media Based on Toondoo Online Comics with Discussion and Question and Answer Methods for Flat Geometry Material for Class X Students at SMA Negeri 5 Semarang," 2016