



Development of Android-Based Gamification Learning Media for Multiplication Material for Grade III Elementary School Students

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Abstract

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The lack of practice questions given by the teacher resulted in students having difficulties in operating multiplication. This study aims to produce an android-based gamification application as a medium to support the learning process in operating multiplication material for third grade elementary school students. This development research uses the Rapid Prototyping model. The subjects involved in this study consisted of 2 material experts, 1 instructional design expert, 1 media expert, 3 students for individual trials, 9 students for small group trials, and 15 students for field trials. Data collection methods used are unstructured interviews and questionnaires. The gamification development process is carried out through 5 stages, namely (a) needs analysis and content analysis, (b) determining objectives, (c) building prototypes, (d) utilizing prototypes, (e) system installation and maintenance. The results of the expert review showed improvement, the results of individual trials and small group trials for all aspects received a positive response but there were 3 suggestions for improvement in the small group test, and the results of the field trial of 15 students had achieved a score above the minimum completeness criteria. Based on the results of this analysis, it can be concluded that Android-based gamification media can be used as enrichment for independent learning for third grade elementary school students.

Keywords:

elementary school students, Gamification, Mathematics, Multiplication, Exercises

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INTRODUCTION

The current era of education is influenced by the industrial revolution 4.0 or better known as education 4.0. Education 4.0 is education that highlights the use of digital technology in the learning process or known as *the cyber system* (Supandi, 2020). Based on that, not only teachers must improve their competence, but students in this era must also improve their skills, so that competitive and productive students will be created in the era of education 4.0 (Wati, 2019). Teachers in this era need to have an adaptive attitude so that they are able to adapt to technological developments, so as to create interactive, challenging and meaningful learning (Priatna, 2020).

The first level of education that is carried out formally is the level of elementary school education (SD), where elementary school is the phase of



children to learn as a start. In this phase, the physical development of the child continues to progress while the development of thinking starts from concrete thinking to abstract thinking. This is in line with Jean Piaget's statement that primary school learners are at the stage of concrete activities (Arif, 2018). At this stage of concrete operations, the child is mature enough to use logical thinking and manipulation, but only for the physical objects that exist at the moment. However, without physical objects or real events in front of them, they will find it difficult to solve logical problems (Nuryati, 2021). Children can cope with complex problems as long as they are concrete and not abstract (Juwantara, 2019).

One of the abstract things in school is the subject of mathematics (Victo, 2020). Mathematics is the abstract science of numbers, sets and spaces. Mathematics is a science in everyday life (Senarai, 2018). But correspondingly, mathematics is also generally considered a rigorous subject and far from everyday reality. From this perspective it appears that studying mathematics students must think seriously and concretely. Therefore, students often assume that mathematics is an elusive and boring subject (2017).

Based on the results of interviews with grade III teachers at SD Negeri Cibubur 11 Pagi, information was obtained that in mathematics subjects the majority of students get scores less than minimum completeness criteria, which is 72. One of them is because students have difficulty in multiplication material. Students find it difficult to understand multiplication problems in the form of story problems, moreover they have to convert them into multiplication forms. In addition, students also have difficulty in operating multiplication. This affects students to deal with other more complex material.

In teaching multiplication material, teachers only use thematic printed books, blackboards and powerpoints, so that the activities presented are too monotonous and there is no interactivity that makes students tend to be passive. In addition, the lack of practice questions given by teachers due to limited study time at school makes students less skilled in doing multiplication problems. Students who are born and live in this era, they are more familiar with the internet, android smartphones,

digital, social media and more. These habits need to be optimized by utilizing them as learning media used for students. Grade III elementary school students who belong to the lower grades are expected to be able to solve multiplication problems as a learning objective contained in the 2013 curriculum and syllabus, because multiplication is a material that cannot be separated in daily activities (Kartikasari, 2018).

In the 2004 definition of Educational Technology from AECT, it can be concluded to facilitate learning, one of which is through the development of learning media with appropriate technology. Therefore, learning media is needed that must be adapted to students, materials, and technological developments. In accordance with the problems that are being faced in the learning process of grade III multiplication material at SD Negeri Cibubur 11 Pagi, the media to be developed is an Android-based gamification application as a supplement or support to operate multiplication in the form of a question practice application for students that can be used at home. This gamification uses game mechanics to provide solutions related to experience or use directly by building specific group

engagement (Hanifah, 2016). The components contained in a game (game) are scores, badges, leaderboards, progress, taahapan, storyline, feedback, task lists, avatars and social graphs (Lister, 2015). However, not all elements of the game are used for learning. The survey results show that game elements that can positively affect learning motivation are scores, badges, *leaderboards* and stages (Rivera, 2021).

Gamification is also considered a learning media that is still new in Indonesia and is still rarely used, especially in the world of education. In addition, at SD Negeri Cibubur 11 Pagi, gamification includes new media that is used as a support for students. According to some studies, gamification can also improve students' learning environments and also as an exercise app for users (Ernata, 2017).

The development of gamification as a supporting medium for learning multiplication material is a significant step to cater to the needs of low-grade students who are inclined towards games and are proficient in operating Android smartphones. The advantages of gamification in increasing student motivation and engagement make it a promising tool for learning. However, despite its potential benefits, the use of gamification in the field of education in Indonesia is relatively new.

Currently, there is a gap in the availability of android-based gamification applications specifically designed to aid the learning process for operating multiplication material in grade III elementary school students. The existing educational applications might not be tailored to address the specific needs and preferences of these students. Therefore, the purpose of this development research is to bridge this gap and produce an android-based gamification application that serves as a dedicated supporting medium for grade III students to practice and enhance their multiplication skills. By filling this research gap, the developer aims to provide students with a user-friendly, engaging, and effective tool to improve their multiplication abilities independently, both in and out of the classroom setting.

METHODS

The research utilized a development model called Rapid Prototyping with five stages: (1) needs analysis and content analysis, (2) goal determination, (3) prototype development, (4) prototype utilization, and (5) system installation and maintenance. The study involved 2 material experts, 1 learning design expert, 1 media expert, and a total of 27 students for trials. Data collection involved unstructured interviews and open questionnaires with qualitative data analysis techniques. Additionally, closed questionnaires were used, and data were analyzed using the Guttman scale for nominal data. Unstructured interviews are free interviews, where researchers do not use systematic and perfectly structured interview guidelines for data collection (Putria, 2020).

The interview aims to obtain information obtained from questionnaires (Ismail, 2019). A questionnaire is a data collection instrument used to collect large amounts of data (Muchlis, 2019). It done to providing a number of structured

written questions to respondents related to their responses to the various variables studied (Hasibuan, 2018). In line with that, the type of questionnaire used in this study is an open questionnaire (Simon, 2019). The data that has been obtained will be analyzed using qualitative data analysis techniques. This technique will bring up data in the form of a series of words (Nasution, 2020). Another used questionnaire is a closed questionnaire containing statements for which answer choices have been provided (Bahrun, 2018). The data analysis technique used in the closed questionnaire is using the *guttman* scale. This scale provides only two answer choices, such as yes-no, good-ugly, never-never, and others (Pranatawijaya, 2019). Therefore, the resulting data is nominal data, where positive answers are given a value of 1 and negative answers are given a value of 0.

Table 1. Material Expert Instrument Grid

No	Aspects	Indicator	Number of Items	Item Number
1	Language	1.Language suitability used	3	1,2,3
2	Contents/materials	1.Completeness of material	3	4,5,6
3	Characteristics of gamification activity	1.Learning objectives	1	7
		2.Accurate and relevant content	4	8,9,10,11
4	The role of learning media	1.Learning delivery is not rigid	2	12,13
		2.Learning becomes more interesting	1	14
		3.Learning becomes more interactive	1	15
		4.Shortens study time	1	16
		5.Student attitudes become more positive towards learning	1	17
		6.Supports self-directed learning	1	18

Table 2. Learning Design Expert Instrument Grid

No	Aspects	Indicator	Number of Items	Item Number
1	Language	1.Language suitability used	3	1,2,3
2	Contents/materials	1.Completeness of material	1	4
3	Characteristics of gamification activity	1.Interaktivitas	1	5
		2.Learning objectives	1	6
4	The role of learning media	1.Learning delivery is not rigid	2	7,8
		2.Learning becomes more interesting	1	9
		3.Learning becomes more interactive	1	10
		4.Shortens study time	1	11
		5.Student attitudes become more positive towards learning	1	12
		6.Supports self-directed learning	1	13

Table 3. Media Expert Instrument Grid

No	Aspects	Indicator	Number of Items	Item Number
1	Principle Gamifikasi	1. Freedom to fail	1	1
		2. Quick feedback	2	2,3
		3. Progress	1	4
		4. Storyline	4	5,6,7,8

2	Pola gamifikasi accounts	1. Level	3	9,10,11
		2. Storyline	3	12,13,14
		3. Unlock	2	15,16
		4. Shorten study time	2	17,18
		5. Challenges	1	19
		6. Badges	1	20
3	Navigation	1. Ease of access	1	21
		2. Function of navigation buttons	1	22
4	Characteristic activity gamifikasi	1. Color	2	23,24
		2. Layout	1	25
		3. Game Rules	1	26

This development research uses 2 data analysis methods, namely qualitative descriptive analysis methods and quantitative descriptive analysis. This qualitative descriptive analysis technique is used to process qualitative data from the results of material expert reviews, learning design experts and media experts. Quantitative data analysis techniques are used to process data obtained through questionnaires with guttman scale assessment criteria as follows.

$$(1) \quad \text{Percentage (100\%)} = \frac{\text{Number of data collection scores}}{\text{Criteria score}} \times 100\%$$

RESULTS AND DISCUSSION

Results

Android-based gamification development uses the Rapid Prototyping development model which consists of 5 stages of development. (1) the needs analysis and content analysis stages. The needs analysis stage is carried out to determine the needs and learning problems of teachers and students in schools during the learning process. This process is carried out using unstructured interview methods and questionnaires. The first stage is a needs analysis carried out at SD Negeri Cibubur 11 Pagi by interviewing teachers, the results obtained that there are learning problems in mathematics subjects, especially multiplication material. In the learning process, students have difficulty in understanding multiplication story problems, especially having to convert them into multiplication form, after that students also have difficulty in operating multiplication. The media used in schools does not vary, using only whiteboards, thematic books, and powerpoints.

The methods used are lectures and questions and answers. To make students passive in the learning process. The time used to learn multiplication material at school is also limited, only 2 meetings. The lack of practice questions given by teachers and limited study time at school resulted in the majority students' math scores below minimum completeness criteria. Furthermore, namely the level of needs analysis by students, it was found that students who were the majority of 9 years old were interested and quickly learned if they used existing media games or quizzes, they also had difficulty to Understanding the multiplication story,

besides that all students have Android smartphones and and have been able to operate them.

So, it can be concluded that students need learning media that contains practice questions that can be packaged to attract more attention and involve students, especially in learning mathematics multiplication material. At the content analysis stage, discussions are held with teachers regarding material that has obstacles and is difficult to understand. The result is the mathematics subject part of the multiplication material with the following description. The needs analysis conducted at SD Negeri Cibubur 11 Pagi revealed specific learning problems in mathematics, particularly related to multiplication material. Students struggled with understanding multiplication story problems and converting them into multiplication form. Additionally, they faced difficulties in operating multiplication. These specific issues were not extensively addressed in previous publications, indicating a unique focus on addressing these challenges.

Table 4. Subject Matter

Subject matter (subject matter)
1) Multiplication by the result of a unit number
2) Multiplication by the result of tens
3) Multiplication by the result of the number hundreds

The next stage is (2) determining learning objectives. This process is carried out based on the results of the previous stages and based on the results of discussions with teachers. The results of the learning objectives are as follows. The study found that students, most of whom were 9 years old, displayed a strong interest in and quick learning when presented with gamified media or quizzes. This level of student engagement and preference for interactive learning through gamification was an unexpected finding, highlighting the potential of using gamification to enhance student interest and involvement in mathematics learning.

Table 5. Learning Objectives

General Learning Objectives	Specific Learning Objectives
After using this android-based gamification media, students can solve multiplication story problems correctly	Students are able to operate story problems <u>multiplication by the result of a unit number</u>
	Students are able to operate story problems <u>multiplication by the result of tens</u>
	Students are able to operate story problems <u>multiplication by the result of the number</u>

The next stage is (3) building a prototype. In this stage, making concept maps, flowcharts, media content lines (GBIM), material description, storyline, storyboards, display design and gamification program components, video content, animation content, gamification media program production. The gamification product received positive responses from experts, indicating its potential efficacy. However, there were still suggestions for improvement from both experts and students during the trial phase. These suggestions provided valuable insights into

further refining the gamification app to better suit the needs and preferences of the users, and these specific aspects of feedback were not predicted in previous publications.

The next stage is (4) utilizing prototypes. This stage conducts expert reviews and trials of gamification products using previously developed questionnaires. At the expert review stage, the results of responses from experts have received a positive response but there are still improvements from each expert. For product trials involving students, individual trials and small group trials have received positive responses from all aspects but there are still suggestions for improvement from students in small group trials. The aspects asked in the individual test and small group test in the form of a closed questionnaire if calculated using the guttman scale criteria assessment produce the following percentage values.

$$\text{Persentase (100\%)} = \frac{120}{120} \times 100\% = 100\%$$

In the field trial conducted by 15 students did 15 questions that had been consulted with the teacher first. The results obtained by all users totaling 15 students have achieved scores above the predetermined minimum completeness criteria of 72. As for some product displays that have been developed. The field trial involving 15 students demonstrated promising outcomes, with all users achieving scores above the predetermined minimum completeness criteria of 72. This finding indicates the effectiveness of the android-based gamification application in improving students' multiplication skills, surpassing expectations in terms of its impact on learning outcomes.



Figure 1. Gamification initial view



Figure 2. Gamification display



Figure 3. Material display in gamification videos

The last stage is (5) installation and maintenance of the system. The final product that has been improved based on the previous stage, then install the app



that can be accessed via an android smartphone via [a https://bit.ly/GamifikasiTreasureHunt](https://bit.ly/GamifikasiTreasureHunt) link or scan the QR Code as follow.

Overall, the study's focus on addressing specific learning challenges in multiplication, its emphasis on student interest and engagement, and the positive

trial outcomes highlight the unique contributions and novel findings of this research, differentiating it from previous publications.

Discussion

The study successfully developed an android-based gamification media using the Rapid Prototyping model, specifically designed for grade III students at SD Negeri Cibubur 11 Pagi. The success of the product can be attributed to various aspects. In terms of language, the media's language aligns well with the content, displaying clear writing and ease of understanding. The language used is also appropriate for the target age group, ensuring that students can engage with the material effectively. Regarding content/material, the study achieved interconnected material that progresses from easy to difficult levels. The gamification activities are aligned with clear learning objectives, in line with the existing curriculum, and free from misconceptions. This ensures that the content supports the learning goals effectively.

The implementation of gamification principles was appropriate, with the chosen principles well-suited for the media's purpose. The use of voice-over was clear, enhancing the overall user experience. In terms of content gamification patterns, the study demonstrated that all level segments were well-matched with the material. Navigation was user-friendly, and the storyline was easily comprehensible. The selected components for content gamification were suitable, contributing to a positive user experience.

The gamification's characteristics were appealing, as attractive colors were utilized, capturing users' attention effectively. Additionally, the theme, which revolved around pirates, was appropriately reflected in the color scheme. The text layout was not overwhelming, and the game rules were easy for users to understand. The role of gamification as a learning medium was significant. It enhanced the learning process, making it more enjoyable and engaging for students. The concise material design also contributed to shorter learning times, fostering enthusiasm among users. The gamification's effectiveness as a supporting tool for independent learning or as a supplementary medium for learning outside the classroom was evident.

The feedback from grade III students, gathered through closed questionnaires with the Guttman scale, was overwhelmingly positive. All students responded positively to the aspects assessed, indicating a 100% success rate for both the individual trial stage and small group trials.

Overall, the study's findings showcase the successful development and implementation of an android-based gamification media using the Rapid Prototyping model. The media's effectiveness in supporting the learning process, combined with positive user feedback, underscores its potential as a valuable tool for grade III students at SD Negeri Cibubur 11 Pagi. However, it's important to consider further validation and testing on a larger scale to ensure broader applicability and to address any potential limitations or challenges in the implementation of this gamification media.

CONCLUSION

Based on the explanation of the research above, it can be concluded that the android-based gamification development process uses the Rapid Prototyping model which consists of 5 stages, namely, the needs analysis and content analysis stage, the stage of determining learning objectives, the stage of building prototypes, the stage of utilizing prototypes, and the stage of installing and maintaining the system where between the stages of building prototypes there will be repeated improvements according to the results obtained in stage utilizing prototypes.

Android-based gamification development received a positive response to the material expert test, learning design expert test and media expert test even though from each expert test there are still improvements. In individual trials and group trials, aspects have received positive responses from all aspects, although in the small group test stage there were minor improvements. Furthermore, in field trials, all 15 students have scored above minimum completeness criteria. Based on these results, android-based gamification has been successfully developed and can be used on *Android smartphones* as an enrichment for independent learning for grade III elementary school students at SD Negeri 11 Cibubur Pagi.

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