

DEVELOPMENT OF CARRING COMMUNITY-BASED MATHEMATICS LEARNING DEVICES USING OPERATIONAL GAMES IN INCREASING STUDENTS' LEARNING MOTIVATION AND ITS EFFECT ON CRITICAL THINKING ABILITY

Nur Hasanah^{1*}, Ida Fitriana Ambarsari², Lusi Endang Sri Darmawati³

^{1,2}Mathematics Education Study Program, STKIP PGRI Situbondo, Jl. Argopuro Gg. VII, Situbondo, Indonesia

³Economic Education Study Program, STKIP PGRI Situbondo, Jl. Argopuro Gg. VII, Situbondo, Indonesia

ABSTRACT

Mathematics-based game learning is made as attractive as possible in order to increase students' motivation and interest in learning, besides that this game can increase students' critical thinking patterns. This research uses a mix method with a combination of sequential exploratory design model with a thiagardjan development model through the 4D realm, namely define, design, develop and disseminate in experimental research using nonequivalent control design with the results obtained from the pretest value functioning to determine initial knowledge and posttest to determine knowledge after being given treatment. development of caring community-based mathematics learning devices using operational games in increasing students' learning motivation and its effect on critical thinking ability Based on the the Asymp Sig (2-tailed) is 0.000, so it is smaller than 0.05.

Keywords: caring community; operation games; critical thinking

1. Introduction

The issue of education is one of the common problems that we often encounter in life and is a topic that never ends, because education has an important role in the progress of a nation.(U. Hasanah et al., 2019). The process in dealing with educational problems requires improvement efforts in learning(Octriana et al., 2019)as with mathematics, learning mathematics requires special treatment so that students can easily understand and enjoy learning (Hasanah et al, 2021).

The process of learning mathematics at school has a very important role. By learning mathematics, students are expected to be able to improve their creative thinking skills, be consistent, independent and honest.(Dian et al.,

2021). Therefore, mathematical knowledge must be mastered but in reality there are still many students who have difficulty in learning mathematics(Nuryami et al., 2022). Low knowledge of mathematics can have an impact on the low quality of education. One of the efforts to increase knowledge of mathematics requires interesting learning, one of which is using learning games (Krisbiantoro Dwi, 2017).

Games that are basically very liked by students are used in the learning process as a way to change students' mindsets towards math subjects (Puspitasari et al., 2019). Basically mathematics is one of the subjects that until now by students is still considered difficult. Whereas, on the other hand, mathematics is an important subject in human life, mathematics plays a role in almost all aspects even in today's technological and digital era.(Siregar, 2017).

Game comes from the English word which has the basic meaning of the game. The game in this case refers to the notion of "intellectual

*) Corresponding Author.

E-mail: aku.hasanah12@gmail.com

Phone: +6282337604494

agility" (intellectual playability). Game can also be interpreted as an arena for the decisions and actions of a player (Hasanah et al., 2022).

According to Dwi Cahyo in (Abror, 2012) games based on different types of classification / game genres, they are classified as follows:

1. Action Game is a type of game that emphasizes physical challenges, including hand, eye coordination, and reaction time. This type of game has many varieties such as fighting games, and shooting games.
2. Adventure Game is a type of game in which the player is assumed to be the main character in an interactive story that is supported by exploration and puzzles.
3. Puzzle game is a type of game that emphasizes solving puzzles. The types of puzzles to solve can test your ability to solve many problems including logic, strategy, pattern recognition, and word completion.
4. RPG (Role Playing Game) is a role-playing game, has an emphasis on the character or the role of the player's representative in the game, which is usually the main character, where as we play it, the character can change and develop in the direction the player wants (usually becoming more powerful). , the stronger, the more influential, etc.) in various parameters which are usually determined by increasing the level, both from the status of intelligence, speed and strength of the character, the more powerful weapons, or the number of friends and pets.
5. Simulation Game is a game with a simulation game by players in the game

Combining games with the learning process is a technique for improving brain function that really helps children learn and maintain their learning outcomes and also creates a pleasant atmosphere for children. (Krisbiantoro Dwi, 2017), Educational games based on mathematical operations as one of the effective media used for children, especially in difficult subjects, such as mathematics with the aim that there is motivation for children to learn mathematics (Murtikusuma et al., 2022). Students who perceive mathematics as a relatively difficult subject and form negative impressions and experiences on mathematics generally have a negative impact on both their motivation to learn mathematics and academic adjustment in school, so it is necessary to make learning very enjoyable. (Siregar, 2017).

Thinking is a mental activity that cannot be separated from human life (Insani et al., 2017) and the critical thinking ability of each individual is different from one another so it needs to be nurtured from an early age. Thinking occurs in every human mental activity that functions to formulate or solve problems, make decisions and find reasons (Insani et al., 2017).

Critical thinking is a systematic process that allows students to formulate and evaluate their own beliefs and opinions. Critical thinking is an organized process that allows students to evaluate the evidence, assumptions, logic and language that underlie other people's statements. Critical thinking is also thinking well, and reflecting on the thinking process is part of thinking well (Hadiyanti et al., 2021).

Someone who thinks critically has a special character that can be identified by seeing how someone reacts to a problem (Khoirunnisa et al., 2021). The information or arguments of these characters can be seen in their habits of acting, arguing and utilizing their intellect and knowledge. Here are some opinions about the character or characteristics of people who think critically.

Critical Thinking Skills Diagram

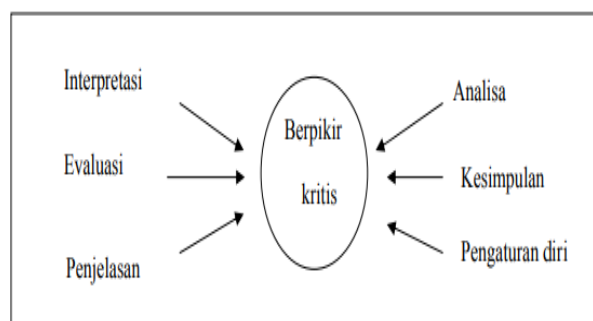


Figure 1. Critical Thinking Indicator

The following is a description of the six main critical thinking skills:

1. Interpretation, is understanding and expressing the meaning or significance of various kinds of experiences, situations, data, events, judgments, habits or customs, beliefs, rules, procedures or criteria.
2. Analysis, is to identify the intended and actual inferential relationships between statements, questions, concepts, descriptions.
3. Evaluation, is assessing the credibility of

statements or representations which are reports or descriptions of perceptions, experiences, judgments, opinions and assessing the logical strength of inferential or intended relationships between statements, descriptions, questions, -questions or other forms of representation.

4. Inference, identify and obtain elements that make sense, make conjectures and hypotheses, and conclude the consequences of the data.
5. Explanation, able to state the results of one's explanation, present one's reasoning in the form of strong arguments.
6. Self-regulation, means consciously monitoring one's cognitive activities, the elements used in these activities and the results obtained, especially by applying skills in analysis and evaluation for self-inferential assessment research by looking at the questions, confirm, validate or correct either its reasoning or its results.

Seeing from this situation, researchers are interested in researching the development of mathematics learning using operating games in increasing students' learning motivation and its effect on students' critical thinking skills.

2. Research Methods

The method used in this research is a combination research method or mixed method (N. Hasanah et al., 2021). This research is a research step by combining two existing forms of research, namely research and development and experimental research. Experimental research is the only research method that can truly test hypotheses about causal relationships (Hadiyanti et al., 2021). The combined research method (mixed method) is a study that combines or combines qualitative and quantitative research, qualitative methods are used to find hypotheses while quantitative methods are used to test hypotheses (Sugiono, 2017:27).

The combination method model used is sequential exploratory design, which is a combination research method that combines qualitative and quantitative research methods sequentially, namely in the early stages of research using qualitative research methods and the next stage using quantitative (Sugiono, 2017:473). The qualitative method in question is development

research and quantitative research using experiments.

This research is a mix method research or a combination with a sequential exploratory design with the process presented in the following figure;

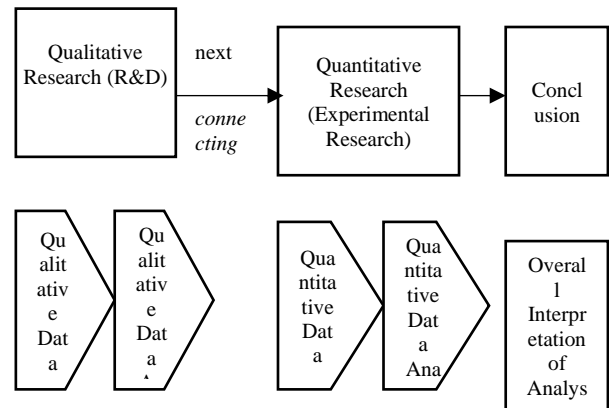


Figure 2. Research Design

This research model begins with qualitative research that aims to produce valid, practical and effective math game-based learning tools (Kusuma et al., 2021).

The development research method uses the Defining Stage stage, which will be developed in the learning process that has been designed, the Planning Stage (Design), the Development Stage (Develop) and the Dissemination (Deseminate). Qualitative research (development research) will produce a hypothesis, namely the device developed has an effect on students' creative thinking abilities. The next stage is to test the hypothesis with quantitative methods (experimental research).

Quantitative Research Design

The design of this study used a nonequivalent control group design with a scheme such as the following table;

Table 1. Research Design

| | | | |
|------------------|-------|---|-------|
| Experiment Class | o_1 | X | o_2 |
| control class | o_3 | | o_4 |

Information :

O_1, O_2 : Pre-test

O_1, O_2 : Post-test

X : Treatment

3. Results and Discussion

Process development of carrying community-based mathematics learning devices using operational games seen from the

results Validation of the development of the device obtained, namely;

The results of the assessment of RPP, LKS and THB by each validator can be seen in the picture;

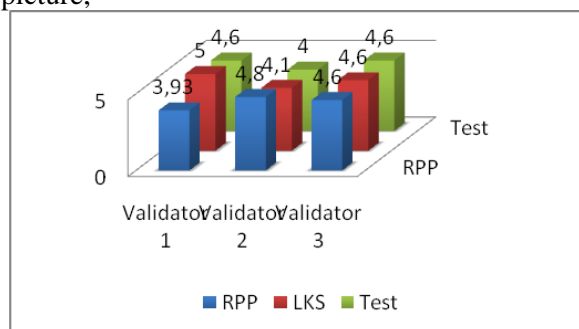


Figure 3. Validator Test

From the picture above, the average validity coefficient and its interpretation can be seen in the following table;

Table 2. Validity Coefficient and its Interpretation

| No | Learning Media | Validity Coefficient | Interpretation |
|----|---------------------------------------|----------------------|----------------|
| 1. | Learning Implementation on Plan (RPP) | 4.5 | Very Valid |
| 1. | Student Worksheet (LKS) | 4.7 | Very Valid |
| 2. | Learning Outcome Test (THB) | 4.6 | Very Valid |

Based on the coefficient of validity, the three learning tools developed were categorized as very valid. Apart from being validated through a validator, the questions on the test were also tested for statistical validity and reliability.

Testing the validity and reliability of the instrument carried out as a condition for conducting data analysis and hypothesis testing. An instrument is said to be valid if the instrument can measure something exactly what it wants to measure. In addition, the instrument is said to be reliable if the measurement is consistent, accurate, and accurate. Following are the results of the calculation of the validity and reliability tests;

Table 3. Results of the Validity Test of Learning Outcomes

| No. | r Table | r Count | Validity test | Information |
|-----|---------|---------|---------------|-------------|
| 1. | 0.325 | 0.929 | Valid | Used Items |
| 2. | 0.325 | 0.895 | Valid | Used Items |

After the validity test is carried out and the item is said to have passed, the next step is to test the reliability as shown in the table below;

Table 4. Reliability Test Results

| Reliability Statistics | |
|------------------------|------------|
| Cronbach's Alpha | N of Items |
| .898 | 3 |

Based on the table above, the Cronbach's alpha coefficient value is 0.898, a variable can be said to be reliable if it has a Cronbach's Alpha coefficient greater than or equal to 0.60 but if the Alpha value is < 0.60 , this indicates that there are several respondents who answered inconsistently. this research trial obtained data obtained Cronbach's alpha value of $0.898 > 0.6$ then the data can be concluded that the data is reliable.

The next step is field research and the data that is tested is obtained, including;

1) Device Effectiveness Data

The effectiveness of learning tools can be seen from the results of observing student activities during lessons, the results of student responses to the applied learning questionnaire, and students' mastery as seen from the results of the mathematical reasoning ability test. The following will describe the analysis of the effectiveness of learning tools;

2) Practical Data and Data Analysis on Learning Devices

To see the practicality of learning tools, observations of teacher activities were carried out in 3 meetings when the model teacher carried out learning in class. The observed scores were then recapitulated and analyzed. The scores of the recorded teacher activity observations are shown in the following figure;

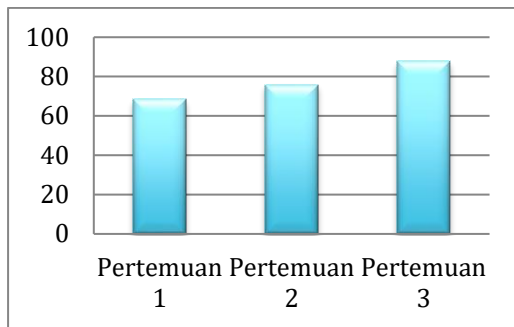


Figure 4. Diagram of the Recapitulation of Teacher Activity Observations

Based on the results of the recapitulation in the picture above, the average overall score of teacher activity observations is 3.8 and the average percentage of overall teacher activity observations is 77.3% based on the criteria for teacher activity, the score of teacher activity observations meets good criteria. Practitioners provide suggestions that do not change the overall learning device. Based on the practicality criteria, the learning tools meet the practical criteria.

The next step is the analysis of student activity observations, the results of student activity data analysis are obtained from observer observations during 3 meetings. The results of observing student activities at each meeting will be presented in the following figure;

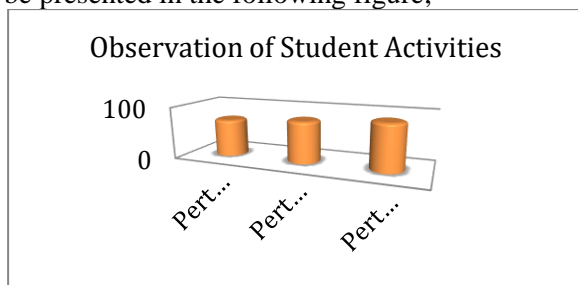


Figure 5. Observation of Student Activities

Based on the results of the analysis in Figure 4.8, it can be seen that student activity during the learning process at meeting 1 is still not good, meeting 2 has increased because they are already accustomed to online group learning, namely the category is quite good and for meeting 3 it is in the good category.

Student Response Questionnaire Results the student response questionnaire sheet was filled out by 36 students. student response scores were then recapitulated and analyzed. The recapitulation of student response scores is shown in the image below;

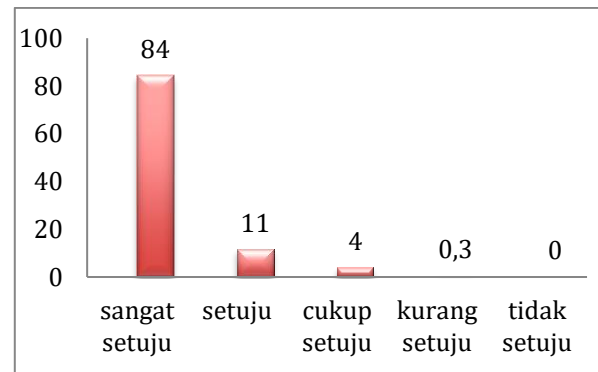


Figure 6. Recap of Student Response Questionnaire Data

Based on the results of the responses that have been presented in the diagram above, the learning tools are considered effective, because students who give positive responses $\geq 80\%$ achieve and how much there is a very good category. So it can be concluded that in general students gave a positive response and the learning tools developed were declared effective.84%

For analysis of critical thinking we can analyze from student answer sheets;

Table 4. Student Ability

| Critical Thinking Indicator | Student Ability |
|-----------------------------|---|
| Analyzing Questions | Students are able to analyze questions using the required information |
| Evaluation | Students are able to descriptions, questions or other forms of representation |
| Inference | Make conjectures and hypotheses, and conclude the consequences of the data. |
| Explanation | Able to explain the results of what is done |
| self regulation | the elements used in these activities and the results obtained |

It can be analyzed that these students are able to formulate the main points of the problem both in terms of the game and in terms of the available questions, and are able to express the facts needed in solving them by trying several operations to complete the game and choosing logical, relevant arguments that are accurate and capable of thinking. from different points of view with his friends. The Process of Development of Caring Community-Based Mathematics Learning

Devices Using Operational Games in Increasing Students' Learning Motivation and Its Effect on Critical Thinking Ability.

This study develops a way for students to collaborate well where the learning media used are in the form of: *operational games* at first they were given learning in the form of games and they formed small groups (Hobriet *al.*, 2018) who are mutually caring and sensitive to their fellow group mates and it appears that they help each other in discussion activities, many students work on the game first and some choose the questions so that a sense of help helps them grow

After they finished discussing with their small groups the explanation of the results of their discussions was presented to the large group, in the large class they carried out a wider discussion because it involved all students in the class as well as other groups. So that with this operational game, it can help run the caring community which was originally built by the teacher and there the teacher acts as a facilitator and cares for students who can even for students who can't.

In addition to paying attention to the Caring Community, students in this study also researched about critical thinking which is a mental activity used to determine scientific steps, namely to understand and formulate problems, collect and analyze the information needed and conclude carefully, evaluate, and decide what is believed to be true, and predict the consequences that will occur. might happen.

The relationship between mathematical operational games and the caring community is that with games students can actively build cooperation, learn to care for each other and be sensitive to the environment. Caring community can foster feelings of pleasure in learning and become a fun learning motivation because their students are always cared for by friends and directly by the teacher.

In addition to this, in this operational game, there are questions that are directly connected to the game in this study using comparison questions that can measure students' critical thinking skills. The questions used in mathematics learning are in the form of open-ended questions. In order to solve open-ended questions, the thinking process that students must have is critical thinking. However, the level of thinking of each student is different. More details about the relationship in this study can be seen in the following picture;



Figure 7. Relationship of Research

It can be seen that children's learning patterns and fun children's learning processes make children able to build good cooperation with their peers and influence their thinking so that they can be able to think abilities in learning, especially in mathematics and can also increase student motivation.

4. Conclusions

The process of developing mathematics learning tools uses the 4-D model (four-D models) proposed by Thiagarajan, Semmel & Semmel (1974). The stages carried out include: the definition stage (Define), the design (Design) and development stages (Develop), the deployment stage (Desiminate).

Results Development of Caring Community-Based Mathematics Learning Devices Using Operational Games in Increasing Students' Learning Motivation and Its Effect on Critical Thinking Ability meet the criteria for the quality and feasibility of developing learning tools that have been determined, namely meeting the criteria for validity, effectiveness and practicality.

The validity of the RPP 4.5 is categorized as very valid, LKS 4.7 is categorized as very valid and the learning outcomes test 4.6 is categorized as very valid and the learning outcomes test is not only tested through the validator but also tested for statistical validity and reliability and shows valid and reliable data.

Practically said to be practical from the activity observer data on the teacher criteria, which obtained a score of 3.8 and met the good criteria. Effectively, it is said that the practical analysis of student activities is in good criteria, 86% of students complete the analysis of completeness in the development class and the results of student response questionnaires that

reach 84% of students who give positive responses.

Implementation results development of carrying community-based mathematics learning devices using operational games in increasing students' learning motivation and its effect on critical thinking abilities shows that on average there is an increase in critical thinking skills. The results of the post test analysis showed students' critical thinking skills or as many as 86% of students completed and 14% of students did not complete.

Based on the "Test Statistic" output, it is known that the Asymp Sig (2-tailed) is 0.000, so it is smaller than 0.05, so it can be concluded that development of carrying community-based mathematics learning devices using operational games in increasing students' learning motivation and its effect on critical thinking ability.

5. References

- Abror, A. F. (2012). Mathematics Adventure Games Berbasis Role Playing Game (RPG) Sebagai Media Pembelajaran Mata Pelajaran Matematika Kelas VI SD Negeri Jetis 1. *Mathematic Adventure Games*, 1(08520244018), 1–10. Retrieved from <http://eprints.uny.ac.id/7554/>
- Dian, L., Sari, K., Idayani, D., Munawwir, Z., Hasanah, N., & Noervadila, I. (2021). Pendampingan Belajar Matematika Peserta Didik RT 01/RW 01 Kelurahan Ardijero Kecamatan Panji Situbondo di Tengah Pandemi Covid-19. *Prosiding Konferensi Nasional Pengabdian Masyarakat (KOPEMAS)*, 2, 560–564.
- Hadiyanti, N. F. D., Hobri, Prihandoko, A. C., Susanto, Murtikusuma, R. P., Khasanah, N., & Maharani, P. (2021). Development of Mathematics E-Module with STEM-Collaborative Project Based Learning to Improve Mathematical Literacy Ability of Vocational High School Students. *Journal of Physics: Conference Series*, 1839(1). <https://doi.org/10.1088/1742-6596/1839/1/012031>
- Hasanah, N., Hobri, Fatekurrahman, M., Kusuma, M. A., & Hadiyanti, N. F. D. (2021). Development of Lesson Study for Learning Community Based Learning Tools Using Google Classroom Media and Its Impact on Students' Creative Thinking Skills. *Journal of Physics: Conference Series*, 1839(1), 0–13. <https://doi.org/10.1088/1742-6596/1839/1/012017>
- Hasanah, Nur, Ambarsari, I. F., Surur, M., Darmawati, E. S., & Rakhman, F. (2022). Training Motivasi Belajar Matematika Berbasis *Thinking Smart Game* pada Siswa MI Multiple Sarina. *Journal of Community Empowerment and Innovation*, 1(2), 62–68.
- Hasanah, U., Kurniasih, N., & Kurniawati, I. (2019). Mengelaborasi Education for All dengan Pendidikan Inklusi Dalam Menumbangkan Hegemoni Diskriminasi Pendidikan. *Ijечи*, 2(2), 1–12.
- Hobri, Septiawati, I., & Prihandoko, A. C. (2018). High-Order Thinking Skill in Contextual Teaching and Learning of Mathematics Based on Lesson Study for Learning Community. *International Journal of Engineering and Technology(UAE)*. <https://doi.org/10.14419/ijet.v7i3.12110>
- Insani, A. A., Nurdiyana, A., Yulizawati, Y., Bustami, L. E., Iryani, D., & Fitriyani, F. (2017). “Berpikir Kritis” Dasar Bidang dalam Manajemen Asuhan Kebidanan. *Journal of Midwifery*, 1(2), 21. <https://doi.org/10.25077/jom.1.2.21-30.2016>
- Khoirunnisa, P. H., & Malasari, P. N. (2021). Analisis Kemampuan Berpikir Kritis Matematis Siswa Ditinjau dari Self Confidence. *JP3M (Jurnal Penelitian Pendidikan dan Pengajaran Matematika)*, 7(1), 49–56. <https://doi.org/10.37058/jp3m.v7i1.2804>
- Krisbiantoro Dwi, H. D. (2017). Game Matematika Sebagai Upaya Peningkatan Pemahaman Matematika Siswa Sekolah Dasar. *Jurnal Telematika*, 10(2), 255–256.
- Kusuma, M. A., Susanto, Yuliati, N., Maharani, P., & Hasanah, N. (2021). Thinking Process of 7th Class Students In Understanding Quadrilateral Concepts Based on Van Hiele Theory. *Journal of Physics: Conference Series*, 1839(1). <https://doi.org/10.1088/1742-6596/1839/1/012012>
- Murtikusuma, R. P., Anon, H., Anon, S., Oktavianingtyas, E., Putri, I. W. S., Anon, N., & Insani, K. (2022). The Development of Learning Device of Lesson Study for Learning Community Using Google Classroom and Quizizz Media and Their Effect on Students Creative Thinking Skills. *International Journal of Scientific and*

- Research Publications (IJSRP)*, 12(3), 160.
<https://doi.org/10.29322/ijsrp.12.03.2022.p12323>
- Nuryami, N., Janan, T., & Hasanah, N. (2022). The Influence of Realistic Mathematics Education on Year 8 Students' Spatial Ability of Cuboids and Cubes. *Kalamatika: Jurnal Pendidikan Matematika*, 7(1), 69–84.
<https://doi.org/10.22236/kalamatika.vol7no1.2022pp69-84>
- Octriana, I., Putri, R. I. I., & Nurjannah, N. (2019). Penalaran Matematis Siswa dalam Pembelajaran Pola Bilangan Menggunakan PMRI dan LSLC. *Jurnal Pendidikan Matematika*, 13(2), 131–142.
<https://doi.org/10.22342/jpm.13.2.6714.131-142>
- Puspitasari, Y., & Hasanah, N. (2019). Pengaruh *Aktivitas Siswa* dan Ujian Nasional terhadap Hasil Belajar Matematika Siswa Kelas X MA Nurul Fata Tahun Pelajaran 2017 / 2018. *EDUSAINTEK: Jurnal Pendidikan Sains dan Teknologi*. 6(1), 34–43.
- Siregar, N. R. (2017). Persepsi Siswa pada Pelajaran Matematika: Studi Pendahuluan pada Siswa yang Menyenangi Game. *Prosiding Temu Ilmiah X Ikatan Psikologi Perkembangan Indonesia*, 224–232.