

---

# DEVELOPMENT OF "PETUALANGAN MATEMATIKA" LEARNING MEDIA USING SCRATCH ON PROBABILITY MATERIAL

Hatimah<sup>1,a</sup>, S Djamilah<sup>1,b,\*</sup>, A G Nugroho<sup>1,c</sup>

<sup>1</sup>Undergraduate Program in Mathematics Education, Faculty of Teacher Training and Education, Muhammadiyah University of Banjarmasin  
Jl. Gubernur Syarkawi Lingkar Utara, Barito Kuala, Kalimantan Selatan  
e-mail: <sup>a</sup>hatimahs447@gmail.com, <sup>b</sup>soraya29.sd@gmail.com, <sup>c</sup>arifgnugroho@umbjm.ac.id

## Abstract

*Mathematics, especially the topic of probability, is often considered abstract, complicated, and boring by students, which leads to low interest in learning. This condition is exacerbated by the use of monotonous conventional teaching methods. This study aims to: (1) provide an overview of the feasibility of developing an educational game titled "Petualangan Matematika" based on smartphones using the Scratch platform for the topic of Probability, (2) explain the validity of the educational game as assessed by expert validators, and (3) describe the practicality of the smartphone-based educational game in supporting the learning process of mathematics, specifically on the topic of Probability. The research employed the Research and Development (R&D) method by adopting the ADDIE development model, which consists of five systematic stages: Analysis, Design, Development, Implementation, and Evaluation. The visual design of the game was created using Canva, while the development of the educational game itself was carried out using the Scratch platform. The final product is an educational game that can be accessed and played on smartphone devices. The research subjects consisted of 27 students, divided into two groups: a small group of 5 students who participated in the readability test, and a larger group of 22 students who took part in the practicality test. The instruments used to assess both validity and practicality were questionnaires utilizing a Likert scale. The data analysis techniques involved evaluating the results of the readability and practicality tests. The results of the study concluded that: (1) the product, a smartphone-based educational game titled "Petualangan Matematika" for the topic of Probability, is categorized as highly feasible for use in learning activities; (2) the validity level of the game is very high, as evidenced by expert assessments: media expert validation yielded a score of 81.25%, while two subject matter experts provided scores of 93.75% and 100%, respectively; and (3) the game demonstrated a very high level of practicality, indicated by a 92% score in the readability test conducted with the small group and a 97.125% score in the practicality test with the larger group.*

**Keywords:** Learning Media; Petualangan Matematika Scratch

## 1. INTRODUCTION

Rapidly advancing technological innovation has penetrated all aspects of life, particularly education. The development of Information and Communication Technology has impacted various areas of life, including learning technology [1]. The use of technology in the learning process requires competent human resources.

By equipping every individual with adequate digital skills, we not only prepare them to face future challenges, but also open up wider opportunities to actively participate in diverse aspects of life, including economic, social, and cultural aspects [2] According to press release No. 662/HM/KOMINFO/10/2024, Indonesia's vision is to become the center of the gaming industry in Southeast Asia. The national gaming industry is showing rapid progress, with over 150 million gamers, making Indonesia one of the largest markets in the region.

Next year, Indonesia is targeted to become a center for talent and creativity development in the gaming industry [3]. Educators can take advantage of this opportunity by developing flexible and effective digital learning media via smartphones [4].

One of the main obstacles in learning mathematics is students' perception that mathematics is complicated and uninteresting, which causes a lack of interest and enthusiasm in learning it [5]. As a result, students tend to lose focus, are less involved, and their learning achievements decline, especially on abstract material. One of the materials that is considered difficult is the concept of probability, which requires visualization and simulation to make it easier to understand [6]. To overcome this problem, the steps that need to be taken are to use media [7]. The use of technology-based media is an innovative solution to increase interest and motivation in learning mathematics [8].

During the School Field Practice at MTs Muhammadiyah 3 Al-Furqan, researchers observed that many students preferred learning

outside the classroom. Students felt bored with conventional methods that lacked variety, leading to a tendency to lose focus during learning. Researchers also found playing games on smartphones to be their favorite activity. However, the ban on smartphone use in schools limits the use of technology-based learning media.

Despite the ban on smartphone use in schools, the potential for integrating educational games remains open. This game is designed to help eighth-grade MTs students understand the concept of probability interactively, with examples and a variety of practice questions available outside of school hours. Educational games are an interesting learning medium because they combine elements of play and learning to create an interactive and fun learning experience [9]. Researchers used the Scratch platform because it supports visual and interactive design according to learning needs. The creation of the “Mathematical Adventure” game was based on three reasons: (1) the material on probability requires a contextual and visual approach, (2) this media takes advantage of students' interest in smartphones, and (3) the challenge elements in the game are designed to increase motivation to learn mathematics.

The novelty of this research compared to research [10], which developed an Android-based educational game with Construct 2, lies in three things: the use of the beginner-friendly Scratch platform, the design of the “Math Adventure” game with story elements to increase motivation, and its design specifically for access via smartphone. Research [11] also emphasizes the potential of Scratch as an interactive learning medium, but is still limited to the topic of quadratic equations and has not yet targeted the material on probability or its use on smartphone devices. Meanwhile, research [12] proves the feasibility of Scratch in probability learning with a high level of validity, but its accessibility still depends on computers in schools. Departing from the limitations of these studies, this research is present with a focus on

---

probability material which is often considered difficult, presented interactively to make it easier to understand, and can be accessed via smartphone to support fun independent learning at home. Thus, the title of this research is: Development of Smartphone-Based Educational Game Learning Media "Mathematical Adventure" Using the Scratch Platform on Probability Material.

## 2. RESEARCH METHODS

The purpose of this study is to describe the development process, validity, and practicality of the media. This research was conducted at MTs Muhammadiyah 3 Al-Furqan (Jalan Cemara Ujung, Banjarmasin Utara, Banjarmasin City, South Kalimantan) from January to May 2025. The small-scale trial involved 5 students from class IX B, while the large-scale trial involved 22 students from class VIII C. This research uses the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation).

The data collection instruments used were validation and practicality sheets [13], the instruments were arranged using a 4-point Likert Scale (SA=4, A=3, D=2, SD=1). The media assessment aspects included content quality, evaluation/exercises, language, and storyboard, while the material aspects included display, language, material presentation, and textbook suitability. Data were analyzed using descriptive quantitative analysis by converting scores into percentages using the formula:

$$P = \frac{\sum X}{N} \times 100\%$$

*Information :*

$P$  = Validity percentage

$\sum X$  = Total score obtained

$N$  = Expected maximum score [14].

The results of these calculations will be grouped into qualitative criteria which are presented in the following table 1:

**Table 1.** Test Criteria

<b>Criteria</b>	<b>Category</b>	<b>Information</b>
$75\% < P \leq 100\%$	Very Valid/Practical	Development continues
$50\% < P \leq 75\%$	Valid/ Practical	Small scale revision
$25\% < P \leq 50\%$	Less Valid/ Practical	Repair
$0\% \leq P \leq 25\%$	Invalid/ Impractical	Repair

### 3. RESULTS AND DISCUSSION

#### **a. Analysis Stage**

Based on a needs analysis of 22 students from class VIII C, all students showed a high interest in educational media in the form of adventure-themed educational games. The students liked games that had interesting themes, immediate feedback, difficulty level options, material repetition features, attractive visual displays, and interactive animations. This indicates a need for media that is enjoyable, adaptive, and contextual to strengthen their understanding of concepts [15].

From a technical perspective, most students have Android-based devices and want games that can be accessed both offline and online, are small in size, and are easy to control via a touchscreen [16]. They also hope for a variety of questions and a discussion feature. Therefore, the development of educational games needs to consider content diversity, material relevance, attractive visuals, as

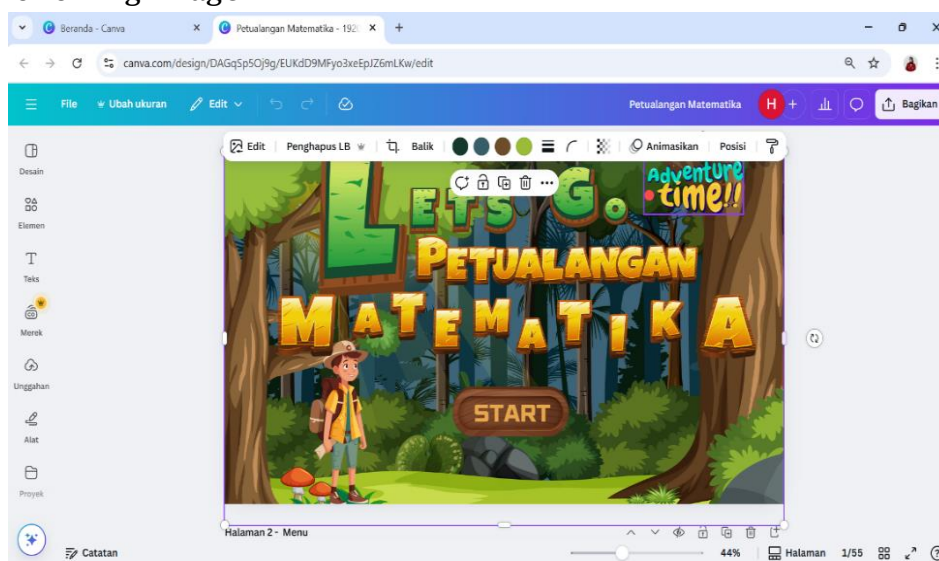
well as ease of access and use, so that the resulting media provides an optimal learning experience [17].

## **b. Design Stage**

This design phase utilized the Canva application intensively for creating visual assets, with the support of the premium version to gain full access to all elements and icons without limitations, and to avoid the presence of watermarks on the design results [18]. This tool was chosen because of its ease of use and the completeness of its graphic elements that can be tailored to learning needs. The following are the steps that have been carried out:

- a) Accessing and installing the desktop version of the Canva application, then creating an account via email.
- b) Designing the main screen display, game menu, main character, background objects, and other supporting elements such as navigation buttons and score icons.
- c) Using the templates available in Canva as a design basis, which were then modified to fit the adventure theme by using elements, icons, shapes, and illustrations to enrich the visual design.

An example of the visual design results, specifically the opening page with the game title and a "start" button, can be seen in the following image 1.



**Figure 1.** Design View in Canva.

### c. Development Stage

The development stage was carried out in several steps as follows:

- a) All assets (character images, navigation buttons, backgrounds) that were designed in Canva were exported and uploaded into Scratch.
- b) The assets were imported as sprites or backdrops and named according to their function to make it easier to manage the code (for example, the learning outcome button was named LO, etc.). The uploaded sprites and backdrops can be seen in the image below.

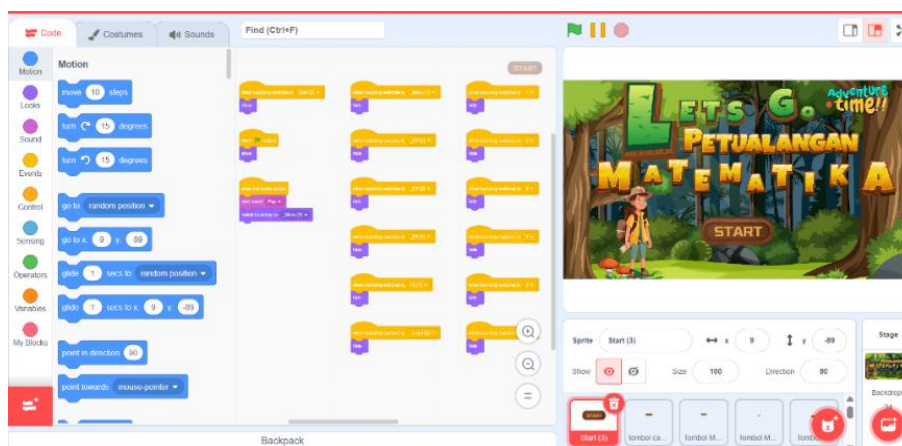


Figure 2. Development Process View.

- c) The game's flow was developed according to the designed storyboard.
- d) To make the navigation buttons move, it was necessary to add programming for interaction by inserting visual blocks in Scratch.
- e) The visual programming blocks can be seen in the following image 3.

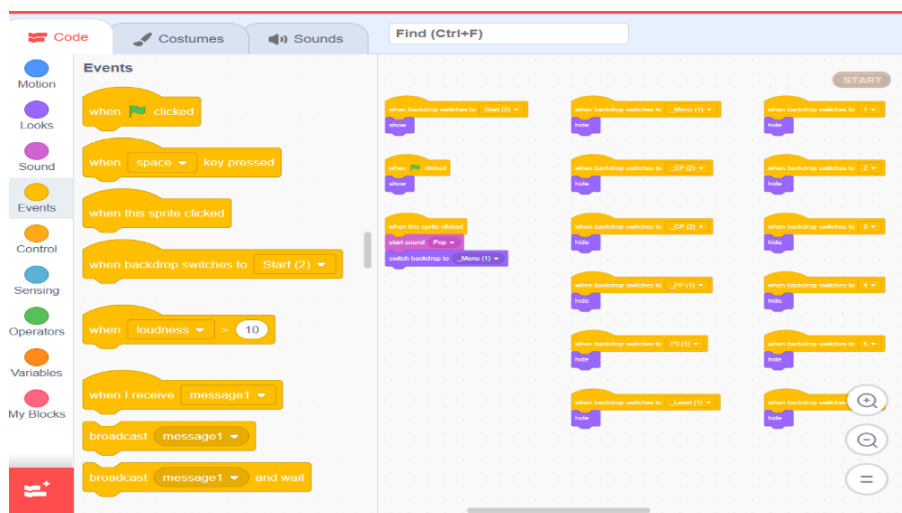


Figure 3. Visual Scratch Programming Blocks View.

To ensure that the educational game developed meets quality standards in terms of appearance, technical aspects, and material content, a validation process was carried out with two categories of experts:

1. Media Expert to assess the design, technical, and interactivity aspects of the media.
2. Material Expert to assess the suitability of the content with the curriculum and the students' level of understanding.

The validation process was conducted using an assessment instrument that was prepared based on guidelines for developing interactive learning media. The validated product was then ready to be tested in the field.

#### d. Implementation Stage

Implementation was carried out on a small scale as an initial step before a wider trial. The main focus of this stage was a legibility test, covering the game instructions, language, text, and the flow of both the learning and the gameplay. Five students who had already studied the probability material were involved as respondents. The results from this stage became the basis for assessing the feasibility of using the game or determining the need for improvements based on the feedback from the initial users [19].

### **e. Evaluation Stage**

The evaluation and revision phase was conducted at every stage of development to ensure the educational game ran optimally up to the validation stage. The evaluation performed was a formative evaluation, carried out progressively from the needs analysis and design to the implementation phase [20]. The assessment covered the game's design and the selection of elements such as videos, audio, materials, quizzes, and game levels, involving material experts, media experts, and a small-group legibility test. During the implementation phase, student responses were used as the basis for improvements [21].

At this stage, the educational game "Mathematical Adventure" for smartphones can be accessed offline. It can be downloaded via the QR code in the following image 4.



**Figure 4.** Math Adventure App QR Code.

**Data description of the answers to the product validity problem formulation**

**Table 2.** Validity Test Results

No	Indicator	Score
1.	The smartphone-based educational game learning media "Mathematical Adventure" has content quality that is appropriate for MTs grade VIII material.	3
2.	The smartphone-based educational game learning media "Mathematical Adventure" has complete evaluation/practice with discussion.	4
3.	The smartphone-based educational game learning media "Mathematical Adventure" uses good and correct Indonesian.	3
4.	<i>The storyboard of the smartphone-based educational game learning media "Mathematical Adventure" is easy to understand.</i>	3
Total		13
Percentage		81,25%
Category		Very Valid

The validation results from the **media expert** show that the smartphone-based educational game "Mathematical Adventure" received a feasibility percentage of **81.25%**, placing it in the "**Very Valid**" category and making it suitable for use as a learning medium. The assessment covered four main indicators: the suitability of the content with the curriculum for 8th-grade MTs students, the completeness of the evaluations and their discussions, the use of proper and correct Indonesian language, and the ease of understanding the storyboard. All indicators received high scores, indicating that the media substantially and technically meets quality standards [22].

**Table 3.** Research results of material expert I

No	Indicator	Score
1.	The material and questions for the smartphone-based educational game learning media "Mathematical Adventure" are presented clearly.	4
2.	The smartphone-based educational game learning media "Mathematical Adventure" uses good and correct Indonesian.	3

3.	The smartphone-based educational game learning media "Mathematical Adventure" presents the material appropriately.	4
4.	The outline of the learning media material for the smartphone-based educational game "Mathematical Adventure" has been presented and is in accordance with the textbook.	4
Total		15
Percentage		93,75%
Category		Very Valid

Next, the assessment of the learning media by Material Expert 1 shows that the product received a feasibility score of 93.75%. This percentage falls into the "Very Valid" category, which means the media has met this quality exceptionally well and is suitable for use in the learning process. The high scores on every indicator show that the material content within the media has been accurately and communicatively structured, and is relevant to the needs of the students.

**Table 4.** Assessment from material experts 2

No	Indicator	Score
1.	The material and questions for the smartphone-based educational game learning media "Mathematical Adventure" are presented clearly.	4
2.	The smartphone-based educational game learning media "Mathematical Adventure" uses good and correct Indonesian.	4
3.	The smartphone-based educational game learning media "Mathematical Adventure" presents the material appropriately.	4
4.	The outline of the learning media material for the smartphone-based educational game "Mathematical Adventure" has been presented and is in accordance with the textbook.	4
Total		16
percentage		100%
Category		Very Valid

The assessment of the "Mathematical Adventure" educational game by Material Expert 2 showed very satisfying results, with a score of

---

100%, which falls into the "Very Valid" category. This result indicates that the media has met all aspects of material feasibility exceptionally well. All indicators received the maximum score, signifying that the content is highly suitable and appropriate for use in mathematics learning.

**Results of Small Group Test (Readability) and Large Group Test (Practicality)**

**Table 5.** Readability Test Results

No	Aspect	Score 5 Students
1.	I can understand the game instructions easily.	90%
2.	The language used in the game is easy to understand.	95%
3.	The in-game instructions or narrative are not confusing.	85%
4.	The text displayed is easy to read (font size, color, etc.).	95%
5.	I can understand the learning flow in the game clearly.	95%
Average		92%
Category		Very Practical

The legibility test results for the educational game "Mathematical Adventure," involving 5 students, showed an average score of 92%, falling into the "very practical" category. The assessment was based on five aspects: understanding instructions, clarity of language, narrative, text readability, and learning flow. The highest score (95%) was obtained in the aspects of language clarity, text, and flow, indicating that students could follow the game's content well. The lowest score (85%) was in the narrative aspect, which still needs minor improvements. Overall, the media has met the legibility criteria very well.

**Table 6.** Results of practicality test

No	Indicator	Big
		Score 22 Students
1.	The smartphone-based educational game learning media "Mathematical Adventure" has an attractive appearance.	100%
2.	The smartphone-based educational game learning media "Mathematical Adventure" is easy to play.	98,8%
3.	The smartphone-based educational game learning media "Mathematical Adventure" makes learning varied and fun.	94,3%
4.	The smartphone-based educational game learning media "Mathematical Adventure" helps students understand the material on probability and expected frequency.	95,4%
Average		97,125%
Category		Very Practical

The practicality test results for the educational game "Mathematical Adventure" showed a very high level of practicality, with an average percentage of 97.125%, which falls into the "very practical" category. The assessment by 22 students covered four indicators related to the ease of use and appeal of the media.

The first indicator, visual display, received a score of 100%, showing that the media is very appealing. Second, ease of use scored 98.8%, indicating smooth access and operation. Third, learning variety and enjoyment scored 94.3%, proving that the media makes learning more diverse. Fourth, the ability to help with understanding probability and expected frequency concepts received 95.4%, signifying the media's effectiveness in supporting material comprehension.

## 5. CONCLUSION AND SUGGESTIONS

Based on the research and development findings, it can be concluded that the smartphone-based educational game, "Mathematical Adventure," built on the Scratch platform for the topic of probability, is suitable for use, as demonstrated through the ADDIE model of development, which included a needs analysis, the design of the storyline and visual assets using Canva, product development with Scratch, implementation through small- and large-group trials, and evaluation at every stage. The media's validity was rated as "very valid" by experts, with scores of 81.25% from the media expert, 93.75% from material expert 1, and 100% from material expert 2, confirming its suitability in terms of content quality, material relevance, presentation, and language. Additionally, the legibility test with an average score of 92% and the practicality test with an average of 97.125% show that the game is highly practical, easy to use, visually appealing, and capable of making learning more varied and enjoyable for students, although a limitation of this study is the lack of an effectiveness test, which future research is advised to address by directly evaluating the game's impact on student learning outcomes [1], [2], [3], [4], [5], [6], [7], [8].

## REFERENCES

- [1] R. Dwi Agustina, Dan Dian Ariesta Yuwaningsih, And A. Dahlan Jl Lingkar Selatan, "Pengembangan E-Modul Matematika Berbasis Android Dengan Pendekatan Problem Solving Pokok Bahasan Matriks," 2023.
- [2] D. Ambarwati, U. B. Wibowo, H. Arsyiadanti, And S. Susanti, "Studi Literatur: Peran Inovasi Pendidikan Pada Pembelajaran Berbasis Teknologi Digital," *Jurnal Inovasi Teknologi Pendidikan*, Vol. 8, No. 2, Pp. 173-184, 2021, Doi: 10.21831/Jitp.V8i2.43560.
- [3] Kementerian Komunikasi Dan Digital, "Optimisme IgdX 2024, Jadikan Indonesia Pusat Industri Gim Asia Tenggara." Accessed: Dec. 05, 2024. [Online]. Available: <https://www.komdigi.go.id/berita/pengumuman/detail/optimisme-igdx-2024-jadikan-indonesia-pusat-industri-gim-asia-tenggara>

- 
- [4] Z. Zuhlina, "Pengembangan Media Pembelajaran Game Edukasi Android Menggunakan Construct 3 Pada Materi Sistem Pencernaan Manusia Kelas Xi Sma," 2023.
- [5] S. Ayu, S. D. Ardianti, And S. Wanabuliandari, "Analisis Faktor Penyebab Kesulitan Belajar Matematika," *Aksioma: Jurnal Program Studi Pendidikan Matematika*, Vol. 10, No. 3, P. 1611, Oct. 2021, Doi: 10.24127/Ajpm.V10i3.3824.
- [6] P. Kairuddin, M. I. Samosir, G. E. Sitorus, H. M. W. Sihotang, And J. Yanty Tanjung, "Penerapan Media Pembelajaran Menggunakan Papan Peluang, Dadu, Dan Multimedia Pembelajaran Interaktif Dengan Pendekatan Rme Di Sma Swasta Pab 8 Saentis," *Desember 2024 Mandalika Mathematics And Education Journal*, Vol. 6, P. 585, 2024, Doi: 10.29303/Jm.V6i2.7821.
- [7] D. A. Saputra, I. Tiara, And Y. Sari, "Pengembangan Media Pembelajaran Bangun Ruang Sisi Datar (Pemeran Barista) Berbasis Video Pembelajaran Untuk Meningkatkan Pemahaman Konsep Pada Siswa SMP Kelas VIII," 2025.
- [8] F. Firmadani, "Media Pembelajaran Berbasis Teknologi Sebagai Inovasi Pembelajaran Era Revolusi Industri 4.0," In *Prosiding Konferensi Pendidikan Nasional* , 2023, Pp. 93-97.
- [9] H. S. Nahampun, "Efektivitas Metode Pembelajaran Berbasis Game Dalam Meningkatkan Motivasi Belajar Siswa Sekolah Dasar," *Sinar Dunia: Jurnal Riset Sosial Humaniora Dan Ilmu Pendidikan*, Vol. 3, No. 3, Pp. 63-68, Jul. 2024, Doi: 10.58192/Sidu.V3i3.2415.
- [10] J. Mardiyah, H. Khotimah, G. Susilo, And U. Balikpapan, "Pengembangan Game Edukasi Besarang (Bermain Sambil Belajar Peluang) Menggunakan Software Construct 2 Pada Siswa Kelas Viii Smp Muhammadiyah 2 Balikpapan Tahun Ajaran 2023/2024," 2024.
- [11] E. Irawan, Y. S. Kusumah, And V. Saputri, "Pengembangan Multimedia Interaktif Menggunakan Scratch: Solusi Pembelajaran Di Era Society 5.0," *Aksioma: Jurnal Program Studi Pendidikan Matematika*, Vol. 12, No. 1, P. 36, Mar. 2023, Doi: 10.24127/Ajpm.V12i1.6226.
- [12] H. Rani And A. Wintarti, "Media Pembelajaran Berbasis Ict Menggunakan Software Scratch Pada Materi Peluang Di Smpn 18 Banjarmasin," *Edu-Mat: Jurnal Pendidikan Matematika*, Vol. 10, No. 1, P. 95, Apr. 2022, Doi: 10.20527/Edumat.V10i1.12936.
- [13] R. Nurmeidina And S. Djamilah, "Pengembangan Lembar Kerja Peserta Didik Berbasis Etnomatematika Banjar Materi Segiempat Dan Segitiga," 2022.
- [14] F. N. Chandra, R. Rahaju, And T. Yuwono, "Pengembangan E-Lkpd Interaktif Materi Himpunan," *Jipmat*, Vol. 8, No. 1, Pp. 90-101, 2023.
- [15] R. Prastowo, S. Huda, R. Umam, K. Jermsttiparsert, and A. Eko, "Academic Achievement and Conceptual Understanding of

- 
- Electrodynamics: Applications Geoelectric Using Cooperative Learning Model,” *J. Ilm. Pendidik. Fis. Al-Biruni*, vol. 8, no. 2, pp. 165-175, 2019, doi: 10.24042/jipfalbiruni.v0i0.4614.
- [16] S. Sumarni et al., “Behavior in early childhood (2-3) years: A case study on the use of gadgets in social environments,” *Int. J. Innov. Creat. Chang.*, vol. 8, no. 8, pp. 384-404, 2019.
- [17] S. Sumarni, R. Ramadhani, Y. Sazaki, R. Tria, W. D. Andika, and A. E. Prasetyo, “Development of " Child Friendly ICT " Textbooks to Improve Professional Competence of Teacher Candidates : A Case Study of Early Childhood Education Program Students To cite this article : Sumarni , S ., Ramadhani , R ., Sazaki , Y ., Astika , R , T ., An,” *J. Educ. Gift. Young Sci.*, vol. 7, no. 3, pp. 643-658, 2019, doi: 10.17478/jegys.596095.
- [18] M. El Baba, P. Kayastha, M. Huysmans, and F. De Smedt, “Evaluation of the Groundwater Quality Using the Water Quality Index and Geostatistical Analysis in,” *Water (Switzerland)*, vol. 12, no. 262, pp. 1-14, 2020, doi: 10.3390/w12010262.
- [19] M. Munifah, A. N. Romadhona, I. Ridhona, R. Ramadhani, R. Umam, and H. S. Tortop, “How to Manage Numerical Abilities in Algebra Material?,” *Al-Jabar J. Pendidik. Mat.*, vol. 10, no. 2, pp. 223-232, 2019.
- [20] M. Yasin, S. Huda, F. G. Putra, M. Syazali, R. Umam, and S. Widyawati, “IMPROVE Learning Model and Learning Independence: Influence and Interaction on Mathematics Problem-Solving Abilities in Islamic Boarding School IMPROVE Learning Model and Learning Independence: Influence and Interaction on Mathematics Problem-Solving Ab,” *J. Phys. Conf. Ser.*, vol. 1467, p. 012003, 2020, doi: 10.1088/1742-6596/1467/1/012003.
- [21] M. U. Ridwanulloh, S. Huda, and R. Umam, “Innovative Leadership Management: The Pattern of School Quality Development at SMP Muhammadiyah 2 Inovasi Malang,” *Progres. J. Pemikir. dan Pendidik. Islam*, vol. 11, no. 01, pp. 25-42, 2022, doi: 10.22219/progresiva.v11i01.20742.
- [22] A. Saregar et al., “International Journal of Educational Methodology Natural Disaster Education in School: A Bibliometric Analysis with a Detailed Future Insight Overview,” *Int. J. Educ. Methodol.*, vol. 8, no. 4, pp. 743-757, 2022, doi: 10.12973/ijem.8.4.743.