Al-Bidayah : jurnal pendidikan dasar Islam
Volume 16 Number 2, December 2024
ISSN: 2549-3388 (online)
Available online at https://ejournal.uin-suka.ac.id/tarbiyah/albidayah
Submitted: October 4, 2024, Accepted: December 31, 2024

Development of Learning Media Gamification Based on Gamimath Android in Mathematics Learning for Elementary School

Sigit Dwi Laksana[1], Anip Dwi Saputro[2], Ayok Ariyanto[3], Dirga Ayu Lestari[4]

Universitas Muhammadiyah Ponorogo, Indonesia[1,2,3], STAI KH Abdul Kabier, Indonesia[4]
E-mail: sigitciovi@umpo.ac.id [1], anipdwisaputro@gmail.com[2], ayokariyanto@gmail.com[3], dirales25@gmail.com[4]

DOI: 10.14421/al-bidayah.v16i2.9585

Abstract

The application of technology in the learning process can be a creative innovation. The use of Gamimath is a strategic step that teachers can develop. The purpose of using Gamimath is to facilitate students learning while being able to increase student involvement in the learning process, Which combines the element of gamification with mathematics learning. Where The purpose of this study is to develop learning media assisted by the GAMIMATH application, especially in mathematics subjects, and provide convenience in the mathematics learning process for students so that no one will say mathematics is challenging to understand learning. This research and development (R&D) project consists of six stages: analysis, design, development, implementation, and evaluation. The subject of this research is PGMI students in the second semester of the Faculty of Islamic Religion, University of Muhammadiyah Ponorogo. The results of this research are that the game math application product has been produced. Based on the results of the validation test by the expert team, it received a score of 85 out of a maximum score of 90 with the category of very good and decent. In addition, during the test, the N-gain Score was 56, which means that the use of the Gamimath application has proven to be quite effective in Improving students' understanding of learning, such as solving problems related to mathematics, collaborating with friends in finding answers to the problems given by following each step in the existing application and solving the challenges given.
Keywords: android gamimath; gamification; learning media; math learning

Introduction

In the ever-evolving digital era, technology has become a key pillar that supports transformation in various sectors of life, including education. With the advancement of information and communication technology, the traditional learning paradigm has undergone a significant shift towards a more dynamic, interactive, and technology-integrated approach. The integration of technology in education is not only a replacement for conventional learning aids but also opens the door for more innovative and effective teaching and learning methods (Laksana, 2017).

In the past, learning was dominated by face-to-face interaction in the classroom, with textbooks being the main source of information. However, along with the development of technology, we are now witnessing the emergence of various digital-

platforms, learning applications, and online resources that can be accessed anytime and anywhere. This allows students to learn in a more flexible and personalized way, adapting to each individual's pace and learning style.

This transformation also brings new challenges for educators and educational institutions. They are required to not only master the latest technology but also understand how it can be used effectively to improve the quality of learning. A student-centered approach, the use of data to personalize learning, and collaboration through digital networks are key elements in the modern education ecosystem (Laksana et al., 2024).

Digital technology has changed the way we access, store, and disseminate information. With the internet and mobile devices, the boundaries of space and time in the teaching and learning process are increasingly eroding. Students are no longer fixated on traditional learning methods in the classroom but can access diverse learning resources whenever and wherever they are (Baran, 2014). Integrating technology into education also allows for the creation of a more interactive and collaborative learning environment. The application of digital tools such as social media, video conferences, and e-learning platforms facilitates the exchange of ideas and discussions between students and provides opportunities for them to participate actively in the learning process (Dhir et al., 2013). In addition, the use of technology in modern education also helps to provide a richer and more meaningful learning experience. Virtual simulations, augmented reality, and other immersive technologies allow students to visualize abstract concepts in a more real and engaging way (Belva Saskia Permana et al., 2024). One of them is the use of gamification in the learning process.

Gamification is defined as the design, implementation, and use of the context, not towards a game in the form of a machine. (1) The use of elements in the game that include levels, challenges, rewards, and points in learning activities. Gamification can support technology in the world of education to be more interesting by encouraging users or students to be actively involved in the behavior that has been set by the teacher, with the aim of helping solve problems. The use of gamification takes advantage of learners' psychological tendency to 'engage in games (Gharibi & Malekzadeh, 2017). The correlation between the use of gamification-assisted technology and improving active student learning behavior can be seen from the trend of playing games among children, which is at its peak. Therefore, incorporating elements in digitally packaged games into

learning will provide a new feel to learning; they will feel enjoy and comfortable while learning (Bakhri, 2023). This is strengthened by research conducted by Srimuliyani, who revealed that respondents showed a very high positive for the use of gamification in the classroom because it can provide a fresh learning environment and is innovative. It was shown by 92% of students that gamification technology is easy to use, and 96% of students feel that gamification helps them increase engagement (Srimuliyani, 2023). In addition, in a study, it was obtained that gamification can be used as a strategy to increase student's motivation to learn by using the web as a platform and utilizing gamification elements, which include rewards, levels, and challenges (Panis et al., 2020). Based on the data above shows that the use of technology in gamification provides innovation in learning, but the application of gamification must be in accordance with and refer to the MDA Framework, which consists of three main components, namely Mechanism, Dynamics, and Aesthetics (Dwi Putra & Yasin, 2021).

Therefore, gamification aims to motivate students in learning activities and maximize the feeling of enjoyment and engagement in the learning process so that the game can attract students' interest in learning (Kotob & Ibrahim, 2019).

Based on the initial data that has been obtained by the researchers, it was found that students still have many difficulties in understanding mathematical materials, especially those that are analytical and require critical thinking skills. Many students who do not pay attention to the material presented, as well as the use of ineffective learning models are one of the factors that cause no student involvement in learning, thus causing grades to drop (Khotimah, n.d.). Starting from the above background, the researcher is interested in conducting research that focuses on the development of learning media assisted by the gamimath application, especially in mathematics subjects in elementary school.

Research Methods

Development Model

This research was conducted using several approaches. In detail, using Research and development, which is a needs analysis to test the effectiveness of products so that they can be used in mathematics learning (Torang Siregar, 2023) in addition to testing the

effectiveness of products in the form of media, is also used to help solve the problem of difficulties in learning mathematics that are still considered problematic.

This research aims to develop learning media in the form of a mobile application called Gamimath in the mathematics learning process in elementary schools. The concept of this media development is taken from several existing application references and available on the Playstore, but it was developed by adding problem-based learning models and reinforcement materials. To make it easier to understand how the Gamimath application works, we present its structure here.

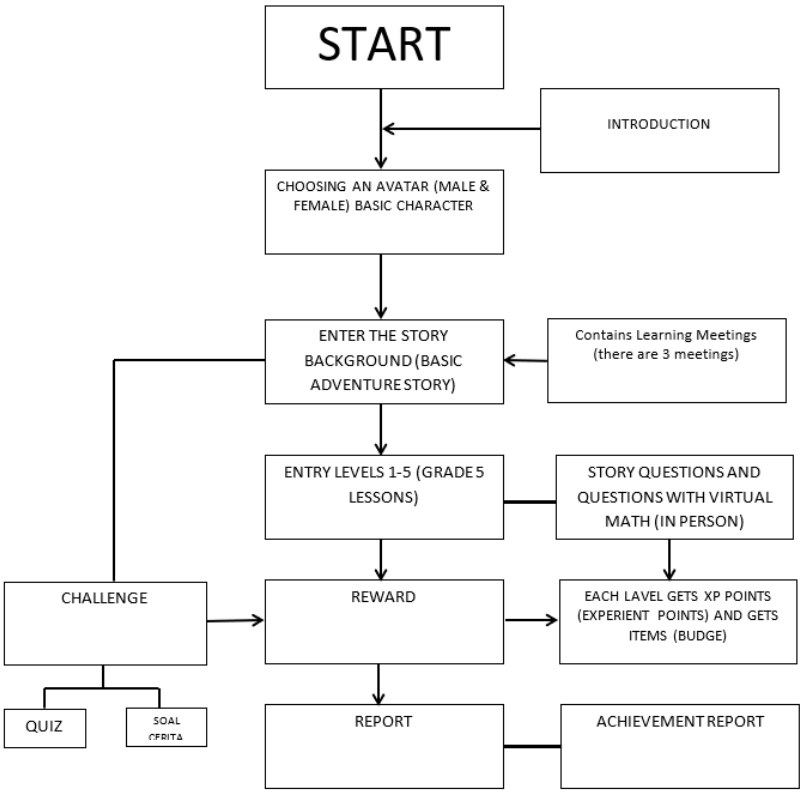

Figure 1
Structure of the Gamimath Application Model in Mathematics Learning
Source: Personal Document

The development model of the gamimath application in mathematics learning is as follows: a) potential and problem, b) data collecting, c) product design, d) design validation, e) design revision, f) product trial, g) product revision, h) trial use, i) product revision, j) finished, the product can be used (Okpatrioka, 2023). The development model of the gamimath application in mathematics learning is as follows.

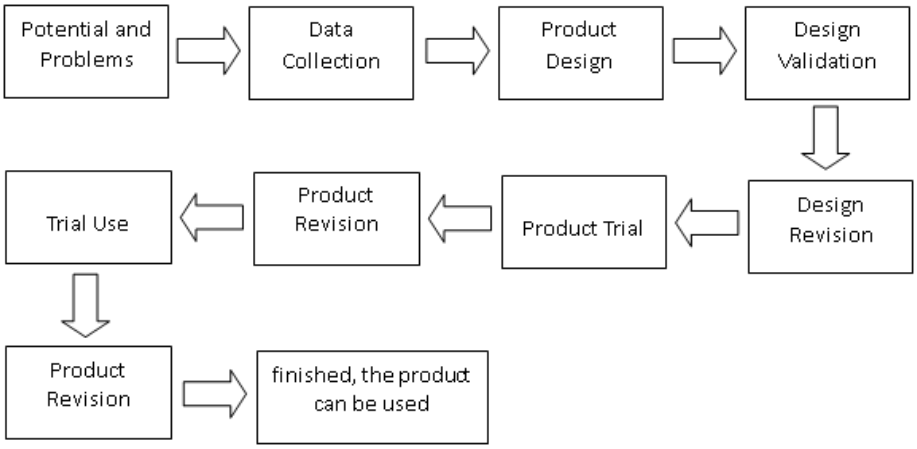

Figure 2
Research Flow of Research and Development
Source: Personal Document

The subjects of this study include PGMI students in the 2nd semester of the mathematics learning course, a total of 30 students. A purposive sample is used so that students who take courses are used as research objects, and the data sources are categorized as respondents. To obtain data validity, the MDA Framework gamification model is used as a reference for making applications and validated by experts. The instruments used to create the Gamimath application refer to the MDA framework as follows.

Table 1
Gamimath instrument with MDA framework model (Dwi Putra & Yasin, 2021)

No.	MDA Framework (type)	Indicator
Mechanics		
1	Player Progression	Point, achievement, leaderboard, level
2	Task	Mission, minigames
3	Game Content	Role-playing, unique controllers, simulations, drag and drop, turn-based
Dynamics		
1	Get a badge, achievement	Players with the best scores get rewards in the form of badges, achievements, or Rewards.
2	Role-playing	Players can choose a character to play in the scenario
3	Real exploration	Players must be able to Complete the missions/tasks provided
4	Puzzle-solving	Players can use their own way to Complete missions
5	Quiz system	Multiple choice groups can provide a value (points), and This value will given/displayed after

No.	MDA Framework (type)	Indicator
		Each question is answered by the player (Fathurrahman & Herdiani, 2024)
Aesthetics		
1	Sensation	Feel good when playing games
2	Challenge	Feeling challenged to Complete tasks
3	Narrative	Interesting Storyline for Players
4	Submission	Full enthusiasm of players at play

Source: Personal Document

Concerning these instruments, the product produced in research and development (R&D) is software in the form of an application called Gamimath. The existence of this application can help teachers make it easier to deliver learning materials and make it easier for students to receive and understand the learning materials delivered in mathematics learning.

Result

Product Development Research Result

This research was carried out on prospective students of MI Teacher in the 2nd semester of the mathematics learning course, Faculty of Islamic Religion, University of Muhammadiyah Ponorogo, with a total of 30 students located on Jalan Budi Utomo No. Siman Ponorogo. This research produces learning media products in the form of the Gamimath application. Before the application is tested, the product is first reviewed by a material expert validator and a design expert validator. This is so that the application developed gets validated and is feasible to use. This study uses the R&D (Research and Development) method with the ADDIE development model (Reigeluth & An, 2020) proposed by Dick and Carry in 1996. Steps in the research and development of the ADDIE model include the Analysis Stage, Design Stage, Development Stage, Implementation Stage, and Evaluation Stage.(Hidayat & Nizar, 2021) The following presents the development process with the ADDIE model:

Analysis

At this stage, the researcher conducts data mining through interviews and observations with the head of the PGMI study program and the research subjects' students. The results of the analysis that have been carried out are used as guidelines and considerations in developing game mathematics applications. At this stage, the researcher

also conducts a needs analysis, which includes learning tools, curriculum, materials, and students. Some of the results of the analysis carried out obtained data that the research subject, namely PGMI Semester II students, found data in the field when carrying out internship one activities (observation) that many learners easily get bored with the material taught because they feel that the delivery still feels monotonous. They prefer to chat on their own. This can be seen in the learning process. At first, learners look calm and follow the lecturer's instructions well, but after a while, they start to get bored and look for other pleasures because this development is focused on allowing learners to enjoy a conducive learning climate.

Design

At this stage, the researcher prepares the application that has been developed, namely game math, so the awake step that must be taken is to design an application by paying attention to the MDA framework that is connected to the material to be taught and adjust to the competencies and learning objectives that have been set. Furthermore, the media that has been made is subjected to a validation process by a team of experts who validate learning tools and materials. At this stage, researchers design the application by including gamification elements such as levels, points, badges, and challenges. The application creation involves a third party, namely a lecturer in Informatics Engineering at the University of Muhammadiyah Ponorogo, as a team that works and makes the application, while the researcher functions as the application drafter. Gamimath itself is an acronym for gamification mathematics, which means mathematics learning that utilizes gamification as an innovative learning medium so that mathematics learning becomes more meaningful. Later, the game math application will run on the .apk-based Android platform.

Development

At this stage, the researcher and the development team began to carry out development activities by making an application that was based on the design that had been prepared. The development is carried out by synchronizing with the analysis of the needs obtained. For example, students who still have difficulty understanding the material presented because of learning that can only be done, so the researcher develops by including a problem-based learning model in a more interesting way. Furthermore, at the stage of developing the content of the material, the researcher adjusts to the existing

curriculum so that the application is still appropriate and can be used repeatedly. On this side, the researcher also added pictures that attracted the attention of students so that students became more motivated to learn. At this stage, the researcher also carried out the process of validating the content of the application 2 times to strengthen the gamimath application.

Furthermore, after the application prototype is ready, experts carry out the validation process. Experts are taken from academics who are experts in the field of application development and academics in the field of learning media. Based on the results of expert validation, the researcher received input, including; 1) On the application dashboard, an animation is added that attracts the attention of students. 2) Add introductory material before entering the storyline. 3) Compose questions based on the HOTS principle. 4) Add instrumental music to make students calmer in working on questions.

Production

At this stage, the application development team carries out the manufacturing process guided by the agreed design, as well as the results of validation from the expert team. The process includes creating an app using Figma and Adobe XD to create a display design and also an application flow. Here is what the app looks like.

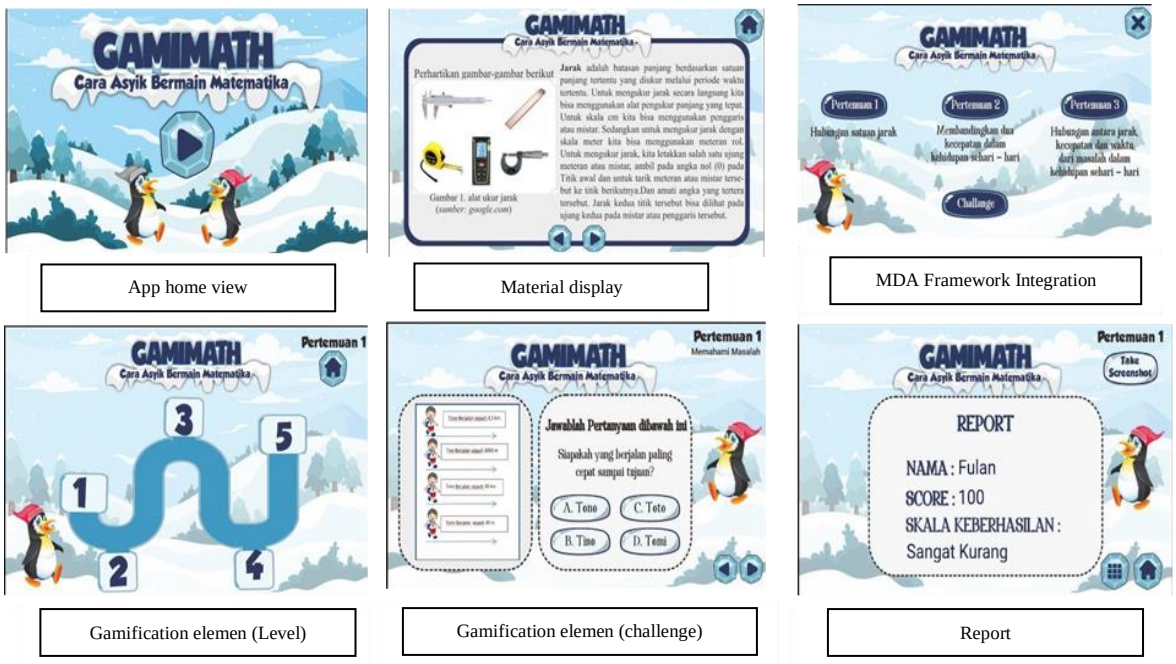

Figure 2
Display Gamimath
Source: Personal Document

At the validation stage from the expert team, a score of 94% of the calculation results (Validation Value = S / N x 100), where the score value is 85 out of a maximum score of 90, then the Validation Value = 85 / 90 x 100 = 94%, is included in the category of Very Good and Worthy of implementation.

Table 2
Results of Media Expert Assessment

Very less	Less	Enough	Good	Very Good
0% - 19%	20% - 39%	40% - 59%	60% - 79%	80 % - 100%

Source: Personal Document

Implementation

At this stage, the researcher carried out implementation activities from the application that had been developed, using an experimental method with two schemes, namely a control class assisted by conventional learning media and an experimental class using gamification-assisted learning media game math. During the learning control class, learning media was provided for free on several existing websites, one of which was a Wordwall application. Learning was carried out during two meeting sessions. In the experimental class, the researcher explained that the application used was by using gamimath, in which the application contains learning materials at the elementary school level; in the application, it also contains gamification elements, including the MDA framework, which includes Mechanics, Dynamics, and Aesthetics.

Evaluation

At the evaluation stage, the purpose of the evaluation was to see the feasibility of the application product produced, in this case the gamimath application in mathematics learning for PGMI students in semester 2 that has been carried out. In assessing the feasibility of the application, excellent results were obtained by getting a high percentage of 94%, which means that the application is suitable for use. Meanwhile, when the results of the experiment that had been carried out using the N-Gain value test in the afternoon got quite good results in the experimental class with an average of 56 in the category of interpretation of the effectiveness of N-Gain in the category of quite effective. Meanwhile, the control class got a score of 53.24, with the interpretation value of the N-gain Score being less effective. This shows that using the game math application has proven to be quite effective in improving student's understanding of mathematics learning.

Table 3
N-Gain Score in The Implementation of Gamimath

No.	Implementation	N-Gain Score	Estimates
1	Class with Gamimath	56	quite effective
2	Class with traditional game	53,24	less effective

Source: Personal Document

Discussion

The rate of technology adoption in learning refers to how fast or how slow educational technology is adopted by society or educational institutions. Well-known technology adoption models, such as the Diffusion of Innovations Model (Rogers, 2017), provide a framework for understanding how innovation is received by individuals or groups in society.

At the analysis stage, The analysis of the need for the use of gamimath media in learning is influenced by several things, namely first, the role of learning media functions to convey messages from teachers to students (Hidayati Rofiah et al., 2024), so that it can help clarify learning messages and reduce obstacles in the learning process. Second, the learning goal is to plan the use of learning media; teachers must see the goals to be achieved (Amelia & Wibowo, 2024). Third, learning materials, where learning that supports the achievement of learning objectives needs to be considered (Handayani et al., 2021); fourth, teaching and learning strategies, where teaching and learning that is appropriate to achieve learning goals need to be considered, and the last is the curriculum, where learning must meet the learning needs of students well so that the use of media must be connected to the existing curriculum (Gultom et al., 2022).

In this digital era, technology has become the backbone of modern learning. The adoption rate of technology in learning has been in the spotlight in various educational settings. From traditional classrooms to higher education institutions, the shift towards the use of technology has become an inevitable paradigm (Prawiradilaga, 2012).

Within this range, there are varying levels of adoption. On the one hand, some schools embrace technology with passion, implementing interactive learning software, online platforms, and other advanced technological equipment as an integral part of their curriculum (Middleton, 2009). They see technology as the key to increasing student

engagement, personalizing learning, and creating a dynamic learning environment (Dwi Laksana et al., 2024).

At the design stage, Designing a learning application, it is necessary to pay attention to several things, such as first Learning objectives; ensuring clear and specific learning objectives will make it easier for teachers to explain the direction of learning (Hamzah et al., 2015); Second the needs of students are by considering the conditions and abilities of students, including age range, gender, interests, and education level (Zhao & Anas, 2023); Third, learning materials that are interesting and relevant to learning objectives (Faizah et al., 2024; Spector et al., 2014); Fifth the design of learning materials that are interesting and relevant to the learning objectives that have been explained at the beginning (Hamzah et al., 2015); Sixth Learning media, by choosing learning media that are by the teaching objectives, support the content of the material, and are easy to obtain. In this stage, the use of the MDA framework is very important in forming gamification-based applications (Arnab & Clarke, 2017); Seventh Content, the form is in the form of planning the type of content to be presented, such as audio, video, text, animation, and others (Tang & Zhang, 2019); Eighth Design templates by choosing templates that are relevant to the material, have a clear layout, and visuals can support student engagement in learning (Baldeon et al., 2015); Nineth Colors and fonts, by ensuring that colors and fonts are easy to read and do not interfere with the view (Busarello et al., 2014); Ten Interactivity, namely by facilitating learner activities, such as fields of content, moving elements, or diagrams that can be modified can provide student interaction directly in the application (Wang & Lieberoth, 2016).

At the development stage, In taking steps to develop the gamimath application, there are two important goals that need to be achieved. Among others: 1. Producing or revising the gamimath application that will be used to achieve the learning objectives that have been formulated. 2. Choose the content on the gamimath application that is best and will be used to achieve learning objectives (Baydas & Cicek, 2019).

At the implementation stage, the use of Gmimath in learning allows students to see real-world applications and the benefits of the subject matter they are following (Aguiar-Castillo et al., 2020). The students can see firsthand how their choices, decisions, and actions in the game result in consequences or rewards.

There are several factors that affect the rate of technology adoption in learning: 1) Relative Advantage: How far is technology considered to be better than conventional methods? If technology can improve the efficiency, effectiveness, or quality of learning, then it is likely to be adopted faster (Sulistiyowati, 2024). 2) Conformity: The extent to which the technology fits the user's needs and context. Technology that is easy to integrate into the existing curriculum or learning process will be easier to accept. 3) Complexity: The more complex the technology, the slower the adoption process. Users tend to prefer technology that is easy to understand and use (Jagust et al., 2017). 4) Resource Availability: Financial and infrastructure factors also play an important role. Schools or educational institutions that have sufficient resources will be more likely to adopt educational technology (V. et al., 2015). 5) Communication and Networking: How information about the technology is disseminated and shared among the educational community can also influence its adoption. If teachers or educational institutions hear about the successful use of technology by peers or similar institutions, they are more likely to try the technology (Zhao & Anas, 2023). 6) Support and Training: The availability of training and technical support for teachers and educational staff is essential. Without adequate support, teachers may be reluctant to try new technologies.

*At the evaluation stage***,** challenges in adopting technology. Some educational institutions may face funding or access limitations that limit their ability to integrate technology into their teaching (Abidin et al., 2019). Additionally, there are also concerns about how technology may affect social interactions and the balance between technology use and more traditional learning experiences (Su & Cheng, 2015). The rate of adoption of technology in learning is also influenced by cultural, regulatory, and leadership factors in each educational environment (Jagust et al., 2017). Visionary education leaders are often the main drivers behind the shift towards wider and more effective use of technology (Sri Suryanti & Supeni, 2019). So that the competencies expected by education leaders can be maximally achieved, such as the ability to think critically, collaborate, and master technology (Ardhani, 2024).

As such, the rate of adoption of technology in learning not only reflects the extent to which technology has been widely accepted in education (Abidin et al., 2019) but is also a reflection of the challenges, opportunities, and values that define today's educational society (Rina et al., 2020).

This is also due to the perception and attitude towards the use of technology, which can vary from individual to individual and is influenced by various factors such as cultural background, education, personal experience, and level of comfort with technology (Bedregal-Alpaca et al., 2020). Some people may have a positive view of technology, seeing it as a tool that makes everyday life easier, increases productivity, and enables global connectivity (Sieckmann et al., 2020).

This is in line with the results of the application implementation that has been carried out on the sample. The findings of the study, which stated that there was an interaction of the gamification-assisted gamimath application on students' problem-solving skills, also showed that the achievement of learning outcomes was influenced by the confidence and enthusiasm of students in learning (İDawati et al., 2020), because they followed each flow of the problem-solving flow very smoothly, where this became a control function in problem-solving(Biloch & Löfstedt, 2013). This can happen because of the role of the student, who is able to control the process of thinking clearly about a known idea or concept (Fitriyanto, 2016).

In terms of mathematical learning problem-solving skills, the factor of comprehension and analysis skills greatly determines the success of students in learning, meaning that students with high analytical skills, who are taught with the gamification-assisted game math application, can produce high problem-solving skills (Hakak et al., 2019). On the other hand, in students with low analytical skills, whether taught with gamification-assisted applications, the results of solving skills will be low (Razami & Ibrahim, 2021). The existence of this interaction is due to the success of learning in the aspect of the results of mathematics learning ability that requires precision and also correct problem-solving procedures, especially in understanding the field of mathematics that uses the concept of stories (Tambunan, 2019). Mathematics learning problem-solving skills include understanding, identifying, and analyzing the concept of mathematics learning problem-solving (Endah Retnowati, Yazid Fathoni, 2018). This study shows that there is an interaction between students and the Gamimath application. Forms of interaction with the game math application The level of student understanding includes Self-monitoring *and reflection*, Where the role of gamification is to give credit to oneself for succeeding in solving a problem or identifying a problem (Losenno et al., 2020). *Planning and strategy*: Elements in gamification can be designed to involve users in

practicing planning, considering what they need and how to implement it, suggest problem-solving strategies (Cabrera-Mejía et al., 2020). *Self-evaluation and assessment play a role in encouraging students to independently evaluate and conduct assessments so that they are more trained* through level elements and challenges (Yansen et al., 2019). *Collaboration and Group dynamics* play a role in engaging learners in social dynamics, including exploration, collaboration, and competition (Yew & Goh, 2016). *Game Aesthetics*: Regularly engaging in the use, planning, and monitoring of strategies can foster a sense of competence when a player knows the tools and strategies (Dwi Putra & Yasin, 2021).

They feel comfortable and motivated to adopt new technologies and explore their potential. (Tang & Zhang, 2019) The positive impact of technology on learning outcomes can be seen from several aspects. First, technology allows for easier access to sources of information and knowledge (Prasannakumar, 2018). Students can access learning materials, videos, and other digital resources more easily, thereby expanding their horizons of knowledge. As Herlambang said, "Technology opens the door for students to explore and acquire knowledge from various sources, thus enriching their learning experience."(Wijaya et al., 2016)

Conclusion

Based on the results of the research and discussion of the research on the development of the gamimath application in mathematics learning in the second semester of PGMI students of the Faculty of Islamic Religion, University of Muhammadiyah Ponorogo, it can be concluded that the research and development process of this research uses the ADDIE model where the model includes the Analysis Stage, Design Stage, Development Stage, Implementation Stage, and Evaluation Stage. Each stage is passed well to produce a product that is ready and feasible to implement. This can be seen from the results of the validation test by the expert team, which got a score of 85 out of a maximum score of 90. In addition, at the time of the test, the N-gain Score was 56, which means that the use of the gamimath application has proven to be quite effective in improving the understanding of mathematics learning. The weakness in designing the gamimath application is that there is maintenance in the application, such as the breakdown of some existing features, but overall, the obstacle can be overcome properly.

Based on the results of the research conducted, it can be described that the use of gamimath can improve critical thinking skills, the ability to collaborate in solving problems, and mastery of technology.

Acknowledgment

This journal article was written by (Sigit Dwi Laksana, Anip Dwi Saputro, Ayok Ariyanto, and Dirga Ayu Lestari) based on the results of research (Development of Gamification-Assisted Learning Media Based on Android Gamimath in Mathematics Learning for Elementary School) financed by the University of Muhammadiyah Ponorogo through the 2023 Research Grant and Community Service Program. The content is entirely the responsibility of the author.

Declaration of Conflicting Interests

All authors declare no conflict of interest.

Funding

The University of Muhammadiyah Ponorogo funds this research through a research and service grant program for the year 2023.

Orcid iD

Sigit Dwi Laksana https://orcid.org/0000-0002-3481-5692

Anip Dwi Saputro https://orcid.org/0000-0002-4544-2051

Ayok Ariyanto https://orcid.org/0000-0002-6431-4936

Dirga Ayu Lestari https://orcid.org/0000-0003-3219-7883

References

Abidin, S. R. Z., Noor, S. F. M., & Ashaari, N. S. (2019). Heuristic evaluation of serious game application for slow-reading students. *International Journal of Advanced Computer Science and Applications*, *10*(7), 466–474. https://doi.org/10.14569/ijacsa.2019.0100764

Aguiar-Castillo, L., Clavijo-Rodriguez, A., Hernández-López, L., De Saa-Pérez, P., & Pérez-Jiménez, R. (2020). Gamification and deep learning approaches in higher education. *Journal of Hospitality, Leisure, Sport and Tourism Education*, *xxxx*.

https://doi.org/10.1016/j.jhlste.2020.100290

Amelia, R., & Wibowo, A. M. (2024). The Development Of Blended Learning-Based Digital Teaching Materials On Kinematics For Islamic Primary Schools, Prospective Teachers In Science Learning. *Al-Bidayah : Jurnal Pendidikan Dasar Islam*, *16*(1), 91–112. https://doi.org/10.14421/al-bidayah.v16i1.9573

Ardhani, A. P. (2024). Keefektifan Penggunaan Media Anagram Dalam Pembelajaran Kosa Kata Bahasa Indonesia. *Al-Bidayah : Jurnal Pendidikan Dasar Islam*, *3*(1). https://doi.org/10.14421/al-bidayah.v3i1.8992

Arnab, S., & Clarke, S. (2017). Towards a trans-disciplinary methodology for a game-based intervention development process: Towards a trans-disciplinary methodology. *Br J Educ Technol*, *48*(2), 279–312. https://doi.org/10.1111/bjet.12377

Bakhri, Z. M. (2023). Penggunaan Media Gamifikasi Berbasis Teknologi Aplikasi dalam Pembelajaran di Sekolah Luar Biasa (SLB). *Atavisme*, *53*(9), 1–5. https://ojs.uvayabjm.ac.id/index.php/pahlawan/index

Baldeon, J., Puig, A., Santiago, I. R., & Lopes-Sanchez, M. (2015). Gamification of Elementary Math Learning : A Game Designer Role-Playing Experience With Kids. *II International Workshop on Gamification in Education: GEducation 2015*, *February 2017*.

Baran, E. (2014). A Review Of Research On Mobile Learning In Teacher Education. *Educational Technology and Society*, *17*(4), 17–32.

Baydas, O., & Cicek, M. (2019). The Examination Of The Gamification Process In Undergraduate Education: A Scale Development Study. *Technology, Pedagogy and Education*, *28*(3), 269–285. https://doi.org/10.1080/1475939X.2019.1580609

Bedregal-Alpaca, N., Sharhorodska, O., Jiménez-Gonzáles, L., & Arce-Apaza, R. (2020). A gamification experience and virtual reality in teaching astronomy in basic education. *International Journal of Advanced Computer Science and Applications*, *11*(5), 513–521. https://doi.org/10.14569/IJACSA.2020.0110566

Belva Saskia Permana, Lutvia Ainun Hazizah, & Yusuf Tri Herlambang. (2024). Teknologi Pendidikan: Efektivitas Penggunaan Media Pembelajaran Berbasis Teknologi Di Era Digitalisasi. *Khatulistiwa: Jurnal Pendidikan Dan Sosial Humaniora*, *4*(1), 19–28. https://doi.org/10.55606/khatulistiwa.v4i1.2702

Biloch, A., & Löfstedt, A. (2013). *Gamification and Performance Management: A tool for driving competitiveness through employee engagement*. 141.

Busarello, R. I., Fadel, L. M., Ulbricht, V. R., & Bieging, P. (2014). Construction parameters for hypermedia comics to learning based on the gamification concept. *9th International Conference on Design and Emotion 2014: The Colors of Care*, 616–622.

Cabrera-Mejía, J. B., Martínez-Suárez, P. C., Ramírez-Coronel, A. A., Montánchez-Torres, M. L., Torracchi-Carrasco, E., & Castro-Ochoa, F. L. (2020). Analysis of problem-based learning impact on academic performance according to the forgotten(Fuzzy) effects theory. *Archivos Venezolanos de Farmacologia y Terapeutica*, *39*(5), 651–659.

Dhir, A., Gahwaji, N. M., & Nyman, G. (2013). The role of the iPad in the hands of the learner. *Journal of Universal Computer Science*, *19*(5), 706–727.

Dwi Laksana, S., Arif, Z., Ariyanto, A., & Saputro, A. D. (2024). Comic Strip Media as an Innovative Media for Adab Learning. *Journal of Educational Technology and Instruction*, *3*(1), 79–877.

Dwi Putra, S., & Yasin, V. (2021). MDA Framework Approach for Gamification-Based Elementary Mathematics Learning Design. *International Journal of Engineering, Science and Information Technology*, *1*(3), 35–39. https://doi.org/10.52088/ijesty.v1i3.83

Endah Retnowati, Yazid Fathoni, O. C. (2018). Mathematics Problem Solving Skill Acquisition: Learning By Problem Posing Or By Problem Solving. *Jurnal Cakrawala Pendidikan*, *37*(1), 1–47. https://doi.org/https://doi.org/10.21831/cp.v37i1.18787

Faizah, A'yuni, K., & Al-Hakim, M. F. (2024). Development Of The Alibaba Media Game Assisted With The Make-A-Match Model In Arabic Language Learning To Improve The Vocabulary Mastery Of Class Iv Primary School Students. *Journal of Education*, *7*(1), 55–65.

Fathurrahman, M. W., & Herdiani, A. (2024). *Pemanfaatan Gamifikasi Learning Managament System Dengan MDA Framework Berdasarkan ARCS Model*. *11*(4), 4545–4557.

Fitriyanto, S. (2016). Peran Metakognisi Untuk Mendukung Kemampuan Pemecahan Masalah Dalam Pembelajaran Fisika. *Prosiding Seminar Nasional Pendidikan*, 377–386. http://eprints.umk.ac.id/270/1/53_-_64.PDF

Gharibi, R., & Malekzadeh, M. (2017). Gamified Incentives: A Badge Recommendation Model to Improve User Engagement in Social Networking Websites. *International Journal of Advanced Computer Science and Applications*, *8*(5), 272–278. https://doi.org/10.14569/ijacsa.2017.080533

Gultom, S., . B., Ampera, D., Endriani, D., Jahidin, I., & Tanjung, S. (2022). Traditional Games in Cultural Literacy to Build the Character of Elementary School Students during the COVID-19 Pandemic. *NeuroQuantology*, *20*(5), 704–712. https://doi.org/10.14704/nq.2022.20.5.nq22226

Hakak, S., Noor, N. F. M., Ayub, M. N., Affal, H., Hussin, N., ahmed, E., & Imran, M. (2019). Cloud-assisted gamification for education and learning – Recent advances and challenges. *Computers and Electrical Engineering*, *74*, 22–34. https://doi.org/10.1016/j.compeleceng.2019.01.002

Hamzah, W. M. A. F. W., Ali, N. H., Saman, M. Y. M., Yusoff, M. H., & Yacob, A. (2015). Influence of gamification on students' motivation in using E-learning applications based on the motivational design model. *International Journal of Emerging Technologies in Learning*, *10*(2), 30–34. https://doi.org/10.3991/ijet.v10i1.4355

Handayani, T., Hamzah, A., & Saskia, D. (2021). Development Of Modified Domino Card Learning Media In Social Science Subjects On The Material Types Of Work For Grade Iii Students Of Madrasah Ibtidaiyah. *Al-Bidayah : Jurnal Pendidikan*

Dasar Islam, *13*(2), 367–382. https://doi.org/10.14421/al-bidayah.v13i2.693

Hidayat, F., & Nizar, M. (2021). Model Addie (Analysis, Design, Development, Implementation and Evaluation) Dalam Pembelajaran Pendidikan Agama Islam. *Jurnal Inovasi Pendidikan Agama Islam (JIPAI)*, *1*(1), 28–38. https://doi.org/10.15575/jipai.v1i1.11042

Hidayati Rofiah, N., Sinta, T. N. A., & Dewi, R. (2024). Development Of Articulate Storyline Media For Enhancing Learning Outcomes In Natural And Social Sciences Among Elementary School Students. *Al-Bidayah : Jurnal Pendidikan Dasar Islam*, *16*(1), 19–40. https://doi.org/10.14421/al-bidayah.v16i1.9559

İDawati, İ., Setyosari, P., Kuswandi, D., & Ulfa, S. (2020). The Effects of Problem Solving Method and Cognitive Flexibility in Improving University Students' Metacognitive Skills. *Journal for the Education of Gifted Young Scientists*, 657–680. https://doi.org/10.17478/jegys.652212

Jagust, T., Boticki, I., Mornar, V., & So, H. J. (2017). Gamified Digital Math Lessons for Lower Primary School Students. *Proceedings - 2017 6th IIAI International Congress on Advanced Applied Informatics, IIAI-AAI 2017*, 691–694. https://doi.org/10.1109/IIAI-AAI.2017.17

Khotimah, N. (n.d.). *Hasil Wawancara Penelitian gamimath*.

Kotob, M. M., & Ibrahim, A. (2019). *Gamification: The Effect on Students' Motivation and*. 22.

Laksana, S. D. (2017). Improving The Quality Of Learning Mathematics Through Innovative Learning Media. *Jurnal Pendidikan Dan Pengajaran Undiksha*, *50*(2), 79–85.

Laksana, S. D., Ariyanto, A., Tajab, M., Syam, A. R., & Sumaryanti, L. (2024). Comic Strip Media Assisted by Digital Gamification: Increasing Student Behavior Targets and User Engagement in the Learning Process. *E3S Web of Conferences*, *500*. https://doi.org/10.1051/e3sconf/202450005006

Losenno, K. M., Muis, K. R., Munzar, B., Denton, C. A., & Perry, N. E. (2020). The dynamic roles of cognitive reappraisal and self-regulated learning during mathematics problem solving: A mixed methods investigation. *Contemporary Educational Psychology*, *61*(April), 101869. https://doi.org/10.1016/j.cedpsych.2020.101869

Middleton, H. (2009). Problem-Solving In Technology Education As An Approach To Education For Sustainable Development. *International Journal of Technology and Design Education*, *19*(2), 187–197. https://doi.org/10.1007/s10798-008-9075-3

Okpatrioka. (2023). Research And Development (R & D) Penelitian yang Inovatif dalam Pendidikan. *Jurnal Pendidikan, Bahasa Dan Budaya*, *1*(1), 86–100.

Prasannakumar, S. (2018). Improving Working Memory in Science Learning through Effective Multisensory Integration Approach. *International Journal Of Mind, Brain & Cognition*, *9*(1–2), 11.

Prawiradilaga, D. S. (2012). *Wawasan Teknologi Pendidikan* (1st ed.). Kencana Prenada Media Group.

Razami, H. H., & Ibrahim, R. (2021). Distance Education during COVID-19 Pandemic: The Perceptions and Preference of University Students in Malaysia Towards Online Learning. *International Journal of Advanced Computer Science and Applications*, *12*(4), 118–126. https://doi.org/10.14569/IJACSA.2021.0120416

Rina, N., Suminar, J. R., Damayani, N. A., & Hafiar, H. (2020). Character Education Based On Digital Comic Media. *International Journal of Interactive Mobile Technologies (IJIM)*, *14*(03), 107. https://doi.org/10.3991/ijim.v14i03.12111

Sieckmann, F., Petrusch, N., & Kohl, H. (2020). Effectivity of Learning Factories to convey problem solving competencies. *Procedia Manufacturing*, *45*(2019), 228–233. https://doi.org/10.1016/j.promfg.2020.04.099

Spector, J. M., Merrill, M. D., Elen, J., & Bishop, M. J. (Eds.). (2014). *Handbook of {Research} on {Educational} {Communications} and {Technology}*. Springer New York. https://doi.org/10.1007/978-1-4614-3185-5

Sri Suryanti, H. H., & Supeni, S. (2019). A problem based learning (PBL) model in developing students' soft skills aspect. *International Journal of Higher Education*, *8*(8), 62–69. https://doi.org/10.5430/ijhe.v8n8p62

Srimuliyani. (2023). Menggunakan Teknik Gamifikasi untuk Meningkatkan Pembelajaran dan Keterlibatan Siswa di Kelas. *Educare*, *1*(1), 30.

Su, C. H., & Cheng, C. H. (2015). A mobile gamification learning system for improving the learning motivation and achievements. *Journal of Computer Assisted Learning*, *31*(3), 268–286. https://doi.org/10.1111/jcal.12088

Sulistiyowati, E. (2024). Peran Blog Sebagai Media Pembelajaran di Madrasah Ibtidaiyah. *Al-Bidayah : Jurnal Pendidikan Dasar Islam*, *3*(2). https://doi.org/10.14421/al-bidayah.v3i2.8998

Tambunan, H. (2019). The Effectiveness of the Problem Solving Strategy and the Scientific Approach to Students' Mathematical Capabilities in High Order Thinking Skills. *International Electronic Journal of Mathematics Education*, *14*(2), 293–302. https://doi.org/10.29333/iejme/5715

Tang, J., & Zhang, P. (2019). Exploring the relationships between gamification and motivational needs in technology design. *International Journal of Crowd Science*, *3*(1), 87–103. https://doi.org/10.1108/ijcs-09-2018-0025

Torang Siregar. (2023). Stages of Research and Development Model Research and Development (R&D). *DIROSAT: Journal of Education, Social Sciences & Humanities*, *1*(4), 142–158. https://doi.org/10.58355/dirosat.v1i4.48

V., I., A., A., & V., V. (2015). Gamification, Virality and Retention in Educational Online Platform. *International Journal of Advanced Computer Science and Applications*, *6*(4), 11–18. https://doi.org/10.14569/ijacsa.2015.060402

Wang, A. I., & Lieberoth, A. (2016). The effect of points and audio on concentration, engagement, enjoyment, learning, motivation, and classroom dynamics using kahoot! *Proceedings of the European Conference on Games-Based Learning*, *2016-Janua*(October), 738–746.

Wijaya, E. Y., Sudjimat, D. A., & Nyoto, A. (2016). Transformasi Pendidikan Abad 21 Sebagai Tuntutan Pengembangan Sumber Daya Manusia di Era Global. *Prosiding*

Seminar Nasional Pendidikan Matematika, *1*, 263–278.

Yansen, D., Putri, R. I. I., Zulkardi, & Fatimah, S. (2019). Developing pisa-like mathematics problems on uncertainty and data using asian games football context. *Journal on Mathematics Education*, *10*(1), 37–46. https://doi.org/10.22342/jme.10.1.5249.37-46

Yew, E. H. J., & Goh, K. (2016). Problem-Based Learning : An Overview of its Process and Impact on Learning. *Health Professions Education*, *2*(2), 75–79. https://doi.org/10.1016/j.hpe.2016.01.004

Zhao, B., & Anas, N. (2023). Development Of A Learning Medium Based On Efas Traditional Game (Engklek Fun And Smart) To Improve Students' Communication Ability In Thematic Learning. *Al-Bidayah : Jurnal Pendidikan Dasar Islam*, *15*(1), 165–182. https://doi.org/10.14421/albidayah.v15i1.818