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DEVELOPING QUIZIZZ-BASED MATHEMATICS LEARNING MEDIA ON EXPONENTS TO IMPROVE HIGH SCHOOL STUDENTS' LEARNING OUTCOMES

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ABSTRACT
This study aims to develop Quizizz-based mathematics learning media on exponents to improve high school students' learning outcomes. This research employed a Research and Development (R&D) method using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation stages (Sugiyono, 2023). Data were collected through expert validation (media and material experts) and learning outcome tests in the form of pretests and posttests. The research subjects were 35 tenth-grade students of SMAN 16 Bandar Lampung in the 2025/2026 academic year, selected using a random sampling technique. The results showed that the average score increased from 59.14 in the pretest to 87.29 in the posttest. Furthermore, the statistical test using the Wilcoxon Signed-Rank Test indicated a significant difference between pretest and posttest results ($p < 0.05$). This finding demonstrates that the developed Quizizz-based learning media is effective in improving students' learning outcomes.
Keywords: exponent; learning media; quizizz

ABSTRAK
Penelitian ini bertujuan untuk mengembangkan media pembelajaran matematika berbasis Quizizz pada eksponen untuk meningkatkan hasil belajar siswa SMA. Penelitian ini menggunakan metode Penelitian dan Pengembangan (R&D) dengan model ADDIE, yang terdiri dari tahapan analisis, desain, pengembangan, implementasi, dan evaluasi (Sugiyono, 2023). Data dikumpulkan melalui validasi ahli (ahli media dan materi) dan tes hasil belajar berupa pretest dan posttest. Subjek penelitian adalah 35 siswa kelas 10 SMAN 16 Bandar Lampung tahun ajaran 2025/2026, yang dipilih menggunakan teknik random sampling. Hasil penelitian menunjukkan bahwa nilai rata-rata meningkat dari 59,14 pada pretest menjadi 87,29 pada posttest. Lebih lanjut, uji statistik menggunakan Uji Peringkat Bertanda Wilcoxon menunjukkan perbedaan signifikan antara hasil pretest dan posttest ($p < 0,05$). Temuan ini menunjukkan bahwa media pembelajaran berbasis Quizizz yang dikembangkan efektif dalam meningkatkan hasil belajar siswa.
***Kata kunci**:* eksponen; media pembelajaran; quizizz

Introduction

The rapid development of technology in today's digital era has brought about significant changes in various aspects of life, including education. Technology now functions not only as a tool but has become a crucial element supporting the success of the learning process (Putra & Pratama, 2023). The integration of technology into teaching and learning activities has also encouraged the emergence of various

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innovative learning media that are interactive and adaptive to the needs of 21st-century students (Nugroho et al., 2025). One subject that requires a technology-based approach is mathematics, as its abstract nature often creates learning difficulties and anxiety for students. Based on observations at SMAN 16 Bandar Lampung, the use of learning media is still relatively limited, especially for exponent material. The learning process generally still focuses on conventional methods such as copying material from the blackboard, reading printed books, using PowerPoint, or working on student worksheets (LKPD). This condition causes learning activities to tend to be monotonous and less interesting, so that student participation in understanding concepts is low (Susanti et al., 2024). In this context, the development of interactive learning media that combines text, images, quizzes, assessments, and animation is very necessary. Quizizz-based mathematics learning media such as is still rarely implemented at SMAN 16 Bandar Lampung, even though several studies show that mathematics learning in Indonesia is still dominated by traditional methods with a low level of technology utilization (Jupri, 2018). Therefore, the development of web-based learning media is expected to be a solution to improve the quality of the teaching and learning process.

The use of digital technology can create an engaging and interactive learning environment, aligning with the characteristics of today's students. One relevant application of technology is the use of game-based learning platforms (Ambarwati et al., 2021). Quizizz is an educational game-based learning application that has been widely used at various levels of education. Through this platform, teachers can deliver material and conduct evaluations through fun, interactive quizzes, thus encouraging active student engagement in the learning process (Maula, 2021). Given the nature of students who tend to be responsive to technology, using Quizizz can be an effective and engaging alternative in teaching exponential material. Previous research also supports the effectiveness of digital learning media in improving mathematics learning outcomes. For example, research by Assidiq et al. (2025) showed that interactive web-based learning media for algebra can improve student learning outcomes by up to 25%. Meanwhile, Karlina (2024) found that implementing mobile learning in geometry learning can increase learning motivation by up to 78%. However, these studies have not specifically focused on exponents and have not integrated gamification elements. This creates a research gap that requires further study, as the topic of exponents requires a different conceptual understanding than other mathematics materials.

The novelty of this study lies in its specific focus on exponent concepts combined with the integration of gamification through digital learning media, which has not been addressed in previous research. While earlier studies by Assidiq et al. And Karlina demonstrated the effectiveness of digital and mobile learning in algebra and geometry, they did not explore exponent material nor incorporate gamified elements to enhance engagement. This research therefore contributes a new approach by designing interactive, game-based learning media specifically tailored to exponents, addressing both conceptual understanding and student motivation simultaneously, and filling the identified gap in the existing literature. While the use of gamification platforms has been extensively researched, the integration of Quizizz's interactive features with visualizations of abstract exponent concepts remains limited. Most studies focus solely on motivation, while this study

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specifically designs question structures that address common student misconceptions about exponents, such as multiplication of powers and negative exponents.

Research Methods

This study applies a Research and Development (R&D) approach with a quantitative orientation, which aims to develop and test the effectiveness of a product in the form of Quizizz-based mathematics learning media on exponent material. According to Sugiyono (2013), the development research method is an approach used to produce a product and assess its level of success in real application. The product developed in this study is an interactive learning media based on Quizizz, which is designed for grade X students at SMAN 16 Bandar Lampung on exponent material. The stages of the development process and the design of the learning media can be seen in Figure 1 below.

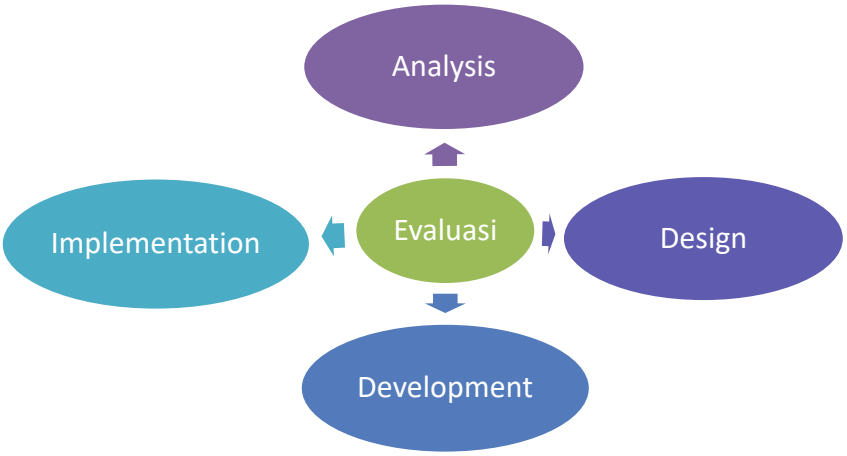

Figure 1. Stages of the ADDIE Research Development Model

Figure 1 illustrates the stages of the ADDIE development model, which consists of five interconnected phases: Analysis, Design, Development, Implementation, and Evaluation. The process begins with the Analysis stage, where learning needs are identified, problems faced by students are examined, and student characteristics related to exponent material are analyzed. Next, in the Design stage, the learning media is planned, including the preparation of materials, questions, and an engaging and interactive Quizizz-based interface. The Development stage follows, involving the creation of the learning media product based on the designed plan, including the development of content, features, and evaluation instruments. After the product is developed, the Implementation stage is carried out by testing the learning media with grade X students to observe its application in real classroom settings. Finally, the Evaluation stage is conducted to assess the effectiveness of the developed media through expert validation and student learning outcomes, allowing identification of strengths and weaknesses for further improvement. These five stages form a systematic and structured cycle in developing effective learning media that meets students' needs.This research was conducted with 35 students of grade 10 at SMAN 16 Bandar Lampung. Data were collected through validation tests by subject matter and media experts, as well as pretests and posttests to determine the effectiveness

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of the developed learning media. The data collected focused on the media's effectiveness in improving student learning outcomes.

The research instruments consisted of expert validation and learning outcome tests. The validation data were analyzed using assessment categories adapted from Nesri and Kristanto (2020) with the following criteria. The assessment categories and validation criteria can be seen in Table 1 below.

Table 1. Validity Criteria

No	Score	Category
1	86 % - 100 %	Very valid
2	71 % - 85 %	Valid
3	51 % - 70 %	Less valid
4	< 50 %	Not valid

Results and Discussion

Analysis (analisis)

The analysis stage involves identifying needs to find problems that require solutions (Waruwu, 2024). The analysis process was conducted at SMAN 16 Bandar Lampung, located on Jl. Darussalam, Susunan Baru, Tj. Karang Bar District, Bandar Lampung City, Lampung 35111. Based on observations and interviews, it was found that mathematics learning outcomes, particularly in exponents, were still relatively low. The study subjects consisted of 35 10th-grade students in the 2025/2026 academic year. The analysis showed that learning in exponents was still dominated by conventional methods, such as lectures and practice problems from textbooks. The learning media used were also limited to printed books, PowerPoint presentations, and student worksheets (LKPD). This situation made learning activities tend to be monotonous and unengaging, resulting in low student participation and motivation. Furthermore, student learning outcomes in exponents did not meet the minimum passing grade (KKM). Judging from student characteristics, 10th-grade students at SMAN 16 Bandar Lampung are a generation accustomed to using digital technology in their daily lives. This presents an opportunity to develop interactive technology-based learning media. One suitable alternative is the Quizizz app, which integrates game-based learning elements with fun and interactive learning evaluation.

Design (desain)

The design stage is the second step in the ADDIE development model (Sugiyono, 2013) after the analysis stage. This stage aims to develop an initial concept for the learning media based on the results of the needs analysis, student characteristics, and the desired learning objectives. At this stage, researchers began developing the conceptual and technical design for the Quizizz-based mathematics learning media. The media design was designed to have an attractive appearance, easy navigation, and interactive features. The design principles emphasized the integration of visual aspects, content, and user interaction, so that the media could increase student engagement and motivation. Furthermore, this design was also adapted to the technology-based learning context commonly used by digital

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generation students. The following are some of the design stages that were implemented on Figure 2.

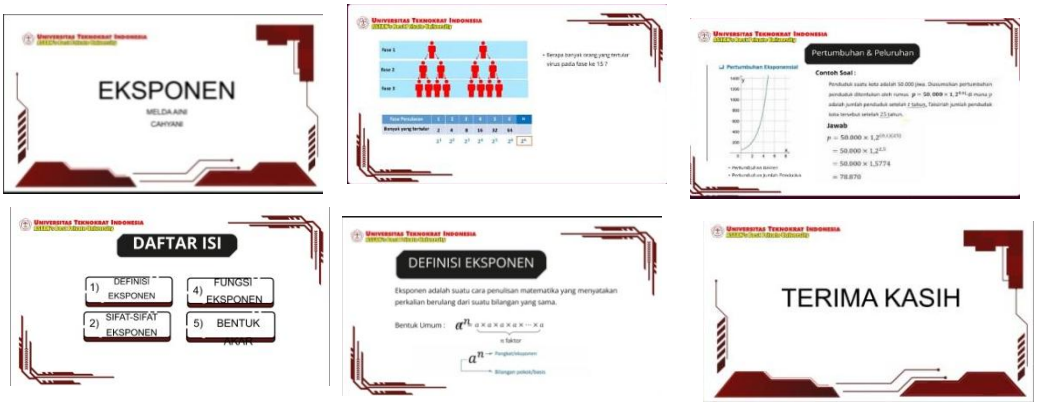

Figure 2. Exponential Material on Quizizz

Figure 2 shows the exponent material presented through the Quizizz application in the form of presentation slides. The material is structured systematically and attractively, beginning with an opening slide, followed by slides containing the definition of exponents, example problems, and a table of contents to facilitate learning navigation.

Each slide is designed with colorful and interactive visuals, complemented by graphic elements such as frames and icons to attract students' attention. Furthermore, there is a closing slide with a "thank you" message to mark the end of the material.

Overall, this image demonstrates that Quizizz is not only used as an evaluation tool but also as a structured, engaging medium for delivering material that supports a more effective understanding of exponent concepts. Next, the classroom learning stage consists of several displays In Figure 3.

Figure 3. Classroom Learning Environment

Figure 3 shows the classroom learning environment, where students appear to be participating in the learning activities by paying attention to a display projected at the front of the class. This illustrates the integration of technology into the learning process, which involves active student participation in Figure 4.

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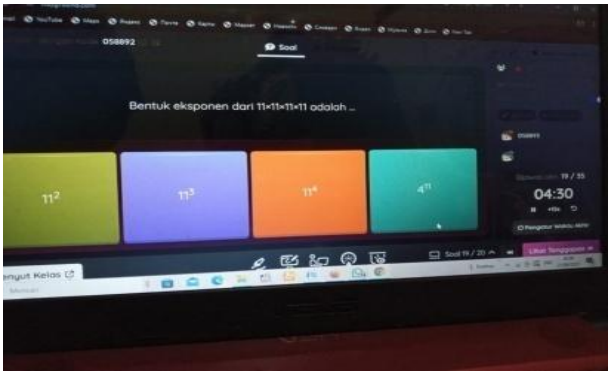

Figure 4. Displays The Question Interface In The Quizizz App

Figure 2 displays the question interface in the Quizizz app, where students are presented with questions with multiple answer choices presented in an engaging and interactive manner. This display supports student engagement in the digital learning evaluation process in Figure 5.

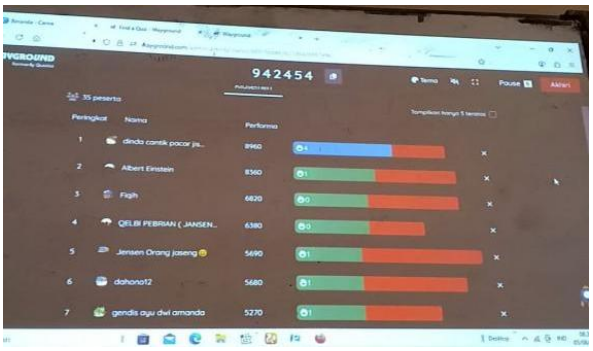

Figure 5. Implementation Of Classroom Learning Using The Quizizz

Figure 3 shows the implementation of classroom learning using the Quizizz app as an interactive learning medium. The first image (top left) displays the results of students' quizzes, presented as a bar graph, showing each participant's score in real time. This display provides an overview of the students' level of understanding of the material being studied. In Figure 6.

Figure 6. Leaderboard Displaying The Three Participants

Figure 6 shows a leaderboard displaying the three participants with the highest scores. This feature creates a healthy competitive atmosphere and can increase student motivation to learn.

Overall, these four images represent the use of the Quizizz app to support interactive, engaging, and technology-based learning in the classroom.

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Development (pengembangan)

The development stage is the process of creating and developing learning media according to the design developed in the previous stage. At this stage, researchers began to translate the conceptual design into a tangible product, a Quizizz-based mathematics learning medium for exponents. This medium was used during four learning sessions in grade 10 (PURNAMASARI, 2020). The material developed in the medium covered several topics, including the definition of exponents, the properties of exponents, exponential functions, and the application of the concepts of growth and decay in everyday life. Each section of the material was packaged in an interactive quiz with elements of educational games (game-based learning), thereby increasing student engagement and motivation. In addition to the media development process, this stage also involved the preparation and validation of research instruments. The instruments used included sheets from material experts and media experts. The validation process was carried out to ensure the appropriateness of the material content, clarity of presentation, ease of use, and the suitability of the media for the learning objectives. The following are the results of the validation assessment by material experts and media experts in Table 2.

Table 2. Results of the Material and Media Validation Sheet

No	Aspect	Expert Type	Score	Average	Result	Category
1	Content suitability	Subject Matter Expert	4, 4, 4, 4, 4, 4	4		
2	Question construction	Subject Matter Expert	5, 4.4, 5, 4, 4, 4	4.4		
3	Language	Subject Matter Expert	4, 4, 4, 4	4		
4	Answer key	Subject Matter Expert	5, 5, 5	5	4.35	Valid
5	Content suitability	Media Expert	4, 3.8, 4, 4, 4, 3	3.8		
6	Language	Media Expert	3, 3, 3, 3	3		
7	Media View	Media Expert	4, 3.8, 3, 4, 4, 4	3.8		
8	Utility	Media Expert	4, 4.8, 5, 5, 5, 5	4.8	3.85	Valid

The category is derived from Table 2, which presents the results of the material and media validation. However, in the methodology section, the assessment results should be presented in percentage form instead of averages to ensure clearer interpretation."

Implementation (pelaksanaan)

The implementation stage is the process of applying the developed learning media into teaching and learning activities (Rangkuti et al., 2023). In this stage, researchers implemented learning using Quizizz-based media, which had undergone a validation process. The trial was conducted on 35 grade 10 students of

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SMAN 16 Bandar Lampung The learning process was conducted over several meetings, utilizing Quizizz sas an interactive medium for delivering exponent material. Students were given a pretest to assess their initial understanding of the material. After the learning activities were completed, a posttest was administered to determine improvements in student learning outcomes after using the developed media.

To analyze the learning outcomes of the media implementation, statistical tests were conducted using SPSS version 25 software. The analysis began with a normality test to determine whether the data were normally distributed. If the data were not normally distributed, the Mann-Whitney test was used as an alternative to test for differences in learning outcomes between the pretest and posttest. The following are the results of the statistical tests obtained through data processing with SPSS 25 in Table 3

Table 3. Results of the Normality Test for Pretest and Posttest Data

Data	Kolmogorov-Smirnov Sig.	Shapiro-Wilk Sig.	Information
Pretest	0,021	0,03	Abnormal
Posttest	0,006	0,06	Abnormal

Based on the results of the normality test, the pretest data were 0.021 and 0.03, respectively, while the posttest data were 0.006 and 0.006, respectively. All significance values were below the 0.05 threshold, thus concluding that the pretest and posttest data were not normally distributed. Therefore, analyzing differences in student learning outcomes cannot be conducted using parametric tests such as the sample t-test. As an alternative, a non-parametric test, the Mann-Whitney U test, was used, which is more appropriate to the characteristics of the data. This test aims to determine whether there are significant differences between learning outcomes using the Quiziz-based learning media that have been developed. The results of the Mann-Whitney U test are shown in the following Table 4.

Table 4. Mann-Whitney Test Results for Pretest and Posttest

Test Statistics	**Mark**
Nilai Mann–Whitney U	4,000
Nilai Wilcoxon W	634,000
Nilai Z	-7,198
Signifikansi Asimtotik (2-tailed)	0,000

Based on the results presented in table 5, the Asymp. Sig. (2-tailed) value was 0.000, which is smaller than the significance level of 0.05. This finding indicates that there is a significant difference between the pretest and posttest results of students. Thus, it can be concluded that the use of the Quizizz-based mathematics learning media developed has a positive influence on improving student learning outcomes.

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This means that there is a real increase in learning outcomes after the application of the media in the learning process in Table 5.

Table 5. Average Values of the Results of the Pretest and Posttest

Data	N	Mean	Standard Deviation	The highest score	Lowest Value
Pretest	35	59,14	6,47	70	45
Posttest	35	87,29	7,89	100	70

Based on the data in Table 5, the descriptive analysis results show that the average student pretest score was 59.14 with a standard deviation of 6.47, while the average posttest score increased to 87.29 with a standard deviation of 7.89. The highest pretest score was 70, while the lowest was 45. Meanwhile, in the posttest, the highest student score reached 100 and the lowest was 70 The average increase of 28.15 points reflects a significant improvement in learning outcomes after implementing Quizizz-based mathematics learning media. Despite a slight increase in the standard deviation, the data distribution shows a positive shift, with the majority of students achieving high scores after using the media.

Evaluation (evaluasi)

The evaluation phase in this study includes two types: formative and summative. Formative evaluation is conducted during the product development process, aiming to assess and make revisions based on input from material and media expert validation. Meanwhile, summative evaluation is conducted after the learning media has been implemented in the classroom to determine its effectiveness in improving student learning outcomes. The analysis shows that Quiziz-based learning media has proven effective in improving student learning outcomes in the exponent material. This media is not only visually appealing but also features interactive elements of educational games (game-based learning) that can increase student motivation and engagement in the learning process. Furthermore, Quiziz's immediate feedback feature helps students quickly identify errors, making learning more meaningful. These findings align with research (Rangkuti et al., 2023), which states that the use of interactive learning media can increase student participation and motivation. Similarly, (Ambarwati et al., 2021) also confirmed that the implementation of game-based learning such as Quizizz can significantly increase student engagement in the classroom. Thus, the evaluation results in this study show that the Quizizz-based learning media developed is not only valid and practical, but also effective in helping students understand mathematical concepts and improve significantly.

Conclusion and Suggestion

Media Feasibility: The learning media developed using the ADDIE model is declared Highly Feasible for educational use. This is supported by the material expert validation score of 4.35 (92%) and the media expert validation score of 3.85 (88%). The media is considered capable of presenting abstract exponential concepts in an interactive and systematic manner. Effectiveness on Learning Outcomes:

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There was a significant improvement in student learning outcomes after utilizing the Quizizz-based media. This is evidenced by the increase in the average score of grade X students at SMAN 16 Bandar Lampung, rising from 59.14 in the pretest to 87.29 in the posttest. Statistical Significance: The hypothesis testing using the Mann-Whitney test yielded an Asymp. Sig. (2-tailed) value of 0.000 < 0.05. This statistically proves that the use of Quizizz-based learning media is effective in improving student learning outcomes in exponent material compared to the previously used conventional methods.

For Mathematics Teachers It is recommended to optimize the use of the Quizizz platform not only as a final evaluation tool but also as an interactive delivery medium (lesson mode) to maintain motivation and provide instant feedback, which is crucial for students in understanding exponential rules. For Schools, given the effectiveness of this digital-based media, schools are expected to support the provision of stable technological infrastructure and internet access to facilitate teachers in implementing IT-based learning innovations. For Future Researchers, it is suggested to expand the scope of research to other mathematics topics that possess similar abstract characteristics. Further research should be conducted regarding the influence of Quizizz media on other psychological variables, such as learning interest or the reduction of math anxiety. It is recommended to integrate more complex Quizizz features to observe their impact on students' Higher Order Thinking Skills (HOTS).

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