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Development of *Turnreative* Media to Improve Understanding of Derivatives in Mathematics Learning

Gelcy Vania Auliani[1], Merlisa[2], Rizma Nurfajriah Qolbi[3], Zulhilmi Gibran Pramudhia[4], Elsa Susanti[5*], Zulkardi[6], Budi Mulyono[7], Meryansumayeka[8]

[1]Sriwijaya University, Palembang, Indonesia, gelcyvaniaa@gmail.com
[2]Sriwijaya University, Palembang, Indonesia, merlisa768@gmail.com
[3]Sriwijaya University, Palembang, Indonesia, rizmanurfajriah@gmail.com
[4]Sriwijaya University, Palembang, Indonesia, zulhilmigp@gmail.com
[5*]Sriwijaya University, Palembang, Indonesia, elsasusanti@fkip.unsri.ac.id
[6]Sriwijaya University, Palembang, Indonesia, zulkardi@unsri.ac.id
[7]Sriwijaya University, Palembang, Indonesia, budimulyono@fkip.unsri.ac.id
[8]Sriwijaya University, Palembang, Indonesia, meryansumayeka@fkip.unsri.ac.id
**corresponding author*

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ABSTRACT

This research develops a game-based interactive learning media called *Turnreative*, which is valid, effective, and practical for improving students' understanding of algebraic function derivatives. The development follows the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Data collection instruments include validation sheets, practicality sheets, pre-test and post-test questions, and interviews. The collected data were analyzed using descriptive quantitative and qualitative techniques to determine the validity, practicality, and effectiveness of the media. The subjects were three public high school students in Palembang. Validation results showed the media was very valid, with scores of 82.5% from media experts and 89.5% from material experts. In terms of practicality, teachers gave 93.52% and students 93.33%. A small-scale trial indicated a significant increase in student understanding, from an average pre-test score of 33.33 to 90 in the post-test. The results conclude that *Turnreative* is feasible to use as a learning medium for algebraic function derivatives and has proven to be effective and efficient in enhancing students' mathematical problem-solving skills.

Keywords**:** *ADDIE, derivative, educational game, learning media, Turneative.*

Pengembangan Media *Turnreative* untuk Meningkatkan Pemahaman Turunan dalam Pembelajaran Matematika

ABSTRAK

Penelitian ini mengembangkan media pembelajaran interaktif berbasis permainan yang disebut Tunreative, yang valid, efektif, dan praktis untuk meningkatkan pemahaman siswa tentan turunan fungsi aljabar. Pengembangan ini mengikuti model ADDIE (Analisis, Desain, Pengembangan, Implementasi, Evaluasi). Alat pengumpulan data meliputi lembar validasi, lembar kepraktisan, soal pre-tes dan post-tes, serta wawancara. Subjek penelitian

adalah tiga siswa SMA negeri di Palembang. Hasil validasi menunjukkan media ini sangat valid, dengan skor 82,5% dari ahli media dan 89,5% dari ahli materi. Dalam hal kepraktisan, guru memberikan skor 93,52% dan siswa 93,33%. Uji coba skala kecil menunjukkan peningkatan signifikan dalam pemahaman siswa, dari skor rata-rata pre-tes 33,33 menjadi 90 pada post-tes. Hasil ini menyimpulkan bahwa *Turnreative* layak digunakan sebagai media pembelajaran untuk turunan fungsi aljabar dan terbukti efektif dan efisien dalam meningkatkan keterampilan pemecahan masalah matematika siswa.

Kata Kunci**:** *ADDIE, media pembelajaran, permainan edukatif, Turnreative, turunan.*

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1. Introduction

21st-century education requires teachers to be able to create graduates who have abilities that will equip students to face the process of life (Fadilah et al., 2024). Mathematics is knowledge that humans can use to solve problems in everyday life (Prastika et al., 2021). In line with the opinion of Dwijayani (2019) that what is interesting about learning mathematics is that it can develop the mind in solving a problem that requires high thinking skills. The ultimate goal of mathematics education is to equip students with the ability to apply mathematical ideas effectively in various contexts, to support the development of quality human resources (Hunter, 2021). Not a few students feel that understanding math is not easy. Algebra is one of the basic sciences of mathematics that emphasizes students' skills to manipulate symbols and rational abilities in solving a problem (Sutiarso et al., 2018). One of the challenging materials from algebraic material is the derivative of algebraic functions.

Understanding the concept of derivatives is very important because it is the basis for solving various mathematical problems, both in academic contexts and everyday life. Mastery of this concept supports students in thinking critically and solving problems more systematically (Kunwar & C, 2023). Derivative material is essential to be taught, analyzed, and understood by students, and this material is a foundation material that includes basic concepts related to other materials (Wihinda et al., 2020). However, derivatives are one of the mathematical materials that are often considered difficult by students, because they require an understanding of abstract concepts and high analytical skills (Wu et al., 2021). By visualizing derivatives in the form of geometric representations, students can more easily understand the concept and its meaning (Stewart, 2015).

A good learning design and well-planned learning techniques, as well as learning materials made according to the level of cognitive understanding, will not mean a lesson if the media used is not appropriate (Widodo & Wahyudin, 2018). Many reasons contribute a factor in the low mathematics learning outcomes of students, one of which is the learning media used by teachers (Amelia, 2021). Meanwhile, the function of this learning medium is to facilitate learning activities so that the desired learning objectives can be achieved optimally (Andriani et al., 2019). On the other hand, the learning approach used by most teachers is still conventional. Many rely on the lecture method with blackboard media and textbooks, so the learning atmosphere tends to be monotonous (Septianing et al., 2024). According to Wu et al.

(2021), one of the key obstacles in mathematics education in East Asia is the strong dependence on conventional teaching approaches that emphasize memorization and repetitive practice, potentially limiting the growth of deeper and more effective learning strategies.

This condition is reflected in research findings (Rajagukguk, 2024), which show that learning outcomes have not reached the optimal level because students lack understanding of the concept of derivatives of algebraic functions. The lack of understanding of the concept is caused by a lack of interest in learning. The impact of the lack of interest in learning is the lack of student concentration in following the learning process (Wardah et al., 2023). This certainly has an impact on learning outcomes. To overcome these challenges, one approach that has proven effective is the use of interactive learning media, because it can increase student motivation and encourage them to use more in-depth learning strategies (Wu et al., 2021). Wulandari (2020) confirms that student motivation to learn mathematics can be increased through the use of interactive learning media. Understanding and learning concepts are the main things that exist in the process of learning mathematics (Faizah et al., 2024; Pratiwi & Shodikin, 2022). This is in line with the views of (Rajagukguk, 2024), who argue that students can benefit greatly from interacting with interactive learning media in understanding mathematical concepts.

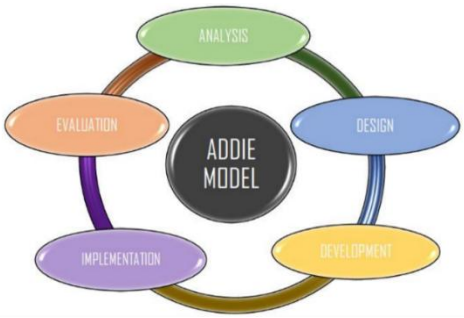
As an effort to revive the spirit of learning mathematics through a more creative and meaningful approach, the moment of the International Day of Mathematics (IDM) in 2025 is the right opportunity. With the theme "Mathematics, Art, and Creativity", IDM invites students, educators, and the general public to convey creative ideas through works that combine elements of mathematics with art and creativity. This theme opens space for the development of learning media that is not only relevant to the material, but also able to attract attention and improve students' understanding of the material.

Several previous studies have explored the development of learning media to improve students' understanding of algebraic function derivatives. For instance, Marzuki et al. (2022) developed digital learning tools to enhance students' critical thinking skills in derivative applications, but these media were limited in terms of interactivity and contextual engagement. Meanwhile, Claudea (2021) successfully designed an educational game for geometry learning that significantly increased students' motivation and learning outcomes, showing the potential of game-based learning in mathematics. In addition, Griseldis et al. (2024) demonstrated that interactive multimedia could improve conceptual understanding in basic mathematics topics such as integer operations. However, few studies have integrated visual elements, educational games, and participatory activities into one unified learning media specifically focused on derivative concepts.

In response to this gap, the present study develops *Turnreative*, a creative and game-based interactive learning medium designed to enhance students' understanding of algebraic function derivatives at the high school level. This research not only examines the validity, practicality, and effectiveness of *Turnreative*, but also aims to provide an innovative and engaging model of game-based learning that integrates visual and participatory elements to strengthen conceptual understanding in mathematics. Furthermore, the findings are expected to enrich the literature on educational game media and serve as a reference for teachers in developing creative learning innovations.

2. Method

This research applies a Research and Development (R&D) strategy with a five-stage development model of Analysis, Design, Development, Implementation, and Evaluation (ADDIE). The following illustrates the stages in the ADDIE development model.



Source: (Wibawa et al., 2021)

Figure 1. ADDIE Stages

Figure 1 shows that each stage in the ADDIE development model is interrelated and arranged systematically. The purpose of this analysis is to find out how much difficulty students face in understanding the concept of derivatives of algebraic functions and what learning media can strengthen students' understanding in learning derivative material.

The subjects in this study consisted of participants from various schools and universities in the South Sumatra region who participated in the International Mathematics Day (IMD) activities organized by Sriwijaya University. In addition, this study specifically involved three high school students in Palembang. At the initial stage, students were given a pre-test sheet before using the *Turnreative* learning media that we developed. After trying the media, students then took the post-test sheet. Students' answers from the pre-test and post-test were analyzed to determine the success rate of the developed media. In addition to testing through questions, this research also involved a short interview session with the students. The interview aims to dig deeper into students' perceptions of algebraic function derivative material, such as whether they have learned the material before, and how their experience in using the media we made. By involving students as respondents in testing and interviews, this research is expected to provide a more comprehensive picture of the success rate of the *Turnreative* learning media developed.

The first step in this research is the analysis stage, where a needs analysis is conducted to identify existing problems, determine appropriate solutions, and assess student competencies. The results of this analysis are then discussed with a team of lecturers who serve as media and material experts (Aisyah et al., 2024).

The second step is the design phase, which aims to prepare a prototype (initial product) of the learning media (Wigati, 2019). During this stage, the main concept and topic to be addressed in the media are defined. The media is developed to be engaging and easy for students to understand. The final product includes various components such as reading texts accessible via QR Codes, game-based question cards, formulas, and rotating wheels as the core features of the media.

Following the design phase, the development and production of the media take place. In this stage, peer validation is conducted to gather constructive feedback for improvement. Each design element created during the design phase is realized into a tangible form (Azzahra et al., 2024). The completed media is then validated by two media experts and two material experts to ensure its feasibility in terms of appearance, functionality, and alignment with learning objectives. After the media meets the eligibility criteria, trials are conducted in two stages. The first trial takes place during the International Mathematics Day (IMD) event at Sriwijaya University, which is attended by participants from various schools and universities across South Sumatra. The second trial involves direct testing with high school students.

The final phase is evaluation, where the learning media is refined and enhanced based on the feedback and input gathered from earlier stages. This step is intended to guarantee that the resulting media is both effective and of high quality.

This research uses descriptive data analysis techniques, both quantitatively and qualitatively. The research instrument used several forms of evaluation consisting of evaluation sheets by media experts and material experts, teacher and student practicality sheets, and pre-test, post-test, and interviews in measuring the effectiveness of the media. Two material experts and two media experts validated and filled out the evaluation sheet to verify the media before testing. Meanwhile, to test the practicality of the learning media, an assessment was carried out based on teacher assessment sheets and student responses. The rating scale uses a scale of 1-5. Where 1 = not good, 2 = less good, 3 = quite good, 4 = good, and 5 = very good.

The formula used to calculate the percentage of assessment results from the assessment sheets of media experts, material experts, teachers, and students is.

$$P(s) = \frac{S}{N} \times 100\%$$

with P(s) = Percentage of sub indicators, S = Total score for each indicator, N = Total maximum score.

The results of the validation sheet are then categorized based on the categories in Table 1. Meanwhile, the practicality sheet is categorized based on the categories in Table 2.

Table 1. Validity Test Criteria

Interval	Criteria
80% ≤ Score ≤ 100%	Very Valid
60% ≤ Score ≤ 80%	Valid
20% ≤ Score ≤ 40%	Less Valid
0% ≤ Score ≤ 20%	Invalid

Table 2. Practically Test Criteria

Interval	Criteria
80% ≤ Score ≤ 100%	Very Practical
60% ≤ Score ≤ 80%	Practical
20% ≤ Score ≤ 40%	Less Practical
0% ≤ Score ≤ 20%	Not Practicall

The data obtained from the validity and practicality questionnaires were analyzed by determining the mean score for each evaluation component, including vision and content quality, learning quality, and technical aspect quality. Experts in related fields and those working in media checked the materials for validity, while classroom teachers and students checked them for practicability. The validity and usability of the learning media were determined by categorizing all assessment findings using a "*Turnreative*" Likert scale. Furthermore, observational data were analyzed using descriptive methods to evaluate the level of student participation and engagement during the learning process. Meanwhile, interview data were examined qualitatively to explore students' perceptions regarding their interest in and comprehension of the algebraic function derivative topic. Through the integration of both quantitative and qualitative analyses, the researcher can determine how effective the learning media is in enhancing students' interest and understanding of the algebraic function derivative material.

3. Result and Discussion

The results of this study show the development of *Turnreative* media for high school students. The media trial was conducted on three public high school students in Palembang. Before the trial, *Turnreative* media was designed to help students' problems in understanding the material of algebraic function derivatives. *Turnreative* media was first validated by peers to

obtain constructive feedback on the media being developed. Furthermore, validation was carried out by media experts and material experts to show the level of validity and feasibility of *Turnreative* media. After the validation stage is complete, a practicality test is carried out in order to find out whether the media that has been developed is practical in its use.

3.1 Analysis

The initial stage in designing learning media starts from the analysis stage, which focuses on discussing and assessing the needs and problems of students. The results of this analysis led researchers to choose derivative material as the focus of learning media development. The analysis conducted in this development includes three main aspects, namely performance analysis, student characteristics analysis, and needs analysis. These three aspects complement each other in providing a comprehensive picture of the actual learning conditions in the field, and become the basis for designing relevant and effective learning media.

In the performance analysis, the researcher identified various challenges faced by six students in understanding the derivative material. This was based on observations that showed that the six students had difficulties when dealing with the concept of derivatives, especially in the context of algebraic functions. Figure 2 presents examples of students' pre-test answer sheets. As shown, the three students each obtained a score of 0.5 points for the first question because they were only able to answer half of the problem, 0.5 points for the second question for the same reason, and 0 points for the third question as it was left unanswered. Therefore, the total score was 0.5 + 0.5 + 0 = 1 point. Given that the test consisted of three questions with a maximum score of 100, this resulted in an average score of 33.33.

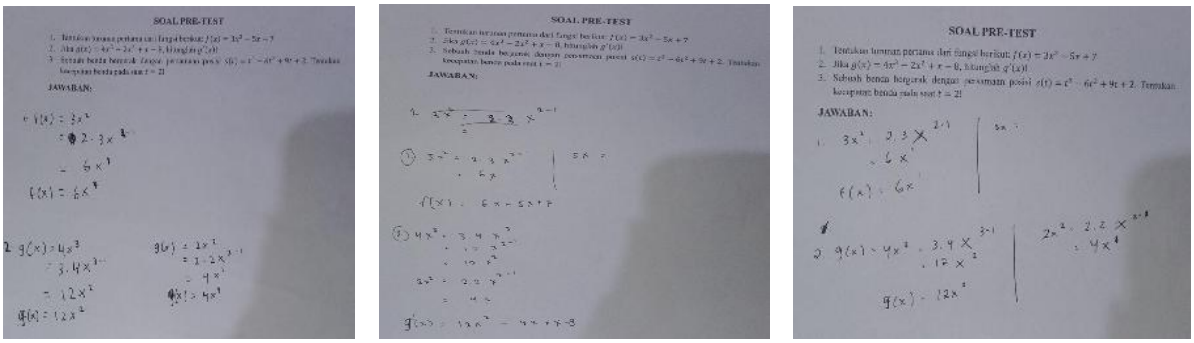


Figure 2. Student Pre-test Answer Sheet

Some students revealed that they had not understood the basic concepts well, so they felt confused in solving problems that required flexible application of understanding. In analyzing student characteristics, based on the results of observations that have been conducted, it is known that students aged 16–17 years are generally at the formal thinking stage. At this stage, students begin to be able to understand abstract concepts and think logically without concrete assistance. However, in practice, not all students of that age have fully achieved formal thinking skills. In the context of mathematics learning, especially on the topic of algebraic function derivatives, which are highly abstract and symbolic, many students still find it difficult to understand the meaning of the concept if it is only conveyed theoretically. Therefore, learning media is still needed to help visualize concepts so that they are easier to understand and attract students' attention. This type of media also plays an important role in building conceptual understanding and encouraging active student involvement during the learning process.

In the needs analysis, the observer found a suitable solution. As a response to this need, an interactive learning media called *Turnreative* was developed. *Turnreative* is a game-based learning media specifically created to make it easier for students to visualize the derivatives of

algebraic functions. One of the solutions offered is the use of innovative and interesting technology-based learning media, in order to create a more pleasant learning atmosphere, make it easier for students to understand mathematical concepts, and increase their learning motivation (Aldi et al., 2022) . This media consists of three main components, namely the rotary wheel, question cards, and activity boards. The rotary wheel serves to assist students in solving the problems obtained from the question card. The question card contains questions about derivatives with five different levels. Meanwhile, the activity board is used to help students write answers and understand the steps of solving problems. The appearance of *Turnreative* is also made as attractive as possible with the appropriate color combination to increase students' interest in learning.

Therefore, the development of *Turnreative* media not only pays attention to attractive visual aspects, but also focuses on being a learning solution that suits the needs of students. This media is designed to improve the quality of mathematics learning, especially in the topic of derivatives, by using a more fun, interactive, and meaningful approach for students.

3.2 Learning Media Design Stage

The next stage is the design stage. The design stage focuses on planning the concept of *Turnreative* media. This media was developed in response to the Math You Can Touch challenge from the IDM 314 website, with the aim of creating an interactive learning experience that not only allows students to understand math concepts visually, but also to feel them through manipulative elements, both digital and physical. Each component is structured to allow students to directly connect abstract math concepts and their real-life representations, making the learning process more intuitive, fun and meaningful.

This media is named *Turnreative*, which stands for Turn and Derivative, because it carries the mechanism of the rotating wheel (turn) as a visual and interactive strategy in understanding the concept of mathematical derivatives. The goal is to simplify the learning process of derivative material that has been considered abstract and difficult by students.

Prototype Stage

In the early stages of development, the *Turnreative* media prototype was still made simply using rice cardboard. As shown in Figure 2, the turning wheel is manually arranged with the numbers 1 to 12 which represent the coefficient (a) and power (n) in derivative problems. In the center of the wheel are the formulas $(a \times n)$ and and *(n - 1)* as the basis for calculations based on the numbers pointed by the needle. In addition to the wheel, there is also a small board for recording results, problem cards, and media labels, all manually laid out on folded cardboard. Despite its simplicity, this prototype reflects the main idea of combining physical activity with mathematical concepts directly.

Figure 3. Prototype 1

This stage was also an initial trial to receive various inputs from media and material experts. The suggestions were related to the physical improvement of the media, visualization of symbols, and clearer flow of activities. In addition, the developer also considered the needs of students and the characteristic of learning mathematics at school, which are often characterized by abstract concepts and teacher-centered instruction, making it difficult for students to develop a deep conceptual understanding (Norberg, 2023). As stated by Fernando (2022), students frequently struggle to connect symbolic representations with real-life contexts because learning tends to focus more on formulas than on conceptual visualization. Therefore, the Turnreative learning media was designed to strengthen the visual connection between symbols, formulas, and values, and to develop learning steps that facilitate understanding, not just playing.

Based on this feedback, revisions were made and the media was developed to the next stage. The media was repackaged using sturdier wood material, with a shape resembling a folding suitcase to make it more practical and durable. The rotating wheel was enlarged and redesigned to make it look more attractive and functional. Mini whiteboards, question cards, and worksheets were added to support learning activities.

Turnreative's final design combines game-based learning principles with concrete and visual aids to create fun and interactive learning. The turning wheel mechanism is used to help students solve the problems they are randomly assigned, so that they are actively involved in mathematical thinking in a gradual and systematic way. The design also takes multimodality into account, incorporating visuals, motor movements and problem solving, to cater to students' diverse learning styles.

Thus, *Turnreative* is not only present as an innovative physical media, but also as a learning approach that is more meaningful and relevant to the needs of today's students, especially in understanding the concept of derivatives. Figure 3 is the design of the *Turnreative* learning media.

Figure 4. *Turnreative* media design

At this stage, *Turnreative* learning media begins to be developed based on the design that has been designed. The development process is carried out in stages, starting from design validation, revision, material collection, to the final production stage. Before the production process is carried out, the concept of *Turnreative* media is first proposed to the supervisor to obtain input and improvements. This validation aims to ensure that the media is in accordance with the learning objectives and student needs.

Two main suggestions were made during the validation process. First, the design of the turning wheel which is the core mechanism in *Turnreative* needs to be improved so that it can rotate smoothly and has clear marking of the derivative rules. Second, the materials used for the boards and cards need to be improved so that the media can be used repeatedly in classroom learning. Previously, we used rice paddy boards or cartons, but we replaced them with wooden

suitcases to make them more durable. The media production process was conducted in two main stages:

Stage One: Preparation of Tools and Materials

After receiving approval and suggestions for improvement from the lecturer, the production process begins by preparing the necessary tools and materials. Materials such as wooden boards / wooden suitcases, wheels made from rice cartons, photo paper for printing media designs, glue, scissors, stickers markers, markers, and additional equipment such as question cards, rule cards, and mini whiteboards. Each component is adjusted to the initial design that has been validated.

Phase Two: Physical Media Production

Researchers began to implement the final design into concrete media. The steps taken include:

1. Printing the designs of the *Turnreative* board, turning wheel, rule cards, and question cards.
2. Laminate each component to make it more durable and not easily damaged.
3. Attach the swivel wheel to the board using nails, so that it can rotate smoothly and stop exactly at a certain segment.
4. Problem cards and guideline cards are made based on derivative material that has been adjusted to the level of student understanding. Each card contains questions or work instructions related to derivative rules, so that students can follow the learning flow systematically and according to the results of the wheel rotation.
5. Assemble all game components into a foldable wooden suitcase with a section for storing cards and a mini whiteboard.
6. Added QR and color elements to increase visual appeal and ease of use.

Figure 5. Results of *Turnreative* learning media development

Figure 6. Material instructions

3.3 Peer Validation

When *Turnreative* learning media has reached approximately 30% of the development stage, researchers carry out validation by peers in order to obtain constructive feedback on the media being developed. This validation process aims to assess the initial feasibility of the media while identifying aspects that need to be improved. Various suggestions and comments from peers were then analyzed and filtered to serve as the basis for making revisions to the media. some of the input obtained includes: (1) The use of board material is recommended to be replaced with wood material to make it stronger and more durable, (2) The description on the turning wheel needs to be clarified so that the information displayed can be read clearly, (3) Visual elements such as pointers or indicators need to be given contrasting colors so that the media display becomes more attractive and communicative, and (4) The wheel hook (nail) in the middle needs to be strengthened so that the wheel does not easily shift during use.

Figure 7. Peer validation

3.4 *Turnreative* Media Validation Test

The media validity test shows the level of validity of a media. The quality of *Turnreative* media has been assessed by two material expert validators and two media expert validators. The validation instrument for material experts and media experts consists of 12 statement items with a Likert scale of 1-5, so the minimum score that can be obtained is 12 and the maximum is 60.

This assessment process produces a percentage score which is calculated using the formula in the method section and according to the validity test criteria in Table 1. The results of validation from material experts on *Turnreative* media are described in Table 3 and the results of validation from media experts on *Turnreative* media Table 4.

Table 3. Validation Results of Turnreative Media by material Experts

Validity Assessment		Total Score
Material Expert	Material Expert 1	90
	Material Expert 2	71
Average Value		80,5
Percentage Value		89,44%
Validity Category		Very Valid

Table 4. Validation Results of Turnreative Media by Media Experts

Validity Assessment		Total Score
Media Expert	Media Expert 1	60
	Media Expert 2	39
Average Value		49,5
Percentage Value		82,5%
Validity Category		Very Valid

Based on the Table 3 and Table 4, it can be concluded that the *Turnreative* instrument is suitable for use. At the revision stage, a number of improvements have been made based on feedback from the validation. This includes the usability of the media itself, and clarifying the instructions for using the media. Overall, the final results of the *Turnreative* media validation showed an excellent level of validity from media experts with a percentage reaching 82.5% and valid from material experts with a percentage reaching 89.44%. This shows that the development of *Turnreative* media has successfully met good quality standards in terms of material and media.

3.5 Practicality Test

The purpose of carrying out the practicality test is to find out whether the media that has been developed is practical in its use, so that it can be implemented effectively and efficiently. The assessment of the practicality of *Turnreative* media is obtained from the assessment sheet filled in by teachers and students. The practicality test sheet consists of 17 questions for teachers and 19 questions for students. The results of the teacher and student practicality test can be seen in Table 5 and Table 6.

Table 5. Results of the Practicality Test by Mathematics Teachers

Appraiser	Score
Math teacher 1	80
Math teacher 2	79
Average score	79,5
Average percentage	93,52%
Practicality category	Very Practical

Table 6. Results of the Practicality Test by Students

Appraiser	Score
Learner 1	92
Learner 2	87
Learner 3	87
Average score	88,67
Average percentage	93,33%
Practicality category	Very Practical

The final results of the practicality of *Turnreative* media showed an excellent level of practicality from mathematics teachers with a percentage reaching 93.52% and the level of practicality from students with a percentage reaching 93.33%. This shows that the practicality of *Turnreative* media can be categorized as very practical to be used as learning media.

3.6 Learning Media Trial (Implementation Stage)

After the learning media development process is complete, the implementation stage begins. The media that has been developed will be tested. First, it was displayed at the learning media exhibition organized by the S3 Study Program of Mathematics Education of Sriwijaya University during the phi-day celebration and won the favorite winner of *Math Teaching Aid Video*. After the exhibition, there were positive and enthusiastic responses received from many visitors who wanted to learn more about *Turnreative* and interest to try it directly. The visitors referred to here are lecturers or teachers who act as validators in the learning media assessment process.

Figure 8. First Implementation

Besides being displayed in the exhibition, *Turnreative* learning media was also tested directly to three high school students. The test was conducted on March 22, 2025. The purpose of this test is to find out how interesting, fun, and how easy this learning media is for students in improving students' understanding of derivative material. This research is still in the small-scale trial stage, namely when the props were tested on three high school students who were studying derivative material.

Figure 9. Second Implementation

From the trial results, some information was obtained through interviews with students, namely: 1) *Turnreative* can help students solve problems and deepen derivative material, 2) *Turnreative* can help students in solving problems to make it easier, 3) Students prefer to learn using *Turnreative* than using conventional learning and 4) Students feel weak when learning derivatives using *Turnreative*.

From the results of the experiment, some important information was obtained through student observations such as:

1. Tested learners have an understanding of mathematical derivatives.
2. During the learning media test, both learners were able to utilize the learning tools well through the instructions and according to the directions given.
3. Learners know how *Turnreative* learning media works.
4. Learners can understand and answer some of the questions on the question cards.
5. Learners can understand the purpose of *Turnreative* learning media.

Based on the information that has been collected from interviews and observations of students using *Turnreative* learning media, it is evident that Turnreative media can improve students' understanding of learning. Students seem happier when learning the material, especially derivatives, and show enthusiasm in using *Turnreative*.

The trial process of *Turnreative* learning media can be seen through the documentation on the following drive link:
https://drive.google.com/drive/folders/1K7EUDrG82H7NOS36EP_WN1kEF8aivniY

3.7 Evaluation of Learning Media (Evaluation stage)

At this stage, an evaluation of the effectiveness of *Turnreative* learning media is conducted through pre-test and post-test activities distributed to a small group of students. The main purpose of this evaluation is to find out students' understanding of derivative material after utilizing *Turnreative* media.

3.8 Effectiveness

The effectiveness aspect is used to collect information about students' problems and needs. During the pilot test, an observation and interview were conducted to assess how effective *Turnreative* learning media is. Through the observation and interview activities, various information was obtained regarding students' responses to the use of *Turnreative*, which can be seen from the following dialog:

Interviewer : "What do you think about the Turnreative media that you have just used?"
Student : "We think Turnreative media is very good, interesting and very helpful in sharpening the brain."
Interviewer : "How about the use of the media? Did you find it difficult to use it?"
Student : "No, it's very easy to use and easy to understand."

From the interview above, it can be concluded that students are greatly helped by the *Turnreative* media because it makes it easier for them to solve the post-test questions given. Meanwhile, the pre-test was conducted before students were introduced to *Turnreative* media. The pre-test questions were designed to measure students' initial understanding of the basic concepts of derivatives, such as power rules, constant rules, and their application in simple problems.

Table 7. *Pre-test* Results to Students

Students	*Pre-test* Result
S1	45
S2	25
S3	30
Average score	33,33

As shown in Table 7, the data is the *pre-test* results of three students, which shows that they still have difficulty when answering derivative questions. After they participated in learning using *Turnreative* media, a *post-test* was conducted where the questions were equivalent to *the pre-test* questions. The *post-test* was held to determine the extent of the development of student learning outcomes after the learning experience through *Turnreative* media.

Table 8. *Post-test* Trial Results to Students

Students	*Post-test* Result
S1	100
S2	75
S3	95
Average score	90

Based on the results obtained in Table 8, there is a significant development in the *post-test* score when compared to the *pre-test*, where the *post-test* score is much higher than the *pre-test* score. The majority of students showed a better understanding, especially in recognizing derivative rules and applying them in problems. Then, students' activeness during learning has also increased, seen from their enthusiasm and participation in using *Turnreative* media.

Based on the validation results, *Turnreative* learning media is declared valid. This means that this media has a high level of validity in line with the opinion of Diniarti (2023) which states that valid media shows high validity, while invalid media has low validity. Therefore, *Turnreative* media is suitable for use. This media development has met high quality standards, both in terms of material and media aspects. The experts' assessment also shows that this media is interesting and easily understood by students. This theory is in line with the opinion of Sulistyawati et al. (2022) which states that the media plays an important role in the learning process to be more interesting and not monotonous.

The practicality assessment results show that *Turnreative* learning media has a very good level of practicality. This is indicated by the high percentage results from math teachers and students. The high percentage from both parties indicates that *Turnreative* media is very practical and easy to use in the learning process. Thus, this media is feasible to be used as an alternative media for effective mathematics learning in the classroom.

At the time of the *Turnreative* media trial to students, it was shown that *Turnreative* learning media not only helped develop knowledge of derivative principles, but also made learning mathematics more fun, interactive, and meaningful. This can be seen in the development of the post-test score which is quite significant compared to the pre-test results, where the post-test score is much higher than the pre-test score.

These findings are consistent with the research by Erşen & Ergül (2022), who reported that game-based learning in mathematics education tends to increase student engagement and improve learning outcomes. Similarly, Mildenhall & Sherriff (2018) emphasized that multimodal semiotic reasoning which integrates visual, kinesthetic, and symbolic representations enhances students' conceptual understanding and makes learning more meaningful. Thus, Turnreative media, which combines interactive and multi-representation elements, has proven to be effective in supporting students' cognitive development in derivative learning, and is in line with previous studies that emphasize the importance of interactivity and diversity of representation in mathematics learning.

4. Conclusion

The development of the *Turnreative* learning media, which integrates educational game elements through rotating wheels, has been successfully implemented using the ADDIE model approach. Validation results from subject matter experts indicated a validity score of 89.44%, while media experts reported 82.5%, both of which fall into the "very valid" category. Small-scale testing conducted with high school students demonstrated a significant improvement in post-test scores. In addition, students responded positively to the media's attractiveness, clarity, and ease of use. These findings suggest that *Turnreative* is a feasible and effective alternative learning tool, designed for long-term use and adaptable to various learning environments.

Moreover, this media has proven to be effective in enhancing students' understanding of algebraic function derivatives, while also increasing their interest and engagement through an interactive and enjoyable learning experience. The success of *Turnreative* in improving both learning outcomes and student motivation is further supported by documentation of the trial process and its presentation at university-level educational exhibitions. Therefore, *Turnreative* not only meets the standards of content and design validity, but also demonstrates practical applicability and real-world effectiveness in the learning process.

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