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Development of Digital Media Adventure "Real or Fact" to Increase Students' Confidence in Multiplication Arithmetic Operations

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ABSTRACT

Low student confidence in understanding the concept of stacked multiplication operations is one of the challenges in learning mathematics in elementary schools. This study aims to develop digital learning media in the form of "Real or Fact" adventure question cards based on a differentiated approach to increase student confidence in elementary schools. This study uses the Research and Development (R&D) method with the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. Data were collected through teacher interviews, classroom observations, and validation by material and media experts. The results of the study showed that this media was considered very feasible with an average validation score of 99% and was able to increase student confidence, with an average increase in pre-test and post-test scores of 32.98%. The "Real or Fact" digital media has proven effective in providing interactive learning experiences and supporting learning based on the Independent Curriculum. This research contributes to the development of innovative digital media in mathematics learning and opens up opportunities for further implementation in various other materials.

1. INTRODUCTION

Mathematics is a fundamental discipline for students' cognitive development, especially in forming logical, analytical, and critical thinking skills among elementary school students (Nurkholis et al, 2022). Through mathematics learning, students are introduced to basic concepts that are useful in solving everyday problems, such as arithmetic operations, measurement, and geometry. Mathematical concepts are also relevant to everyday activities, such as seeing or calculating time, making buying and selling transactions, measuring distance and speed, saving, and many more (Silvia et al, 2023). According to Sirait et al, (2023), a good

understanding of mathematics from an early age is important to support rational thinking skills needed in various areas of life.

This finding is in line with the view that targeted technology-based training can improve students' ability to apply mathematical concepts effectively in various contexts (Hawes et al., 2022). This has an impact on various difficulties in learning, for example understanding and applying mathematical concepts, especially in the material on multiplication and division operations, this is reinforced by Silvia et al, (2023), difficulties in learning multiplication arithmetic operations are caused by students' beliefs that mathematics is difficult, which causes them to feel bored and lack understanding of the concept.

The results of the Puspendik, (2018), analysis showed that of the 85 questions used in AKSI in 2016, only three questions were considered easy by students—more than 70% of students answered correctly—and only eleven questions could be answered correctly by more than 50% of students (Mufliva & Iriawan, 2022). In line with this Sihombing et al, (2023), revealed that elementary students often experience difficulties in learning multiplication and division due to multiple factors: lack of motivation, careless mistakes, failure to memorize multiplication tables, conceptual misunderstandings, and difficulty understanding the steps needed to solve word problems. Students also struggle with place value, misinterpretation of mathematical symbols, and lack of attention during instruction. These difficulties severely impact students' ability to process calculations and story problems, which in turn limits their learning progress and self-efficacy.

Difficulties in learning mathematics in elementary school students can come from internal factors including learning motivation, self-confidence, attitudes, interests and mathematical intelligence of students. Meanwhile, external factors include teacher teaching methods, variations in learning media that are less appropriate, teaching approaches and support from the learning environment. Student self-confidence is an important element in successful learning, because students who are confident are more active in participating and are better able to face difficulties (Oktarini et al., 2018; Jayanti et al., 2020; Audina, 2021; Aristiantika & Widiono, 2024).

In addition, according to Fardani et al, (2021) showed that students who have high self-confidence are better able to face difficulties and develop strategies to solve mathematical problems compared to students who have low self-confidence. Low student self-confidence often hinders their participation in class discussions, thereby reducing their opportunities to explore their understanding. Based on research by Khotimah et al, (2024), at MI Tarbiyatus Sa'adah Class IV, it was shown that students who tend not to dare to actively participate in class discussions or answer questions feel insecure or afraid of making mistakes when asked to show their answers in front of the class.

In addition to low self-confidence, students also experience difficulties in communicating mathematical ideas during classroom interactions. Even students who are categorized as confident or enthusiastic learners often face challenges in expressing their understanding without clear instructional scaffolding. Lutfi & Elfitriadi (2023) found that students with sanguine personality types, who are typically more confident, still struggled to convey mathematical reasoning effectively during group discussions when not supported by proper guidance from the teacher. This highlights that building mathematical communication skills requires not only confidence, but also structured support through media and learning strategies that guide students in articulating concepts clearly and logically.

This situation underscores the importance of providing differentiated learning media that align with students' individual needs and preferences. Differentiated instruction, when supported by appropriate and engaging media, can foster deeper student involvement in the learning process. As emphasized by Alfina et al, (2024), such an approach not only enhances motivation and self-confidence but also helps reduce perceptions of unfairness by promoting a more inclusive and student-centered learning environment.

In addition to self-confidence, the variety of learning media is an important factor in the success of learning mathematics. Sirait et al, (2023), stated that students often feel bored with monotonous and less varied learning methods. For example, the use of learning media that only focuses on textbooks makes it difficult for students to imagine abstract concepts in mathematics. To overcome this, more interactive learning media such as digital applications or graphic visualizations are needed so that students are more interested and motivated in learning (Windho & Kartikasari, 2017).

Technology-based approaches in mathematics learning are now starting to be implemented as one solution. The use of digital technology such as interactive learning applications allows students to participate more actively in the teaching and learning process. A study by Hendriani & Gusteti, (2021), shows that problem-based digital learning media, such as electronic LKPD, can increase students' self-confidence and problem-solving skills. With this media, students can learn independently through digital devices, which can reduce dependence on teacher instructions and increase their confidence in understanding the material (Hendriani & Gusteti, 2021).

On the other hand, effective learning methods can also affect students' ability to solve mathematical problems. According to research by Kafuji & Mahpudin (2023), the problem-solving model has been shown to improve students' ability to solve mathematical problems, especially in multiplication and division materials. This model helps students understand the logical steps needed to solve problems, so that they are better prepared to face questions that require a deep understanding of concepts.

The problem-solving approach also allows students to think critically and creatively in finding alternative solutions. Group discussion is another effective method to improve students' understanding. Ramadhanti & Manurung (2022), found that the discussion method can improve students' learning outcomes in the material on units of length. Through discussion, students can collaborate and exchange ideas so that it is easier to understand mathematical concepts. The interaction in this discussion also provides an opportunity for students to practice their mathematical communication skills, which are important in conveying their understanding verbally.

Supporting the effectiveness of the model in learning, the Cognitive Load Theory (CLT) theory can also be applied to manage students' cognitive load. Adriana et al, (2022), noted that students often feel overwhelmed in learning complex mathematics material, especially when faced with problems that require in-depth analysis. The application of CLT in mathematics learning can help teachers design activities that do not burden students excessively, by simplifying instructions and providing clear guidance for each stage of problem solving. Parents also have an important role in supporting the success of their children's mathematics learning.

According to Oktarini et al. (2018) showed that supportive parenting can increase students' motivation and confidence in learning mathematics. Support from parents, either through direct assistance in learning or through emotional encouragement, has a positive

impact on children's academic achievement. Students who feel supported by their parents tend to be more confident and motivated to be active in the learning process.

Differentiated approach is one of the relevant strategies to improve students' interest and learning outcomes. Rukmi et al, (2023), found that differentiated learning tailored to students' needs and characteristics can significantly improve self-confidence and mathematics learning outcomes. Through this approach, students who are having difficulties can get additional help and guidance tailored to their abilities, while more advanced students are given additional challenges that encourage them to develop (Rukmi et al, 2023).

Based on the challenges and solutions that have been presented, this study aims to develop digital learning media in the form of "Real or Fact" adventure question cards based on a differentiated approach, which is designed to increase students' self-confidence and problem-solving skills in understanding the concept of stacked multiplication operations. By using this media, students are expected to be able to learn in a more interesting way, be actively involved, and be able to overcome the obstacles they experience during.

2. METHODS

The method used in this research activity is Design and Development (D&D). The Design and Development research method is employed to create or improve products. This type of development research focuses on the creation and validation of educational products (Hajidi, 2018). The research utilizes the ADDIE model, which consists of the stages: Analysis, Design, Development, Implementation, and Evaluation (Rusdi, 2019). The table below can be seen:

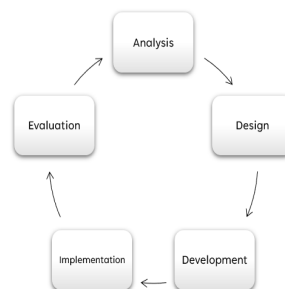**Figure 1.** ADDIE Model Stages (Rusdi, 2019).

The population in this study consists of fourth-grade students at SDN Dayeuh Luhur IV. The sample selected for this research includes 5 fourth-grade students. The sample represents a small-scale group chosen to test the effectiveness of the developed learning media in a real classroom setting. At the Analysis stage, the educational needs of the fourth-grade students were identified using multiple methods, including teacher interviews, classroom observations, and a review of relevant literature.

3. RESEARCH RESULTS AND DISCUSSION
3.1 Research result

This section presents the results of research related to the validation and trial of the digital media "Real or Fact", which is designed to support mathematics learning based on a differentiated approach. The validation results from material experts, media experts, and

limited trials on students were evaluated to assess the feasibility, effectiveness, and practicality of the media. These findings provide an overview of the media's contribution to improving student learning outcomes and motivation.

3.1.1 Results of Validation and Trial of Digital Media "Real or Fact"
    The results of the validation of the digital media "Real or Fact" show that this media has met the criteria for very good eligibility. Based on the assessment of material experts, media experts, and limited trials of students, this media has advantages in terms of content, design, and ease of use. The evaluation results are summarized in the following table:

Table 1. Learning Media Validation Results

Assessment aspects	Media Expert (%)	Material Expert (%)	Category
Media Appearance	100%	100%	Very Good
Image Appearance	100%	100%	Very Good
Text Composition	95%	100%	Very Good
Ease of Use	100%	100%	Very Good
Adaptability	100%	100%	Very Good
Self-Instruction	100%	100%	Very Good
Stand-Alone	100%	100%	Very Good
Average	99%	100%	Very Good

    The validation results of the digital media "Real or Fact" reflect an outstanding level of feasibility and effectiveness in supporting mathematics learning for elementary students. The assessment table shows consistently high ratings from both media and material experts, with most components rated at a perfect score of 100% and one aspect slightly lower at 95%, resulting in an overall average of 99–100% categorized as "Very Good." These scores demonstrate that the media excels in key aspects such as media and image appearance, text

composition, ease of use, adaptability, self-instruction, and its ability to stand alone without additional support. This reflects the careful design and instructional coherence built into the media, making it highly suitable for independent learning and differentiation.

From a qualitative standpoint, the perfect scores across various elements such as "Ease of Use" and "Self-Instruction" signify the media's strong potential to facilitate self-guided learning. This is particularly important in a differentiated learning context, where students' abilities and needs vary widely. The high ratings from material experts also suggest that the content aligns closely with curriculum standards, particularly in helping students understand complex mathematical operations like stacked multiplication. In terms of design and adaptability, the media's game-based structure and engaging visuals offer significant pedagogical benefits, creating a more interactive and less intimidating environment for young learners.

Moreover, the media's ability to function effectively as a **stand-alone tool** reflects thoughtful integration of instructional guidance, visual supports, and scaffolded challenges. This means students can navigate and complete learning tasks without heavy reliance on teacher facilitation. Such independence fosters confidence, aligns with the goals of the Merdeka Curriculum, and empowers students to engage in self-directed learning. Overall, the validation results confirm that "Real or Fact" is not only technically and content-wise strong but also pedagogically meaningful and accessible to a diverse range of learners.

3.1.2 Validation by Experts

Validation by material experts assesses the extent to which the content of this media is in accordance with the learning outcomes and the relevance of the material to students' needs. Based on the evaluation results, this media received an average score of 100% in the Self Instruction, Self Contained, and Stand Alone aspects, all of which are included in the very appropriate category. This media is considered capable of providing clear learning directions, with complete materials and allowing students to learn independently without intensive guidance from teachers.

The assessment of the Self Instruction aspect shows that this media provides systematic and relevant learning guidance. The questions presented refer to the learning outcomes of stacked multiplication operations, with gradual levels of difficulty. This approach helps students understand concepts gradually, giving them the confidence to solve more complex problems. In addition, the visual illustrations included support the learning process by simplifying abstract concepts into more concrete ones.

In the Self Contained aspect, this media includes all the materials students need to understand the learning topic, including interactive narratives and questions based on everyday life contexts. This approach supports differentiated learning by providing space for students to learn according to their abilities. Material experts also note that the visual approach in this medium helps students with kinesthetic and visual learning styles to understand the material more easily.

3.1.3 Trial on Students

A limited trial was conducted to measure the level of acceptance and effectiveness of the media in helping students understand the material. The results showed an average score of 95%, which is included in the very decent category. The trial covered three main aspects: ease of use, learning motivation, and the usefulness of the media in improving student understanding.

In the *Ease of Use* aspect, students felt that this media was intuitive and easy to use. The design is simple with clear guidance, so that students can explore the media without difficulty. Student responses showed that they did not find it difficult to access the available features, both on computers and smartphones. To support this process, students were provided with a Kartu Jawaban (Answer Card) to record their answers while working through the "Real or Fact" challenges. This answer card is divided into colored blocks labeled "Jawaban", allowing students to categorize whether each statement is "Real" or "Fact". The structure of this card supports independent learning by guiding students through their responses visually and clearly. The form of the card is illustrated below:

Figure 2. Adventure Card Cover

The initial appearance of this digital media is an adventure card cover containing information about the title, class, and design depicting an adventurer. The design is equipped with natural elements and numbers. This page aims to introduce the identity of the adventure card in the mathematics subject of the concept of stacked arithmetic multiplication.

Figure 3. Adventure Card Rules

An adventurer will face every challenge of the game. The first challenge will be given five questions containing addition, multiplication, subtraction, fractions, and calculating

triangle angles. Some of the questions given already have answers, students must prove whether the answer is "Real or Fake". There are rules that contain words to increase students' confidence in working on the questions. Positive words are very helpful for students because they build good and easy thinking about math problems.

Figure 4. First Challenge Question

An adventurer will face every challenge of the game. The first challenge will be given five questions containing addition, multiplication, subtraction, fractions, and calculating triangle angles. Some of the questions given already have answers, students must prove whether the answer is "Real or Fake". There are rules that contain words to increase students' confidence in working on the questions. Positive words are very helpful for students because they build good and easy thinking about math problems.

Figure 5. Second Challenge Question

Next, an adventurer will face the second challenge question. The question contains multiplication operations in the form of story questions. There are traps in some questions to train the level of accuracy of students in working on the questions. Each question has an answer to be proven by students whether it is "Real or Fact". A forest ranger in the form of a

tree introduces himself and gives instructions to complete the mission in the form of the given challenge questions.

Figure 6. Third Challenge Question

An adventurer will face the third challenge question after completing the previous challenge mission. The question in the third challenge contains a multiplication operation that contains a story question about the character Mr. Rudi, a mango farmer.

Figure 7. Fourth Challenge Question

Next, an adventurer will face the fourth challenge question. The question contains a multiplication operation that contains an answer to prove the question is true or false. There is a trap question that must be investigated by students.

Figure 8. Fifth Challenge Question

The last mission that must be completed by an adventurer contains a story question about a running race, the question is the concept of multiplication operations
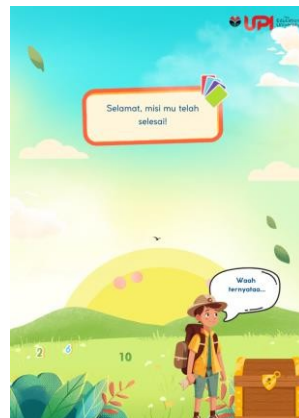

Figure 9. Mission Completed

After an adventurer completes all his missions by working on stacked multiplication operation problems by proving "Real or Fact". Next, an adventurer will get a box containing treasure. The treasure is in the form of an award for the student's achievements in completing all the challenges
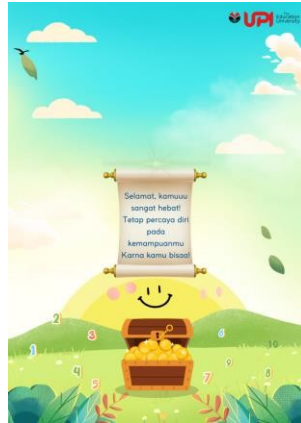
Figure 10. Mission Completed

The last page is a treasure that contains congratulations and positive words that can increase students' confidence for trying to do math problems. then students are given an answer sheet that has been designed in such a way to be filled in by students, the following is an image of the student answer sheet below:

Figure 11. Student Answer Card

The integration of this card proved beneficial in reinforcing students' sense of ownership over their answers, while the colorful design made the task more visually appealing. It also aligned with the differentiated learning approach by guiding students of various ability levels through a structured response process.

The learning motivation aspect scored a perfect 100%, indicating a strong emotional and cognitive engagement from the students. The adventure-themed narrative, combined with visual storytelling and gamified elements, made the learning experience highly enjoyable. Students expressed excitement when tackling each challenge, especially due to the embedded animations and character interactions that accompanied the math problems. These features helped reduce math anxiety and promoted a positive learning climate.

On the aspect of usefulness, students noted that the contextual problems presented in the media made it easier to understand abstract concepts such as stacked multiplication. The use of real-life scenarios—such as calculating purchases or story problems involving characters—helped bridge the gap between conceptual learning and daily application. The effectiveness of this media is further supported by the data from the pre-test and post-test assessments, as presented in the table below:

Table 2. Pre-test and Post-test Results in Field Trial

No. Students	Pre-Test	Post-Test	Difference in Improvement	Improvement (%)
1	85	85	15	21,43%
2	50	90	14	80,00%
3	75	90	15	20,00%
4	65	95	14	19,44%
5	80	95	16	23,88%
∑	355	455	85	165,88%
X	71,00	91,00	17,00	32,98%

The trial results show that the "real or fact" media is able to significantly improve student learning outcomes. Based on the latest pre-test and post-test data, the average student score increased from 71.0 to 91.0, with an average difference of 17.00 points or an increase of 32.98%. This increase shows that the media has succeeded in helping students understand the stacked multiplication material better. The interactive media design, coupled with an attractive visual approach, provides a fun learning experience and makes it easier for students to understand the concepts being taught.

The digital media feature in the form of a "real or fact" adventure in this differentiated learning plays a major role in increasing student confidence. Game-based challenges make students more enthusiastic, especially for those who initially had low scores. For example, student 2 experienced an 80% increase, reflecting how this media helps students who have difficulty learning become more confident and enthusiastic. This supports previous research which states that interactive elements can significantly improve learning outcomes.

However, not all students experienced improvement. For example, student 1 who had a high initial score showed no change in the post-test results. This may be because the students have mastered the material before the media is used, so they do not get new challenges from this media. To overcome this, further development is needed, such as adding a question feature with a level of difficulty that can be adjusted based on the student's initial ability.

This media is designed to support learning that is relevant to the Merdeka Curriculum. The active and independent approach offered by this media encourages students to explore

mathematical concepts in more depth. The questions presented also help students apply their knowledge in everyday life, thereby increasing overall understanding. These results prove that technology-based learning innovations not only help students achieve better learning outcomes but also accelerate the learning process. Compared to traditional methods that are often monotonous, this media provides a more interesting and effective experience.

3.2 Discussion

The findings of this study indicate that the adventure-based digital media "Real or Fact" is effective in enhancing students' understanding of stacked multiplication operations. This is evidenced by a significant improvement in student performance, with an average score increase of 32.98% from pre-test to post-test. Such a result demonstrates that the media is not only successful in facilitating conceptual comprehension but also plays a vital role in strengthening students' self-confidence when facing mathematical problems. These findings are in line with the study by Ishak et al, (2021), which asserts that interactive digital learning tools can foster student confidence by offering a more engaging and experience-driven learning process. Similarly Pramestika, (2020), highlights that digital-based media can enhance students' literacy, numeracy, and cognitive skills due to its contextualized and appealing presentation.

Moreover, the impact of the media is particularly evident among students with initially lower scores. For instance, student 2 experienced an 80% improvement, suggesting that the media's interactive features and narrative format provide strong scaffolding for students who require more support. The combination of gamification, visual storytelling, and contextualized problem-solving not only enriches the learning atmosphere but also addresses diverse learning needs. This supports the claim by Rambe & Rajagukguk (2021), who emphasize that technology-based learning diversifies educational experiences and makes them more inclusive and motivating for students of varying abilities.

On the other hand, students with higher prior knowledge, such as student 1, demonstrated minimal score gains. This outcome indicates that while the media is effective for reinforcing basic understanding, it may be less impactful for advanced learners unless further differentiated. To address this, adaptive features that calibrate question difficulty based on each student's ability would be beneficial. In line with this, Hawes et al, (2022), emphasize the importance of individualized scaffolding and differentiated challenge levels in maximizing the effectiveness of digital mathematics tools.

A notable innovation in this study is the inclusion of the "Kartu Jawaban" (Answer Card) as part of the learning process. This tool not only served as a worksheet but also encouraged reflective thinking and autonomy. By requiring students to categorize each problem as "Real" or "Fact," the card supported metacognitive engagement and helped students make sense of their reasoning. This feature also aligns with the principles of Cognitive Load Theory (CLT), as outlined by Adriana et al, (2022), by structuring complex mathematical tasks into simpler, manageable steps that reduce cognitive overload and enhance learning efficiency.

Taken together, these findings highlight the significant potential of adventure-based digital media to improve both cognitive and affective aspects of mathematics learning. When combined with narrative-driven tasks, visual interactivity, and tools that promote self-regulation, such media can foster deeper engagement and understanding. In the context of the Merdeka Curriculum, which encourages differentiated, student-centered, and contextual

learning, the "Real or Fact" media aligns closely with current pedagogical objectives. It supports independent exploration, critical reasoning, and meaningful application of mathematical concepts in students' everyday lives.

4. CONCLUSION

This study concludes that the digital media "Real or Fact", developed based on a differentiated learning approach, is effective in improving students' understanding and confidence in learning stacked multiplication operations. The media was validated by both material and media experts and received outstanding ratings across all assessment aspects— such as content quality, user interface, self-instructional design, and adaptability—confirming its high feasibility for use in primary education.

The average score increase of 32.98% in pre-test and post-test results demonstrates the media's strong impact on student learning outcomes. Particularly, students with lower initial performance benefited significantly from the visual, interactive, and gamified learning experience. The integration of storytelling, contextual problem-solving, and scaffolded challenges helped reduce learning barriers and fostered motivation. Additionally, the use of a structured Answer Card allowed students to independently navigate through the tasks, reflect on their reasoning, and build self-confidence.

Aligned with the Merdeka Curriculum, this media promotes active, student-centered learning and supports the principles of differentiation. It not only simplifies abstract mathematical concepts through engaging visual representations but also encourages students to apply their knowledge in meaningful contexts. The flexibility and interactivity embedded in the design make it a valuable tool for classroom learning and self-paced study.

For future development, it is recommended that the media be enhanced with adaptive learning features that allow the level of difficulty to be adjusted according to student ability. Enriching the adventure narrative and including automated feedback mechanisms could further increase student engagement and facilitate real-time understanding. Broader trials across various grade levels and subject areas are also encouraged to assess the scalability and long-term effectiveness of this digital learning innovation.

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