

The Implementation of Website-Based Dakon Smart Media in Number Pattern Material: Perspectives of Teachers and Students

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Abstract

The low ability of elementary school students in solving number pattern problems remains a challenge, partly due to limited interactive and contextual learning media. This study aims to describe the implementation of Website-Based Dakon Smart media on number pattern material from the perspectives of teachers and students. A qualitative descriptive case study approach was employed. The subjects were 30 fourth-grade students and one mathematics teacher at MI Ma'arif 29 Miftahul Ulum Ambulu Jember. Data were collected through participatory observation, semi-structured interviews, and documentation, then analyzed using Miles and Huberman's thematic analysis with source and technique triangulation. The findings reveal four main themes: (1) the need for concrete and enjoyable interactive media, (2) the implementation process integrating traditional dakon games with digital technology, (3) students' experiences of being more active and supported in solving number pattern problems, and (4) technical challenges and teacher scaffolding strategies. Teachers and students perceived Dakon Smart as an engaging, easy-to-use medium that facilitates understanding of number patterns. This study concludes that integrating traditional games with digital technology can be an innovative alternative for mathematics learning in Madrasah Ibtidaiyah. Further research is recommended to integrate databases and test the media on a broader scale.

Keywords

Dakon Smart, Number Patterns, Teacher And Student Perspectives, Interactive Media, Qualitative.



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INTRODUCTION

Mathematics education at the Madrasah Ibtidaiyah level holds a strategic position in building the foundations of students' logical, systematic, and critical thinking. Mathematics is not merely understood as a collection of numbers and formulas, but as a means of forming rational thinking patterns needed in everyday life (Aldi & Hidayat, 2025). However, the numeracy achievement of Indonesian students remains relatively low. The 2022 PISA results show that Indonesia's mathematics score is 366, far below the OECD average of 472 (OECD, 2023). Data from the 2023 National Assessment also indicates that more than 50% of elementary school students are at the "Special Intervention Needed" and "Basic" levels in numeracy, including the ability to understand number patterns (Pusmendik, 2023).

Ideally, mathematics learning at Madrasah Ibtidaiyah is directed so that students are able to recognize patterns, continue patterns, and solve contextual problems (BSKAP No. 046 of 2025). However, preliminary observations in grade IV at MIMA 29 Miftahul Ulum Ambulu indicate that most students still experience difficulties in understanding number pattern material. These difficulties are particularly evident when students must determine the pattern rule or continue a number pattern. Many students merely guess without understanding the relationships among numbers, so they often make mistakes when determining the difference or the next number in sequence (Observation, 2026). This condition is reinforced by the homeroom teacher's statement that number pattern learning still requires more concrete and engaging media (Fadhilah, 2026).

The gap between the ideal and the reality of number pattern learning in Madrasah Ibtidaiyah is rooted in the abstract nature of number patterns, which demands students' ability to recognize regularity and relationships among numbers. Meanwhile, students at the Madrasah Ibtidaiyah level are still at the concrete operational stage, requiring learning experiences that involve concrete objects, visual media, and direct manipulation (Heruman, 2020). This mismatch between the abstract characteristics of number patterns and the concrete cognitive characteristics of students indicates the need for learning media that can bridge the two, namely media that are concrete, interactive, and capable of visualizing number patterns in a tangible way.

Learning media plays an important role in bridging abstract mathematical concepts to become more concrete. Traditional games such as dakon have been proven effective in mathematics learning. Research by Mutiari and Shodikin (2025) shows that dakon is effective in helping students recognize patterns and develop computational thinking. Meliasari and Wardana (2023) found that

ethnomathematics-based dakon media has a significant effect on students' mathematical problem-solving abilities. Meanwhile, Juliana et al. (2021) proved that dakon media can increase students' learning motivation. These studies indicate that dakon has been widely recognized as an effective traditional game for mathematics learning.

Nevertheless, most of these studies still focus on dakon in its concrete form or for other mathematics materials, and have not specifically developed dakon media integrated with website-based technology for number pattern material. Not many studies have deeply explored how teachers and students perceive the implementation of dakon media integrated with website-based technology. Therefore, this study aims to describe the implementation of website-based Dakon Smart media on number pattern material from the perspectives of teachers and students. Theoretically, this study is expected to contribute to the development of mathematics learning media based on traditional games. Practically, the results of this study can serve as a reference for teachers in selecting and implementing learning media that suit the characteristics of Madrasah Ibtidaiyah students.

METHOD

This study employed a qualitative descriptive approach with a case study design. This approach was chosen because the study aimed to describe in depth the implementation of Dakon Smart media and to explore the perspectives of teachers and students regarding the use of the media in number pattern learning. A case study allows the researcher to understand the phenomenon in its natural context holistically and deeply (Sugiyono, 2019).

1. Research Subjects

The subjects of this study consisted of three groups with distinct roles. First, 30 fourth-grade students participated as implementation participants who used the Dakon Smart media during the learning sessions. Second, one mathematics teacher acted as an informant who provided insights into the learning process and the implementation of the media. Third, six students were selected as interview informants based on variations in comprehension levels (high, medium, and low) to explore their experiences and perceptions in depth. The subjects were selected purposively considering that grade IV was studying number pattern material in accordance with Phase B Learning Outcomes, and the preliminary observation results indicated a need for

interactive learning media. The study was conducted in the odd semester of the 2026–2027 academic year.

2. Data Collection Techniques

Data were collected through three main techniques:

1. Participatory observation, conducted during two learning sessions (2 × 35 minutes) to observe teacher activities, student activities, and student interactions with Dakon Smart media.
2. Semi-structured interviews, conducted with the fourth-grade teacher and six students selected based on variations in comprehension levels (high, medium, low) to explore their experiences and perceptions.
3. Documentation, including teaching modules, media screenshots, photographs of learning activities, and field notes.

3. Research Instrument

The primary instrument in this study was the researcher herself (human instrument), assisted by observation guidelines, interview guidelines, and documentation guidelines. The interview guidelines were developed based on the research focus, namely experiences of using the media, ease of use, attractiveness of the display, and the media's contribution to understanding number patterns.

4. Data Analysis

Data analysis in this study was carried out through two complementary stages: first, the Miles and Huberman model as the main analytical framework, and second, thematic analysis as a specific technique to identify themes. These two stages are not separate models but rather interconnected parts of a single systematic analytical process.

Stage 1: Miles and Huberman Analysis Framework

The Miles and Huberman model was used as the main framework for analyzing qualitative data. This model consists of three systematic stages that are carried out interactively and cyclically:

1. Data Reduction

In this stage, the researcher selected, focused, simplified, and transformed the raw data obtained from participatory observation, semi-structured interviews, and documentation. The reduction process involved selecting relevant data, creating field notes,

coding initial data, and identifying emerging patterns. Data that were not relevant to the research focus were set aside, while data that were relevant were organized systematically.

2. Data Display

After reduction, the data were organized and presented in the form of narratives, tables, and charts to facilitate interpretation. The data display included:

- Tables of student engagement before and after implementation
- Tables of challenges and strategies in media implementation
- Narratives of teacher and student experiences
- Field notes from observations
- Transcripts of interviews

3. Conclusion Drawing/Verification

In this stage, the researcher constructed meaning from the data that had been presented. Conclusions were drawn gradually, starting from tentative conclusions that were then verified through triangulation, member checking, and extended observation. The final conclusions were formulated as four main themes that portray the perspectives of teachers and students on the implementation of Dakon Smart media.

Stage 2: Thematic Analysis with Inductive Coding

After the Miles and Huberman framework was applied, thematic analysis was used as a specific technique to identify themes from the data. Thematic analysis was carried out through an inductive coding process, which consisted of the following steps:

1. Initial Coding

The researcher read and re-read the data (interview transcripts, observation notes, and documentation) to gain familiarity. Initial codes were then generated by labeling meaningful units of data that were relevant to the research focus. For example, codes such as "boredom with textbooks," "enthusiasm for games," and "difficulty finding buttons" were identified.

2. Categorization

The initial codes were grouped into categories based on their similarities and relationships. For example, codes related to student boredom and the need for engaging media were grouped into the category "need for interactive media." Codes related to technical difficulties and teacher assistance were grouped into the category "technical

challenges and scaffolding."

3. Theme Development

The categories were then refined and developed into broader themes that captured the essence of the data. The process involved reviewing the categories, comparing them with the research questions, and identifying patterns that emerged consistently across the data. The final result was four main themes:

- a. Theme 1: The need for concrete and enjoyable interactive media
- b. Theme 2: The implementation process of Dakon Smart integrating traditional games with technology
- c. Theme 3: Students' experiences of being more active and supported in solving number pattern problems
- d. Theme 4: Technical challenges and teacher scaffolding strategies

The relationship between the two analytical stages can be summarized in the following table:

Table 1. Summary of the Data Analysis Process

Stage	Activity	Output
Data Reduction	Selecting, focusing, simplifying, and transforming raw data	Coded data, field notes, initial patterns
Data Display	Organizing data into narratives, tables, and charts	Tables of engagement, challenge strategies, narratives
Conclusion/Verification	Constructing meaning and verifying through triangulation	Verified conclusions
Initial Coding	Labeling meaningful units of data	Codes (e.g., boredom, enthusiasm, difficulty)
Categorization	Grouping codes based on similarities	Categories (e.g., need for media, technical challenges)
Theme Development	Refining categories into broader themes	Four main themes

Source: Researcher Analysis, 2026

FINDINGS AND DISCUSSION

Findings

Based on the data analysis obtained through participatory observation, semi-structured interviews, and documentation during the implementation of Website-Based Dakon Smart media on number pattern material, four main themes were identified that portray the perspectives of teachers and students. These four themes are presented systematically as follows:

1. The Need for Concrete and Enjoyable Interactive Media

The results of preliminary observations and interviews indicated that number pattern learning was previously dominated by the use of textbooks and verbal explanations from the teacher. Students tended to be passive and quickly lost focus when learning consisted only of lectures and written exercises. The fourth-grade teacher stated that learning which relied solely on books and worksheets made students easily bored and inattentive. According to the teacher, students were more interested when there was media that could be played or used directly.

This statement was in line with students' admissions that they felt bored with conventional learning. One student stated that learning that only involved reading books and doing worksheets was sometimes confusing, and it would be more enjoyable if there were games in the learning process.

Preliminary observation data conducted on January 23, 2026, recorded that out of 30 students, only about 8 students (27%) appeared actively attentive to the teacher's explanation, while the rest seemed sleepy, talked with friends, or daydreamed.

The teacher realized that fourth-grade students are still at the concrete operational stage, thus requiring media that can visualize abstract concepts of number patterns in a tangible way. The teacher explained that for number pattern material, if it was only explained and then followed by textbook exercises, some students still experienced difficulties. Students were happier when there were activities or games, but these still needed to be directed to align with the material being studied.

The teacher also added that students needed learning media that could encourage them to think more and use their reasoning, not just work on textbook problems. Students needed to practice understanding problems and finding ways to solve them.

2. The Implementation Process of Dakon Smart Integrating Traditional Games with Technology

Dakon Smart media was developed by adapting the traditional dakon board into an interactive website. Students could interact through activities such as clicking on dakon holes, dragging numbers or dakon seeds, and completing number pattern challenges. The teacher considered this innovation a compelling breakthrough. According to the teacher, game-based media would be more attractive to students, especially if they could play while working on problems. The teacher also emphasized that the media should not be too difficult to use and must align with the material being taught.

Observations during learning showed that students appeared enthusiastic when asked to try the media in turns. Some students even raised their hands to try first. Field notes from the first meeting recorded that students competed to try the media, and some students who were usually passive in class appeared eager when it was their turn to use the laptop.

Dakon Smart media was equipped with automatic feedback in the form of correct/incorrect pop-ups and explanations of solution steps. This feature helped students understand their mistakes without having to wait for the teacher's explanation. One student stated that when their answer was wrong, the media immediately displayed an explanation so they knew where the mistake was. Another student stated that the score feature motivated them to keep trying until their answer was correct.

The teacher also appreciated this feature. According to the teacher, the feedback provided by the media helped students understand mistakes without waiting for the teacher's explanation, allowing students to learn more independently.

3. Students' Experiences of Being More Active and Assisted in Solving Number Pattern Problems

All interviewed students (6 out of 6 informants) stated that learning with Dakon Smart was more enjoyable than regular learning. Observations showed that students appeared enthusiastic and actively involved in activities. Observation data recorded an increase in student engagement as follows:

Tabel 1. Comparison of Student Engagement Before and After Dakon Smart Implementation

No	Aspect Observed	Before Implementation	After Implementation
1	Students pay attention to teacher/media explanation	8 students (27%)	26 students (87%)
2.	Students actively ask or answer questions	5 students (17%)	22 students (73%)
3.	Students are directly involved in using the media	0 students (0%)	30 students (100%)
4.	Students are able to follow number patterns through the media	10 students (33%)	25 students (83%)
5.	Students cooperate with peers	7 students (23%)	24 students (80%)

Source: Observation Sheet, September 14–15, 2026

Students expressed that learning with Dakon Smart felt like playing a game, so it was not boring. Another student stated they became more enthusiastic because of the score feature.

Another student felt that learning became fun because they could play while learning, not just listen to the teacher's explanation.

Students found it easier to understand number patterns because they could directly see the regularity through the dakon holes and seeds. This concrete visualization helped students recognize pattern rules, both increasing and decreasing patterns. One student stated that the pattern became more visible, for example, jumping by 2 or jumping by 3. Another student admitted they were able to work on problems that had not been taught because they already understood the pattern.

The teacher confirmed this. According to the teacher, students found it easier to see regularity because of the visualization of the dakon holes. They could directly count and see the difference. Observation results also showed that students who previously had difficulty determining pattern rules, after using the media, became more able to explain pattern rules independently.

Dakon Smart media was designed with problems that followed Polya's stages, namely understanding the problem, devising a plan, carrying out the plan, and looking back. The teacher observed that students began to get used to understanding the problem before answering. According to the teacher, students became more thorough, read the problem first before answering, and tried again until correct when their answer was wrong.

Field notes from the second meeting recorded that when faced with contextual problems, several students appeared to discuss with their peers to determine a solution strategy. They tried to apply the steps taught by the teacher. The teacher also added that this media trained students to think systematically, not just guess, but try to understand first.

4. Technical Challenges and Teacher Scaffolding Strategies

Although Dakon Smart media was designed with a child-friendly interface, some students were not yet accustomed to operating a laptop. Observations noted that several students had difficulty finding navigation buttons, opening menus, and scrolling the media display. One student admitted they were initially confused, but after being helped by the teacher, they could do it. Another student stated they had never used a laptop before, so the teacher had to show them first.

The teacher added that some students were indeed not used to using laptops. They more frequently used mobile phones, so when they had to use a laptop, some felt confused. The

teacher applied alternating scaffolding strategies and asked more proficient students to help their peers. The teacher explained that they walked around to help students who had difficulties, and sometimes asked students who already could to help their friends so that learning continued. Observations noted that the teacher and researcher took turns assisting students who experienced difficulties. More proficient students also appeared to help their desk mates.

Although the media could be accessed offline, the limited number of devices was a challenge. The teacher suggested using a projector for classical learning. According to the teacher, if devices were limited, the media could be displayed via projector first, then students could try it in turns.

Table 2. Challenges and Strategies in Dakon Smart Implementation

No	Challenge	Strategy Applied
1	Students are not used to using laptops	Alternating scaffolding by teacher and researcher
2	Limited number of devices	Use of projector for classical demonstration, students try in turns
3	Students have difficulty finding navigation buttons	Teacher provides initial guidance before media use
4	Differences in student learning pace	More proficient students are asked to help their peers
5	Time management	Learning is divided into two meetings, each 2 × 35 minutes

Source: Observation and Interviews, September 2026



Figure 1. Students using Dakon Smart Media in Turns

Discussion

1. Interpretation of Findings

The results of this study indicate that the implementation of Website-Based Dakon Smart media on number pattern material provided positive learning experiences for teachers and students. This media successfully bridged the abstract concept of number patterns into something more concrete through the visualization of dakon holes and seeds. This finding aligns

with Piaget's theory that elementary school children are at the concrete operational stage, so mathematics learning should be presented through concrete objects or manipulative media (Heruman, 2020). The use of visual and manipulative media has been proven to help students understand abstract mathematical concepts, as stated by Arsyad (2017) that learning media can clarify the delivery of messages and information, thereby facilitating the student learning process.

The first theme confirms that students need media that not only presents material but also actively involves them. The boredom with conventional media expressed by students indicates that mathematics learning needs to be designed more variedly. This aligns with the findings of Sartika et al. (2025) who stated that the use of attractive learning media can increase student motivation and learning outcomes. Monotonous learning conditions tend to reduce student interest and engagement, especially in materials considered difficult such as number patterns. Therefore, the presence of media capable of changing the learning atmosphere into a more enjoyable one becomes an urgent need.

The second theme shows that the integration of traditional games with digital technology is an innovation well-received by teachers and students. The adaptation of dakon into a website form allows students to learn while playing, while also preserving local cultural values. This finding supports the research of Mutiari and Shodikin (2025) which showed that dakon is effective in helping students recognize patterns and develop computational thinking. The automatic feedback feature in the media also proved to help students understand mistakes and correct their answers independently, in line with the principle of independent learning proposed by Sanjaya (2012). Fast and specific feedback allows students to immediately know where their mistakes are without waiting for the teacher's explanation, making the learning process more effective.

The third theme reveals that students' learning experiences became more enjoyable and meaningful. The increase in student engagement from 27% to 87% in the aspect of paying attention to explanations, and 100% of students being directly involved in using the media, indicates that Dakon Smart is capable of creating active learning. This aligns with the findings of Juliana et al. (2021) that dakon media can increase student learning motivation. Furthermore, students' ability to understand number patterns and train problem-solving gradually also improved, as seen from students' ability to apply Polya's steps. This finding supports the

research of Meliasari and Wardana (2023) which found that ethnomathematics-based dakon media has a significant effect on students' mathematical problem-solving abilities. Dakon Smart media not only helps students find answers but also trains them to think systematically in solving problems.

The fourth theme reveals the technical challenges that emerged during implementation, especially the limitations in students' laptop operation skills. However, these challenges could be overcome through the scaffolding strategies applied by the teacher. This finding provides insight that the implementation of technology-based media in elementary schools requires readiness not only in terms of devices but also in terms of user skills. This aligns with the opinion of Norfadila et al. (2025) that technology-based learning media requires scaffolding to be used optimally. The teacher plays an important role in facilitating students to overcome technical barriers and stay focused on learning objectives.

2. Comparison with Previous Studies

The results of this study reinforce the findings of Mutiari and Shodikin (2025) which showed that dakon is effective in helping students recognize patterns. This study also aligns with Meliasari and Wardana (2023) who found that dakon media affects mathematical problem-solving abilities. However, this study offers novelty in the form of integrating traditional games with website-based technology, which has not been widely developed for number pattern material in Madrasah Ibtidaiyah.

The difference with the study by Juliana et al. (2021) which used a Classroom Action Research (CAR) method and focused on learning motivation, this study uses a qualitative approach to explore teacher and student perspectives in depth. Meanwhile, the study by Arlinda et al. (2022) which developed congklak media also differs because this study integrates automatic feedback features and a point system not found in previous studies. The study by Komariah (2020) which developed dakon media for GCD and LCM concepts also differs because this study focuses on number pattern material with a Deep Learning approach.

Tabel 4. Comparison with Previous Studies

No	Researcher (Year)	Focus	Difference from This Study
1	Mutiari & Shodikin (2025)	Dakon and computational thinking	Did not develop website-based media; did not explore teacher and student perspectives
2	Meliasari & Wardana (2023)	Ethnomathematics dakon and problem-solving	Material was whole number operations, not number patterns; no automatic feedback feature

3	Juliana et al. (2021)	Dakon and learning motivation	CAR method, not qualitative; not focused on number patterns
4	Arlinda et al. (2022)	Congklak and mathematics learning	Used congklak, not dakon smart; not focused on number patterns
5	Komariah (2020)	Dakon for GCD and LCM	Material was GCD and LCM, not number patterns; not website-based
6	This study	Website-based Dakon Smart on number patterns	Integrates traditional games with technology; explores teacher and student perspectives

Source: Researcher Analysis, 2026

3. Practical Implications

This study contributes to the development of learning media theory, particularly in the context of integrating local wisdom (traditional games) with digital technology. Dakon Smart media also supports the Deep Learning approach which emphasizes mindful, meaningful, and joyful learning. The findings of this study enrich the literature on the development of mathematics learning media in Madrasah Ibtidaiyah, as well as provide empirical evidence about the effectiveness of traditional games modified digitally. Furthermore, this study affirms that Piaget's learning theory about the concrete operational stage remains relevant in the context of mathematics learning in elementary schools, especially when integrated with technology that suits student characteristics.

4. Implikasi Praktis

Practically, the results of this study can serve as a reference for mathematics teachers in Madrasah Ibtidaiyah in selecting and implementing interactive learning media. Dakon Smart media can be an alternative to increase student engagement and train problem-solving skills gradually. Teachers are advised to pay attention to scaffolding strategies that suit student characteristics, especially in terms of technical skills. Additionally, schools can consider procuring adequate devices to support the implementation of technology-based media. For media developers, the results of this study can serve as a reference in designing learning media that is not only visually attractive but also capable of training students' higher-order thinking skills.

5. Limitations

This study has limitations, including subjects limited to one class in one madrasah, so the results cannot be generalized widely. Additionally, the Dakon Smart media developed does not use a database, so student learning outcome data is not stored permanently. The diverse technical skills of students also require more varied scaffolding strategies. Future research is

recommended to involve broader subjects, integrate databases, and develop media for other mathematics materials.

CONCLUSION

This study concludes that the implementation of Website-Based Dakon Smart media on number pattern material provided positive and meaningful learning experiences for teachers and fourth-grade students in Madrasah Ibtidaiyah. The four main themes revealed in this study indicate that Dakon Smart media is capable of answering students' needs for concrete, interactive, and enjoyable learning media. The integration of traditional dakon games with website-based technology proved to be an innovation well-received by both teachers and students, and was able to increase students' active engagement in learning. The automatic feedback and point system features in the media helped students understand mistakes and correct their answers independently, while the visualization of dakon holes and seeds made it easier for students to see the regularity of number patterns concretely. Nevertheless, technical challenges in the form of limited student skills in operating laptops and limited device availability still require appropriate scaffolding strategies from teachers so that learning can run optimally.

Overall, this study affirms that the integration of local wisdom with digital technology can be an innovative alternative in mathematics learning in Madrasah Ibtidaiyah, especially on number pattern material. Dakon Smart media does not only function as a tool for delivering material but also as a means to train students' problem-solving abilities gradually through enjoyable learning activities. Future research is recommended to develop media for other mathematics materials, integrate databases so that student learning outcomes can be stored permanently, and test media implementation on a broader scale by involving more schools and diverse student characteristics.

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