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DEVELOPMENT OF MICROSITE-BASED INTERACTIVE DIGITAL TEACHING MODULES IN ELEMENTARY SCHOOLS

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Abstrak
Pengembangan modul ajar digital interaktif yang diintegrasikan pada platform *microsite* ini ditujukan untuk menghadirkan media pembelajaran IPA sekolah dasar yang layak dan praktis. Metode yang diterapkan yaitu *Research and Development* (R&D) dengan memanfaatkan lima tahapan skema ADDIE, yakni tahap analisis, perancangan, pengembangan, implementasi, serta evaluasi. Subjek penelitian melibatkan 2 orang validator ahli (ahli materi dan ahli media), serta 28 siswa kelas V SDN Bakalan Krajan 2 Malang dan 1 orang guru kelas V sebagai pengguna uji coba kepraktisan. Instrumen pengumpulan data menggunakan lembar validasi dan angket respons pengguna. Berdasarkan penilaian tim ahli, modul yang dikembangkan berhasil memperoleh rerata skor kevalidan sebesar 90,37% sehingga masuk dalam kategori sangat valid. Sementara itu, tingkat kepraktisan produk saat diimplementasikan pada pengguna menunjukkan hasil yang sangat praktis dengan capaian persentase sebesar 90,38%. Modul digital ini terbukti efektif memfasilitasi proses pembelajaran melalui integrasi lima fitur utama dalam satu platform *microsite*, yaitu petunjuk penggunaan, materi IPA interaktif, kuis berbasis gamifikasi, aktivitas *ice breaking*, dan ruang refleksi diri. Kesimpulannya, modul ajar digital interaktif berbasis *microsite* ini valid, sangat layak, dan praktis digunakan sebagai bahan ajar inovatif dalam pembelajaran IPA di sekolah dasar.
Kata Kunci: Modul ajar digital, *Microsite*, Pembelajaran IPA, Model ADDIE

Abstract
The development of interactive digital teaching modules integrated into this microsite platform is intended to provide appropriate and practical science learning resources for elementary schools. The method applied was Research and Development (R&D), utilizing the five stages of the ADDIE model: analysis, design, development, implementation, and evaluation. The research subjects included two expert validators (a subject matter expert and a media expert), as well as 28 fifth-grade students from SDN Bakalan Krajan 2 in Malang and one fifth-grade teacher who served as a user for the practicality test. The data collection instruments consisted of a validation sheet and a user response questionnaire. Based on the expert panel's assessment, the developed module achieved an average validity score of 90.37%, placing it in the "highly valid" category. Meanwhile, the product's

practicality when implemented by users yielded highly practical results, with a percentage of 90.38%. This digital module has proven effective in facilitating the learning process through the integration of five key features into a single microsite platform: user guides, interactive science materials, gamified quizzes, icebreaker activities, and a self-reflection space. In conclusion, this interactive, microsite-based digital teaching module is valid, highly suitable, and practical for use as an innovative teaching resource in science education at the elementary school level.
Keywords: Digital Teaching module, Microsite, Science learning, ADDIE model

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INTRODUCTION

Advances in information and communication technology have brought about significant transformations in the elementary education ecosystem. The integration of technology into elementary school learning no longer serves merely as a conventional visual aid, but rather as an interactive ecosystem that facilitates a more active, flexible, and meaningful learning experience for students. In the context of science education in elementary school, the appropriate use of digital media is crucial. Science instruction often requires an understanding of abstract natural concepts, so students need visual representations and structured instruction that can make the material more concrete (Bond, 2020; Hillmayr et al., 2020).

However, the reality of science education at the elementary school level is often still constrained by the limited availability of interactive and student-centered learning materials. Based on preliminary observations conducted in the fifth-grade class at SDN Bakalan Krajan 2 in Malang, the science learning process still relies predominantly on conventional printed teaching materials and lecture-based methods. This situation results in learning interactions that tend to be one-way, so students' enthusiasm and active engagement in exploring the material have not yet been optimally fostered (Rustiyana et al., 2024). Elementary school students are in great need of stimulating learning materials that not only present text but are also capable of guiding their learning activities in a systematic and enjoyable way in the classroom (Makransky & Petersen, 2021).

To address these challenges, there is a need for innovative digital learning resources that are integrated, easily accessible, and child-friendly. The use of streamlined web-based platforms such as microsites (e.g., S.id) offers a highly promising pedagogical solution. Microsites allow for the integration of various multimedia features and learning instructions into a single link (a one-stop platform) that can be easily accessed via mobile devices or laptops without the need to install additional apps (Tiningrum et al., 2025).

When implemented in the classroom, this microsite-based interactive digital medium is designed to support a guided learning model. Teachers can act as facilitators, while

students interact directly with structured digital instructions to carry out various activities-ranging from reading interactive materials, participating in group icebreakers, and answering quizzes, to reflecting on the material (Arnab et al., 2022; Clark & Mayer, 2024).

Several previous studies have utilized technology in learning. First, a study by (Dhohirrobbi & Fathi Pusposari, 2025) highlights that interactive digital learning resources serve as effective catalysts for boosting student motivation and achievement. Second, complementing these findings, (Tiningrum et al., 2025) argue that microsite-based delivery supports instructional innovation through concise resource access, despite lacking full optimization across broader instructional models. Third, research by (Hayu & Suciptaningsih, 2024) confirms that the integration of microsite-based media into IPAS instruction in elementary schools can create a more dynamic learning environment. Nevertheless, a review of the literature indicates that a research gap still exists: there have not been many studies that comprehensively develop and test the operational feasibility of microsite-based digital modules specifically designed with various integrated features to serve as guides for classroom activities in science classes at the elementary school level.

Based on this gap, this study aims to develop an innovative product in the form of an Interactive Digital Teaching Module Based on a Microsite for science education in elementary schools, with a focus on testing its validity and practicality. The novelty of this product lies in its instructional design, which simultaneously integrates five key features into a single child-friendly microsite platform, namely: 1) module usage instructions, 2) science content presentation, 3) interactive quizzes, 4) icebreaker activities, and 5) a self-reflection space. Through this research, it is hoped that a digital learning medium can be developed that is valid based on expert assessment and practical based on user interaction experiences (fifth-grade students at SDN Bakalan Krajan 2 Malang along with their facilitator teachers), making it ready for widespread use within the elementary education ecosystem.

METHOD

This study employs a research and development (R&D) approach aimed at creating and testing the feasibility and practicality of instructional materials. The development model used is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) (Branch & Stefaniak, 2019). This model was chosen because it features highly systematic and prescriptive stages and is specifically designed to produce learner-centered, technology-based instructional materials.

The research procedure was carried out through the five stages of the ADDIE model, adapted to the needs of the field:

1. Analysis: Includes a needs assessment through observation of the science learning process in the fifth-grade classroom at SDN Bakalan Krajan 2 in Malang, an analysis of the cognitive characteristics and learning behaviours of elementary school-aged students, and an analysis of the science curriculum and materials.
2. Design: This phase involved mapping out science learning topics, wireframing the interface on the S.id microsite platform, and establishing a cohesive instructional sequence—incorporating user guides, core content, energizing icebreakers, quizzes,

MUBTADI: Jurnal Pendidikan Ibtidaiyah
Vol. 8 No. 1, Juli – Desember 2026
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and reflection spaces. Additionally, evaluation rubrics and data collection tools were formulated.

3. Development: The interactive digital module was built on the microsite platform following the structural design. To ensure product quality, expert reviewers conducted a rigorous validity assessment (*expert judgment*), followed by iterative revisions based on qualitative feedback until the module was declared fit for pilot testing.
4. Implementation: Implementing the validated interactive digital modules in the science learning process directly in the fifth-grade classroom at SDN Bakalan Krajan 2 in Malang. Instruction was conducted using a guided learning scenario, in which the teacher acted as a facilitator and students actively interacted with the instructions in the modules.
5. Evaluation: Evaluating the practicality of the module's use based on data from student and teacher questionnaires after the classroom implementation process is complete.

The subjects in this study consisted of two groups:

1. Expert Validators (Feasibility Test): Two experts, consisting of an elementary school science subject matter expert and a media expert
2. Practicality Test Subjects: Consisting of 28 fifth-grade students from SDN Bakalan Krajan 2 in Malang and one fifth-grade teacher.

Data were collected using instruments in the form of validation sheets (for the validators) and practicality questionnaires (for students and teachers). All instruments were designed using a 1–4 Likert scale to avoid neutral responses.

Table 1 - Indicator Matrix for the Validity and Practicality Assessment Tool

Type of Instrument	Respondents	Assessment Aspects / Indicators
Content Validation Sheet	Science Content Expert	1. Alignment of content with Learning Outcomes 2. Accuracy and correctness of science concepts 3. Clarity of language and readability for elementary school students
Media Validation Sheet	Media Expert	1. Layout design and visual aesthetics 2. Ease of navigation and microsite accessibility 3. Interactivity of features (quizzes and icebreakers)
Teacher Practicality Survey	5th-Grade Teachers	1. Ease of classroom management when using the module 2. Clarity of the module's instructional guidelines 3. Time efficiency and support for the teaching process

Type of Instrument	Respondents	Assessment Aspects / Indicators
Student Usability Survey	5th Grade Students	1. Ease of accessing and using the module 2. Clarity of text and visual presentation/features 3. Enjoyment/enthusiasm while learning (icebreakers & quizzes)

The quantitative data obtained from the validation sheets and practicality questionnaires were analysed using the average percentage technique with the following formula:

$$P = \frac{\Sigma x}{\Sigma xi} \times 100\%$$

Notes:

P = Percentage of validity/practicality

Σx = Total score obtained from respondents

Σxi = Maximum/ideal total score

The resulting percentages were then converted into standard categorization criteria to determine the modules' levels of suitability and practicality, as shown in Table 2:

Table 2 - Criteria for Assessing the Feasibility and Practicality of Modules

Percentage Range (%)	Feasibility Criteria (Validator)	Practicality Criteria (Students & Teachers)	Action/Decision
85,00 – 100,00	Highly Valid/Highly Feasible	Highly Practical	The product can be used without revisions
70,00 - 84,99	Valid/Feasible	Practical	The product can be used with minor revisions
50,00 - 69,99	Fairly Valid	Fairly Practical	The product requires moderate revisions
01,00 - 49,99	Invalid	Impractical	The product requires a complete revision / is not feasible

This microsite-based interactive digital module is deemed eligible and ready for use if it meets the minimum criteria of "Valid" (≥70%) in the feasibility test and "Practical" (≥70%) in the practicality test.

RESULT

Feasibility of Interactive Digital Teaching Modules (Expert Validation Test)

The development of this microsite-based interactive digital teaching module underwent a feasibility test involving two expert validators: one expert in elementary school science curriculum and one media expert. This expert evaluation aimed to ensure the

scientific accuracy of the content and the technical reliability of the media before they were used in the classroom learning process. The quantitative assessment results from both validators are presented in detail in Table 3.

Table 3 - Summary of Expert Validation Results

Validator	Evaluation Criteria	Average Score (%)	Eligibility Category
Subject Matter Expert	Curriculum Alignment & Accuracy of Science Concepts	89,50 %	Highly Valid
	Text Readability & Clarity of Language for Elementary School Students	87,50 %	Highly Valid
Media Expert	Visual Presentation & Layout Design	91,00 %	Highly Valid
	Navigation, Microsite Access, & Feature Interactivity	93,50 %	Highly Valid
Overall Average	**Total**	**90,37 %**	**Highly Valid**

Based on the quantitative data in Table 3, the overall analysis results show that the microsite-based interactive digital module achieved an average validity percentage of 90.37%, which falls within the "Highly Valid" criteria range. The high evaluation by subject matter experts was based on the accuracy of the explanation of the 5th-grade science Learning Outcomes (CP) as well as the accuracy of the representation of scientific concepts presented in a communicative manner. Meanwhile, media experts commended the efficiency of the layout, the child-friendly color contrast, and the practicality of the microsite platform, which allows for the integration of five main features into a single link (a one-stop platform).

Although the module cumulatively met the "highly suitable" criteria, there were several qualitative notes in the form of suggestions and constructive feedback from the validators aimed at improving the module's quality. The product refinement process based on these expert notes is summarized in Table 4.

Table 4 - Validator Feedback and Product Improvements (Before and After)

Validator	Comments/Suggestions	Improvement Actions (Revisions)
Subject Matter Expert	Some of the scientific terms in the science curriculum are too complex for fifth-grade elementary school students.	Rewrite the sentences to make them clearer, more communicative, and child-friendly.
Subject Matter Expert	The questions in the reflection section need to be made more explicit so that students can easily assess their understanding.	Craft simpler prompts that directly reference the core material.

MUBTADI: Jurnal Pendidikan Ibtidaiyah
Vol. 8 No. 1, Juli – Desember 2026
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Media Expert	The navigation buttons on the mobile view are too small for elementary school students' fingers.	Increase the color contrast and size of the navigation buttons to make them more touch-friendly.
Media Expert	The duration and pacing of the icebreaker video feature should be made more concise so as not to take up too much class time.	Replace the icebreaker video with one that is more effective in terms of duration (2–3 minutes) and is interactive.

Qualitative refinements were carried out comprehensively in accordance with the recommendations of both validators. The subject matter expert emphasized the importance of simplifying scientific terminology to avoid placing an excessive cognitive burden on 10- to 11-year-old students; consequently, the researchers revised the sentence structure to make it more accessible and supplemented it with supporting illustrations. Regarding the media aspect, improvements focused on the responsiveness of the interface when accessed via mobile devices, particularly by enlarging the size of the navigation buttons and adjusting the pace of the icebreaker activities to ensure that the allocation of time for science learning in the classroom remains effective and proportionate.

The Practicality of the Modules and the Dynamics of Student Interaction in the Classroom

The practicality test was conducted in the context of science instruction in a fifth-grade classroom at SDN Bakalan Krajan 2 in Malang, using a guided learning scenario. This practicality evaluation involved 28 students as primary users and one fifth-grade teacher as the learning facilitator. Quantitative data on the practicality of the module, collected through a response questionnaire, are presented in Table 5.

Table 5 - Summary of the Module Usability Test Results

Respondents	Practicality Aspect	Average Score (%)	Practicality Category
5th-Grade Teacher	Classroom Management & Clarity of Module Instructions	92,50%	Very Practical
5th-Grade Student	Ease of Navigation & Clarity of Text	88,00%	Very Practical
	Learning Engagement (Icebreakers & Quizzes)	94,50%	Very Practical
	Ease of Completing the Self-Reflection Section	86,50%	Very Practical
Overall Average	**Overall Practicality of the Module**	**90,38%**	**Very Practical**

The data in Table 5 confirm that the microsite-based interactive digital module received an average practicality score of 90.38%, falling into the "Very Practical" category.

MUBTADI: Jurnal Pendidikan Ibtidaiyah
Vol. 8 No. 1, Juli – Desember 2026
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Classroom teachers gave high ratings (92.50%) because the module's systematic structure greatly helped them guide the learning stages without having to repeatedly give verbal instructions. The availability of integrated scenarios within the microsite allowed teachers to fulfill their role as facilitators by focusing more on supporting students who were struggling with their learning.

An in-depth analysis of the implementation process in Grade 5 at SDN Bakalan Krajan 2 in Malang revealed highly positive dynamics in student interactions with this digital module. Unrestricted by heavy application downloads, students accessed the module simultaneously via a lightweight microsite link, which encouraged early exploration without technical delays. Student interest grew markedly as the lesson transitioned into an icebreaking routine—a strategy that cultivated a positive classroom atmosphere and re-engaged student focus right before diving into the core science content.

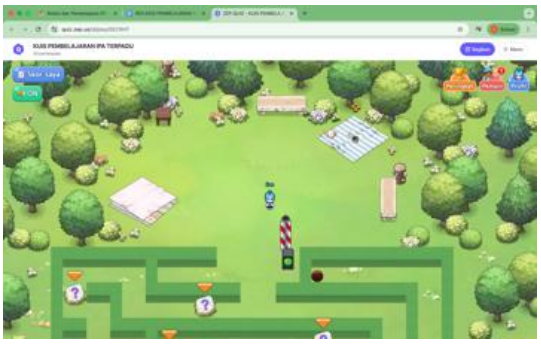

Figure 1 - Screenshot of the Gamification-Based Interactive Quiz Feature in the Digital Module

During the material presentation process, the module's interactivity allows students to learn at their own pace. One of the main attractions that most strongly reinforces students' positive responses is the inclusion of gamified interactive quizzes, as shown in Figure 1. The use of thematic visuals in the form of a maze game creates a game-based learning environment that is highly popular among elementary school students. This quiz feature includes automatic feedback that allows students to immediately assess their level of understanding of the newly learned science concepts on their own. This instant feedback triggers students' internal motivation to correct their answers. Furthermore, during the self-reflection activity, the instructions provided on the microsite proved effective in guiding students to identify which material they had understood well and which parts still required guidance from a facilitator.

DISCUSSION

The development of an interactive microsite module for elementary science education (Grade V, SDN Bakalan Krajan 2 Malang) achieved strong empirical support, recording a 90.37% validity rate and a 90.38% practicality index. Incorporating operational steps, core concepts, quizzes, icebreakers, and reflection prompts within one platform creates a cohesive, student-friendly learning environment. This result validates instructional design theory, demonstrating that effective digital media relies on frictionless access, interactivity,

MUBTADI: Jurnal Pendidikan Ibtidaiyah
Vol. 8 No. 1, Juli – Desember 2026
P – ISSN : 2715 – 7067
E – ISSN : 2720 – 8850

and well-aligned instructional components (Anggraini & Walid, 2016; Arnab et al., 2022; Clark & Mayer, 2024).

The choice of a microsite platform proved to be highly relevant to the characteristics of elementary school students. This is directly reflected in the high practicality scores for visual appeal and ease of navigation. The absence of a requirement to install additional applications on devices allows the microsite to reduce technical barriers that often trigger cognitive overload in elementary school students. These findings support and refine previous studies indicating that the use of a streamlined web-based platform can expand access to materials and simplify the management of learning content without overburdening users' devices (Hayu & UNMA, 2024; Tiningrum et al., 2025). The transformation in this module has successfully filled that gap by providing an adaptive, learner-centered learning ecosystem, as outlined in modern technology integration theory (Bond, 2020; Hillmayr et al., 2020).

Moreover, the module's interactive capabilities offer a targeted approach to resolving traditional difficulties in teaching science to young learners. Science education is often hindered by the process of conveying abstract concepts that are difficult to represent effectively through conventional approaches(Qolbi et al., 2025). Through the integration of interactive content, gamified maze quizzes (pixel art mazes), and reflective assignments, this module bridges students' difficulties in constructing a concrete understanding of scientific concepts. The inclusion of icebreaker activities has proven effective in maintaining students' motivation and enthusiasm for learning in the classroom (Makransky & Petersen, 2021). As emphasized in Dhohirrobbi's study(Dhohirrobbi & Fathi Pusposari, 2025), Interactive digital resources consistently demonstrate a strong positive impact on student motivation.

From a pedagogical perspective in elementary school, the implementation of this module supports the use of guided learning scenarios. In this scenario, the digital module does not replace the teacher's role but rather reinforces the teacher's function as a facilitator. Teachers can guide the learning process more efficiently, while students actively engage with structured instructions on the microsite. The integration of these five features has proven successful in creating a dynamic, interactive, and conducive classroom environment. (Getenet et al., 2024; Max et al., 2023).

Although this product has proven to be highly valid and practical, there are limitations to the research that leave room for further scientific study. Guided by developmental research principles (Richey & Klein, 2014; Branch & Stefaniak, 2019), this assessment was restricted to validating feasibility and practical usability. To build upon these findings, subsequent studies are encouraged to execute controlled experimental trials—utilizing pre-test and post-test measures—to verify how effectively this tool improves student cognitive outcomes.

CONCLUSION

This study concludes that an interactive digital teaching module based on a microsite for teaching natural sciences in elementary school was successfully developed to a very high standard using the ADDIE model. This product was proven to be highly valid based on

evaluations by subject matter experts and media experts, achieving a score of 90.37%, and was also proven to be highly practical for use in fifth-grade classes at SDN Bakalan Krajan 2 in Malang, as evidenced by the average response scores from students and teachers, which reached 90.38%. The integration of five key features within a single microsite link—including user instructions, interactive science materials, gamified quizzes, icebreaker activities, and a self-reflection space—has proven capable of facilitating a flexible, child-friendly learning ecosystem and increasing students' enthusiasm for understanding scientific concepts. Based on these results, this microsite-based module is highly recommended as an innovative learning medium for elementary school teachers, with suggestions for further development including large-scale pilot testing and testing its effectiveness on students' cognitive learning outcomes.

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