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Fostering Deep Learning in Elementary Science Education: Developing a Meaningful, Mindful, and Joyful Interactive Flipbook

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Abstract: This study aims to develop a deep learning-integrated flipbook for enhancing elementary students' science learning outcomes. In this study, deep learning refers to a learning approach that promotes meaningful, mindful, and joyful learning experiences. The study was motivated by the need to transform surface-level learning into meaningful and reflective learning experiences in primary science education. This research employed a Research and Development (R&D) approach using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The participants consisted of 20 fourth-grade students selected through purposive sampling. The developed flipbook integrated deep learning principles through meaningful learning activities, mindful reflection, and joyful learning experiences. Data were collected through expert validation sheets, learning outcome tests, and student response questionnaires. The research instruments were reviewed by experts to ensure their content validity and suitability for elementary science learning. Data analysis used descriptive statistics and N-Gain analysis. The results showed that the flipbook achieved a very valid category. The practicality evaluation showed a teacher response score and a student response in excellent category or very practical. Student learning outcomes improved significantly, as indicated high category. These findings indicate that the developed flipbook is valid, practical, and effective in supporting elementary science learning. This study contributes to elementary science education by providing an innovative digital learning media that integrates deep learning through meaningful, mindful, and joyful learning experiences to enhance students' learning outcomes.

Keywords: elementary education; integrated flipbook; learning media; pedagogical deep learning; science learning

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Introduction

Science learning at the elementary school level plays a critical role in developing students' conceptual understanding, scientific literacy, and critical thinking skills (Putra et al., 2023; Shoffa et al., 2023; Zafirah et al., 2025). However, science instruction in many elementary classrooms remains dominated by teacher-centered practices and memorization, limiting students' opportunities to construct knowledge and apply scientific concepts to real-life situations (Putra et al., 2023; Wati et al., 2023). This condition is particularly concerning in Indonesia, where scientific literacy achievement remains relatively low compared with the OECD average, indicating persistent challenges in students' higher-order thinking and meaningful conceptual understanding (Kementerian Pendidikan Dasar dan Menengah, 2025; Pratiwi, 2024). In 21st-century education, science learning is expected to move beyond passive knowledge acquisition toward student-centered experiences that foster active engagement, inquiry, reflection, and meaningful understanding (Alfiana & Fathoni, 2022).

Constructivist perspectives proposed by Piaget and Vygotsky emphasize that students develop knowledge through interaction, experience, exploration, social engagement, and scaffolding rather than through passive information reception (Piaget, 1977; Vygotsky, 1978). Accordingly, elementary science instruction needs to provide opportunities for students to connect prior knowledge with new information through discussion, experimentation, reflection, and contextual problem-solving (Prastowo, 2011; Shoffa et al., 2023). Such approaches are particularly important because science requires students to observe phenomena,

establish relationships, reason from evidence, and apply concepts to everyday situations. Therefore, improving elementary science learning requires not only innovative media but also pedagogical designs capable of simultaneously supporting cognitive, metacognitive, and affective dimensions of learning.

In response to these needs, the Indonesian Ministry of Primary and Secondary Education has introduced a pedagogical deep learning approach consisting of meaningful learning, mindful learning, and joyful learning as part of the implementation of the *Merdeka Curriculum* (Kementerian Pendidikan Dasar dan Menengah, 2025). In this study, deep learning refers specifically to this pedagogical framework rather than the artificial intelligence or machine learning paradigm commonly used in computer science. Meaningful learning enables students to connect new knowledge with prior experiences, mindful learning promotes reflection, self-regulation, and metacognitive awareness, while joyful learning strengthens motivation, emotional engagement, and active participation (Fitriani & Santiani, 2025; Kementerian Pendidikan Dasar dan Menengah, 2025). These three dimensions complement one another by integrating cognitive, metacognitive, and affective processes, making the framework highly relevant to elementary science education (Wati et al., 2023).

However, translating these principles into concrete instructional materials remains a challenge, particularly when learning materials continue to emphasize content delivery rather than active exploration and reflection. Digital learning media provide an opportunity to address this challenge by presenting scientific content through visual, dynamic, interactive, and flexible learning experiences (Masrifa et al., 2023). Among these media, digital flipbooks can integrate text, images, audio, video, simulations, and interactive activities within a single learning environment, enabling students to access and revisit materials according to their learning pace (Af'ida & Sumadi, 2025). Previous studies have demonstrated that digital flipbooks can improve students' motivation and learning outcomes when appropriately designed (Nur et al., 2024). Nevertheless, the educational value of a flipbook depends not merely on its technological or visual features but on the pedagogical design embedded within it.

The potential of flipbook media is theoretically supported by Mayer's cognitive theory of multimedia learning, which proposes that students learn more effectively when words and relevant visual representations are meaningfully integrated rather than presented through text alone (Mishra, 2025). Carefully designed multimedia elements can facilitate meaningful cognitive processing and make abstract scientific concepts more accessible, while inappropriate or excessive multimedia may instead increase cognitive load (Lailli et al., 2026; Mishra, 2025). Digital media can also provide flexible learning opportunities because students can access learning materials anytime and anywhere and revisit difficult concepts according to their individual learning pace (Masrifa et al., 2023). However, preliminary observations and informal discussions with elementary school teachers revealed that existing digital flipbooks are generally used as electronic versions of textbooks enriched with images and videos, with limited opportunities for reflection, inquiry, and meaningful interaction.

Students therefore tend to use the flipbooks primarily for reading, while their potential to develop conceptual understanding, metacognitive awareness, and active engagement remains underutilized. This field evidence is consistent with previous research showing that many digital teaching materials prioritize content delivery and visual attractiveness rather than deeper cognitive engagement (Lailli et al., 2026). Similarly, digital media may function merely as substitutes for printed materials when they are not supported by instructional designs that promote reflection, active exploration, and meaningful learning experiences (Maulidya et al., 2025). These conditions indicate that technological innovation alone is insufficient; rather, digital science materials require pedagogical integration that deliberately supports meaningful, mindful, and joyful learning. uch integration should position students as active constructors of knowledge rather than passive recipients of digitally presented information. Furthermore, embedding reflective prompts, inquiry-based activities, and opportunities for self-regulated learning within digital materials may enhance their capacity to foster deeper and more sustainable learning outcomes.

Recent research further demonstrates that effective digital science learning should facilitate collaborative inquiry, metacognitive regulation, and shared conceptual understanding rather than merely provide access to digital information. Lämsä et al. (2025), for example, demonstrated that students develop deeper understanding during collaborative inquiry when digital learning environments support socially shared regulation of learning, enabling learners to collectively monitor, reflect on, and adapt their learning processes. Their findings reinforce the argument that meaningful conceptual change emerges through active engagement with evidence and collaborative reflection rather than passive information acquisition. Although previous studies have widely demonstrated the potential of flipbook media to improve motivation and academic achievement, limited research has systematically integrated the deep learning framework of meaningful, mindful, and joyful learning into flipbook-based science instruction at the elementary school level (Maulidya et al., 2025).

Existing studies have predominantly emphasized technological features, accessibility, or visual attractiveness, while insufficient attention has been given to how digital instructional materials can

simultaneously facilitate cognitive engagement, metacognitive reflection, and emotional involvement (Maulidya et al., 2025). Consequently, a clear research gap remains concerning the systematic integration of these three pedagogical dimensions within digital science learning materials. This gap is particularly important because elementary science learning requires students not only to acquire factual knowledge but also to develop conceptual understanding, reflective thinking, curiosity, and sustained engagement (Wati et al., 2023). Addressing this gap requires a unified instructional design that connects pedagogical principles with digital technology rather than treating technology as an end in itself. Therefore, developing a pedagogically grounded digital flipbook represents an important avenue for strengthening the quality and meaningfulness of elementary science learning.

To address these theoretical, empirical, and pedagogical gaps, this study proposes the development of a deep learning-integrated flipbook based on meaningful, mindful, and joyful learning principles for elementary science education. The novelty of the study lies in the systematic embedding of these three dimensions into the structure and learning activities of digital instructional materials, rather than merely adding multimedia features to conventional teaching materials (Kementerian Pendidikan Dasar dan Menengah, 2025). The flipbook is designed to facilitate meaningful learning through contextual exploration of scientific concepts, mindful learning through reflection and metacognitive activities, and joyful learning through interactive multimedia features. Unlike previous digital learning materials that primarily emphasize technological attractiveness or content presentation, the proposed flipbook positions instructional design as the central mechanism for fostering meaningful cognitive engagement and conceptual understanding. This integrated approach is expected to create learning experiences that are interactive, reflective, cognitively meaningful, and emotionally engaging while remaining consistent with constructivist and multimedia learning principles.

The urgency of this study is reinforced by the continuing challenges of conceptual understanding, scientific literacy, and active participation in Indonesian elementary science education (Kementerian Pendidikan Dasar dan Menengah, 2025; Pratiwi, 2024). Accordingly, this study aims to develop and evaluate a deep learning-integrated flipbook based on meaningful, mindful, and joyful learning principles and to examine its validity, practicality, and effectiveness in improving elementary students' science learning outcomes. The study is expected to contribute theoretically by demonstrating how pedagogical deep learning principles can be operationalized within digital instructional materials and practically by providing teachers with an innovative science learning medium that integrates technology with meaningful, reflective, and enjoyable learning experiences. Based on this rationale, the study addresses the following research question: How can a pedagogical deep learning-integrated flipbook based on meaningful, mindful, and joyful learning be developed to produce a valid, practical, and effective learning medium for improving elementary students' science learning outcomes?

Methods

This study employed a Research and Development (R&D) design using the ADDIE model which consists of five stages: analysis, design, development, implementation, and evaluation (Creswell & Creswell, 2017; Branch, 2009). This design was selected because the primary objective of the study was not only to test effectiveness but also to produce and validate an instructional product in the form of a deep learning–integrated flipbook. The ADDIE model provides a systematic framework for developing instructional materials and ensures that the product is theoretically grounded and empirically tested. In this study, the developed flipbook was designed based on the deep learning framework, which includes meaningful learning, mindful learning, and joyful learning as proposed in the Indonesian *Merdeka Curriculum* (Kementerian Pendidikan Dasar dan Menengah, 2025). Furthermore, each ADDIE stage was used to progressively refine the flipbook so that its content, pedagogical design, and digital features were aligned with learners' needs and the intended learning outcomes.

The participants comprised 20 fourth-grade students from an elementary school. The sample was selected using purposive sampling, considering that the students had experienced difficulties in understanding science concepts based on preliminary observations. The participants were involved in the implementation stage, where they used the developed flipbook in science learning activities. Since this study followed a Research and Development approach aimed at evaluating the feasibility of the developed product, the limited sample size was considered appropriate for preliminary product testing rather than for broad generalization. Prior to data collection, permission to conduct the research was obtained from the school administration. Participation in the study was voluntary, and informed consent was obtained from the classroom teacher as well as from the students' parents or guardians. The identities of all participants were kept confidential, and the collected data were used solely for research purposes in accordance with ethical principles in educational research.

The implementation stage was conducted through a series of structured learning activities using the developed deep learning integrated flipbook. At the beginning of the lesson, students completed a pretest to identify their initial understanding of the science concepts. The teacher then introduced the flipbook and guided students in exploring the learning materials through contextual examples, multimedia presentations, and interactive activities. The implementation was conducted over four science learning sessions during two consecutive weeks, with each session lasting approximately 70–90 minutes. The learning activities followed the lesson plans developed within the ADDIE framework and were facilitated by the classroom teacher with assistance from the researcher. Each session integrated meaningful learning through contextual activities, mindful learning through reflective tasks, and joyful learning through interactive multimedia and collaborative learning experiences. At the end of the implementation, students completed a posttest to measure learning improvement and filled out a response questionnaire regarding the practicality and attractiveness of the developed flipbook. The teacher also evaluated the usability of the learning media during classroom implementation.

Data were collected through several techniques to support the development and evaluation of the product. First, expert validation was conducted to assess the feasibility of the flipbook in terms of content and media design. Second, a pretest and posttest were administered to measure students' learning outcomes before and after the implementation of the flipbook. Third, student response questionnaires were distributed to obtain feedback on the usability and attractiveness of the developed product. The data collection process was carried out during the implementation phase of the ADDIE model.

The instruments used in this study consisted of expert validation sheets, learning outcome tests, and student response questionnaires. The expert validation sheets were designed to assess the quality of the developed flipbook in terms of content accuracy, instructional design, language appropriateness, and media presentation. The learning outcome test consisted of 10 multiple-choice questions, 5 fill-in-the-blank questions, and 5 essay questions that measured students' conceptual understanding of science and was administered as both a pretest and a posttest. The student response questionnaire evaluated the practicality of the developed flipbook by examining students' perceptions regarding meaningful learning, mindful learning, joyful learning, ease of use, attractiveness, and overall learning experience. All instruments were developed based on relevant indicators and reviewed to ensure their suitability for elementary school students.

The expert validation instrument included indicators of content suitability, instructional design, language clarity, visual presentation, and technical quality. The student response questionnaire measured meaningful learning through students' ability to relate concepts to prior experiences, mindful learning through reflection and self-awareness during learning, joyful learning through motivation and engagement, as well as usability and attractiveness of the developed media. Before implementation, all research instruments underwent expert validation to evaluate their content relevance, clarity, and suitability for fourth-grade elementary students. The validation process involved experts in science education, instructional media, and educational language. Feedback from the validators was used to revise and improve the instruments prior to classroom implementation. The validation process aimed to guarantee that the collected data accurately represented students' learning outcomes and responses toward the developed flipbook, thereby increasing the credibility of the research findings.

Descriptive statistics were used to summarize and analyzed the results of expert validation, student responses, and learning outcomes. The effectiveness of the developed flipbook was analyzed using the Normalized Gain (N-Gain) score to determine the magnitude of students' learning improvement after the intervention. The N-Gain analysis was selected because it measures learning gains by considering students' initial achievement levels. The use of N-Gain in this study is based on its ability to measure learning improvement proportionally by considering students' initial ability (Padang et al., 2022). The interpretation of N-Gain values is categorized as follows: high ($g \geq 0.7$), medium ($0.3 \leq g < 0.7$), and low ($g < 0.3$). This approach is appropriate for research and development studies, as it focuses on evaluating the effectiveness of the instructional product in improving learning outcomes rather than comparing different groups.

Result and Discussion

The Development of Interactive Flipbook

The results of this study indicate that the developed deep learning integrated flipbook is valid and effective in improving elementary students' science learning outcomes. Product validation was conducted by three experts consisting of media experts, language experts, and material experts to evaluate the feasibility of the developed flipbook. The validation results showed that the product achieved a very valid category with an average score of 92.3%. The detailed results are presented in **Table 1**.

Table 1. Product Validation Results

Aspect	Percentage	Category
Material Validation	93.8%	Very Valid
Media Validation	91.5%	Very Valid
Language Validation	91.6%	Very Valid
Average	92.3%	Very Valid

The high validation scores across the three assessed aspects demonstrate that the developed flipbook satisfies the quality standards for instructional media. The material aspect obtained the highest score (93.8%), indicating that the learning content is relevant, scientifically accurate, and aligned with the learning objectives of the *Merdeka Curriculum*. The media and language aspects also achieved very valid categories, suggesting that the flipbook is visually appropriate, user-friendly, and understandable for fourth-grade elementary students. The developed product was considered feasible for classroom implementation without requiring substantial revisions. These findings further indicate that the integration of well-structured content, accessible language, and appropriate multimedia design strengthens the flipbook's potential to support meaningful and effective learning experiences for elementary students.

The validation results indicate that the developed flipbook fulfilled the criteria of instructional quality in terms of content accuracy, language appropriateness, and media design. The material presented in the flipbook was aligned with the learning objectives and suitable for fourth-grade students. In addition, the language used in the flipbook was communicative and easy to understand, while the media design was visually attractive and interactive. These findings indicate that the integration of meaningful learning, mindful learning, and joyful learning principles was successfully implemented in the digital learning media. In addition to validity, the practicality of the developed flipbook was evaluated through teacher and student response questionnaires after the implementation process.

Table 2. Practicality Evaluation Results Based on Teacher and Student Responses

Respondent	Score (%)	Category
Teacher	96.00	Very Practical
Students	92.50	Very Practical
Average	94.25	Very Practical

The practicality evaluation demonstrated that both teachers and students positively perceived the developed flipbook as an instructional medium. As illustrated in **Table 2**, the teacher response questionnaire yielded a practicality score of 96.00%, while the student response questionnaire obtained 92.50%, resulting in an average practicality score of 94.25%, which falls into the very practical category. These findings indicate that the developed flipbook was easy to use, attractive, and supportive of classroom learning activities. Students reported that the multimedia features, contextual illustrations, and reflective questions helped them understand scientific concepts more effectively. Teachers also indicated that the flipbook facilitated the implementation of meaningful, mindful, and joyful learning in accordance with the objectives of the *Merdeka Curriculum*. The high practicality results indicate that the developed flipbook can be effectively used in elementary classroom learning. This finding is important because practical learning media not only attract students' attention but also support teachers in creating meaningful and enjoyable learning experiences. These results are consistent with previous studies stating that interactive digital media can increase students' participation and learning motivation in science education (Alsarayreh, 2026; Huff & Tseng, 2026; Dewi & Korompis, 2023).

Learning outcomes in this study refer to cognitive achievement as classified in Bloom's Taxonomy proposed by Benjamin Bloom (Anderson & Krathwohl, 2001). Cognitive learning outcomes involve students' abilities to remember, understand, apply, and analyze scientific concepts (Zikriana et al., 2026; Khoy, 2025). The improvement in students' posttest scores indicates that the developed flipbook successfully facilitated higher levels of conceptual understanding through meaningful and reflective learning activities. The implementation results revealed a significant improvement in students' learning outcomes after using the developed flipbook. The average pretest score increased from 58.21 to 86.75 in the posttest, with an N-Gain score of 0.71 categorized as high (Padang et al., 2022). This result indicates that the flipbook effectively enhanced students' conceptual understanding of science topics. The improvement occurred because students were actively involved in learning activities through contextual materials, reflective exercises, and interactive learning experiences provided in the flipbook.

The significant improvement in students' learning outcomes (N-Gain = 0.71) suggests that the integration of deep learning principles into digital instructional media contributes to enhanced conceptual understanding. This aligns with constructivist learning theory, which emphasizes that knowledge construction occurs when learners actively engage with content, reflect on their understanding, and apply concepts in meaningful

contexts. The improved learning outcomes reflect the learning mechanisms embedded in the developed flipbooks. Meaningful learning enables students to connect new scientific concepts with prior knowledge and authentic experiences, while mindful learning fosters metacognitive regulation through reflection and self-evaluation. Enjoyable learning enhances students' intrinsic motivation and sustained attention, creating favorable conditions for active knowledge construction. The interaction between these three dimensions explains why the developed flipbooks are able to facilitate deeper conceptual understanding and improve science learning outcomes.

Classroom observations during the implementation further supported these quantitative findings. Students demonstrated greater participation in learning activities by actively responding to the teacher's questions, engaging in group discussions, and relating scientific concepts to their everyday experiences. The reflective prompts embedded in the flipbook encouraged students to explain their reasoning and evaluate their own understanding, while interactive multimedia elements stimulated curiosity and sustained attention throughout the lesson. Compared with conventional classroom instruction, students appeared more confident in expressing ideas and collaborating with peers, indicating that the integration of meaningful, mindful, and joyful learning fostered a more active and student-centered learning environment. In a line with statement that experience with deep learning could make student's learning motivation and outcomes (Kurnianingsih et al., 2026; Andayanie et al., 2025; Salong & Ansiska, 2025).

The findings of this study are in line with previous research showing that digital learning media positively affect students' achievement and learning motivation in elementary education. The integration of deep learning principles into instructional media supports students in constructing conceptual understanding meaningfully rather than relying only on memorization. The developed flipbook not only improves learning outcomes but also promotes more reflective and enjoyable learning experiences. From a theoretical perspective, this study contributes to the development of instructional media by demonstrating that deep learning principles can be effectively integrated into digital flipbook media for elementary science learning (Hanifah et al., 2026; Mailis & Mansor, 2025). Practically, the developed flipbook can be used as an innovative learning medium to support the implementation of the *Merdeka Curriculum* and create meaningful, mindful, and joyful learning experiences in elementary classrooms.

Although many previous studies have reported positive effects of digital learning media on students' achievement and motivation, some researchers argue that the use of technology alone does not automatically improve learning outcomes. Digital media may become merely an alternative format for presenting information if it is not supported by an appropriate pedagogical design. The present findings suggest that the effectiveness of the developed flipbook is attributable not simply to its digital characteristics but to the systematic integration of meaningful, mindful, and joyful learning principles. This interpretation extends previous studies by demonstrating that instructional design plays a more decisive role than technology itself in facilitating deep conceptual understanding and active learning.

The effectiveness of the developed flipbook can be explained through the principle of constructive alignment, which emphasizes the consistency between learning objectives, instructional activities, and assessment (Biggs & Tang, 2011). The learning activities embedded in the flipbook were intentionally designed to support conceptual exploration, reflection, and active participation, ensuring alignment with the intended learning outcomes. According to Mishra (2025), students learn more effectively when verbal and visual information are meaningfully integrated, reducing unnecessary cognitive load while facilitating deeper information processing. The integration of pedagogical principles and multimedia technology provides a plausible explanation for the substantial improvement in students' science learning outcomes observed in this study.

Integration of Deep Learning Framework in Flipbook Design

The effectiveness of the developed flipbook is strongly influenced by the integration of the deep learning framework, which consists of meaningful learning, mindful learning, and joyful learning (Budiono et al., 2026; Maulidya et al., 2025). These three dimensions are systematically embedded in the instructional design of the digital flipbook to support cognitive, metacognitive, and affective aspects of student learning. Unlike conventional learning materials that primarily emphasize information transmission, the developed flipbook positions students as active learners who construct knowledge through interaction, reflection, and engagement with contextualized content. This integration enables learning experiences to move beyond content acquisition toward deeper understanding, self-awareness, and active participation in the learning process (Tirtawati et al., 2025). Furthermore, the alignment of these three dimensions within the flipbook creates a coherent learning environment in which students can connect new knowledge with prior experiences while developing greater ownership of their learning.

From a theoretical perspective, this integration aligns with constructivist learning theory, which emphasizes that knowledge is actively built by learners through meaningful experiences rather than passively received (Intan et al., 2025; Romdhon et al., 2024). In this regard, the flipbook serves as a learning environment that facilitates exploration, conceptual connection, and reflective thinking. The integration of these three dimensions was intentionally embedded into the instructional design of the flipbook rather than presented as separate learning components. Each learning activity was designed to simultaneously encourage conceptual understanding, reflective thinking, and positive emotional engagement, thereby creating a holistic learning experience consistent with the objectives of the deep learning framework.

Meaningful Learning

Meaningful learning in the flipbook is realized through the presentation of science concepts that are closely connected to students' real-life experiences. This design encourages learners to relate new information to prior knowledge, thereby strengthening conceptual understanding and long-term retention.

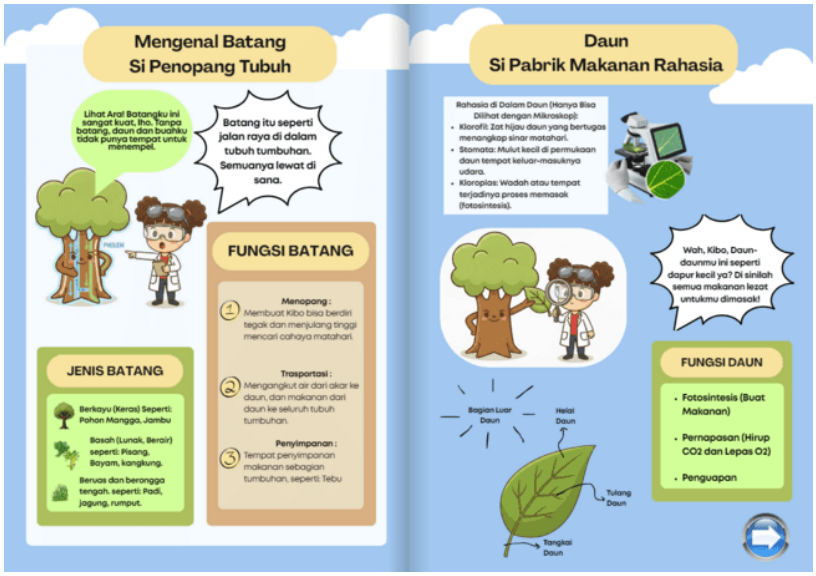

Figure 1. Example of Flipbook Page Supporting Meaningful Learning

The contextual scenarios presented in Figure 1 encouraged elementary school students to activate their prior knowledge and connect scientific concepts with authentic experiences embedded in the flipbook content. This mechanism likely contributed to the improvement in conceptual understanding reflected in the posttest results by enabling students to relate newly presented information to familiar situations. Such an approach is consistent with Mayer's Cognitive Theory of Multimedia Learning, which suggests that learning becomes more effective when verbal and visual information are integrated in a coherent and meaningful way (Lailli et al., 2026; Mishra, 2025). By reducing cognitive overload and facilitating dual-channel processing, the flipbook enhances students' ability to construct scientific understanding more effectively through contextualized learning experiences (Ferreira et al., 2022). Thus, the integration of meaningful learning within the deep learning framework allows students to understand scientific concepts not merely as abstract information but as knowledge that is relevant to their everyday lives.

Meaningful learning is essential in science education because it enables students to transfer knowledge to real-world situations, which is a key indicator of conceptual mastery. In the developed flipbook, meaningful learning is reflected through the integration of contextual scenarios, scientific concepts, and visual-verbal representations that encourage students to actively construct connections between learning content and their experiences. The effectiveness of the developed flipbook lies not only in presenting information but also in facilitating students to construct meaning through contextual experiences and active cognitive processing. This integration strengthens the meaningful dimension of deep learning by positioning students as active participants who interpret, relate, and apply scientific knowledge within relevant contexts (Sexton, 2025; Ferreira et al., 2022). Consequently, the flipbook provides a meaningful learning environment that supports deeper conceptual understanding while making scientific learning more relevant and accessible to elementary school students..

Mindful Learning

This presented in **Figure 2** were integrated into the flipbook content to promote mindful learning by encouraging students to pause, reflect on their understanding, and recognize misconceptions before

proceeding to subsequent learning activities. This reflective process supports metacognitive regulation, as students are guided to become aware of what they know, what they do not yet understand, and how they can improve their learning. Such integration is particularly relevant to deep learning, in which students are expected to engage actively with learning content rather than merely receive and reproduce information. According to Zafirah et al. (2025), active cognitive involvement and self-awareness in learning significantly enhance students' understanding and problem-solving abilities. Within the flipbook, reflective prompts therefore function as an integral component of the learning content that facilitates students' awareness during the learning process. By encouraging students to think about their understanding while interacting with the presented materials, the flipbook creates opportunities for more intentional and meaningful engagement. This process demonstrates how mindful learning can be embedded within deep learning activities through carefully designed content and reflective prompts (Tursinawati & Maulydia, 2026; Wicaksono et al., 2026).

The integration of mindful learning within the flipbook further strengthens students' metacognitive engagement by encouraging them to consciously monitor their comprehension while interacting with the learning materials. Rather than moving directly from one section of the content to another, students are invited to evaluate their understanding and identify possible misconceptions before continuing to subsequent activities (Wicaksono et al., 2026). This approach enables reflection to become an inherent part of the learning experience, linking students' awareness of their cognitive processes with the content presented in the flipbook. Such engagement is consistent with the principles of deep learning, which emphasize active cognitive processing, meaningful understanding, and the ability to connect new information with existing knowledge. In this context, the reflective prompts do not function merely as supplementary questions but as mechanisms that guide students to engage more mindfully with the learning content. The flipbook consequently provides a structured environment in which students can regulate their learning while simultaneously processing the concepts presented. Through this integration, mindful learning supports the deeper cognitive engagement required for meaningful learning outcomes.

Figure 2. Example of Flipbook Page Supporting Mindful Learning

This approach is also consistent with constructivist principles, in which learners are not merely receivers of knowledge but active evaluators and constructors of their own understanding. The flipbook content provides opportunities for students to interact with information, reflect on their comprehension, and reconsider their understanding through the reflective prompts embedded within the learning sequence. Mindful learning contributes to deeper cognitive processing and improved learning outcomes by enabling students to become more attentive to their thoughts, understanding, and learning experiences. When integrated into deep learning, this process encourages students to engage with the content deliberately and reflectively rather than passively consuming the information presented. The combination of content-rich flipbook materials and reflective prompts therefore creates a learning environment that connects cognitive engagement with students' awareness of their own learning processes. In this way, mindfulness becomes embedded within the instructional content and supports the development of metacognitive regulation throughout the learning process (Nugraheni et al., 2025; Rida et al., 2025). Ultimately, the integration of mindful learning into the flipbook demonstrates how digital instructional materials can facilitate deep learning by connecting content exploration, reflection, self-awareness, and meaningful knowledge construction.

Joyful Learning

The multimedia and interactive elements illustrated in **Figure 3** increased students' engagement and sustained attention, thereby creating a positive emotional learning environment that supported deeper cognitive processing. Within the flipbook, these elements were integrated with science learning content to provide elementary school students with an engaging and enjoyable learning experience. Emotional engagement is an important factor in sustaining students' attention and learning persistence in digital learning environments (Damayanti, 2023; Ferreira et al., 2022). The integration of interactive visuals, multimedia representations, and relevant learning content encourages students to participate more actively while exploring scientific concepts. Thus, joyful learning in the deep learning framework is reflected not merely through entertaining features but through the creation of meaningful emotional experiences that strengthen students' engagement with the learning content.

Joyful learning contributes to sustained attention and learning persistence by creating a psychologically supportive environment in which students are more willing to participate, ask questions, and explore scientific concepts. In the developed flipbook, the integration of joyful elements with instructional content allows students to experience science learning as an engaging process while maintaining focus on the intended learning objectives. Emotional engagement becomes an important mechanism that supports deeper cognitive processing rather than merely making learning entertaining (Alhebaishi et al., 2025; Plass & Kaplan, 2016). Through this integration, the flipbook facilitates a learning environment in which enjoyment, active participation, and cognitive engagement work together to support deep learning. Consequently, joyful learning strengthens the affective dimension of deep learning while supporting elementary school students in developing sustained engagement with the scientific concepts presented in the flipbook..

Figure 3. Example of Flipbook Page Supporting Joyful Learning

The integration of meaningful, mindful, and joyful learning within the flipbook results in a holistic learning experience that addresses cognitive, metacognitive, and emotional dimensions of learning (Marta et al., 2025). Unlike conventional instructional materials that primarily focus on content delivery, the developed flipbook facilitates active learning processes through contextual exploration, reflection, and engagement (Azzahra & Prayogo, 2022). The findings of this study indicate that the effectiveness of digital learning media is determined not only by technological sophistication but also by the quality of instructional design in promoting meaningful cognitive engagement. This supports the view of Dewi & Korompis (2023), who stated that the effectiveness of digital learning tools largely depends on their ability to facilitate meaningful learning experiences rather than merely providing interactive features. Therefore, the integration of these three dimensions within the flipbook demonstrates how thoughtfully designed digital content can transform technology-mediated instruction into a deeper, more holistic, and learner-centered educational experience.

This study has several limitations: First, it only involved 20 fourth-grade students from a single elementary school, thus limiting the generalizability of the findings. Second, the effectiveness analysis relied primarily on descriptive statistics and N-Gain analysis without inferential statistical testing. Third, although the instruments underwent expert validation, future studies should include more comprehensive reliability testing and involve larger and more diverse samples. Further research is recommended to examine the effectiveness of the developed flipbook across different educational contexts and student populations. Future investigations should

also consider longitudinal designs to determine whether the learning gains facilitated by the flipbook are sustained over time and transferred to other learning contexts. In addition, comparative studies involving different instructional media and learning approaches could provide stronger evidence regarding the specific contribution of the deep learning framework integrated into the flipbook.

Conclusion

This study concludes that the pedagogical deep learning-integrated flipbook based on the meaningful, mindful, and joyful learning framework was successfully developed and demonstrated satisfactory validity, practicality, and effectiveness for elementary science learning, thereby achieving the research objective. Expert evaluations confirmed that the product met high standards in terms of content, media design, and language quality, while positive responses from teachers and students indicated that the flipbook was practical, engaging, and easy to implement in classroom learning. Its effectiveness was reflected in the high N-Gain score (0.71), suggesting that the integration of meaningful learning, mindful learning, and joyful learning supported students in connecting scientific concepts with real-life experiences, developing reflective and metacognitive awareness, and maintaining motivation and active engagement during learning. These findings should be interpreted cautiously because the study involved only a limited sample of fourth-grade students from a single elementary school and relied primarily on descriptive statistics and N-Gain analysis. The results indicate the potential effectiveness of the developed flipbook rather than broad generalizability to all educational contexts. Future research is recommended to involve larger and more diverse samples, apply inferential statistical analyses, and investigate the long-term impact of integrating meaningful, mindful, and joyful learning into digital instructional media across different subjects and educational settings.

Author Contributions

J, Z, and SMS conceptualized the study. J, Z, RSP, and SMS developed the methodology, while RSP, SMS, and RDS performed the formal analysis. The investigation was carried out by J, Z, and RSP. J, Z, and RSP prepared the original draft. SMS and RDS contributed to writing, reviewing, and editing the manuscript, and provided overall supervision.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal

Use of Artificial Intelligence

Generative AI was used to assist in drafting portions of the manuscript. All AI-generated text was critically reviewed, revised, and verified by the authors. The authors assume full responsibility for the accuracy and integrity of the final manuscript.

References

Af'ida, S. L., & Sumadi, S. (2025). Analisis validitas media pembelajaran digital flipbook berbasis canva pada mata pelajaran IPAS kelas 3 sekolah dasar. *Jurnal Ilmiah Profesi Pendidikan*, *10*(3), 2722–2728. https://doi.org/10.29303/jipp.v10i3.3795

Alfiana, A., & Fathoni, A. (2022). Kesulitan guru dalam menerapkan pembelajaran IPA berbasis etnosains di sekolah dasar. *Jurnal Basicedu*, *6*(4), 5721-5727. https://doi.org/10.31004/basicedu.v6i4.3123

Alhebaishi, S., Stone, R., & Ameen, M. Emotional engagement and teaching innovations for deep learning and retention in education: A literature review. *International Journal of Advanced Computer Science and Applications*, *16*(3), 35-45. https://doi.org/10.14569/IJACSA.2025.0160304

Alsarayreh, A. H. (2026). The impact of learning platforms technologies on student motivation and engagement: A psychological perspective. In *Business resilience and business innovation for sustainability: The double-*

edged role of artificial intelligence and other disruptive technologies, 1311-1322. https://doi.org/10.1007/978-3-031-87584-7_95

Andayanie, L. M., Adhantoro, M. S., Purnomo, E., & Kurniaji, G. T. (2025). Implementation of deep learning in education: Towards mindful, meaningful, and joyful learning experiences. *Journal of Deep Learning*, 47-56. https://doi.org/10.23917/jdl.v1i1.11157

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives* (Complete ed.). Longman.

Azzahra, F., & Prayogo, J. A. (2022). Development of flipbook based module as learning media on a phonology course. *Journal of Language, Literature, and Arts*, *2*(10), 1442–1452. https://doi.org/10.17977/um064v2i102022p1442-1452

Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). McGraw-Hill Education.

Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer Science & Business Media.

Budiono, H., Zahyuni, V., & Mananghaya, M. E. (2026). Development of an interactive heyzine flipbook e-module for ipas with a deep learning approach in elementary schools. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, *15*(2), 343-353. https://doi.org/10.33578/jpfkip.v15i2.343-353

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Dewi, K. R., & Korompis, F. L. S. (2023). Pemanfaatan media digital dalam proses pembelajaran di kelas X SMK Negeri 1 Busungbiu. *Journal of Learning and Technology*, *2*(1), 26–32. https://doi.org/10.33830/jlt.v2i1.5842

Ferreira, M., da Silva, A. L. S., & da Silva Filho, O. L. (2022). Meaningful learning theory and science teaching through research: Interfaces from a narrative literature review. *Revista Brasileira de Pesquisa em Educação em Ciências*, *22*, 1-27. https://www.redalyc.org/journal/5716/571674320049/571674320049.pdf

Fitriani, A., & Santiani, S. (2025). Analisis literatur: Pendekatan pembelajaran deep learning dalam pendidikan. *Jurnal Ilmiah Nusantara (JINU)*, *2*(3), 50–57. https://doi.org/10.61722/jinu.v2i3.4357

Hanifah, N. H., Walid, M., Abdillah, W., & Putri, C. A. (2026). Flipbook digital media development to improve learning outcomes elementary school class V water cycle material. *Limas PGMI: Limas Pendidikan Guru Madrasah Ibtidaiyah*. https://repository.uin-malang.ac.id/28105/

Huff, T., & Tseng, D. C. Y. (2026). Active learning in open digital textbooks: Designing for learner engagement and motivation using H5P. *TechTrends*, *70*(1), 240-252. https://doi.org/10.1007/s11528-025-01144-3

Intan, N., Dani, R., Suryati, S., & Adiansha, A. A. (2025). Analisis peran guru dalam pembelajaran berdiferensiasi di sekolah dasar. *Jurnal Pengajaran Sekolah Dasar*, *4*(1), 158–166. https://doi.org/10.56855/jpsd.v4i1.1323

Kementerian Pendidikan Dasar dan Menengah. (2025). *Naskah akademik pembelajaran mendalam: Menuju pendidikan bermutu untuk semua*. Pusat Kurikulum dan Pembelajaran, Badan Standar, Kurikulum, dan Asesmen Pendidikan.

Khoy, B. (2025). Unlocking cognitive learning objectives: A comprehensive evaluation of how textbooks and syllabi align with revised Bloom's taxonomy across disciplines. *Curriculum Perspectives*, *45*(2), 189-202. https://doi.org/10.1007/s41297-024-00295-2

Kurnianingsih, E., Prayitno, H. J., Mu'ti, A., Baidhawy, Z., & Jufriansah, A. (2026). Deep Learning as an Integrated pedagogical framework: Synthesizing mindful, meaningful, and joyful learning for transformative educational experiences. *Journal of Deep Learning*, 125-143. https://doi.org/10.23917/jdl.v2i2.16008

Lailli, A. N., Birzah, E. Q. F., Yulianingsih, Y., Bilqis, M., Azhar, K., & Kusumaningrum, H. (2026). Analisis karakteristik media pembelajaran digital melalui perspektif prinsip multimedia Mayer dan cognitive load theory. *Jurnal Multidisiplin Ilmu Akademik (JMIA)*, *3*(2), 976–989. https://doi.org/10.61722/jmia.v3i2.9635

Lämsä, J., Sobocinski, M., Edwards, J., & Järvelä, S. (2025). Students' socially shared regulation of learning during a collaborative inquiry task: Do groups' diverse preconceptions matter? *International Journal of Science Education*, 1–23. https://doi.org/10.1080/09500693.2025.2504642

Mailis, M. I., & Mansor, R. (2025). Teachers' Pedagogical transformation towards 21st century learning in enhancing students' thinking skills. *Pedagogia: Jurnal Ilmiah Pendidikan*, *17*(2), 201-214. https://doi.org/10.55215/pedagogia.v17i2.79

Marta, M. A., Purnomo, D., & Gusmameli, G. (2024). Konsep taksonomi Bloom dalam desain pembelajaran. *Lencana: Jurnal Inovasi Ilmu Pendidikan*, *3*(1), 227–246. https://doi.org/10.55606/lencana.v3i1.4572

Masrifa, A., Munirah, S., Cahyani, A. R., & Fauziyah, D. H. (2023). *Media interaktif pembelajaran IPAS*. Cahya Ghani Recovery.

Maulidya, D., Setiawati, D. N. A. E., Umamy, N. A., & Syukri, M. (2025). Analisis literatur peran deep learning dalam mendorong pembelajaran bermakna di sekolah dasar. *Jurnal Pengabdian Masyarakat dan Riset Pendidikan*, *4*(2), 9072–9084. https://doi.org/10.31004/jerkin.v4i2.3330

Mishra, D. (2025). Mayer's cognitive theory of multimedia learning: An overview. *Technology Driven Language Learning: Innovations and Applications*, 7-16. https://doi.org/10.1007/978-3-031-77232-0_2

Nugraheni, D., Wuryandani, W., & Purwanto, A. (2025). Developing a digital cultural flipbook to enhance understanding concept of diversity and tolerance. *Jurnal Ilmiah Sekolah Dasar*, *9*(2), 290-299. https://doi.org/10.23887/jisd.v9i2.83192

Nur, S. A., Atiqoh, A., & Karyono, H. (2024). Pengembangan bahan ajar elektronik flipbook berbasis kearifan lokal sebagai sumber belajar muatan IPS bagi peserta didik kelas 5. *Jurnal Pendidikan: Riset dan Konseptual*, *8*(1), 120–137. https://doi.org/10.28926/riset_konseptual.v8i1.939

Padang, F. A. L., Ramlawati, R., & Yunus, S. R. (2022). Media assemblr edu berbasis augmented reality untuk meningkatkan hasil belajar materi sistem organisasi kehidupan makhluk hidup. *Diklabio: Jurnal Pendidikan dan Pembelajaran Biologi*, *6*(1), 38–46. https://doi.org/10.33369/diklabio.6.1.38-46

Piaget, J. (1977). *The development of thought: Equilibration of cognitive structures*. Basil Blackwell.

Plass, J. L., & Kaplan, U. (2016). Emotional design in digital media for learning. In *Emotions, technology, design, and learning*, 131-161. https://doi.org/10.1016/B978-0-12-801856-9.00007-4

Prastowo, A. (2011). *Panduan kreatif membuat bahan ajar inovatif*. Diva Press.

Pratiwi, N., Yantoro, & Syahrial. (2024). Pengembangan bahan ajar elektronik pembelajaran matematika berbasis problem based learning dengan menggunakan aplikasi Flip PDF professional di sekolah dasar. *Jurnal Cerdas Proklamator*, *12*(1), 1–8. https://doi.org/10.37301/cerdas.v12i1.224

Putra, A. D., Yulianti, D., & Fitriawan, H. (2023). Pengembangan bahan ajar berbasis flipbook digital untuk meningkatkan efektivitas pembelajaran pada siswa sekolah dasar. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *6*(4), 2173–2177. https://doi.org/10.54371/jiip.v6i4.1748

Ramadhan, T. L., & Tirtoni, F. (2025). Penggunaan flipbook digital dalam pembelajaran IPAS pada materi kearifan lokal berbasis etnosains di Sidoarjo. *Jurnal Ilmiah Profesi Pendidikan*, *10*(3), 2641–2649. https://doi.org/10.29303/jipp.v10i3.3198

Rida, M. N. H., Fatmawati, U., Karyanto, P., & Kusumawati, L. (2025). Developing a flipbook on environmental change topics to enhance students' conceptual understanding of sustainable living. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *11*(1), 195-207. https://doi.org/10.22219/jpbi.v11i1.37548

Romdhon, J., Masrifah, M., Shiyama, N. M., & Suharyati, H. (2024). Applying constructivist learning theory to enhance student learning outcomes in elementary schools. *International Journal of Sustainable Development & Future Society*, *2*(2), 62-69. https://doi.org/10.62157/ijsdfs.v2i2.73

Salong, A., & Ansiska, P. (2025). Integrating mindful, meaningful, and joyful learning to enhance student engagement and learning outcomes in economic education. *Al-Ishlah: Jurnal Pendidikan*, *17*(3), 4543-4557. https://doi.org/10.35445/alishlah.v17i3.7484

Sexton, S. S. (2025). Meaningful Learning—David P. Ausubel. In *Science education in theory and practice: An introductory guide to learning theory* ,157-171. https://doi.org/10.1007/978-3-031-81351-1_10

Shoffa, S., Subroto, D. E., Nasution, F. S., Astuti, W., Romadi, U., Cholid, F., Azhari, D. S., Hafidz, Kardi, J., Umar, R. H., & Gusmirawati. (2023). *Media pembelajaran*. CV. Afasa Pustaka.

Tirtawati, I. G. A., Wibawa, I. M. C., & Dharmayanti, P. A. (2025). Development of problem-solving-based flipbook learning media to improve science learning outcomes of fifth grade elementary school students. *Journal of Education Technology*, *9*(2), 353-363. https://doi.org/10.23887/jet.v9i2.91622

Tursinawati, T., & Maulydia, C. (2026). Development of green literacy teaching materials based on flipbook maker in elementary school science learning. *Jurnal Pendidikan Progresif*, *16*(3), 1533-1561. https://doi.org/10.23960/jpp.v16i3.pp1533-1561

Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. https://doi.org/10.2307/j.ctvjf9vz4

Wati, A. N., Riyanto, Y., & Subroto, W. T. (2023). Pengembangan multimedia e-book magic (E-Boma) materi ASEAN untuk meningkatkan hasil belajar peserta didik kelas VI sekolah dasar. *Edukasia: Jurnal Pendidikan dan Pembelajaran*, *4*(1), 149–162. https://doi.org/10.62775/edukasia.v4i1.233

Wicaksono, A. G., Jumanto, J., & Khalifah, V. N. (2026). Deep learning approach (mindful, joyful, and meaningful learning) in elementary school science education: A systematic literature review. *MIMBAR PGSD Undiksha*, *14*(2), 330-343. https://doi.org/10.23887/jjpgsd.v14i2.107823

Zafirah, Z., Wijaya, M. A., & Rohyana, H. (2025). Strategi deep learning terhadap hasil belajar siswa di sekolah dasar. *JOEBAS: Journal of Education, Behavior, and Social Studies*, *1*(1), 41–47. https://doi.org/10.65624/joebas.v1i1.95

Zikriana, L., Sharfina, S., Khairunnisak, K., & Safarati, N. (2026). Enhancing students' cognitive ability on Newton laws through the integrated SSCS-TPACK learning model. *International Journal on Education Insight*, *7*(2), 225-232. https://doi.org/10.12928/ijei.v7i2.15960