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Development of Deep Learning-Based Instructional Tools to Enhance Conceptual Understanding of Cultural Diversity Learning in Elementary Schools

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Abstract: This study aims to develop and examine the effectiveness of deep learning-based instructional tools, consisting of a teaching module and Google Sites-based learning media, in improving elementary school students' conceptual understanding of cultural diversity. The study employed a Research and Development (R&D) method using the ADDIE model and was conducted with 34 fourth-grade students at SDN Gerendong 2, Banten, Indonesia. Data were collected through validation sheets, observations, and learning outcome tests and were analyzed using descriptive statistics and paired-sample t-tests. The results showed that the developed instructional tools were highly valid, with Aiken's V coefficients ranging from 0.88 to 0.94 and validation percentages exceeding 90% across the material, media, and language aspects. The paired-sample t-test results indicated a significant difference between the pretest and posttest scores ($p < 0.001$), with an average N-gain score of 0.63, which falls into the moderate category, and a very large effect size (Cohen's $d = 4.02$). These findings demonstrate that the instructional tools effectively improved students' conceptual understanding. Furthermore, the results indicate that deep learning-based instructional tools integrated with digital media can enhance meaningful and student-centered learning. This study contributes to the growing body of knowledge on instructional design by providing empirical evidence regarding the effectiveness of combining teaching modules and web-based media. It also offers practical implications for teachers in implementing innovative learning strategies that promote conceptual understanding in elementary education.

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Introduction

The rapid advancement of digital technologies, along with ongoing curriculum reforms, has significantly transformed educational practices worldwide. In elementary education, the integration of digital learning media is increasingly emphasized to enhance student engagement and conceptual understanding. In Indonesia, the implementation of the Merdeka Curriculum promotes meaningful, student-centered learning that encourages higher-order thinking and real-life relevance (Kemdikbudristek, 2022; OECD, 2021). However, previous studies indicate that the mere use of technology does not automatically lead to meaningful learning outcomes, particularly when it is not supported by appropriate pedagogical approaches (Fullan et al., 2021; Hodges et al., 2020).

From a theoretical perspective, deep learning emphasizes students' ability to analyze, evaluate, and synthesize knowledge through meaningful and contextual learning experiences (Hattie, 2020; Hidayat & al., 2025). Conceptual understanding, as defined by Anderson and Krathwohl, involves the ability to interpret, classify, and apply concepts in various contexts (Anderson & Krathwohl, 2001). In elementary education, particularly in learning about

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cultural diversity, conceptual understanding is essential for fostering students' tolerance, empathy, and social awareness (Banks, 2020; Gay, 2021; Saputra & al., 2025).

Recent studies highlight that effective deep learning requires not only appropriate pedagogical strategies but also the support of interactive and well-designed learning environments. Digital platforms, when aligned with pedagogical principles, can facilitate inquiry-based learning, reflection, and collaborative knowledge construction (Redecker, 2021; Schindler et al., 2022; Utami, 2023). This aligns with the demands of 21st-century learning, where students are expected to develop critical thinking, creativity, and problem-solving skills through authentic learning experiences (Banks, 2021; Voogt & Roblin, 2021).

In this context, instructional design plays a crucial role in bridging the gap between technology and pedagogy. Well-structured instructional tools, such as teaching modules integrated with digital media, can guide students through meaningful learning processes, including exploration, analysis, and reflection (Branch, 2020; Morrison et al., 2021). The ADDIE model has been widely recognized as an effective framework for developing systematic and learner-centered instructional products across various educational contexts (Adeoye, 2024; Molenda, 2021).

Among various digital learning platforms, selecting appropriate media is essential to ensure alignment with both pedagogical goals and curriculum demands. Compared to more complex Learning Management Systems such as Moodle or design-oriented platforms like Canva, Google Sites offers distinct advantages in elementary learning contexts. Google Sites provides a simple and user-friendly interface that enables teachers to integrate multimedia elements such as videos, images, hyperlinks, and interactive resources into a structured and easily navigable learning environment. This structured presentation supports students in exploring content independently, thereby facilitating inquiry, reflection, and knowledge construction as emphasized in deep learning theory (Hattie, 2020; Redecker, 2021b).

Furthermore, Google Sites strongly aligns with the principles of the Merdeka Curriculum, particularly in promoting learner autonomy, flexibility, and student-centered learning (Kemdikbudristek, 2022). Its accessibility across devices allows students to engage with learning materials anytime and anywhere, supporting self-paced learning and independent exploration, which are essential characteristics of effective digital learning environments (Abdullah & Halim, 2024). In addition, Google Sites enables the integration of multimedia elements such as videos, images, and hyperlinks, which can enhance student engagement and conceptual understanding (Hakim et al., 2024; Rahayu et al., 2024). Previous studies also indicate that Google Sites-based learning media is effective in improving students' learning outcomes and motivation (Basyori, 2025; Hartari & Putra, 2024). In contrast, platforms such as Moodle often require more complex management systems and technical infrastructure, while Canva primarily focuses on visual design and lacks structured learning pathways. Therefore, Google Sites provides a more accessible, flexible, and pedagogically aligned solution for implementing deep learning in elementary classrooms.

Previous research has predominantly focused on the implementation of instructional models such as Problem-Based Learning, Project-Based Learning, and TPACK in improving learning outcomes. While these approaches have been effective in promoting active learning, they tend to emphasize instructional strategies without being supported by systematically designed digital learning environments that sustain deep learning processes. In many cases, digital media are used only as supplementary tools rather than as integral components that structure students' learning experiences (Dewi & al., 2023; Kurnianto & Sarwono, 2022; Siregar & Aghni, 2021; Zhang, 2022).

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Moreover, studies on digital learning media often focus on the use of specific platforms without critically examining how their features align with deep learning principles (Redecker, 2021; Schindler et al., 2022). As a result, there is still limited research that integrates pedagogical frameworks with accessible and structured digital platforms capable of guiding students through higher-order thinking processes, such as exploration, analysis, and reflection (Hattie, 2020; Voogt & Roblin, 2021). Although platforms such as Moodle, Canva, and mobile-based applications have been widely used, their implementation in elementary education frequently encounters challenges related to complexity, accessibility, and the lack of structured learning pathways (Branch, 2009; Molenda, 2003). This indicates that the key issue lies not only in the availability of technology, but also in how it is pedagogically designed to support meaningful learning.

Empirical conditions in schools further reinforce this gap. Observations in elementary classrooms show that learning activities are still predominantly teacher-centered, with limited opportunities for students to engage in higher-order thinking processes. Although digital media are available, they are often used merely as complementary tools rather than as integral components of meaningful learning experiences (Putri & Wahyudi, 2022; Widiastuti, 2024). Consequently, students tend to demonstrate surface-level understanding, focusing more on memorization than on conceptual application.

Therefore, this study addresses the need to develop instructional tools that systematically integrate deep learning principles with accessible and structured digital media. This study aims to design and examine the effectiveness of deep learning-based instructional tools, consisting of teaching modules and Google Sites-based digital learning media, in improving elementary school students' conceptual understanding of cultural diversity. This study contributes theoretically by offering a more integrated perspective on the relationship between instructional design, digital media, and deep learning. Practically, it provides an innovative and applicable instructional solution that supports teachers in implementing meaningful and student-centered learning aligned with the Merdeka Curriculum, while also demonstrating how digital platforms such as Google Sites can effectively bridge the gap between technological advancement and pedagogical effectiveness.

Research Method

This study employed a Research and Development (R&D) method using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation (Branch, 2020; Molenda, 2021). Each stage was conducted systematically to ensure the development of valid, practical, and effective deep learning-based instructional tools aimed at improving elementary school students' conceptual understanding of cultural diversity. The developed product consisted of a teaching module, Google Sites-based digital learning media, and assessment instruments.

At the analysis stage, data were collected through classroom observations and teacher discussions to identify students' difficulties in understanding cultural diversity concepts and to examine the alignment of instructional materials with the current curriculum. The results of this stage served as the basis for formulating learning objectives and designing instructional strategies based on deep learning principles.

The design stage involved developing a blueprint of the instructional tools, including structuring the teaching module, designing the layout and features of the Google Sites-based digital media, preparing learning activities oriented toward conceptual understanding, and constructing validation and assessment instruments. This stage resulted in the initial version of the product.

In the development stage, the initial design was transformed into a complete instructional product consisting of a teaching module, Google Sites-based digital learning media, and assessment instruments. Both the teaching module and digital media were systematically developed and integrated into a coherent instructional system.

Expert validation was conducted to evaluate the feasibility of each component of the product. The teaching module and digital media were validated by nine experts, consisting of three subject-matter experts, three media experts, and three language experts. Content validation focused on the accuracy, depth, and relevance of the material to the curriculum; media validation examined visual design, interactivity, and usability of the Google Sites-based media; and language validation assessed clarity, readability, and appropriateness for elementary school students. Meanwhile, the test instruments were also evaluated to ensure their alignment with learning objectives and their suitability for measuring students' conceptual understanding.

The validation results were analyzed using Aiken's V, and revisions were made based on expert suggestions to improve the quality of the teaching module, digital media, and assessment instruments, resulting in a refined version of the product.

At the implementation stage, the revised product was tested in a real classroom setting at SDN Gerendong 2 Pandeglang Regency, involving 34 fourth-grade students. The participants were selected using a purposive sampling technique, as the class was considered representative of elementary students and had characteristics relevant to the objectives of this study. The selection of the school was based on several considerations, including the availability of digital learning facilities, the school's readiness to implement technology-based instruction, and the need to improve students' conceptual understanding of cultural diversity. The trial employed a one-group pretest–posttest design to measure students' conceptual understanding before and after the implementation of the instructional tools. Practicality data were collected through student and teacher response questionnaires.

The evaluation stage included both formative and summative evaluations. Formative evaluation was conducted at each stage to improve the product continuously, while summative evaluation focused on determining the overall quality of the instructional tools in terms of validity, practicality, and effectiveness. The effectiveness of the product was measured based on the improvement in students' conceptual understanding after implementation.

The instruments used in this study included content, media, language, and test validation sheets; student and teacher response questionnaires; and a conceptual understanding test consisting of 20 multiple-choice items developed based on the revised taxonomy of Anderson and Krathwohl (2001). All validation and response instruments employed a five-point Likert scale ranging from 1 (Very Poor) to 5 (Very Good), which is commonly used to measure attitudes and perceptions in educational research (Likert, 1932; Sugiyono, 2019). The interpretation of percentage scores followed established criteria to determine the level of validity and practicality. The detailed description of the instruments used in this study is presented in Table 1.

Table 1. Research Instrument

No	Instrument	Purpose	Scale/Type
1	Content validation sheet	To assess the accuracy, relevance, and depth of the material	Likert scale (1–5)
2	Media validation sheet	To evaluate design, interactivity, and usability	Likert scale (1–5)
3	Language validation sheet	To assess clarity, readability, and appropriateness	Likert scale

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			(1–5)
4	Test validation sheet	To evaluate the quality of test items	Likert scale (1–5)
5	Student response questionnaire	To measure practicality from students' perspective	Likert scale (1–5)
6	Teacher response questionnaire	To measure practicality from teacher's perspective	Likert scale (1–5)
7	Conceptual understanding test (20 items)	To measure students' conceptual understanding based on Anderson & Krathwohl taxonomy	Multiple-choice test

Data analysis techniques included both quantitative and qualitative approaches. Quantitative data were analyzed using descriptive statistics in the form of percentage scores to determine the levels of validity and practicality. Inferential statistical analysis was conducted using normality testing (Kolmogorov–Smirnov test) and a paired sample t-test to identify significant differences between pretest and posttest scores. In addition, the normalized gain (N-Gain) was calculated to measure the magnitude of improvement in students' conceptual understanding using the following formula:

$$N\text{-}Gain = \frac{Posttest - Pretest}{Maximum\ Score - Pretest}$$

(Hake, 1998).

Qualitative data in the form of suggestions and comments from validators were analyzed descriptively to support product refinement.

Results and Discussion

Analysis

The analysis stage identified several conditions in the learning process. Learning activities were predominantly teacher-centered, and the use of instructional media was limited. Students showed low participation during learning activities. The average pretest score indicated that students' initial conceptual understanding of cultural diversity was relatively low.

Design

At the design stage, the instructional product was systematically planned. The design included the development of a teaching module structure, Google Sites-based learning media layout, learning objectives aligned with the curriculum, and assessment instruments. The product design emphasized student-centered learning, interactive activities, and the integration of visual and contextual elements.

Development

At this stage, the development process involved the creation of instructional materials, Google Sites-based learning media, and assessment instruments, which were subsequently validated by experts. The validation results are presented in Table 2.

The developed learning media is implemented through a Google Sites platform (as shown in Figure 1) which serves as a centralized digital learning environment. This platform integrates learning objectives, instructional materials, learning resources, and evaluation tools in a structured and accessible format. The design of the Google Sites interface is intended to support student autonomy in learning by providing clear navigation and systematically organized content. In addition, multimedia elements such as images and videos are incorporated to enhance student engagement and improve understanding of the learning materials.

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Figure 1. Main Page of Google Sites Learning Media

The Google Sites-based learning media shown in Figure 1 was subsequently subjected to expert validation to ensure its feasibility in terms of content, design, and instructional quality. The validation process involved media and material experts who evaluated the appropriateness and effectiveness of the developed product based on predetermined assessment criteria. The results of this validation are presented in Table 2.

Table 2. Expert Validation Result of Instructional Product

Aspect	Percentage (%)	Aiken's V	Category
Content	93%	0.92	Very Valid
Media	91%	0.88	Very Valid
Language	92%	0.90	Very Valid
Test Instrument	90%	0.89	Very Valid

The results show that all validation aspects achieved percentage scores above 90%, with Aiken's V values ranging from 0.88 to 0.92.

Implementation

The developed instructional tools were implemented in a fourth-grade classroom involving 34 students. Practicality data were collected through student and teacher response questionnaires. The results are presented in Table 3. Both student and teacher responses fall within the 81–100% range.

Table 3. Practicality Results

Respondent	Percentage (%)	Category
Students	85%	Very Practical
Teacher	88%	Very Practical

Evaluation

The effectiveness of the developed instructional tools was evaluated using pretest and posttest scores. Prior to hypothesis testing, a normality test was conducted. The results are presented in Table 4.

Table 4. Normality Test Results

Data	Kolmogorov-Smirnov Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Pretest	0.134	34	0.126	0.953	34	0.150
Posttest	0.136	34	0.112	0.956	34	0.187
Gain	0.210	34	0.001	0.950	34	0.123

The normality test results indicate that all data distributions meet the assumption of normality. This is evidenced by the significance values of both the Kolmogorov-Smirnov and Shapiro-Wilk tests, which are greater than 0.05 for pretest, posttest, and gain data. Therefore, the data can be considered normally distributed, allowing the use of parametric statistical

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tests for further analysis, particularly the paired sample t-test. The results of the paired sample t-test are presented in Table 5.

Table 5. Paired Sample T-Test Results

Variable	Mean Difference	t	df	Sig. (2-tailed)
Pretest–Posttest	-32.353	-24.785	33	< 0.001

The results of the paired sample t-test indicate a significant difference between the pretest and posttest scores. The significance value of < 0.001 ($p < 0.05$) suggests that there was a statistically significant improvement after the implementation of the treatment. This is further supported by a mean difference of 32.353, indicating a substantial increase in students' learning outcomes.

Discussion

The findings of this study indicate that the instructional intervention had a statistically significant effect on students' learning outcomes, as evidenced by the paired sample t-test results ($p < 0.001$). The substantial mean difference (32.353) suggests that the intervention contributed to meaningful improvements in students' cognitive achievement.

Furthermore, the N-Gain analysis yielded an average score of 0.63, which falls into the moderate category (Meltzer, 2002). This indicates that the instructional tools were effective in improving students' conceptual understanding, although the level of improvement has not yet reached the high category. The observed improvement reflects the effectiveness of student-centered learning environments that promote active engagement and knowledge construction (Hake, 1999; Prince, 2004).

More specifically, these findings can be interpreted through the lens of Deep Learning, particularly the framework of Fullan's 6Cs (Fullan, 2013), which include critical thinking, collaboration, communication, creativity, character, and citizenship. The implementation of Google Sites-based learning media facilitated several of these competencies. For instance, the integration of multimedia elements such as videos and interactive content encouraged critical thinking, as students were required to analyze cultural diversity concepts rather than merely memorize them. The structured navigation within Google Sites supported self-directed learning, allowing students to explore materials independently, which aligns with the development of learner autonomy and deeper conceptual processing. In addition, learning activities embedded in the instructional tools promoted communication and collaboration, as students engaged in discussions and shared their understanding during the learning process.

Importantly, the role of Google Sites goes beyond simply making learning more "active." Its features enable the organization of content in a structured yet flexible manner, guiding students through stages of exploration, analysis, and reflection. This structure supports higher-order thinking processes by allowing students to revisit materials, connect concepts, and construct meaning progressively. Such conditions are essential for achieving deep learning outcomes, where understanding is not only retained but also transferable to new contexts.

Despite these positive outcomes, the moderate N-Gain score suggests that several factors may have limited the extent of learning improvement. First, the relatively short duration of implementation may not have been sufficient for students to fully internalize complex concepts related to cultural diversity. Deep learning processes typically require sustained engagement over longer periods. Second, variations in students' digital literacy and access to technology may have influenced their ability to optimally utilize the Google Sites platform. Limited familiarity with digital tools can reduce the effectiveness of self-directed learning environments. Third, the abstract and contextual nature of cultural diversity content

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may have posed cognitive challenges for elementary students, requiring more scaffolding and guided instruction to achieve higher levels of understanding.

These findings are consistent with previous studies emphasizing the effectiveness of active learning approaches. (Hake, 1998) demonstrated that interactive engagement significantly improves conceptual understanding compared to traditional instruction. Similarly, (Freeman et al., 2014) found that active learning increases student performance and reduces failure rates. The present study extends these findings by demonstrating their applicability in an elementary education context using digital learning media.

The results also align with constructivist learning theory, which posits that knowledge is actively constructed through interaction and experience (Bruner, 1961; Piaget, 1970). The observed improvement indicates that students were able to reconstruct their understanding through meaningful learning activities. In addition, Vygotsky's sociocultural theory highlights the importance of scaffolding and interaction (Vygotsky, 1978), which were reflected in the guided learning processes implemented in this study.

From a cognitive perspective, the findings support cognitive load theory, suggesting that well-designed instructional materials can facilitate efficient learning (Sweller, 2011). However, the moderate N-Gain score also indicates that further optimization of instructional design is needed to reduce cognitive overload and enhance retention. Furthermore, (Hattie, 2023) emphasizes that instructional quality, feedback, and teacher clarity are critical factors influencing student achievement, which aligns with the outcomes observed in this study.

The findings of this study have several important implications. First, teachers should integrate deep learning principles by designing learning environments that promote critical thinking, collaboration, and independent learning. Second, instructional design should be continuously refined to enhance learning effectiveness, particularly by incorporating more interactive and scaffolded activities. Third, teachers should adopt evidence-based practices by regularly evaluating learning outcomes using quantitative measures such as N-Gain and pretest–posttest analysis.

Conclusion

This study concludes that the development of deep learning-based instructional tools integrated with Google Sites was successfully implemented and proven to be valid, practical, and effective in improving elementary school students' conceptual understanding of cultural diversity. The results confirm that the systematic instructional design supported by digital learning media significantly enhances students' learning outcomes, highlighting the critical role of well-structured instructional design and technology integration in fostering meaningful learning experiences in elementary education. The findings also indicate that student-centered and interactive learning environments contribute positively to students' cognitive development and conceptual mastery.

Recommendation

Based on the findings, it is recommended that elementary school educators implement student-centered learning strategies supported by well-designed digital platforms such as Google Sites to facilitate meaningful and interactive learning experiences. Teachers are encouraged to utilize specific features developed in this study, such as interactive multimedia (videos, images, and hyperlinks), to help students visualize abstract concepts of cultural diversity and enhance conceptual understanding. In addition, the structured navigation system within Google Sites can be used to guide students through sequential learning stages, including exploration, analysis, and reflection, thereby supporting higher-order thinking

processes. Teachers are also advised to integrate formative assessment features, such as embedded quizzes and reflective tasks, to monitor students' understanding and provide immediate feedback, while the use of self-directed learning pathways can promote learner autonomy by allowing students to access materials flexibly and revisit content as needed. Policymakers are encouraged to support the development and dissemination of digital learning resources that emphasize not only technological integration but also pedagogically structured design, including multimedia integration, scaffolding, and interactive learning activities. Future research should explore the application of similar instructional designs across different subject areas, involve larger sample sizes, and employ experimental designs with control groups to enhance the generalizability and robustness of the findings.

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