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DEVELOPING AND VALIDATING DEEP LEARNING-BASED TOOLS FOR HIGHER-ORDER THINKING SKILLS IN INDONESIAN ELEMENTARY SCHOOLS

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Abstract
Deep learning–based approaches have been implemented across various school subjects, such as mathematics, social studies, and literacy; however, their application in Pancasila Education remains limited, despite the subject's strategic role in fostering students' character development and national values. This study aims to design and validate an innovative deep learning–based instructional tool to enhance higher-order thinking skills in Indonesian elementary schools. Employing a development research design, the study was conducted in three stages: (1) a preliminary investigation to identify teachers' instructional needs, (2) the design and prototyping of the learning tool, and (3) an assessment phase involving expert validation. Data were collected through questionnaires, semi-structured interviews, and expert review instruments. Six teachers from SD Islam A Kota Palembang participated in the needs analysis phase. The data were analyzed descriptively to determine levels of instructional need and product feasibility. The preliminary findings revealed that 84.76% of teachers recognized the importance of deep learning approaches, yet continued to rely predominantly on conventional instructional methods. Teachers also expressed strong interest in developing and implementing deep learning–based lesson plans. Expert validation results demonstrated a high level of feasibility of the developed product, with validity scores of 92% for material aspects, 96% for media aspects, and 84% for language aspects, resulting in an overall validity score of 90%, which falls into the *very feasible* category. These findings indicate that the deep learning–based instructional tool is valid in terms of content accuracy, media design, and language clarity, and is suitable for further classroom implementation and empirical evaluation. This study contributes to the advancement of deep learning practices in Pancasila Education and provides a foundation for strengthening students' higher-order thinking skills through innovative instructional design.
Keywords: deep learning, developing and validating, elementary school, HOTS, innovative learning tool

Introduction

In the 21st century, educators are challenged to design educational practices that develop critical thinkers capable of contributing to social and economic systems, while also cultivating knowledge-conscious citizens who can participate responsibly in a global society. (Gunartha, 2024). High-Order Thinking Skills (HOTS) refer to students' cognitive abilities that involve critical, logical, and reflective thinking processes beyond simple recall, including analyzing, evaluating, and creating knowledge (Abraham et al., 2021).

One cause of the weakness of HOTS is the continued dominance of conventional, teacher-centered learning approaches, which rely on rote learning and tend to produce surface learning (Chaffee, 1992). Whereas basic education is a critical phase in forming the foundation of cognitive,

socio-emotional skills, and students' character (Hamzah et al., 2022), innovation in learning design and strategies is needed that not only emphasize cognitive aspects but also integrate approaches that foster mindful learning, build meaningful connections in real-world contexts (meaningful learning), and create a fun and motivating learning environment (joyful learning), hereinafter abbreviated as MMJ. The concept of learning that incorporates MMJ is gaining increasing attention in the development of 21st-century education in Indonesia. These three principles are considered capable of addressing the challenge of learning that is not solely oriented toward cognitive achievement but also supports character development, well-being, and HOTS (Higher Order Thinking Skills).

Based on the official results of the OECD Programme for International Student Assessment (PISA) 2022, a substantial proportion of students demonstrated limited proficiency in higher-order cognitive processes, with most students performing at levels that emphasize basic understanding rather than analysis, evaluation, or problem-solving (OECD, 2023). In the Indonesian context, student performance in literacy, numeracy, and science remains below the OECD average, indicating persistent challenges in developing higher-order thinking skills across subject areas (Bouckaert, 2023). These findings are particularly relevant to elementary education, where foundational cognitive and character development occurs. In Pancasila Education, learning is expected not only to transmit civic knowledge but also to foster critical thinking, moral reasoning, decision-making, and responsible citizenship. However, low literacy and numeracy proficiency, closely associated with limited HOTS, constrains students' ability to analyze social issues, reflect on values, and apply Pancasila principles in meaningful ways (Grotlüschen et al., 2020; Maharani et al., 2024). Consequently, low student achievement in HOTS affects not only academic outcomes but also the development of essential character traits emphasized in Pancasila Education, such as responsibility, cooperation, reflexivity, and civic judgment.

A Deep Learning (DL)-based instructional approach that integrates meaningful learning, critical thinking, and reflective practice has been shown to enhance student engagement and support HOTS development (Kovač et al., 2025; Maharani et al., 2022). Nevertheless, existing DL-based studies are largely concentrated in mathematics, science, and language learning. In Pancasila Education, prior research has mainly addressed character education, digital citizenship, or project-based civic learning, with limited attention to structured DL-based instructional designs (Gustifal et al., 2024). To date, no empirical studies have proposed or validated a DL-based learning design grounded in MMJ principles for elementary-level Pancasila Education. Moreover, teachers report limited understanding of DL concepts, a lack of pedagogical models, and the absence of validated instructional tools tailored to this subject area (Suwandi et al., 2024).

Existing studies on deep learning–based instruction have predominantly focused on improving higher-order thinking skills in subjects such as mathematics, science, social studies, and literacy. However, these studies generally emphasize cognitive outcomes or instructional media use, without providing a structured pedagogical framework that integrates deep learning principles with subject-specific values. In the context of Pancasila Education, prior research mainly addresses character education, civic literacy, or project-based learning, while the systematic development and empirical validation of learning designs aimed at fostering higher-order thinking skills remain limited. Furthermore, few studies explicitly operationalize deep learning through a clear theoretical framework, such as the Meaningful, Mindful, and Joyful (MMJ) principles, leaving teachers with insufficient guidance for classroom implementation.

To address these limitations, this study proposes and empirically validates a deep learning–based learning design grounded in MMJ principles specifically for elementary-level Pancasila Education. The novelty of this study lies in integrating deep learning principles with the civic and

value-oriented objectives of Pancasila Education, translating the MMJ framework into validated learning tools, and examining their effectiveness in enhancing students' higher-order thinking skills. By doing so, this research contributes a theoretically grounded and empirically tested pedagogical model that extends existing literature and responds to practical instructional needs. The purpose of this study is to design an innovative deep learning–based learning tool to enhance higher-order thinking skills in elementary schools. Specifically, the study aims to ensure the validity and feasibility of the developed design through expert review and practicality assessment. Based on the research focus on developing and validating deep learning-based tools for Higher-Order Thinking skills in Indonesian elementary schools, the study is guided by the following research questions: (1) What pedagogical needs and classroom challenges are identified through the preliminary investigation regarding the implementation of deep learning to foster higher-order thinking skills in elementary schools? (2) How valid is the developed learning tool in terms of content, media, and language as evaluated during the prototype validation stage?

Literature Review

This literature review explains about deep learning, high order thinking skills, and education technology which are elements of the product developed in this research. These concepts are important to be guidelines in developing innovative learning tool products based on deep learning for high-level thinking skills in elementary schools.

Deep Learning

The deep learning approach foster thorough reflection and critical analysis of issues (Aderibigbe, 2021). The concept of deep learning represents one important part of this "new-pedagogies" assembly that over time has become popular, well recognized and frequently used in contemporary education (Kovač et al., 2025). A deep-learning approach develops higher cognitive levels and logical reasoning compared to a surface-learning approach. A deep-learning approach promotes abilities to explain, hypothesize, argue and reflect theories (Paleenud et al., 2024). Students with a deep learning approach tend to enjoy the learning process by actively constructing their understanding through the process of reading literature, integrating knowledge with personal experience, and connecting various facts to conclude (Silalahi et al., 2022).

Deep learning applies the principles of mindful, meaningful, and joyful learning (MMJ). Mindful learning involves students' comprehensive involvement in the learning process, increasing their awareness of their thoughts, feelings, and surroundings. Meaningful learning occurs when students can connect new information to their existing knowledge, ultimately forming a deeper understanding of a concept. Joyful learning focuses on positive emotions related to the learning process, including curiosity, enthusiasm, and motivation (Kemendikdasmen, 2025). Few studies clearly articulate how they align theoretically with DL. The present study views MMJ as an operational framework that supports the characteristics of DL, creating learning conditions conducive to developing deep, conceptual understanding.

Higher Order Thinking Skills

The four skills needed in the 21st century are critical, creative, collaborative and communicative thinking skills. HOTS is an important element in education because of its benefits in improving of students' learning performance, reducing weakness, interpreting, synthesizing,

solving problems, and controlling information, ideas and day-to-day activities (Kwangmuang et al., 2021). HOTS fall under the umbrella of twenty-first-century skills, which comprise the essential skills that youth need to prepare for the future (Lu et al., 2021). Teachers are expected to stimulate children in the development of higher-order thinking skills (Wijnen et al., 2023). Learning activities when students are presented with HOTS questions will have an impact on increasing self-confidence, creative and critical thinking skills (Hasanah et al., 2024). A substantial body of research shows that DL naturally supports the development of HOTS. DL promotes interpretation, conceptualization, justification, argumentation, and reasoning-all components of HOTS. Therefore, DL-based instruction is theoretically suitable for creating conditions in which HOTS can emerge and be strengthened.

Pancasila education pedagogy dan technology

In today's digital age, technology is a key source of knowledge and reference in the learning process. Educational technology has become an issue along with the development of human life and the need for education and learning (Kurniawan & Wanto, 2023). Educational technology has a positive impact on advancing teaching and learning activities at all levels, from elementary school to university (Miasari et al., 2022). Technology provides students with learning experiences they wouldn't otherwise experience, creating a sense of ownership and new phenomena (Sadriani et al., 2023). Pancasila Education aims to develop civic values, national identity, moral reasoning, and responsible citizenship in Indonesian learners. However, instructional practices in Pancasila Education often remain teacher-centered, content-heavy, and oriented toward factual recall. This leads to surface-level learning, limiting students' ability to apply concepts in real contexts or develop civic-related HOTS.

Instructional design frameworks are essential in creating pedagogically sound learning tools. Models such as Plomp's development phases and Tessmer's formative evaluation emphasize systematic design, prototyping, and validation to ensure that learning tools are valid, practical, and effective. In the context of Pancasila Education, properly developed tools can support teachers in implementing structured, student-centered learning aligned with curricular goals. DL and HOTS share common goals: conceptual depth, reflective reasoning, and the ability to apply knowledge in unfamiliar contexts. DL facilitates interpretation, argumentation, and synthesis processes that are central to HOTS. Pancasila Education demands reasoning about values, perspectives, civic problems, and ethical decisions—skills fundamentally aligned with HOTS. Integrating DL–MMJ principles helps move Pancasila Education beyond memorization toward reflective, participatory learning.

Methodology

Research design and approach of the study

This research is a developmental study based on the Plomp model (Plomp & Nieveen, 2013), which consists of three main stages: (1) preliminary investigation, (2) design/prototype phase, and (3) assessment phase. The Plomp model is a model consisting of Preliminary research, Prototyping phase, and Assessment phase with the quality of valid, practical, and effective learning tools (Hidayat et al., 2022). However, in this study only the first two phases were implemented, because the research was limited to product development within a restricted timeframe. Therefore, the

assessment phase which requires extended classroom implementation to evaluate effectiveness was not conducted.

The preliminary research phase focused on identifying problems and needs related to deep-learning–based learning tools for Pancasila Education. Data were collected through observations, teacher questionnaires, interviews, and a literature review to examine existing practices, challenges, and conceptual foundations. The results of this phase were used to formulate the initial design specifications of the learning tools.

The prototyping phase involved the systematic design and development of learning tools integrating deep learning principles with the Meaningful, Mindful, and Joyful (MMJ) approach, emphasizing conceptual understanding, inquiry-based learning, and active student engagement. Prototype development followed Tessmer's formative evaluation model and was conducted through two iterative cycles. The first cycle consisted of a self-evaluation by the researchers to examine alignment with theoretical frameworks, learning objectives, and content standards, resulting in revisions related to instructional coherence, task sequencing, and clarity of activities. The second cycle involved an expert review conducted by subject-matter and instructional design experts. Expert feedback was gathered using structured validation instruments focusing on content validity, pedagogical alignment, and feasibility. The feedback was synthesized by categorizing comments into major and minor revisions, with major revisions prioritized for improving learning objectives, instructional strategies, and assessment components, and minor revisions addressing clarity and usability. These two iterative cycles were considered sufficient given the study's scope, which was limited to product validation rather than full classroom implementation.

Research site and participants

This study involved participants across two stages of the development process: the preliminary investigation and the prototype validation. In the needs analysis stage, six teachers from SD Islam A Palembang participated. These teachers were responsible for teaching Pancasila Education at the elementary level and were selected through purposive sampling to ensure that the data reflected instructional challenges encountered directly in classroom practice. Their responses provided essential information regarding existing learning conditions, teacher needs, and pedagogical gaps.

During the prototype validation stage, expert validators were involved to assess the quality of the developed learning tools. The experts consisted of: (1) media experts, who were lecturers specializing in educational technology and experienced in instructional media design; (2) material experts, who were lecturers with expertise in Pancasila Education at the elementary level; and (3) language experts, who were lecturers specializing in elementary language education and responsible for evaluating clarity and linguistic suitability. These experts were selected based on their academic qualifications and relevance to the validation focus. As the study was limited to the preliminary investigation and design/prototyping phases, no students were involved, and classroom implementation was not carried out. Participants were recruited through purposive sampling to ensure that each individual provided expertise aligned with their role in the research process.

Data collection and analysis

This study employed questionnaires, interview, and observation with data collected following the two implemented phases of the Plomp development model: the preliminary investigation and the design/prototyping phase. During the needs analysis, six Pancasila Education

teachers from SD Islam A Palembang participated in classroom observations, semi-structured interviews, and questionnaire responses to identify instructional challenges and the need for Deep Learning–MMJ–based learning tools. The qualitative data from observations and interviews were analyzed descriptively to identify recurring themes, while questionnaire responses were used to determine teachers' perceptions of existing learning tools and their expectations for improvement. These findings were used to formulate the conceptual and technical specifications of the initial prototype.

In the design/prototyping phase, draft learning tools, consisting of teaching modules and interactive media were developed and validated by expert reviewers. Media experts in educational technology, material experts specializing in Pancasila Education, and language experts in elementary language instruction assessed the prototype using structured validation instruments. After obtaining the results of the expert validation questionnaires for material, teaching modules, language, and interactive learning media, the data were interpreted into feasibility categories, as presented in Table 1 below.

Table 1. *Feasibility criteria for learning devices*

Achievement Level (%)	Category
76-100	Very Feasible
56-75	Feasible
40-55	Less Feasible
0-39	Not Feasible

(Sugiyono, 2014)

Indicator of Media Expert are media suitability with CP, TP, and ATP, media suitability with classroom student characteristics, suitability with learning materials, media design suitability, media display appeal, and suitability with deep learning principles while material expert indicators are alignment of learning module content with CP, TP, and ATP, alignment of learning module content with class student characteristics, alignment of learning module content with learning materials, alignment of learning module content design and presentation, attractiveness of learning modules to student learning motivation, and alignment of learning module content with deep learning principles. Indicator of Language Expert are language conformity with PUEBI, language conformity with elementary school student development level, language conformity with the curriculum and language conformity with learning materials.

Findings

Preliminary investigation

The findings section presents results from the needs analysis and expert validation. The initial investigation revealed that 84.76% of teachers reported continuing to use conventional instructional approaches or had not yet implemented Deep Learning (DL) in their classrooms. Questionnaire data also indicated a strong teacher demand for guidance and support in designing and implementing innovative DL-based learning plans, reflecting limited familiarity with DL concepts and practical strategies.

These findings were reinforced by interview data collected during the initial investigation, which showed consistency with the questionnaire results. Teachers expressed challenges in

adapting to curriculum demands that emphasize immersive learning and highlighted the absence of suitable instructional tools. As one teacher noted, "*While teaching, I use traditional approaches like assignments, and the curriculum is now geared toward immersive learning. If there were innovative learning tools that could support this immersive learning, that would be great.*"

In response to the identified needs, the development of an innovative deep learning–based learning tool was carried out to support the enhancement of higher-order thinking skills in elementary schools. Addressing the research question What pedagogical needs and classroom challenges are identified through the preliminary investigation regarding the implementation of deep learning to foster higher-order thinking skills in elementary schools? the findings indicate that teachers still rely heavily on conventional instructional approaches, possess limited understanding of deep learning strategies, and lack structured tools to guide HOTS-oriented learning. Teachers also reported difficulties in designing immersive and inquiry-driven activities aligned with curriculum demands, reflecting a significant gap between expectations and classroom reality. This gap confirms the urgency for a practical, teacher-friendly DL-based design. The expert validation process further strengthens this effort by ensuring that the developed tool meets the required standards of content relevance, media quality, and language clarity. Thus, the results not only address the research purpose but also demonstrate that the developed learning tool is relevant, feasible, and aligned with the goal of promoting higher-order thinking in elementary Pancasila Education.

Prototype validation

In the design phase, researchers developed innovative deep learning-based learning tools according to the needs of the initial investigation phase. This phase continued with expert validation tests for teaching modules, interactive learning media, language, and material testing. To measure the validity of the developed media, an instrument was used. The following is a summary of the questionnaire for media expert validators.

Table 2. *Media expert validation*

No.	Indicator	Score	Percentage (%)	Category
1.	Media Suitability with CP, TP, and ATP	24	96	Very Feasible
2.	Media Suitability with Classroom Student Characteristics	24	96	Very Feasible
3.	Suitability with Learning Materials	25	100	Very Feasible
4.	Media Design Suitability	23	92	Very Feasible
5.	Media Display Appeal	23	92	Very Feasible
6.	Suitability with Deep Learning Principles	25	100	Very Feasible

Based on the expert team's validation results, the material validation aspect scored 144 out of a total score of 150, or an average validator rating of 24 on a scale of 25. This means that 96% of the media used in the deep learning-based learning device is very suitable for use, as presented in Table 2. However, several media components in the deep learning-based learning device need improvement, including: the audio narration in the meeting video is too fast, the use of AI for a more lifelike image, and the use of appropriate bulletin and numbering for a neat appearance. The learning device was then subjected to a material expert validation test, the results of which are outlined in Table 3 below.

Table 3. *Material expert validation*

No.	Indicator	Score	Percentage (%)	Category
1.	Alignment of learning module content with CP, TP, and ATP	25	100	Very Feasible
2.	Alignment of learning module content with class student characteristics	23	92	Very Feasible
3.	Alignment of learning module content with learning materials	23	92	Very Feasible
4.	Alignment of learning module content design and presentation	23	92	Very Feasible
5.	Attractiveness of learning modules to student learning motivation	20	80	Very Feasible
6.	Alignment of learning module content with Deep Learning principles	24	96	Very Feasible

Based on the expert team's validation results, the material validation aspect scored 138 out of a total score of 150, or an average validator rating of 23 on a scale of 5. This means that 92% of the teaching module material used in the deep learning-based learning device is very suitable for use, as presented in Table 3. However, several material components in the deep learning-based learning device need improvement, including the lack of space for writing answers or answer choices in the interactive quiz in meeting 2. The learning device was then validated by linguists, the results of which are outlined in Table 4 below.

Table 4. *Language expert validation*

No.	Indicator	Score	Percentage (%)	Category
1.	Language Conformity with PUEBI	19	76	Very Feasible
2.	Language Conformity with Elementary School Student Development Level	23	92	Very Feasible
3.	Language Conformity with the Curriculum	22	88	Very Feasible
4.	Language Conformity with Learning Materials	20	80	Very Feasible

Based on the validation results of the expert team, the language validation aspect has a value of 84 out of a total score of 100, or obtained an average validator assessment of 21 on a scale of 5. This means that 84% of the language used in the deep learning-based learning device is very suitable for use, according to the results presented in Table 4. However, there are several languages that need to be improved in the deep learning-based learning device, including errors in the use of capital letters and punctuation, for example, in the explanation of norms. The validation results of media experts, materials, and language experts are collected and given an average in table 5.

Table 5. *Expert validation results*

No.	Expert	Percentage (%)	Category
1.	Media Expert	96	Very Feasible
2.	Materials Expert	92	Very Feasible
3.	Linguist	84	Very Feasible
Average		90	Very Feasible

Expert validation involved three groups of reviewers: media experts, material experts, and language experts. Quantitative validation results showed that the learning tool achieved an overall feasibility score of 90%, categorized as very feasible. Media experts highlighted strengths in visual clarity and interactivity but suggested enhancing consistency in layout and navigation. Material experts assessed content relevance and alignment with Pancasila Education competencies, recommending the addition of more real-world civic scenarios. Language experts evaluated readability and linguistic appropriateness for elementary learners, suggesting revisions to simplify complex sentences and improve instructional clarity. All qualitative comments were systematically compiled to guide further refinement, addressing research question how valid is the developed learning tool in terms of content, media, and language as evaluated during the prototype validation stage

Revisions were implemented based on experts' qualitative feedback. Key improvements included: content refinement – addition of contextual civic cases, expanded HOTS-based activities, and improved alignment with learning outcomes. Media enhancement – improved visual hierarchy, color consistency, iconography, and interactive navigation. Language adjustments – simplification of instructions, revision of long sentences, and adaptation of wording to match elementary students' comprehension levels. These revisions improved clarity, usability, and pedagogical alignment, resulting in a more robust learning tool suitable for further testing in future research stages.

The findings from expert validation and subsequent revisions demonstrate that the developed deep learning–MMJ–based learning tool meets the criteria of validity and feasibility in accordance with the research objectives. The structured review process ensured that the tool was not only conceptually appropriate but also practically implementable in elementary classrooms to support higher-order thinking skill development. The integration of expert feedback into content, media, and language refinements signifies that the product has achieved quality standards required for instructional use. Thus, the outcomes affirm that the study has successfully designed an innovative deep learning tool that is both valid and feasible for Pancasila Education, fulfilling the intended purpose and laying the groundwork for future practicality testing in classroom contexts.

Discussion

The findings of this study demonstrate that the deep learning–based learning tool developed for Pancasila Education meets a high level of validity, with an overall feasibility score of 90%. Material experts rated the tool at 96%, indicating strong alignment with curriculum competencies and clarity of conceptual content. Media experts assigned a score of 92%, suggesting that the visual, structural, and interactive components were well-constructed and pedagogically supportive. Language experts provided an 84% rating, identifying the need for minor revisions to ensure readability and appropriateness for elementary school learners. Collectively, these results confirm that the developed tool successfully integrates deep learning principles and MMJ (Mindful–Meaningful–Joyful) learning into a coherent instructional design that is ready for further empirical testing.

The needs analysis findings indicate that participating teachers reported limited prior experience with deep learning approaches and a lack of structured learning tools specifically designed for Pancasila Education. However, these results should be interpreted cautiously, as they are derived from a limited sample and reflect the contextual conditions of the schools involved in this study. The findings do not necessarily represent the experiences of all elementary school teachers, particularly those in different regions or institutional settings. Nevertheless, within this specific context, the needs analysis highlights a concrete instructional gap that justifies the

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development of the proposed deep learning–MMJ learning tools. Rather than serving as a basis for broad generalization, these findings function as contextual evidence informing the design rationale of the study and underscore the importance of further research involving larger and more diverse samples to validate and extend the applicability of the proposed model.

Furthermore, the results of this study align with its primary objective, namely designing an innovative deep learning–based learning tool to enhance higher-order thinking skills in elementary schools and ensuring its validity and feasibility through expert evaluation. The high validation scores obtained from material, media, and language experts indicate that the developed tool meets the required pedagogical, conceptual, and linguistic standards for classroom use. The practicality indications drawn from teacher feedback further support that the learning tool is implementable and relevant to instructional needs, although continued refinement remains necessary for broader application. These findings affirm that the developed MMJ–based deep learning design is appropriate as an instructional resource and demonstrates strong potential to facilitate deeper learning processes among elementary students.

Deep learning should be understood not as a new curriculum, but as a pedagogical approach intended to promote deep conceptual understanding, critical thinking, meaningful knowledge construction, and student engagement (Khotimah & Rohmad, 2025). However, the relevance of this approach in Pancasila Education requires careful consideration. As a value- and character-oriented subject, Pancasila Education places strong emphasis on moral reasoning, civic reflection, and the internalization of national values—learning outcomes that are inherently abstract and reflective. This characteristic may partially explain why teachers in this study reported difficulties in adopting deep learning approaches, as the absence of concrete instructional models makes it challenging to translate abstract civic concepts into structured learning activities (Mudrikah et al., 2025).

Although prior studies suggest that deep learning can enhance understanding, motivation, and knowledge application (Jiang, 2022), such findings should not be assumed to transfer directly to Pancasila Education contexts. The needs analysis in this study reflects the experiences of a limited group of elementary teachers and should therefore be interpreted as context-specific rather than broadly generalizable. Nevertheless, within this context, the findings highlight a pedagogical gap: teachers require practical, curriculum-aligned examples of deep learning implementation that are sensitive to the normative and character-building aims of Pancasila Education.

This study extends existing research by shifting the focus of deep learning from predominantly cognitive subjects, such as mathematics, science, and literacy toward character and citizenship education. However, given that the present research is limited to expert validation without classroom implementation, its contribution should be understood as developmental rather than confirmatory. The validated prototype demonstrates conceptual and pedagogical feasibility based on expert judgment, but it does not yet provide empirical evidence of instructional effectiveness or student learning outcomes. Accordingly, this study offers a preliminary contribution by providing a theoretically grounded and expert-validated deep learning–MMJ instructional design for elementary Pancasila Education. Its primary contribution lies in establishing a foundation for future empirical research, which is necessary to examine how such designs function in classroom practice and to what extent they support higher-order thinking and character development among students.

Conclusion and recommendations/implications

The study demonstrates that the developed deep learning–based learning tools meet strong validity standards, indicating that their structure, content orientation, and pedagogical design are aligned with the principles of deep learning, HOTS, and Pancasila Education. Rather than merely fulfilling technical criteria, the validation results suggest that the product has conceptual coherence and instructional potential—particularly in its ability to guide teachers toward implementing learning that encourages deep understanding, inquiry, and reflective thinking. The collective feedback from experts suggests that the product has the capacity to offer a structured learning model that may assist teachers in instructional planning and is designed to support students' cognitive engagement. However, these implications are based on expert judgment and require further empirical investigation through classroom implementation to be substantiated.

Despite these strengths, the product's current validation does not automatically guarantee classroom effectiveness. Its use has not yet been tested across diverse contexts, and some refinement is still needed, especially in ensuring linguistic clarity and usability for teachers with varying levels of experience. The limited scope of expert evaluation also means that the product's adaptability, scalability, and long-term sustainability remain unexamined. Future research should therefore move beyond feasibility to investigate actual pedagogical impact, such as how the tools influence student engagement, the development of HOTS, and the internalization of Pancasila values. Studies employing classroom trials, teacher training models, iterative design cycles, and broader sample testing are recommended to further refine the product and strengthen its contribution to deep learning implementation in Indonesian schools.

In summary, the research has successfully produced a deep learning–based learning tool that is valid, feasible, and pedagogically aligned with MMJ principles, showing strong potential to support HOTS-oriented Pancasila Education at the elementary level. The results imply that teachers now have a structured model that can guide lesson development toward deeper learning, addressing the previously identified gap in instructional resources. Nevertheless, the tool's effectiveness in real classroom settings remains to be validated. Therefore, it is recommended that further implementation studies be conducted to test practicality, measure learning outcomes, and evaluate user experience across varied contexts, enabling continuous refinement and broader applicability.

Disclosure statement

No potential conflict of interest was reported by the authors.

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