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Need Analysis for Coding and Artificial Intelligence Learning Media to Improve Computational Thinking Skills

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Abstract
Coding and Artificial Intelegence in the national curriculum aims to equip pupils with computational thinking skills, its implementation in Indonesia is still hampered by conventional teaching methods and low levels of digital literacy among teachers, which results in the material being presented in a manner that is too abstract.This study aims to analyse teachers' needs for coding and artificial intelligence learning media at the primary school level. This study is part of a The data was collected by distributing an online questionnaire to 62 respondents, comprising primary school teachers in Boyolali Regency and analysed using descriptive qualitative methods. The questionnaire results show that primary school teachers have a high need for support in the form of coding and artificial intelligence learning media, including: the need for specific teaching modules (77.4%), relevant case studies (74.2%), visual media (74.2%), and interactive media (75.8%). In addition, teachers need simple physical equipment (67.7%) and a centralised digital platform (79%) that is user-friendly (74.2%), safe for children (77.4%), equipped with progress tracking features (71%), and a teacher community forum (71%). Overall, the results of the needs analysis confirm that to support effective coding and artificial intelligence practices, an integrated digital ecosystem is needed that can simplify complex technological concepts into concrete, interactive, and easy-to-understand material.
Keywords: *Coding, Artificial Intelligence, Needs Analysis, Learning Media, Primary School, Computational Thinking.*

Abstrak
Pembelajaran pemrograman dan kecerdasan buatan dalam kurikulum nasional bertujuan untuk membekali siswa dengan keterampilan berpikir komputasional; namun, penerapannya di Indonesia masih terhambat oleh metode pengajaran konvensional dan rendahnya literasi digital di kalangan guru, yang mengakibatkan materi disampaikan dengan cara yang terlalu abstrak. Penelitian ini bertujuan untuk menganalisis kebutuhan guru akan media pembelajaran pemrograman dan kecerdasan buatan di tingkat sekolah dasar. Penelitian ini merupakan bagian dari Data dikumpulkan dengan menyebarkan kuesioner daring kepada 62 responden, yang terdiri dari guru sekolah dasar di Kabupaten Boyolali, dan dianalisis menggunakan metode kualitatif deskriptif. Hasil kuesioner menunjukkan bahwa guru sekolah dasar memiliki kebutuhan yang tinggi akan dukungan berupa media pembelajaran pemrograman dan kecerdasan buatan, termasuk: kebutuhan akan modul pengajaran khusus (77,4%), studi kasus yang relevan (74,2%), media visual (74,2%), dan media interaktif (75,8%). Selain itu, guru membutuhkan peralatan fisik yang sederhana (67,7%) dan platform digital terpusat (79%) yang ramah pengguna (74,2%), aman bagi anak-anak (77,4%), dilengkapi dengan fitur pelacakan kemajuan (71%), serta forum komunitas guru (71%). Secara keseluruhan, hasil analisis kebutuhan ini menegaskan bahwa untuk mendukung praktik pemrograman dan kecerdasan buatan yang efektif, diperlukan ekosistem digital terintegrasi yang dapat menyederhanakan konsep-konsep teknologi yang kompleks menjadi materi yang konkret, interaktif, dan mudah dipahami.
Kata kunci: Koding, Kecerdasan Artifisial, Analisis Kebutuhan, Media Pembelajaran, Sekolah Dasar, Berpikir Komputasional.

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INTRODUCTION

Massive global technological developments have made digital literacy an essential competency for future generations. In response to this challenge, Coding and Artificial Intelligence have been designated as elective subjects in the national curriculum in Indonesia to equip students with computational thinking skills from an early age. The subjects of Coding and Artificial Intelligence are positioned as a form of strengthening computer science disciplines oriented towards the development of computational thinking skills, digital skills, mastery of algorithms, data processing, and understanding of the ethics of artificial intelligence utilisation (Education Standards and Assessment Agency, Ministry of Education and Culture, 2025). The presence of the elective subjects of Coding and Artificial Intelligence is a response to the urgent need to improve students' digital literacy amid rapid advances in technology. This programme is designed so that each student can understand the concepts and achieve specific competencies in line with their stage of development (Ministry of Primary and Secondary Education of the Republic of Indonesia, 2025). Basic education lays an important foundation for the development of logical reasoning and problem-solving skills through coding-based learning and artificial intelligence literacy. Research shows that teaching coding and computational thinking at the primary school level improves students' algorithmic and abstraction skills, while also strengthening their collaboration, communication, and creativity (Martin, 2024).

Coding and artificial intelligence subjects are not merely technical activities involving writing lines of code, but rather pedagogical instruments designed to hone the pillars of computational thinking through structured problem solving. Computational thinking can be defined as a systematic problem-solving methodology that adopts the basic principles of informatics. This ability involves the process of breaking down complex problems into simpler elements through decomposition techniques, identifying similar characteristics through pattern recognition, simplifying the focus on crucial aspects through abstraction, and compiling a logical sequence of solutions in the form of algorithms (Stempedia, 2024).

Efforts to equip students with computational thinking skills began in 2014 in various developed countries through education system reforms. This step was based on the assumption that mastery of computational thinking is crucial in guiding students to have systematic reasoning and a more organised framework of thinking (Gunawan Supiarmo, 2021). Computational thinking is a key skill that serves as an important instrument in harmonising technological advances with strengthening individual competitiveness (Cahdriyana & Richardo, 2020). The introduction of computational thinking skills at the primary school level is crucial as a foundation for students to not only become users of technology, but also to be able to understand the logic and problem-solving behind these digital innovations. Through computational thinking, individuals are expected to be able to identify the most efficient and effective solutions. Furthermore, problem-solving competencies can be reapplied to face various other challenges (Singhal, 2022). In addition, introducing computational thinking at an early age fosters a systematic and innovative mindset that enhances interdisciplinary learning and equips students for technological advancement. (Dağ, 2023) (Zeng, 2023)

Based on the results of interviews and observations conducted previously, it appears that the implementation of this curriculum faces significant obstacles in the field due to its status as a new subject for primary school levels. Observation and interview data in primary school environments indicate significant deficiencies in the integration of educational technology. Educators still rely heavily on traditional methods, including lectures and direct instruction, which is consistent with research showing the dominance of teacher-centred approaches in various educational settings (Fernández-Rodríguez, 2023) (Mugo, 2024). Currently, there is no adequate learning media available to facilitate

teachers in transforming complex concepts of coding and artificial intelligence into easily understandable material. Learning media is understood as a supporting instrument in educational interactions that plays a role in optimising the delivery of instructional material. Essentially, media functions as an intermediary of information from educators to students to ensure that learning objectives are achieved to the maximum extent possible (Daniyati, et al., 2023).

The lack of ready-to-use teaching materials for coding and AI forces primary school teachers to continue relying on abstract, conventional methods, making it difficult to bridge the gap in pupils' ability to understand computational thinking in a concrete way in the classroom. This gap has become increasingly pronounced since the implementation of the Merdeka Curriculum for the 2025/2026 academic year, in which coding and AI have become compulsory elective subjects for Year 5 primary school pupils, yet teachers face challenges in understanding CTS and infrastructure limitations. Although previous studies such as Papadakis (2021) have demonstrated the effectiveness of ScratchJr through puzzles and sandboxes for CT, Fanchamps et al. (2021) have highlighted the benefits of visual media for complex concepts, and Leung (2023) has emphasised interactive tools, research in Indonesia remains limited to general explorations of CTS without a focus on integrated coding-AI media for primary school teachers.

Without the right media solutions, pupils fail to grasp the full potential of this new subject, whilst primary school teachers in Indonesia report difficulties with integration due to a lack of understanding and facilities—risking a hindrance to digital competence in the age of AI. Recent studies such as Zourmpoukis (2025) on ScratchJr gamification and Zapata-Cáceres (2021) on pre-school robotics have not addressed the local adaptation of the Merdeka Curriculum, leaving a gap in mapping the needs of primary school teachers in developing countries.

This research is innovative because it specifically analyses and designs an integrated coding-AI media platform tailored to the needs of Indonesian primary school teachers, going beyond previous general approaches by offering ready-to-implement solutions that simplify complex material for pupils. The results ensure a concrete link between the new curriculum, teachers' limitations and the development of pupils' computational thinking skills.

METHOD

This research is part of Research and Development (R&D) that adopts the development procedure according to the Sukmadinata model (Syawaludin, 2019). The main focus of this article is on the initial stage of development, namely the preliminary study stage focused on needs analysis. Participants in this study involved 62 respondents who were primary school teachers in the Boyolali Regency. Data collection was carried out systematically through the distribution of online questionnaires (Google Forms) to reach respondents widely and efficiently. The questionnaire instrument was designed to explore comprehensive data on pedagogical constraints, teachers' ICT literacy levels, and specific preferences for coding and artificial intelligence learning media support relevant to primary school levels. The collected data was then processed using descriptive qualitative analysis techniques. To ensure data quality, the research instrument first underwent expert validation to ensure that its content aligned with the objectives of the problem mapping. Furthermore, the validity of the research findings was ensured through systematic qualitative descriptive techniques, whereby data from 62 respondents were analysed in depth and cross-checked against observations of the actual state of teachers' ICT literacy in Boyolali to avoid interpretative bias.

RESULTS AND DISCUSSION

The preliminary study in this research served as a starting point for conducting a comprehensive needs analysis. Through this stage, researchers were able to identify the extent of primary school teachers' specific needs for coding and artificial intelligence learning media to support students' computational thinking skills, as well as the characteristics of the learning platform needed by teachers to simplify complex technological material for primary school students. The data in this study was collected through a digital questionnaire distributed using the Google Form platform. Data collection was conducted online in September-October 2025 with a total of 62 primary school teachers spread across Boyolali Regency. The use of this online instrument was chosen to ensure flexibility for respondents in providing objective responses regarding the need for coding and artificial intelligence learning media. The following is the analysis presented in tables and figures. Table 1 presents the results of an analysis of teachers' statements regarding the need for coding and AI learning resources in primary schools. Based on this data, there appears to be a strong tendency for teachers to require a platform that not only visualises programming logic but also provides simple operational guidance.

Table 1. Analysis of teachers' needs regarding appropriate coding and AI learning resources for primary school pupils

Statement	Alternative Answers	% Selection
Teaching modules/guidance books specific to coding and AI that are appropriate for the level of understanding of primary school students are needed as an effort to improve computational thinking skills	1	0
	2	0
	3	22.6
	4	77.4
The availability of relevant project examples or coding/KA case studies related to students' daily lives in the media is crucial in efforts to improve computational thinking skills.	1	0
	2	1.6
	3	24.2
	4	74.2
Visual learning media (infographics, short videos) will greatly assist primary school pupils in understanding the concept of Artificial Intelligence.	1	0
	2	1.6

	3	24.2
	4	74.2
Interactive media (such as educational games or simple simulations) are needed to improve computational thinking	1	0
	2	0
	3	24.2
	4	75.8
Availability of simple physical equipment (e.g., entry-level robotics or microcontroller kits) is required for hands-on practice	1	0
	2	4.8
	3	27.4
	4	67.7
I would find it helpful if there were a centralised digital platform for accessing all teaching materials and media. Coding/KA	1	0
	2	1.6
	3	19.4
	4	79
An ideal digital platform should provide automatic assessment features or track student progress in coding practice.	1	0
	2	0
	3	29
	4	71
The platform must be user-friendly and accessible via various devices (computers/tablets).	1	0

	2	0
	3	25.8
	4	74.2
Digital platforms must provide secure and child-friendly web-based coding tools	1	0
	2	1.6
	3	21
	4	77.4
A discussion forum or teacher community is needed within the platform to share best practices	1	0
	2	1.6
	3	27.4
	4	71

Based on the needs analysis data in the table, an urgent need for teaching resources and digital infrastructure to support coding and AI education at primary school level has been identified. A total of 77.4% of respondents strongly agreed that teaching modules or specialised guides tailored to the level of understanding of primary school pupils are essential, indicating that coding and AI materials must be contextualised through projects relevant to pupils' everyday lives.

This finding (77.4% requirement for specialised modules) is higher than that of a previous study by Apriliani (2024), which found that only 65% of primary school teachers required personalised AI materials due to infrastructure limitations. The need for visual and interactive media (74.2%–75.8%) aligns with Papadakis (2021) on the effectiveness of ScratchJr for CT, as well as Fanchamps et al. (2021), who highlighted visual media for complex concepts; however, this study confirms the urgency of physical devices such as simple robots (67.7%), which have not yet been explored in depth.

Demand for centralised platforms (79%) exceeded Leung's (2023) expectations regarding interactive tools, with no particular emphasis on automated assessment (71%) or community forums (71%). Compared with Zourmpakis (2025) on ScratchJr gamification and Zapata-Cáceres (2021) on pre-school robots, these results emphasise multi-device access (74.2%) for rural digital divides. Additional research, such as that by Williyansen et al. (2023), found that only 60% of teachers were prepared to use AI coding worksheets due to infrastructure disparities, whilst Tarigan et al. (2023) reported a 70% need for digital ecosystem training in Banjarmasin primary schools, confirming the

novelty of this local mapping. Overall, this empirical data fills a gap by focusing on Indonesian primary school teachers

Based on the findings of this needs analysis, it can be concluded that there is a very high urgency for the provision of contextualised teaching modules and the strengthening of digital infrastructure to support coding and artificial intelligence education at primary school level. The need for materials tailored to pupils' levels of understanding shows a significant increase compared to previous research, suggesting that teachers now require practical guidance relevant to pupils' daily lives. Furthermore, the reliance on centralised platforms and interactive visual media further underscores that an integrated digital ecosystem is highly anticipated. These findings also highlight the importance of providing physical devices such as simple robotics and cross-device accessibility as solutions to the digital divide across various regions, whilst filling the empirical gap regarding the readiness and specific needs of primary school teachers in facing technological transformation in Indonesia.

Despite facing various limitations, teachers have begun to explore and identify various digital tools that are considered effective for introducing the digital world to students in a visual and interactive way. Logic introduction platforms that use tools such as Scratch, Blockly Games, and Code.org are the top choices because of their child-friendly drag-and-drop features and their ability to turn complex programming concepts into fun games. The use of digital platforms can increase student participation and independent learning through personalised feedback, which ultimately strengthens their digital literacy skills (Yasa, 2024) (Yaseen, 2025). Visualisation and creativity from Canva have emerged as the most consistently used platform by teachers to create visually appealing learning media to help students understand the material. The adoption of artificial intelligence technology, where it is evident that some teachers have begun to utilise Generative AI technologies such as ChatGPT, Gemini, and Suno as material support assistants or teaching aids to introduce KA concepts directly to students. Additionally, gamification and interactive evaluations are employed to maintain learning enthusiasm, with quiz- and game-based applications such as Wordwall, Kahoot, and Quizizz being utilised to create a more dynamic and positively competitive classroom atmosphere.

The needs analysis discusses the dynamics of challenges and projections for strategic solutions regarding the implementation of coding and Artificial Intelligence at the primary school level. It also discusses how to address multidimensional obstacles, including infrastructure, teacher competence, and the socio-economic conditions of students. One of the questions raised is about the technological infrastructure gap, namely the main physical obstacle reported is the lack of hardware such as laptops, tablets, or Chromebooks in schools, which is exacerbated by unstable internet access and inadequate electricity networks. Regarding teacher readiness and confidence, there are significant findings regarding low IT literacy among teachers, where many teachers feel insecure because they have not mastered the basic concepts of coding and AI in depth. Psychographic and environmental barriers for students, where teachers face challenges in simplifying abstract algorithm concepts to suit the comprehension level of primary school students. The presentation of abstract programming material and the lack of visual media make it difficult for students to internalise basic principles such as logic, algorithms, and computational thinking frameworks. This phenomenon highlights the gap in teachers' digital competence, an issue that is often highlighted in various studies on educators' digital literacy (Wohlfart, 2022) (Jung, 2024). In addition, the lack of personal devices and low educational support from parents at home are factors that hinder the continuity of learning. In addition to hoping for an integrative solution as a way out, teachers are eagerly awaiting the availability of systematic and integrated teaching modules, as well as practical training that is evenly distributed (not only for certain

schools). Teachers also propose an "unplugged" approach (activities without computers) as a creative alternative to continue instilling computational thinking logic amid facilitation limitations.

The results of this needs analysis confirm that the development of coding and AI learning resources for primary schools in Indonesia must incorporate the concept of synchronising technology with accessibility. Although teachers have demonstrated adaptability through the use of interactive tools, infrastructure limitations and low digital literacy remain the primary obstacles that render the material abstract. Therefore, the urgent strategic solution is not merely the provision of sophisticated applications, but the development of educational media products that integrate visual-concrete methods with a systematic unplugged approach. This transformation is crucial to bridging the gap between the demands of the national curriculum and actual capabilities in the field, to ensure that pupils' computational thinking skills can be developed sustainably without being hindered by hardware limitations.

CONCLUSION

A needs analysis has revealed a pressing need to provide teaching resources and digital infrastructure to support the teaching of coding and artificial intelligence (AI) in primary schools. The majority of respondents emphasised that this material should be delivered through modules or guidebooks contextualised around everyday projects. Effective teaching strategies are considered to depend heavily on the integration of visual media, short videos, interactive media such as simulations, and the provision of physical equipment in the form of basic robotics to provide a tangible learning experience.

The implications of this study point to the need for a transformation in learning management through a centralised, child-friendly digital platform that supports collaboration among teachers. However, this implementation faces significant challenges, ranging from hardware limitations and unstable internet connections to low digital literacy and teachers' lack of confidence in teaching the subject matter in depth. Furthermore, there are challenges in simplifying algorithmic logic to suit pupils' level of understanding.

As a recommendation, the development of learning materials should prioritise integrated solutions through systematic modules that are easily accessible to teachers across various regions. Given the infrastructure constraints, the use of unplugged methods or computer-free activities is strongly recommended. This creative approach serves as a vital foundation for developing computational thinking skills in.

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