

Netnography of Elementary School Teachers' Interpretations of Coding and Artificial Intelligence

¹⁾Devitasari Septiana Dewi, ²⁾MS Viktor Purhanudin

^{1,2)} Elementary Madrasah Teacher Education Study Program, State Islamic University of Salatiga, Salatiga, Central Java, Indonesia.

*Correspondence Author: devidevitasari68@gmail.com

Article Info Keywords: artificial intelligence; coding; computational thinking; netnography; primary school teachers.	ABSTRACT The introduction of Coding and Artificial Intelligence (CAI) in primary education raises new pedagogical demands for teachers. This study examines how primary school teachers construct words about, interpret, and negotiate its implementation through publicly available digital traces. A qualitative netnographic approach was employed. The corpus comprised 30 meaningful units drawn from six public teacher-generated digital artifacts on two platforms during August-December 2025. Data were analyzed through open coding, focused coding, cross-data comparison, and interpretive thematic analysis. The analysis focused on how teachers translated policy demands into age-appropriate pedagogical decisions and negotiated ethical boundaries around AI use. Four themes emerged: an implementation gap between conceptual acceptance and classroom practice; pedagogical domestication of coding into computational thinking through contextual and unplugged learning; the positioning of artificial intelligence as an assistant rather than an authority; and the influence of the wider school ecosystem. Successful implementation depends on teachers' technological competence, pedagogical translation, critical AI literacy, professional learning, infrastructure, guidance, and sustained institutional support.
Article Information Kata Kunci: guru sekolah dasar; kecerdasan artifisial; koding; netnografi; berpikir komputasional.	ABSTRAK Penerapan Koding dan Kecerdasan Artifisial pada pendidikan dasar menghadirkan tuntutan pedagogis baru bagi guru. Penelitian ini menganalisis cara guru sekolah dasar memaknai, menafsirkan, dan menegosiasikan implementasinya melalui jejak digital publik. Penelitian menggunakan pendekatan netnografi kualitatif. Korpus terdiri atas 30 unit makna dari enam artefak digital publik yang diproduksi guru pada dua platform selama Agustus-Desember 2025. Data dianalisis melalui pengodean terbuka, pengodean terfokus, perbandingan lintas data, dan analisis tematik interpretatif. Analisis difokuskan pada cara guru menerjemahkan tuntutan kebijakan menjadi keputusan pedagogis yang sesuai dengan perkembangan anak serta membentuk batas etis penggunaan AI. Empat tema ditemukan: kesenjangan antara penerimaan konseptual dan praktik kelas; domestikasi pedagogis koding menjadi berpikir komputasional melalui pembelajaran kontekstual dan tanpa perangkat; kecerdasan artifisial sebagai asisten, bukan otoritas; serta pengaruh ekosistem sekolah. Keberhasilan implementasi bergantung pada kompetensi teknologi guru, penerjemahan pedagogis, literasi kecerdasan artifisial yang kritis, pengembangan profesional, infrastruktur, panduan, dan dukungan institusional yang berkelanjutan. Temuan menempatkan guru sebagai penerjemah kebijakan teknologi ke dalam praktik pembelajaran sekolah dasar.
Article History	Received : 15/08/2026 Revised : 10/09/2026 Accepted : 21/10/2026 ✉ Corresponding Author: (1) Devitasari Septiana Dewi, (2) Elementary School Teacher Education Study Program, (3) Salatiga State Islamic University, (4) Salatiga, Central Java, Indonesia, (5) Email: devidevitasari68@gmail.com

1. Introduction

The development of artificial intelligence and computing has broadened the meaning of literacy required of students at the elementary level. Digital literacy now encompasses operational skills, understanding how technology works, systematic problem-solving, information processing, and the critical and responsible use of artificial intelligence (AI). A systematic review of artificial intelligence literacy in K-12 education positions the introduction of AI as an increasingly relevant need as students grow up in an environment influenced by algorithmic systems and data-driven technologies [1]. In elementary education, AI literacy intersects with digital literacy, data literacy, computational thinking, and ethical understanding, so learning needs to be tailored to the child's developmental stage [2]. Within this framework, coding and artificial intelligence serve as tools for building the ability to understand, assess, and critically interact with the digital environment.

These changes have taken concrete form in Indonesian education policy through the development of Coding and Artificial Intelligence (KKA) learning. KKA policy documents and learning guidelines position computational thinking, digital literacy, programming, data utilization, artificial intelligence, and ethical use of technology as skills that are developed gradually [3], [4]. At the elementary school level, learning orientation includes device recognition, understanding patterns and algorithms, decision-making, problem-solving, and responsible use of technology. The pedagogical consequences are clear: schools need to translate relatively complex technological concepts into developmentally appropriate learning experiences.

Teachers are the primary link between policy direction and classroom practice. KKA learning requires a combination of knowledge of technology, content, pedagogy, data, coding, and ethics. Kim and Kwon mapped elementary school teachers' AI education competencies into technology use, coding, data, instructional design, learning environments, and ethical issues [5]. A study of 1,664 K-12 teachers also found a gap between general pedagogical readiness and readiness in AI content knowledge and technology [6]. Both findings underscore the need for professional development that specifically integrates AI content, technology, and pedagogy.

Implementation issues are increasingly complex because positive acceptance of technology does not automatically translate into teaching readiness. Perceptions of AI's benefits can coexist with the need for technical support, strengthening content knowledge, infrastructure, and practical experience before the technology is optimally integrated [7]. In the Indonesian context, elementary school teachers' readiness for AI and coding is related to digital literacy, opportunities for professional development, and varying access to facilities and training [8]. Teacher readiness for KKA is therefore multidimensional and is formed through the interaction of pedagogical, technological,

professional, and institutional aspects.

Recent research in Indonesia has begun to map elementary school teachers' perspectives on the implementation of KKA. Sabna and Setiawan found positive perceptions of KKA's potential to support students' computational thinking, critical thinking, problem-solving, creativity, and digital literacy; similar findings also addressed issues related to devices, the internet, teacher workload, implementation clarity, and students' basic technological skills [9]. A cross-national study of 943 Indonesian and Korean elementary school teachers linked perceptions of AI to experiences with technology use, perceived usefulness, changes in learning, and changes in teachers' roles [10]. These findings position teachers' voices as a crucial resource for understanding the process of implementing technological innovation in elementary education.

The evidence base regarding teachers' perceptions of KKA is still dominated by surveys, questionnaires, interviews, and case studies that position teachers as respondents to researchers' questions [9], [10]. These methods are effective for mapping attitudes, readiness, needs, and barriers. Their limitations lie in their ability to capture the spontaneous processes when teachers share experiences, ask questions, express doubts, respond to colleagues' practices, or reflect on learning in digital spaces. Previous studies primarily describe what teachers perceive. The process of forming, exchanging, and negotiating professional meaning in digital communication practices is still relatively limited in the context of Indonesian elementary school teachers.

Teacher professional development occurs through formal training and digital spaces. Teachers acquire and produce knowledge through webinars, educational channels, online communities, comment spaces, digital reflections, and publications of practical experiences. These digital footprints capture narratives of experiences, questions, responses, recurring terms, concerns, and shared strategies. This series of footprints allows researchers to observe how professional communities make meaning of educational change more naturally.

Netnography offers a suitable approach to understanding these processes. This method adapts an ethnographic sensibility to examine social practices, culture, interactions, and meaning-making in digital environments [11]. Netnographic analysis encompasses the content of comments, the context of conversations, the relationships between digital traces, the character of the community, the process of immersion, reflexivity, and ethical considerations. Methodological studies of digital ethnography emphasize the importance of social context, diverse data forms, rigor, reflexivity, and the protection of user identity [12]. This framework allows research to move from an inventory of opinions to an explanation of how teachers construct and negotiate the meaning of KKA in digital spaces.

Based on these gaps, this study aims to analyze elementary school teachers' interpretations of Coding and Artificial Intelligence through their public digital footprints. The analysis

focuses on the meaning of KKA implementation, the development of expectations and concerns, and the negotiation of policy demands with professional readiness, student characteristics, learning practices, and school conditions. The research's novelty lies in shifting the unit of analysis from individual attitudes to the process of constructing professional meaning in the digital space. This perspective positions teachers as actors who translate technological innovation into elementary education practices.

2. Research Methods

2.1. Research Design and Approach

This study uses a qualitative approach with a netnography method to understand how elementary school teachers interpret, and negotiate Coding and Artificial Intelligence (KKA) through public digital traces. Netnography was chosen to integrate content analysis of opinions with context, meaning-making practices, narratives of experience, and relationships between digital traces in online spaces. This method adapts ethnographic principles to understand culture, social practices, and meaning-making mediated by digital technology [11].

The research is interpretive. Teacher statements are read alongside the publication context, content objectives, response formats, narrated professional experiences, and other relevant digital traces. This approach directs the analysis from measuring attitudes to understanding the process of professional meaning-making in digital spaces. Reflexivity, sensitivity to context, and digital research ethics are applied throughout the research process [12].

2.2. Field and Sources of Netnographic Data

The netnographic field is limited to two Indonesian-language public platforms that contain digital artifacts produced directly by elementary school teachers. The corpus includes six artifacts: one teacher reflective article, three On-the-Job Training reports, one training reflection script, and one professional development plan. All artifacts were published or uploaded between August and December 2025, the initial phase of implementing Coding and Artificial Intelligence (KKA) in elementary education.

The search used keywords such as 'Coding and Artificial Intelligence', 'elementary school KKA', 'elementary school coding teachers', 'KKA reflections', and 'KKA OJT'. The primary data consisted of narratives of experiences, reflections, concerns, adaptation strategies, and follow-up plans written by teachers. Institutional sources, policy documents, and previous research were placed outside the corpus and used to contextualize and dialogue the findings in the discussion section.

The selection of sources followed three considerations: the professional identity of elementary school teachers could be verified from public artifacts; the content was directly related to KKA at the elementary school level; and the documents contained substantive reflections or experiences that went

beyond administrative descriptions.

2.3. Data Selection and Collection

Data selection was conducted purposively and iteratively. Data were included in the corpus if they met four criteria: (1) were publicly available without access to private spaces; (2) discussed KKA, coding, computational thinking, or the use of AI in the context of primary education; (3) had sufficient contextual information to connect digital footprints to teachers' professional experiences; and (4) contained substantive views, experiences, questions, concerns, hopes, or reflections regarding KKA implementation.

The user's identity as an elementary school teacher was verified through explicit statements about their profession or the grade they taught, public information about their school or job, or narratives of experiences clearly demonstrating professional involvement at the elementary school level. Digital traces without sufficient professional context were excluded from the primary evidence regarding the meaning of elementary school teachers.

Comments containing attendance, emojis, promotions, short, unargued remarks, duplication, and irrelevant content were excluded from the corpus. Data from private accounts, private conversations, or closed groups were also not collected. The study did not use comments or digital footprints that could be identified as belonging to elementary school students.

Each source was recorded on an inventory sheet containing the source code, platform, publication or observation date, professional context, meaning unit, initial code, category, theme, and inclusion decision. The unit of analysis was defined as a segment of meaning that conveys a single substantive idea about the KKA. After filtering, the final corpus consisted of 30 substantive meaning units from six public digital artifacts on two platforms. To maintain anonymity in reporting, artifacts were coded S1-S6 and meaning units were coded sequentially within each source.

2.4. Data Analysis Procedure

Analysis was carried out simultaneously with data collection. Researchers read the corpus repeatedly and take digital field notes to understand context, recurring terms, patterns of experience, contradictions, and relationships between data. The next stage uses open coding to label units of meaning that emerge from the data.

Initial codes included teacher readiness, implementation gaps, training, pedagogical practices, computational thinking, student-specific fit, AI benefits, ethical AI use, technology dependency, infrastructure, policy support, and learning adaptation. This list served as working codes and was updated throughout the analysis until final themes emerged through a comprehensive comparison of the data.

Codes were grouped through focused coding and cross-data comparisons to identify relationships between categories.

Researchers also looked for cases that deviated from the dominant pattern, or negative cases. This step was used to test the robustness of interpretations and reduce the tendency to select data that supported the KKA.

The analysis yielded four main interpretative themes: (1) from acceptance to implementation gap; (2) pedagogical domestication of coding: from programming to thinking; (3) artificial intelligence as an assistant, not an authority; and (4) KKA in the school ecosystem. The relationships between themes were used to construct a thematic map and the KKA Pedagogical-Ecosystem Translation Model.

Data collection was discontinued when additional observations no longer yielded distinct major conceptual categories and significantly reinforced the patterns already identified. Conceptual saturation was established based on the stability of categories over additional observations.

2.5. Validity and Ethics of Research

The validity of interpretations was maintained through repeated readings, cross-source comparisons, the search for cases that deviated from dominant patterns, reflective journaling, and the documentation of analytical decisions through an audit trail. Code and theme changes were recorded to trace the path from meaning units to interpretations. Policy documents and previous empirical research were external to the corpus and used to contextualize and dialogue the findings.

Publicly available data retains an ethical dimension. Account names, individual names, profile photos, and other information that could allow identification are omitted from the report. Each user is assigned an anonymized code. Quotes with a high risk of being retrievable through search engines are paraphrased while preserving their meaning. Researchers also do not link digital identities to users' offline identities.

Reflexivity was achieved through notes on the researcher's initial assumptions, changes in understanding, and potential biases during the analysis process. The netnographic corpus was positioned as a source of contextual understanding of KKA's meaning-making practices in the observed digital field, rather than as a statistical representation of all elementary school teachers in Indonesia.

3. Results and Discussion

Netnographic analysis reveals a hierarchical pattern from acceptance of the KKA to a pedagogical translation process. Teachers acknowledge the relevance of the KKA and then confront implementation demands related to professional competence, student characteristics, pedagogical strategies, assessment, ethical use of AI, facilities, and school support. This pattern positions teacher readiness as the result of the interaction between professional capacity and ecosystem conditions.

The corpus profile is presented in Table 1 to show the

composition of the sources and the number of meaning units analyzed. All sources were produced by elementary school teachers and were publicly available at the time of observation.

Table 1. Netnography Corpus Profile

Digital sources	Unit
S1 Timelines.id: teacher reflective articles	5
S2 Scribd: OJT report for class V	9
S3 Scribd: Elementary school teacher OJT report	5
S4 Scribd: class teacher OJT report	5
S5 Scribd: phase C training reflection	3
S6 Scribd: professional development plan	3
Total: 6 artifacts on 2 platforms	30

Note: personal identities are not shown in the manuscript; URLs and observation dates are stored in the research audit trail.

Table 2. Mapping of Netnography Categories and Themes

Analytical Categories and Representation of Meaning	Theme
Teacher readiness and assessment: the introduction of KKA does not automatically translate into implementable capabilities	Implementation gap
Computational thinking and device-free learning: coding translated into concrete ways of thinking and activities	Pedagogical domestication
Benefits, ethics, and verification of AI: AI is used as a tool that still requires human judgment.	AI as an assistant
Training, facilities and guidance: implementation depends on the support of the school ecosystem.	School ecosystem

Table 2 presents teacher readiness as a result of an interaction between factors. Difficulties in implementing KKA arise when professional knowledge intersects student characteristics, material complexity, school conditions, and implementation support. Therefore, the findings are more appropriately interpreted as a process of translating policy into practice rather than as a measurement of attitudes toward technology.

The relationships between these themes are visualized in Figure 1.

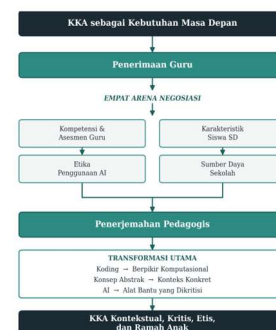


Figure 1. Thematic Map of Teachers' Interpretation of Coding and Artificial Intelligence

Source: Results of researcher analysis (2026).

The thematic map positions acceptance of the KKA as the initial stage. Afterward, teachers enter four negotiation arenas:

professional readiness, elementary school student characteristics, the ethics of AI use, and the condition of school resources. These four arenas encourage pedagogical translation through computational thinking, device-free learning, concrete analogies, and critical use of AI.

3.1. From Acceptance to Implementation Gap

The first theme highlights the gap between conceptual acceptance of the KKA and the ability to operationalize it in learning. In S3-U3, a teacher mentioned that some KKA material still needed to be re-learned after the training. In S2-U9, the training transformed initial views of coding and artificial intelligence, which initially felt distant from teachers' daily lives, into part of teaching and learning activities. These two units demonstrate that acceptance of the KKA can grow alongside the need to strengthen implementation competencies.

This condition is understood as an implementation gap, namely the gap between recognition of the relevance of the KKA and the ability to translate it into pedagogical action. This gap relates to teachers' experience, beliefs, and opportunities to experiment with appropriate learning formats. Thus, conceptual acceptance cannot yet be used as an indicator of readiness for practice.

This finding aligns with Kim and Kwon's mapping of teacher competencies in AI education, which encompass coding, data, AI technology, pedagogy, and ethics [5]. Yue et al. found that general pedagogical readiness was not automatically followed by readiness in AI content knowledge and technology [6]. In the Indonesian context, elementary school teachers' positive perceptions of KKA also coexist with issues of devices, internet, clarity of implementation, and students' basic technological skills [9].

The netnography results clarify the difference between knowing about KKA and being able to teach it. Implementation relies on transforming knowledge into pedagogical decisions: selecting conceptual representations, designing activities, determining assessments, and adapting learning to students' circumstances. It is at this point that training takes on meaning as a bridge from acceptance to practice.

3.2. Pedagogical Domestication of Coding: From Programming to Thinking

The second theme demonstrates the shift in how teachers interpret coding when the concept is introduced to elementary school. In the digital footprints analyzed, coding is understood through the ability to think sequentially, solve problems, recognize patterns, organize steps, and determine solutions. This shift shifts the focus from the technical activity of programming to the pedagogical function of coding as a means of training thinking.

This process is understood in this research as pedagogical domestication, namely the work of teachers translating relatively

complex technological concepts into learning experiences that are familiar and manageable in the child's world. This concept is derived from data patterns and is used to explain the mechanisms by which materials, language, media, and activities are adapted to students' concrete experiences.

The pattern of conceptual simplification appears consistent across the corpus. In S2-U2, the concept of decomposition, considered abstract, is explained through everyday activities. In S4-U2, the term "algorithm" that confused students is interpreted through an analogy of the sequence of making a simple meal. Teachers modify the presentation of technology materials to align with students' concrete experiences. Device-free learning is also used when devices or networks are inadequate.

This finding is related to research linking computational thinking with problem-solving skills and higher-order cognitive processes [13]. In this study, computational thinking serves as both a learning outcome and a framework for adapting coding to the characteristics of elementary school students.

Teacher discourse thus shifts from questions about the need to become programmers to pedagogical questions about the thinking experiences that can be developed through coding. This shift brings KKA closer to the goals of basic education and directs attention to the development of ways of thinking, problem-solving, and decision-making.

3.3. Artificial Intelligence as an Assistant, Not an Authority

The third theme reflects the acceptance of artificial intelligence, accompanied by the formation of pedagogical boundaries. In S1-U1, teachers expressed initial concerns about the possibility of AI displacing teachers and diminishing creativity. After the training, S1-U3 and S1-U5 demonstrated a shift in meaning: AI was positioned as a tool to increase efficiency and creativity, with pedagogical decisions remaining with the teacher. This shift indicates an increasingly critical acceptance process.

Teacher reflections emphasize the importance of reviewing AI results and avoiding dependency. This shifts AI literacy from operational skills to the ability to assess output, recognize limitations, and maintain human reasoning. Teachers and students need to understand AI as a useful system, but also as a system capable of producing erroneous or out-of-context information.

Studies on AI ethics education in K-12 place responsible use, bias, risk, and ethical considerations as important parts of AI literacy [14]. The direction of KKA learning in Indonesia also includes ethical dimensions, limitations, and responsible use of technology [3], [4].

Based on data patterns, the principle of AI as an assistant, not an authority, is formulated through three conceptual boundaries: the use of AI requires verification; available output does not guarantee understanding; and technological assistance must still

leave room for human reasoning. These three boundaries clarify AI's position in the learning relationship.

Concerns about AI in the corpus actually reflect professional awareness of the importance of pedagogical and ethical boundaries. These concerns serve as a control mechanism that guides teachers toward more critical, measured, and responsible use of AI.

3.4. Coding and Artificial Intelligence in the School Ecosystem

The fourth theme shows that KKA implementation depends on individual teacher capacity and the condition of the school ecosystem. Training, availability of equipment, connectivity, learning guides, support from school leaders, and opportunities for discussion with colleagues create a space of possibilities for teachers to implement KKA.

Resource limitations emerge concretely in the corpus. In S2-U7, fewer devices than students and poor wireless connectivity led to teachers sharing devices within groups and using hotspots. In S4-U5, unstable internet connections were addressed by downloading materials in advance and displaying them offline. This data confirms that pedagogical creativity can mitigate operational barriers. The need for adequate infrastructure remains a crucial part of implementation.

Pratiwi et al.'s findings link teacher readiness for AI and coding to digital literacy, professional development, and facility availability [8]. Yim and Wegerif also link acceptance of AI technology to technical support, infrastructure, teaching experience, and acceptance of the school environment [7]. This evidence reinforces the reading of readiness as a relational condition shaped by individuals and institutions.

The term 'teacher readiness' therefore needs to be interpreted as the result of the interaction between professional capacity and ecosystem support. Highly motivated teachers can still face implementation limitations when guidance, tools, training, or institutional support are inadequate. This interpretation shifts the focus of evaluation from individual deficiencies to the quality of implementation support.

These four themes form a broader pattern: KKA implementation occurs through the interplay of policy, teacher capacity, student characteristics, and school conditions. A synthesis of these relationships is presented in Figure 2.



Figure 2. Pedagogical Translation Model-Coding Ecosystem and Artificial Intelligence

Source: Results of researcher analysis (2026).

Figure 2 maps the path from KKA policy to classroom practice through several friction points: limited knowledge, abstract concepts, assessment needs, student characteristics, facilities, and AI ethics. These friction points prompted adaptations in the form of device-free learning, concrete analogies, games and projects, the integration of computational thinking, and the critical use of AI.

The model positions teachers as active pedagogical translators who transform policy demands into learning decisions. Schools and education systems serve as a supportive ecosystem through training, professional communities, leadership, facilities, guidance, and mentoring.

The model's contribution lies in shifting the unit of analysis from individual digital competence to the interaction between professional capacity, pedagogical choices, student characteristics, technology ethics, and institutional support. This perspective helps explain why the same policy can produce different practices in different school contexts.

Overall, the research results demonstrate four interrelated processes: acceptance, negotiation, adaptation, and pedagogical boundary formation. Coding is translated from a technical activity into a means of constructing ways of thinking. AI is positioned as a tool with pedagogical authority remaining with humans. Strengthening KKA in elementary schools therefore requires teachers to be able to translate technology into contextual, critical, ethical, and developmentally appropriate learning experiences.

4. Conclusion

Elementary school teachers' understanding of Coding and Artificial Intelligence moves from acceptance to a process of pedagogical translation. Teachers acknowledge the relevance of Coding and Artificial Intelligence for future education. Practical readiness is influenced by the ability to transform concepts into

appropriate learning experiences. An implementation gap emerges between conceptual understanding and pedagogical decisions.

Pedagogical domestication is a key mechanism in this process. Teachers translate coding from a technical programming activity to developing ways of thinking through computational thinking, device-free learning, concrete analogies, games, and contextual activities. Artificial intelligence is positioned as a tool that requires verification, ethical awareness, and maintaining space for human reasoning.

The implementation of the KKA is also determined by the quality of the school ecosystem. Training, professional communities, school leadership, facilities, learning guides, and mentoring create a space for teachers to implement the KKA. Teachers therefore need to be positioned as pedagogical interpreters, connecting policy demands with student needs and the real-world conditions of the school.

Conceptually, this study proposes a Pedagogical Translation-Ecosystem Model for KKA in Elementary Schools. The model portrays policy as a process that moves through acceptance, negotiation, adaptation, and the establishment of pedagogical boundaries before becoming classroom practice. Practically, teacher professional development needs to encompass mastery of tools, learning experience design, assessment, critical AI literacy, and adapting KKA to children's developmental characteristics.

The main limitation of this study lies in the use of public digital footprints, which do not represent all elementary school teachers in Indonesia. Teachers who are active online may have different experiences and levels of digital literacy than those who are not. Future research could expand the scope of netnography, use a longitudinal design, compare school contexts, or combine netnography with classroom observations and interviews to examine the relationship between digital meanings and learning practices.

Bibliography

- [1] L. Casal-Otero, A. Catala, C. Fernández-Morante, M. Taboada, B. Cebreiro, S. Barro, AI literacy in K-12: A systematic literature review, *International Journal of STEM Education* 10 (2023) 29. <https://doi.org/10.1186/s40594-023-00418-7>.
- [2] IHY Yim, A critical review of teaching and learning artificial intelligence literacy: Developing an intelligence-based AI literacy framework for primary school education, *Computers and Education: Artificial Intelligence* 7 (2024) 100319. <https://doi.org/10.1016/j.caeai.2024.100319>.
- [3] S. Riady, D. Setiawan, Ismah, A. Purwarianti, A. Jihad, RS Rachmahana, A. Audah, Izzatusholekha, Muhaemin, TS Siadari, AS Zakaria, SE Nugroho, Academic Paper: Coding and Artificial Intelligence Learning in Elementary and Secondary Education, Ministry of Elementary and Secondary Education, Jakarta, 2025.
- [4] S. Astuti, EK Budiardjo, A. Hidayat, A. Wahyudin, A. Jihad,

L. Alhapip, SE Nugroho, BAWW Jayanti, IB Aji, D. Safitri, Coding and Artificial Intelligence Subject Guide: Phases C, D, E, and F, Educational Standards, Curriculum and Assessment Agency, Jakarta, 2025.

- [5] K. Kim, K. Kwon, Exploring the AI competencies of elementary school teachers in South Korea, *Computers and Education: Artificial Intelligence* 4 (2023) 100137. <https://doi.org/10.1016/j.caeai.2023.100137>.
- [6] M. Yue, MS-Y. Jong, DTK Ng, Understanding K-12 teachers' technological pedagogical content knowledge readiness and attitudes toward artificial intelligence education, *Education and Information Technologies* 29 (2024) 19505–19536. <https://doi.org/10.1007/s10639-024-12621-2>.
- [7] IHY Yim, R. Wegerif, Teachers' perceptions, attitudes, and acceptance of artificial intelligence educational learning tools: An exploratory study on artificial intelligence literacy for young students, *Future in Educational Research* 2(4) (2024) 318–345. <https://doi.org/10.1002/fer3.65>.
- [8] DE Pratiwi, N. Agustin, Suprihatien, N. Wahyuning Subayani, Digital literacy, reading culture, and elementary teachers' readiness for AI and coding: A comparative study of Indonesia and Malaysia, *EduStream: Jurnal Pendidikan Dasar* 10(1) (2026) 19–30 <https://doi.org/10.26740/eds.v10n1.p19-30>.
- [9] A. Sabna, A. Setiawan, Perceptions of elementary school teachers towards the implementation of Coding and Artificial Intelligence subjects, *Jurnal Educatio FKIP UNMA* 12(3) (2026) 470–482. <https://doi.org/10.31949/educatio.v12i3.19334>.
- [10] S. Lim, K. Lee, S. Kim, A cross-national comparison of elementary school teachers' perceptions of artificial intelligence: Korea and Indonesia, *Journal of Studies on Schools and Teaching* 10(3) (2025) 115–139. <https://doi.org/10.23041/jsst.2025.10.3.006>.
- [11] RV Kozinets, *Netnography: The Essential Guide to Qualitative Social Media Research*, 3rd ed., SAGE, London, 2020.
- [12] LX Jensen, M. Bearman, D. Boud, F. Konradsen, Digital ethnography in higher education teaching and learning: A methodological review, *Higher Education* 84 (2022) 1143–1162. <https://doi.org/10.1007/s10734-022-00838-4>.
- [13] C. Montuori, F. Gambarota, G. Altoé, B. Arfé, The cognitive effects of computational thinking: A systematic review and meta-analytic study, *Computers & Education* 210 (2024) 104961. <https://doi.org/10.1016/j.compedu.2023.104961>.
- [14] M. Ma, DTK Ng, Z. Liu, GKW Wong, Fostering responsible AI literacy: A systematic review of K-12 AI ethics education, *Computers and Education: Artificial Intelligence* 8 (2025) 100422. <https://doi.org/10.1016/j.caeai.2025.100422>.