Understanding Teachers' Ethical AI Use: A Backward Mapping Study in Indonesian Vocational Education

Nisrina Nur Aini[1], Febrina Aliefia Zahra[2], Yaya Nur Fajar Tri Rahmadani[3], Muhammad Saiful Anwar[4], Muh Zacky Fadhil Rachmat[5]

[1,2,3,4] Universitas Negeri Yogyakarta, Indonesia
[5] Universitas Al-Azhar Cairo, Egypt
e-mail: ainuen2711@gmail.com[1], febrinaaliefia@gmail.com[2], yayawn12@gmail.com[3], saifulanwar@uny.ac.id[4], zackyfadil2@gmail.com[5]

Abstract: Previous studies have examined artificial intelligence (AI) adoption in education, focusing primarily on pedagogical benefits, digital competence, and ethical challenges. However, limited attention has been paid to how AI ethics are implemented at the school level through the interplay between educators' practices, institutional arrangements, and policy awareness. This study analyzes the implementation of AI ethics among teachers at SMK Negeri 3 Yogyakarta, Indonesia, through Richard Elmore's backward mapping perspective. Using a qualitative case study design, data were collected through participant observation, in-depth interviews, and documentation involving the vice principal, teachers, and students. The findings reveal that teachers use AI to support lesson planning, instructional material development, and assessment. Although teachers recognize ethical risks, particularly data security and students' dependence on technology, most have limited understanding of Minister of Communication and Informatics Circular Letter No. 9 of 2023 on AI ethics. Consequently, ethical practices remain informal and largely dependent on individual teachers' discretion. Key barriers include inadequate infrastructure, limited policy dissemination, and the absence of school-specific AI regulations. These findings highlight the need to align national ethical guidance with institutional policies, teacher capacity development, and practical school-level implementation. The study's original contribution is its identification of a gap between teachers' emerging ethical awareness and the institutional mechanisms required to translate AI ethics into consistent educational practice.

Keywords: Backward Mapping, Artificial Intelligence Ethics, Teachers' Digital Literacy, AI Governance in Education.

INTRODUCTION

The rapid development of artificial intelligence (AI) has transformed educational practices by providing teachers with new opportunities to design instructional materials, develop assessments, and facilitate more adaptive learning experiences (Li et al., 2025; Mazi & Yildirim, 2025). Ideally, AI integration in education should be guided not only by technological competence but also by ethical awareness, professional responsibility, and a commitment to student well-being. Responsible AI use requires educators to consider data privacy, algorithmic bias, transparency, accountability, and the preservation of students' independent thinking (Parambil et al., 2024; Ray, 2023; Hazaimeh & Al-Ansi, 2024). Accordingly, ethical AI literacy should become an integral component of teachers' professional competence rather than an optional supplement to digital skills.

In Indonesia, the growing accessibility of generative AI applications, including ChatGPT, Gemini, and Meta AI, has encouraged teachers to incorporate these technologies into their everyday instructional activities (Ghosh et al., 2026). Denny et al. (2024) highlight the potential of generative AI to support educational processes through digital tutoring, teacher assistance, and collaborative learning. Similarly, Sumual et al. (2025) identified the increasing use of AI-based platforms to support instructional preparation and assessment. These developments illustrate how AI adoption can emerge from teachers' immediate pedagogical needs, even when institutional guidelines and professional development opportunities have not developed at the same pace.

Despite these opportunities, the expansion of AI use raises concerns about whether teachers possess sufficient knowledge and practical guidance to use the technology ethically. Tamba (2025) emphasizes the potential consequences of AI implementation without clear ethical principles, while Raharjo (2023) discusses risks associated with privacy violations, algorithmic bias, technological dependence, and diminished critical thinking. Azzahra et al. (2025) likewise highlights concerns about student data protection and independent problem-solving. These issues indicate that the central challenge is not merely whether teachers use AI, but whether their decisions and practices reflect an adequate understanding of ethical principles and their implications for educational responsibilities.

At the policy level, Indonesia issued Minister of Communication and Informatics Circular Letter No. 9 of 2023 concerning AI ethics. The document provides ethical guidance encompassing principles such as inclusiveness, security, humanity, accountability, and personal data protection. However,

the existence of national guidance does not automatically ensure its understanding or implementation within individual schools. As a non-binding policy instrument, the circular letter relies substantially on dissemination, institutional interpretation, professional awareness, and voluntary compliance. This situation creates an implementation challenge: ethical principles established at the national level must be translated into practical decisions by teachers who encounter the immediate consequences of AI use in classrooms.

Previous studies have examined AI governance in Indonesia primarily through regulatory, normative, and public-policy perspectives, including questions of transparency, accountability, and legal oversight (Wulandari, 2025; Zhang et al., 2026). Other research has addressed the educational opportunities and ethical risks associated with AI adoption, particularly student privacy, digital competence, and learning outcomes (Raharjo, 2023; Azzahra et al., 2025). Denny et al. (2024) have also discussed the potential educational applications of generative AI. Although these studies provide important conceptual and empirical foundations, they do not necessarily explain how teachers interpret ethical guidance and negotiate competing pedagogical demands in their daily professional practices. The distinction between establishing ethical principles and understanding their enactment remains important for examining responsible AI integration at the school level.

A further research gap concerns the relationship between individual teacher awareness and institutional implementation mechanisms. Aisyah et al. (2026) point to the limited empirical evidence concerning teachers' direct experiences of AI use in classroom settings. Nevertheless, the available literature must be examined critically to determine whether this limitation reflects a broader lack of school-level implementation studies or a more specific lack of research connecting teachers' ethical understanding, organizational support, and national policy guidance. Addressing this gap requires an analytical perspective capable of examining implementation from the experiences and constraints of frontline actors rather than assuming that formal policy objectives are automatically reflected in educational practice.

Richard Elmore's backward mapping offers a relevant perspective for addressing this problem (Osuala et al., 2023). Unlike conventional top-down approaches that begin with policy objectives and trace their implementation downward through administrative structures, backward mapping begins with the problem-solving behavior of actors closest to the intended outcomes.

Applied to educational AI ethics, this perspective directs attention to teachers' actual uses of AI, their interpretations of ethical responsibilities, the resources available to them, and the organizational conditions shaping their decisions. It also enables researchers to examine how school-level practices relate to institutional arrangements and broader policy guidance. Rather than treating teachers merely as recipients of national regulations, backward mapping their positions as central actors whose capacities and working conditions influence policy implementation.

SMK Negeri 3 Yogyakarta provides a relevant setting for investigating these relationships because of its vocational orientation in technology and engineering and its reported involvement in digital learning initiatives, including the Jogja Smart School program since 2025. Such a context offers an opportunity to examine how digital learning environments shape teachers' practical engagement with AI and their understanding of ethical responsibilities. However, technological orientation should not automatically be interpreted as evidence of comprehensive AI ethical readiness. Examining the school's actual practices is therefore necessary to identify whether technological adoption is accompanied by adequate ethical awareness, institutional guidance, and mechanisms for responsible implementation.

The novelty of this study lies in its school-level, actor-centered analysis of AI ethics implementation through Elmore's backward mapping perspective. Rather than examining AI ethics solely as a regulatory framework or measuring technology adoption as an indicator of digital progress, this research connects teachers' practical uses of AI with their understanding of ethical guidance and the institutional conditions surrounding their decisions. By focusing on a vocational school in Indonesia, the study also provides context-specific evidence concerning how national AI ethics guidance is interpreted and implemented in everyday educational practice. Its contribution is therefore analytical and empirical: it investigates the relationship between frontline professional judgment and the institutional arrangements required to support responsible AI use.

The urgency of this research arises from the need to ensure that educational innovation develops alongside ethical responsibility. Without a clearer understanding of how teachers interpret and apply AI ethics, national guidance may remain disconnected from classroom practices, leaving decisions about privacy, accountability, and appropriate AI use largely dependent on individual discretion. Accordingly, this study aims to analyze and describe teachers' understanding and implementation of ethical AI use at SMK Negeri 3 Yogyakarta through Richard Elmore's backward mapping

perspective. The findings are expected to contribute to educational policy research by clarifying the relationship between frontline practices, institutional support, and policy dissemination, while offering practical insights for strengthening teacher capacity and developing school-level guidelines for safe, ethical, and educationally appropriate AI use.

METHOD

Research Design

This study employed a qualitative approach using a case study design to examine teachers' understanding and implementation of ethical artificial intelligence (AI) use at SMK Negeri 3 Yogyakarta, Indonesia. A case study enables an in-depth investigation of a phenomenon within its real-life context, particularly when the interaction between the phenomenon and its institutional environment is central to the research questions (Harahap, 2020). This design was appropriate because ethical AI implementation involves not only teachers' individual understanding but also school-level conditions, professional practices, and the interpretation of national policy guidance. The study was guided by Richard Elmore's backward mapping perspective, which emphasizes the actions and problem-solving capacities of frontline actors as the starting point for understanding policy implementation. Accordingly, the analysis focused on teachers' actual uses of AI, their understanding of ethical responsibilities, and the institutional factors that influence their practices.

Research Setting and Period

The research was conducted at SMK Negeri 3 Yogyakarta, located in Cokrodiningratan, Jetis District, Yogyakarta City, Special Region of Yogyakarta, Indonesia. The site was selected purposively based on its vocational orientation in technology and engineering and its relevance to examining the relationship between digital learning practices and the implementation of AI ethics. The school provided a context for investigating how national ethical guidance, particularly Minister of Communication and Informatics Circular Letter No. 9 of 2023 on AI Ethics, relating to teachers' professional practices and institutional arrangements.

Data collection took place from April 20 to May 21, 2026. This period was used to conduct observations, in-depth interviews, and document collection. These activities were intended to capture participants' experiences and perspectives on AI use in educational activities and to identify the practical challenges associated with implementing ethical principles in the school environment.

Participants and Sampling Strategy

Participants were selected using purposive sampling, a technique in which individuals are chosen because their knowledge, experiences, or involvement make them relevant to the research objectives (Sugiyono, 2015, as cited in Suriani et al., 2023). The primary participants were teachers who had experience using AI in teaching and learning activities. A vice principal responsible for the Internal Quality Assurance System (Internal Quality Assurance System, SPMI) was included to provide information about institutional arrangements, while Grade XI students were included to offer supplementary perspectives on teachers' use of AI in learning.

A total of 19 participants were involved in the study, consisting of one vice principal, ten teachers, and eight students. Their roles and contributions are summarized in Table 1.

Table 1. Research Participants and Their Contributions

Participant group	Number	Primary contribution to the study
Vice principal responsible for SPMI	1	Institutional arrangements, school-level support, and quality assurance perspectives
Teachers	10	Experiences of AI use, understanding of ethical principles, and implementation challenges
Grade XI students	8	Supplementary perspectives on AI-supported teaching and learning practices
Total	**19**	**Multiple perspectives on school-level AI ethics implementation**

The inclusion of these participant groups enabled the study to examine AI ethics from individual, institutional, and classroom-related perspectives. Teachers constituted the primary analytical focus, while the vice principal and students provided contextual information to help interpret teachers' accounts. The findings were therefore intended to explain the experiences and practices of the participants within this particular school rather than to produce statistically generalizable conclusions about all Indonesian vocational schools.

Research Procedures

The research procedures encompass three interconnected stages: preparation, data collection, and data analysis. First, the preparation stage involved reviewing relevant literature on AI ethics, educational technology, and Elmore's backward mapping framework. The researchers also prepared observation and interview guidelines and arranged research authorization with the school. This stage established the conceptual and procedural

foundations for investigating teachers' ethical understanding and AI-related practices.

Second, the data collection stage involved participant observation, in-depth interviews, and documentation. Observation focused on relevant educational activities and the use of AI in teaching and learning. Interviews explored participants' experiences, interpretations of ethical responsibilities, and perceptions of the opportunities and challenges associated with AI use. Documentation was used to examine relevant school records, policy materials, and supporting literature. Combining these techniques enabled the researchers to compare accounts of AI use with the contextual information available from observations and documents.

Third, the analysis stage involved organizing the collected data, identifying recurring themes, comparing information across participant groups and data sources, and developing interpretations related to the research questions. The analytical process was informed by the study's qualitative design and the backward mapping perspective, particularly the relationship between frontline practices, institutional support, and national ethical guidance.

Data Sources, Research Instruments, and Data Collection

The study used primary and secondary data. Primary data were obtained from interviews and observations involving the vice principal responsible for SPMI, teachers, and Grade XI students. These data provided information about teachers' AI-related practices, participants' understanding of ethical issues, and the institutional context in which AI was used. Secondary data consists of relevant school documents, policy materials, scholarly articles, journal publications, and books.

The researcher served as the primary research instrument, responsible for collecting, interpreting, and synthesizing information from the field (Rachman et al., 2024). Supporting instruments included observation guidelines, interview protocols, and documentation records. Three data collection techniques were employed.

1. Participant observation. Observation was used to examine relevant educational activities and instances of AI use in the school context. It provided contextual information for interpreting participants' accounts of AI-supported teaching and learning.
2. In-depth interviews. Interviews were conducted with the vice principal, teachers, and students to explore their experiences and perspectives.

Attention was given to teachers' understanding of AI ethics, their reasons for using AI, their awareness of potential risks, and the institutional conditions affecting their practices.

3. Documentation. Relevant school documents, policy materials, and scholarly literature were examined to provide contextual information and support the interpretation of interview and observation data. Attention was given to materials relevant to AI ethics and the institutional implementation of ethical guidance.

The combination of these techniques supported a contextual examination of the research problem. Information from different participant groups and documentary sources could be compared to identify convergences, differences, and issues requiring further interpretation.

Data Analysis

The data were analyzed using the qualitative analysis model developed by Miles and Huberman, which involves data reduction, data display, and conclusion drawing and verification (Qomaruddin, 2024). These activities were treated as interconnected analytical processes rather than strictly separate stages.

First, data reduction involves selecting, organizing, and condensing information relevant to the research questions. Interview transcripts or records, observation notes, and documentary information were examined to identify meaningful statements concerning teachers' AI use, ethical understanding, institutional support, and implementation barriers. Information unrelated to the research focus was excluded from the main analytical categories.

Second, data display involved organizing the reduced information into meaningful categories and descriptive patterns. Information from teachers, the vice principal, and students was compared to identify similarities and differences in their perspectives. The analysis also considered how reported practices related to the availability of school-level guidance, teacher capacity, and awareness of national AI ethics principles.

Third, conclusion drawing and verification involved interpreting the patterns identified in the displayed data and examining whether the resulting interpretations were supported by the collected evidence. The researchers considered relationships between participants' experiences, institutional conditions, and the implementation of ethical AI use. Conclusions were reviewed against the available data to reduce the risk of unsupported interpretations.

To maintain alignment with the theoretical framework, the analysis was organized around the relationship between frontline practices and the broader conditions shaping implementation. The analytical orientation is summarized in Table 2.

Table 2. Analytical Orientation Based on Backward Mapping

Analytical dimension	Focus of examination	Relationship to the research objective
Frontline practices	Teachers' actual uses of AI in instructional planning, material development, and assessment	Identifies how AI is incorporated into everyday educational activities
Ethical understanding	Teachers' awareness of privacy, accountability, student dependence, and responsible AI use	Examines how ethical principles are understood by frontline actors
Institutional conditions	School-level guidance, support, resources, and policy dissemination	Identify organizational factors that facilitate or constrain implementation
Policy–practice relationship	The relationship between national AI ethics guidance and teachers' reported practices	Examines how ethical guidance is interpreted and enacted in the school context

The table presents the study's analytical orientation rather than an additional empirical finding. It clarifies how teachers' practices serve as the starting point for examining the institutional and policy conditions associated with ethical AI implementation.

Trustworthiness of the Research

The trustworthiness of this qualitative case study was addressed through the principles of credibility, transferability, dependability, and confirmability. These criteria were used to guide the assessment of the quality and consistency of the evidence concerning teachers' understanding and implementation of ethical artificial intelligence (AI) use at SMK Negeri 3 Yogyakarta. Given the study's focus on teachers' experiences, institutional conditions, and the interpretation of national AI ethics guidance, particular attention was directed toward the relationship between participants' accounts, observations of relevant educational activities, and supporting documentary evidence.

Credibility concerns the extent to which the interpretations also represent the participants' experiences and the phenomenon under investigation. In this study, credibility could be strengthened by comparing information obtained from the vice principal responsible for the Internal

Quality Assurance System (SPMI), ten teachers, and eight Grade XI students. Interview data could also be examined alongside observation notes and relevant documentation to identify converging accounts, differences in perspectives, and inconsistencies requiring further interpretation. This process is particularly relevant for distinguishing teachers' stated awareness of AI ethics from the practices and institutional arrangements described in the collected data.

Transferability concerns the extent to which the findings may be relevant to other contexts with comparable characteristics. To support this criterion, the study describes its setting at SMK Negeri 3 Yogyakarta, the vocational and technological orientation of the school, the characteristics of the participant groups, and the research period from April 20 to May 21, 2026. Such contextual information enables readers to assess the relevance of the findings to other educational institutions. However, because this study examines a single school through purposive sampling, its findings are intended to provide contextual and analytical insights rather than statistical generalizations to all vocational schools in Indonesia.

Dependability refers to the consistency and transparency of the research process. This criterion can be supported by maintaining a clear record of the research procedures, including participant selection, the use of observation and interview guidelines, documentation, and the stages of data analysis based on the Miles and Huberman model. A systematic record of how data were reduced, displayed, and interpreted would enable the analytical process to be analyzed and understood. Particular attention should be given to maintaining consistency between the research questions, the backward mapping framework, the data collection procedures, and the resulting interpretations.

Confirmability concerns the extent to which the findings are grounded in the collected evidence rather than solely in the researchers' assumptions. In this study, confirmability can be strengthened by linking analytical claims to relevant interview excerpts, observation records, and documentary evidence. The researchers should also distinguish participants' statements from their own interpretations and consider evidence that challenges, rather than merely supports, emerging conclusions. This is especially important when examining the relationship between teachers' ethical awareness, institutional support, and the implementation of national AI ethics guidance.

Taken together, these criteria provide a framework for assessing the methodological quality of the study and ensuring that its conclusions remain consistent with the available evidence. Their application is particularly

important when using Richard Elmore's backward mapping perspective, because the analysis must establish a credible connection between frontline educational practices, institutional conditions, and the broader policy environment.

RESULTS AND DISCUSSION

Results

The Use of Artificial Intelligence in Teaching and Learning

The findings from observations, interviews, and documentation indicate that artificial intelligence (AI) has begun to influence teaching and learning activities at SMK Negeri 3 Yogyakarta. Teachers and students use AI to support various academic tasks, although its adoption is not uniform across the school community. The extent of use appears to depend on individual needs, familiarity with digital tools, and the ways teachers incorporate technology into their instructional practices. This variation suggests that AI adoption is developing through everyday educational experiences rather than through a comprehensive, school-wide implementation framework.

Teachers reported using applications such as ChatGPT, Gemini, and Meta AI to support lesson planning, search for instructional references, develop teaching materials, and prepare assessment questions. These applications provide practical assistance in locating information and generating preliminary learning resources. Nevertheless, teachers did not necessarily regard AI-generated outputs as final products. One teacher of Pancasila Education explained that information generated by AI was compared with other sources and screened before being used in teaching. This practice indicates that at least some teachers retain an active role in evaluating AI-generated information rather than relying entirely on automated outputs.

The findings also reveal that teachers' ethical awareness is expressed through practical judgments about the appropriate use of AI. Participants were referred to the importance of protecting personal information, checking the accuracy of generated content, and preventing students from misusing AI. However, these practices were primarily shaped by personal experience and professional judgment rather than by systematic engagement with formal AI ethics guidance. The distinction between practical awareness and formal policy knowledge is important because a teacher may recognize risks without being familiar with the principles, scope, or implementation implications of the relevant national guidance.

Teachers' Understanding of AI Ethics

A notable finding was the difference between teachers' general awareness of ethical concerns and their understanding of formal AI ethics guidance. Although teachers expressed concerns about privacy, information accuracy, and students' dependence on technology, most participants reportedly had limited knowledge of Minister of Communication and Informatics Circular Letter No. 9 of 2023 concerning AI ethics. Some participants indicated that they became aware of the document during the research process. This finding suggests that ethical awareness had developed primarily through practical encounters with AI rather than through systematic policy dissemination.

Teachers generally interpret ethical AI use as exercising caution, setting boundaries, and ensuring that technology does not undermine students' independent thinking. Several teachers emphasized that students should not use AI without appropriate guidance and supervision. They also expressed concern that unrestricted access to AI could encourage students to depend on generated answers rather than engage in independent reasoning. These concerns indicate that teachers understand AI ethics partly through its implications for learning integrity and students' intellectual development.

Nevertheless, the findings suggest that this awareness has not yet developed into a shared, clearly articulated school-wide understanding of AI ethics. Teachers' approaches varied according to their individual judgments and classroom requirements. Without a common institutional reference, ethical principles were translated into different instructional rules, potentially producing inconsistent expectations across subjects and classes. The central issue, therefore, was not a complete absence of ethical awareness, but the lack of a systematic mechanism for translating that awareness into consistent educational practice.

School-Level Implementation of AI Ethics

The study found that SMK Negeri 3 Yogyakarta did not have a specific written regulation governing AI use by teachers and students at the time of the research. According to the information obtained from the vice principal responsible for the Internal Quality Assurance System (SPMI), school supervision is primarily concerned with general student discipline and technology use. Occasional mobile-phone inspections were conducted by the school discipline team, but these activities were not specifically designed to monitor AI ethics or establish standards for teachers' professional use of AI.

In the absence of school-specific guidelines, teachers independently established rules for students' AI use. Student accounts indicated that some teachers prohibited students from copying AI-generated answers directly, while others permitted AI as an initial reference or supplementary learning resource (Teng & Huang, 2025). These practices illustrate how ethical boundaries were established at classroom level through teachers' professional discretion. However, the absence of a common institutional framework means that the rules could differ across teachers and subjects, leaving students to navigate potentially inconsistent expectations.

The findings consistently reveal a policy–practice gap between national ethical guidance and school-level implementation. The national circular letter provided a general ethical reference, but the participants' accounts indicated limited awareness of the document and no corresponding school-specific regulations. Rather than being translated into a coordinated institutional mechanism, AI ethics was addressed mainly through individual decisions and informal supervision. From a backward mapping perspective, this pattern makes teachers' classroom practices an important starting point for identifying the institutional conditions that shape implementation.

Institutional Support and Implementation Barriers

The school provided some support for digital learning through internet access, the use of digital instructional media, and opportunities for teachers to participate in training sessions or webinars related to AI. However, access to professional development was not equally distributed among teachers. Some participants reported that training opportunities were selective and often depended on individual interest or access to opportunities. Consequently, the existence of training opportunities did not necessarily ensure that all teachers developed comparable levels of AI competence or ethical understanding.

The study also identified several structural and technical barriers, including limitations in internet connectivity, suboptimal technological facilities, insufficient understanding of AI ethics, and the absence of formal school-level AI regulations. These barriers indicate that responsible AI use depends on more than individual motivation (Zhuang et al., 2025). Teachers also require appropriate infrastructure, accessible professional development, and institutional guidance that translates broad ethical principles into practical expectations for teaching and assessment (Pham & Ngo, 2026; Eiroa-Solans & Inzlicht, 2025).

Another prominent challenge concerns the verification of students' work. Teachers expressed difficulty determining whether assignments reflected students' independent thinking or relied excessively on AI-generated content. To address this concern and maintain confidence in assessment, some teachers returned to manual or conventional assessment practices. Although this response may help teachers exercise greater control over the assessment process, it also indicates that the school has not yet established a shared approach to AI-assisted assignments, disclosure of AI use, or the assessment of students' independent learning.

The findings are summarized in Table 1, which consolidates the principal empirical patterns identified across the four areas of inquiry.

Table 1. Summary of Findings on AI Ethics Implementation at SMK Negeri 3 Yogyakarta

Analytical dimension	Empirical findings	Identified issue
AI use in teaching	AI supports lesson planning, reference searches, instructional materials, and assessment preparation	Adoption varies among teachers
Ethical awareness	Teachers recognize concerns involving privacy, information accuracy, and student dependence	Awareness is mainly practical and experience - based
Policy knowledge	Most teachers have limited familiarity with the 2023 national AI ethics circular	Limited policy dissemination and understanding
Classroom implementation	Teachers establish individual rules for student AI use	Inconsistent expectations across classes
Institutional arrangements	No specific written school regulation on AI ethics was reported	Lack of a common implementation framework
Institutional support	Internet access, digital media, and some training opportunities are available	Support and training opportunities are uneven
Assessment practices	Internet access, digital media, and some training opportunities are available	Need for clearer assessment guidance and procedures

Table 1 shows that AI integration and ethical implementation are developing at different rates. Teachers already use AI for practical instructional purposes and recognize several associated risks, but these practices are not yet supported by consistent policy knowledge, school-level rules, or shared assessment procedures. The central empirical pattern is therefore a discrepancy between emerging individual awareness and the institutional mechanisms needed to support responsible and consistent AI use.

Discussion

AI Adoption as a Practice-Driven Educational Process

The findings indicate that AI adoption at SMK Negeri 3 Yogyakarta has developed primarily in response to teachers' practical instructional needs. Its use for lesson planning, material development, reference searches, and assessment preparation reflects the perceived usefulness of AI in reducing routine workloads and supporting instructional preparation. However, the uneven adoption of AI across the school suggests that technological availability alone does not guarantee consistent integration. Teachers' digital familiarity, professional judgment, and access to relevant support may influence how these tools are incorporated into educational activities. This interpretation highlights the need to distinguish between the adoption of AI applications and the institutionalization of responsible AI practices.

The reported practice of checking AI-generated information against other sources is particularly important. It suggests that some teachers retain responsibility for evaluating the accuracy and relevance of generated content before using it in teaching. This practice is consistent with the broader principle that AI should support rather than replace professional judgment. Nevertheless, the presence of individual verification practices does not establish that all teachers possess sufficient AI literacy or consistently evaluate outputs for factual errors, bias, and inappropriate content. Schools therefore need to strengthen teachers' capacity to assess AI-generated information regularly rather than relying exclusively on personal caution.

Ethical Awareness and the Limits of Informal Knowledge

The distinction between teachers' practical ethical awareness and their limited familiarity with formal guidance represents one of the study's central findings. Teachers recognized concerns related to privacy, accuracy, and students' dependence on AI, but their understanding was not necessarily connected to an explicit national policy framework. This finding suggests that ethical awareness may emerge from everyday professional experiences before it becomes structured knowledge of formal ethical principles. Although such experience-based awareness is valuable, it may leave important issues insufficiently addressed, particularly accountability, the appropriate handling of personal data, and the institutional responsibilities associated with AI use.

This finding also demonstrates why ethical AI education should extend beyond general warnings about technological risks. Teachers need practical

opportunities to translate ethical principles into decisions concerning instructional materials, student assignments, personal information, and assessment procedures. Formal guidance becomes more meaningful when educators can relate it to recurring classroom situations. Consequently, professional development should combine policy familiarization with case-based learning, opportunities to discuss ethical dilemmas, and clear examples of acceptable and unacceptable AI practices.

Interpreting the Policy–Practice Gap through Backward Mapping

Richard Elmore's backward mapping perspective provides a useful framework for interpreting the discrepancy between national guidance and teachers' everyday practices. In his approach, implementation analysis begins with the behavior and problem-solving capacity of actors closest to the intended outcomes and then works backwards to identify the institutional and policy conditions influencing those actors (Elmore, 1979). Applied to this study, the relevant starting point is how teachers use AI, how they establish ethical boundaries, and what resources they need to perform these tasks responsibly. The analysis then considers whether school arrangements and policy dissemination also support those practices.

In this study, backward mapping is used as an analytical perspective rather than as a claim that the entire policy implementation process has been empirically traced across all administrative levels. The analysis begins with teachers' reported practices and ethical judgments, then examines the institutional conditions associated with those practices, including school-level guidance, access to professional development, and awareness of national AI ethics principles. This analytical sequence helps identify potential points at which implementation support may be strengthened. However, the findings do not establish a complete causal chain between central policy decisions and classroom outcomes, nor do they demonstrate that a particular administrative actor is solely responsible for the implementation gap.

The findings suggest that the implementation challenge cannot be explained solely by teachers' limited knowledge of the national circular letter. A backward mapping analysis also raises questions about the mechanisms through which policy information reaches schools, how school leaders interpret their responsibilities, and whether teachers have access to practical guidance and relevant professional development. The absence of specific school-level AI regulations and the uneven distribution of training opportunities indicates that implementation depends on institutional conditions as well as individual awareness. However, the study does not independently establish which

administrative level caused the dissemination gap or prove that central government communication was the sole source of the problem. Such conclusions would require additional evidence about the actual dissemination process.

Teacher Discretion and Inconsistent Classroom Rules

The variation in classroom rules illustrates the importance of teacher discretion in educational policy implementation. Some teachers permitted AI as a preliminary reference, whereas others prohibited students from copying generated answers directly. These approaches reflect attempts to balance the benefits of technological assistance with concerns about academic integrity and independent thinking. From a backward mapping perspective, teachers are not merely passive recipients of policy; they actively interpret broad principles and adapt them to the immediate circumstances of their classrooms. Their judgments therefore play a central role in determining how AI ethics is experienced by students.

Nevertheless, professional discretion becomes problematic when it operates without a shared institutional reference. Different expectations across subjects may make it difficult for students to understand when AI assistance is permitted, how it should be acknowledged, and what constitutes inappropriate use. The findings thus suggest that institutional guidance should not eliminate teachers' professional autonomy but establish common minimum standards within which contextual decisions can be made. Such standards could address disclosure of AI assistance, verification of generated content, protection of personal information, and the distinction between supporting learning and substituting for students' own work.

Institutional Governance and the Role of School Leadership

The absence of a specific written AI policy indicates that existing school supervision arrangements have not yet been developed into a dedicated framework for responsible AI use. General disciplinary monitoring, including mobile-phone inspections, may address certain aspects of student conduct, but it does not automatically address questions of AI-generated content, privacy, accountability, or teachers' professional responsibilities. Ethical governance therefore requires a clearer distinction between general technology supervision and the educational principles that should guide AI-supported teaching and learning (Atias & Mawasi, 2025; Lee & Lee, 2025).

School leadership is important in bridging this gap. A school-level framework could translate national ethical principles into practical procedures suitable for the school's educational context. This could include defining responsibilities,

establishing guidance for students and teachers, identifying appropriate practices for assessment, and providing a process for addressing ethical concerns. In backward mapping terms, these arrangements should be developed with attention to teachers' actual needs and constraints rather than simply reproducing general policy statements. The objective is to create a framework that supports implementation while remaining adaptable to the school's changing technological environment.

Infrastructure and Professional Capacity as Implementation Conditions

The reported limitations in internet connectivity, technological facilities, and access to training demonstrate that responsible AI implementation is partly conditioned by material and professional resources. Ethical guidance cannot be implemented consistently if teachers lack opportunities to develop the competencies needed to apply it. Similarly, uneven access to professional development may produce differences in teachers' confidence and understanding, even within the same school. These findings indicate that infrastructure provision and ethical capacity development should be considered complementary components of AI governance.

A backward mapping interpretation directs attention to the practical conditions required for teachers to achieve responsible educational outcomes. Rather than if issuing guidance will automatically change classroom behavior, school leaders and policymakers need to identify the resources, training, and organizational support teachers require. Professional development should not focus exclusively on operating AI applications; it should also address information verification, data protection, bias awareness, academic integrity, and pedagogically appropriate uses. The study's findings support this direction, although they do not establish the relative influence of each barrier or demonstrate the effectiveness of any intervention.

AI, Assessment Integrity, and Students' Independent Thinking

Teachers' difficulty verifying the originality of student assignments highlights a tension between the accessibility of generative AI and established assessment practices. When students can obtain AI-generated responses quickly, teachers may find it more difficult to determine whether an assignment demonstrates independent understanding (Khojasteh et al., 2025). The reported return to manual or conventional assessment methods represents a practical response to this uncertainty. However, relying exclusively on conventional assessment may limit opportunities to develop students' ability to use emerging technologies responsibly.

A more constructive institutional response would combine clear expectations for AI use with assessment methods that make students' reasoning and learning processes more visible. For example, teachers could ask students to explain their answers orally, document how they developed an assignment, compare AI-generated information with credible sources, or reflect on the limitations of an AI-generated response. Such approaches are recommendations derived from the identified problem, not interventions tested in this study. They illustrate how ethical governance can be integrated into pedagogical design instead of being treated only as a mechanism for detecting misuse.

National Ethical Guidance and Local Policy Translation

Minister of Communication and Informatics Circular Letter No. 9 of 2023 provides a national reference for ethical AI development and use. However, the findings show that the existence of this guidance does not necessarily ensure its familiarity among teachers or its translation into school-level procedures. The policy–practice gap identified in this study therefore concerns not only the content of ethical principles but also the mechanisms through which they become accessible, understandable, and actionable for educational practitioners.

The findings support the development of a more connected implementation process involving national policy communication, institutional interpretation, and classroom-level application. At the school level, this could involve disseminating the relevant policy, preparing practical guidance, providing regular professional development, and creating opportunities for teachers to discuss implementation challenges. Such recommendations should be understood as context-sensitive responses to the findings rather than evidence that the national circular letter itself is ineffective. A more definitive assessment of policy effectiveness would require broader evidence concerning policy dissemination, institutional responses, and implementation across multiple schools.

Theoretical Contribution: From Individual Awareness to Institutional Capacity

The study's principal theoretical contribution is its use of backward mapping to connect teachers' practical ethical judgments with the organizational conditions surrounding AI implementation. The findings suggest that understanding AI ethics at school level requires more than documenting teachers' attitudes or listing the risks they recognize. It also

requires examining whether institutional arrangements provide the knowledge, resources, and shared expectations needed to translate awareness into consistent practice. This perspective helps distinguish individual ethical awareness from the broader capacity of an educational institution to support responsible AI use.

The case also illustrates the analytical value of beginning with frontline practice. Teachers' accounts reveal how ethical boundaries are established in the absence of specific school rules, while the reported limitations in policy knowledge, training, and infrastructure help identify conditions that may constrain more consistent implementation. Nevertheless, this study should not be interpreted as a complete test or validation of Elmore's theory. Rather, it demonstrates the relevance of backward mapping as an analytical lens for exploring the relationship between frontline discretion, institutional support, and the implementation of ethical guidance in a particular educational setting.

Toward a School-Level Framework for Responsible AI Use

Taken together, the findings suggest that strengthening ethical AI implementation requires coordinated action at the teacher, school, and policy levels. Teachers need practical ethical literacy and assessment strategies; school leaders need to establish common standards and accessible support; and policymakers need to ensure that national guidance is communicated in forms that educational institutions can interpret and apply. These components are interdependent: teacher training without institutional guidance may produce inconsistent practices, while written rules without adequate capacity development may remain difficult to implement.

A practical implication is the need for a school-level AI ethics framework developed through consultation with teachers, school leaders, and relevant stakeholders. Such a framework could establish minimum standards for acceptable AI use, procedures for protecting personal information, expectations for disclosing AI assistance, and guidance for assessing students' independent learning. Consistent with backward mapping, the framework should be informed by actual classroom challenges and reviewed as teachers' needs and AI technologies evolve. Because this study concerns one school and does not evaluate a specific policy intervention, the proposed framework should be treated as a recommendation for development and subsequent evaluation, rather than as a proven solution.

Analytical Synthesis of the Findings

To clarify the relationship between frontline practices and the institutional shaping AI ethics implementation, Table 2 presents an analytical synthesis informed by Elmore's backward conditions mapping perspective.

Table 2. Backward Mapping Analysis of AI Ethics Implementation

Level of analysis	Evidence from the case	Implementation challenge	Recommended direction
Frontline teachers	Teachers use AI and establish individual classroom rules	Ethical decisions rely substantially on personal judgment	Strengthen practical AI ethics literacy and professional guidance
Teaching and assessment	Teachers verify AI - generated information; some return to conventional assessment	Uncertainty about content reliability and assignment originality	Develop transparent AI-use and assessment procedures
School institution	No specific written AI ethics regulation was reported	Inconsistent expectations and limited coordination	Establish school-level AI ethics guidelines
Professional development	Some training opportunities are available but are unevenly accessed	Unequal opportunities to develop AI competence	Provide accessible and sustained teacher training
National policy implementation	Most teachers have limited familiarity with the 2023 circular letter	Weak connection between national guidance and classroom practice	Improve policy dissemination and contextual translation

Table 2 demonstrates that the policy–practice gap is not confined to teachers' limited awareness of national guidance. It is also associated with the absence of specific school-level rules, uneven professional development opportunities, and unresolved challenges in teaching and assessment. Viewed through backward mapping, these conditions should be examined from the perspective of the practical tasks' teachers must perform and the institutional support needed to perform them responsibly. The table therefore identifies potential intervention points across different levels without if any single factor independently explains the implementation gap.

The findings have theoretical and practical implications for educational policy and responsible AI integration. Theoretically, the study illustrates how Elmore's backward mapping perspective can be used to examine the relationship between teachers' ethical judgments, institutional arrangements, and national policy guidance. Practically, the findings indicate the need for

school-level AI ethics guidelines, accessible professional development, clearer expectations for AI-assisted assignments, and procedures for protecting student data. School leaders and policymakers should develop these measures in consultation with teachers so that policy implementation responds to actual classroom conditions rather than relying exclusively on formal directives. These implications are grounded in the observed case and require further evaluation before being generalized to other educational settings.

This study has several limitations. First, it focuses on a single vocational school and involves 19 purposively selected participants, limiting the transferability of its findings to other schools and educational levels. Second, the data collection period was approximately one month, which may not capture longer-term changes in teachers' ethical understanding or institutional responses to AI. Third, the findings rely on observations, interviews, and documentation within the available research context; the evidence does not establish the causal influence of individual institutional factors on implementation outcomes. Finally, the study examines the relationship between national AI ethics guidance and school-level practices but does not independently evaluate the complete policy dissemination process across administrative levels. These limitations should be considered when interpreting the findings and assessing their broader applicability.

The study's principal contribution lies in identifying a distinction between individual ethical awareness and institutional capacity for responsible AI implementation. The findings suggest that teachers may recognize practical risks associated with AI without having sufficient familiarity with formal ethical guidance or access to a shared school-level framework. By examining this relationship through backward mapping, the study shifts analytical attention from the mere existence of national guidance to the conditions that shape its interpretation and enactment by frontline educators. This contribution is context-specific and should not be interpreted as evidence that the same implementation pattern exists across all Indonesian schools. Further comparative research is needed to establish the extent to which this relationship is evident in other educational settings.

Future research should examine AI ethics implementation across multiple schools, vocational and general education settings, and different institutional contexts to determine whether similar patterns emerge. Longitudinal studies could investigate changes in teachers' policy awareness and classroom practices following structured professional development or the introduction of school-level AI guidelines. Further research could also evaluate practical interventions addressing data protection, AI-assisted

assessment, academic integrity, and the verification of AI-generated information. At the institutional level, schools are encouraged to develop clear and context-sensitive AI ethics guidelines, disseminate relevant national guidance, and provide equitable access to teacher training. Such initiatives should be evaluated through subsequent research to establish their feasibility, effectiveness, and sustainability.

CONCLUSION

This study examined teachers' understanding and implementation of ethical artificial intelligence use at SMK Negeri 3 Yogyakarta through Richard Elmore's backward mapping perspective. The findings indicate that teachers have begun incorporating AI into lesson planning, instructional material development, reference searches, and assessment preparation. They also recognize ethical concerns involving personal data, information accuracy, students' dependence on technology, and independent thinking. However, this practical awareness has not been accompanied by comprehensive familiarity with Minister of Communication and Informatics Circular Letter No. 9 of 2023 concerning AI ethics. In addition, the absence of specific school-level regulations, uneven access to training, and technical constraints contribute to an implementation environment in which ethical practices depend substantially on individual teachers' professional judgment. The study's distinctive finding is the coexistence of emerging ethical awareness among teachers and limited institutional mechanisms for translating that awareness into consistent school-wide practices.

Theoretically, the findings demonstrate the relevance of backward mapping for examining how frontline educational practices interact with institutional conditions and national policy guidance. The study suggests that responsible AI implementation cannot be achieved through policy dissemination alone; it also requires appropriate resources, professional capacity development, and practical institutional arrangements. Accordingly, SMK Negeri 3 Yogyakarta and comparable educational institutions should consider developing school-level AI ethics guidelines, strengthening teacher training, and establishing transparent procedures for AI-assisted learning and assessment. Policymakers should also improve the accessibility and practical translation of national ethical guidance for educational settings. Because the study focuses on a single school, these recommendations should be adapted to local contexts and evaluated through further research. Such efforts may help bridge the gap between ethical awareness and responsible, consistent, and educationally appropriate AI use.

REFERENCES

Aisyah, N., Kautsar, M. D. Al, Hidayat, A., & Koto, F. (2026). Grounding AI-in-Education Development in Teachers' Voices: Findings from a National Survey in Indonesia. *ArXiv Preprint ArXiv:2604.01630*. http://arxiv.org/abs/2604.01630.

Atias, O., & Mawasi, A. (2025). Conceptualizing AI literacies for children and youth: A systematic review on the design of AI literacy educational programs. *Computers and Education: Artificial Intelligence*, 100491. https://doi.org/10.1016/j.caeai.2025.100491.

Azzahra, F., Irsyad, & Setiawati, M. (2025). ANALISIS RISIKO KEAMANAN DATA SISWA DALAM SISTEM ADMINISTRASI BERBASIS DIGITAL. *Global Research and Innovation Journal (GREAT)*, *1*(3), 3150–3154. https://journaledutech.com/index.php/great.

Denny, P., Gulwani, S., Heffernan, N. T., Käser, T., Moore, S., Rafferty, A. N., & Singla, A. (2024). Generative AI for Education (GAIED): Advances, Opportunities, and Challenges. *ArXiv, Abs/2402.01580.*

Dr. Arif Rachman, drg. , SH. , MH. , MM. , MTr.Hanla., Sp. Pros. , CIQnR. , CIQa., Dr.(Cand)E. Yochanan., SKM. , Skep. , MM. , MARS. , PIA. , KMK., Dr. Ir. Andi Ilham Samanlangi, S. T. , M. T., & Hery Purnomo, S. E. , M. M. (2024). *METODE PENELITIAN KUANTITATIF, KUALITATIF DAN R&D*. Saba Jaya Publisher.

Dr. Nursapiah Harap, M. A. (2020). *Penelitian Kualitatif* (Dr. Hasan Sazali M.A, Ed.). Wal Ashri Publishing.

Eiroa-Solans, C., & Inzlicht, M. (2025). From Extrinsic to Intrinsic Motivation: Testing an AI-powered Motivational Interviewing System to Foster Prosocial Motivation. *Computers in Human Behavior Reports*, 100882. https://doi.org/10.1016/j.chbr.2025.100882.

Ghosh, P., Barua, S., & Golder, U. (2026). Artificial intelligence in academic writing: A decade of trends and influences. *Sustainable Futures*, *12*, 102034. https://doi.org/10.1016/j.sftr.2026.102034.

Hazaimeh, M., & Al-Ansi, A. M. (2024). Model of AI acceptance in higher education: arguing teaching staff and students perspectives. *The International Journal of Information and Learning Technology*, *41*(4), 371-393. https://doi.org/10.1108/IJILT-01-2024-0005.

Ikhsan, S. M., Ismawartati, Karlina, D., Sari, D. P., & Naridha, A. N. F. (2025). Analisis Yuridis Atas Hak Pencipta Karya Berbantuan Ai (Artificial Intelligence) Dalam Pemenuhan Kebutuhan Reformasi Undang-Undang Hak Cipta. *Rio Law Jurnal*, *6*(2), 1104–1115. https://doi.org/10.36355/.v1i2.

Khojasteh, L., Shokrpour, N., & Moslehi, S. (2025). Decision-making in

decoding AI-generated content: Emotional dynamics and pedagogical strategies in English for specific purposes education. *Teaching and Teacher Education*, *157*, 104952. https://doi.org/10.1016/j.tate.2025.104952.

Lee, J. W., & Lee, K. (2025). Building a consensus: Harmonizing AI ethical guidelines and legal frameworks in Korea for enhanced governance. *Government Information Quarterly*, *42*(3), 102060. https://doi.org/10.1016/j.giq.2025.102060.

Li, K., Wang, P., & Chen, G. (2025). How can AI be integrated into teacher professional development programs? A systematic review based on an adapted technology-based learning model. *Teaching and Teacher Education*, *168*, 105219. https://doi.org/10.1016/j.tate.2025.105219.

Mazý, A., & Yýldýrým, Ý. O. (2025). Primary school teachers' opinions on the use of artificial intelligence in educational practices. *Social Sciences & Humanities Open*, *11*, 101576. https://doi.org/10.1016/j.ssaho.2025.101576.

Osuala, R., Kushibar, K., Garrucho, L., Linardos, A., Szafranowska, Z., Klein, S., ... & Lekadir, K. (2023). Data synthesis and adversarial networks: A review and meta-analysis in cancer imaging. *Medical Image Analysis*, *84*, 102704. https://doi.org/10.1016/j.media.2022.102704.

Parambil, M. M. A., Rustamov, J., Ahmed, S. G., Rustamov, Z., Awad, A. I., Zaki, N., & Alnajjar, F. (2024). Integrating AI-based and conventional cybersecurity measures into online higher education settings: Challenges, opportunities, and prospects. *Computers and Education: Artificial Intelligence*, *7*, 100327. https://doi.org/10.1016/j.caeai.2024.100327.

Pham, T. C., & Ngo, T. T. A. (2026). How AI tutor features influence motivation and learning outcomes: psychological pathways in high school STEM education. *Telematics and Informatics Reports*, *22*, 100344. https://doi.org/10.1016/j.teler.2026.100344.

Qomaruddin, H. S. (2024). Kajian Teoritis tentang Teknik Analisis Data dalam Penelitian Kualitatif: Perspektif Spradley,Miles dan Huberman. *Journal of Management, Accounting and Administration*, *1.*

Raharjo, B. (2023). *TEORI ETIKA DALAM KECERDASAN BUATAN (AI)*. Yayasan Prima Agus Teknik.

Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of things and cyber-physical systems*, *3*, 121-154. https://doi.org/10.1016/j.iotcps.2023.04.003.

Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach (Third Edition)*.

Subhaktiyasa, P. G. (2024). Menentukan Populasi dan Sampel: Pendekatan

Metodologi Penelitian Kuantitatif dan Kualitatif. *Jurnal Ilmiah Profesi Pendidikan*, *9*(4), 2721–2731. https://doi.org/10.29303/jipp.v9i4.2657.

Sumual, S. D. M., Kairupan, M., Tooy, A., & Darise, S. (2025). PEMANFAATAN ARTIFICIAL INTELLIGENCE DALAM MENDUKUNG PEMBELAJARAN MENDALAM BAGI GURU DI SMK NEGERI 3 BITUNG. *EduTIK: Jurnal Pendidikan Teknologi Informasi Dan Komunikasi*, *5*(6), 2456–2462.

Suriani, N., Risnita, & Jailani, M. S. (2023). Konsep Populasi dan Sampling Serta Pemilihan Partisipan Ditinjau Dari Penelitian Ilmiah Pendidikan. *IHSAN: Jurnal Pendidikan Islam*, *1*(2), 24–36. http://ejournal.yayasanpendidikandzurriyatulquran.id/index.php/ihsan.

Tamba, G. (2025). Integrasi Pendidikan Agama Kristen dalam Era AI dan Teknologi Digital: Tantangan dan Peluang. *Jurnal Ilmiah Multidisiplin*, *2*(1), 74–86. https://doi.org/10.62282/juilmu.v2i1.74-86.

Teng, M. F., & Huang, J. (2025). Incorporating ChatGPT for EFL writing and its effects on writing engagement. *International Journal of Computer-Assisted Language Learning and Teaching (IJCALLT)*, *15*(1), 1-21. https://doi.org/10.4018/IJCALLT.367874.

Wulandari, Y. S. (2025). KECERDASAN BUATAN DAN PERLINDUNGAN DATA: ANALISIS REGULASI YANG ADIL UNTUK SISTEM HUKUM INDONESIA. *THE JURIS*, *9*(1), 24–31. http://ejournal.stih-awanglong.ac.id/index.php/juris.

Zhang, L., Mao, Y., & Cheang, P. Y. S. (2026). Responsible AI governance, privacy concerns and the adoption of financial AI: an extension of UTAUT2 and communication privacy management. *Information & Computer Security*, 1-27. https://doi.org/10.1108/ICS-10-2025-0432.

Zhuang, Z., Chen, J., Xu, H., Jiang, Y., & Lin, J. (2025). Large language models for automated scholarly paper review: A survey. *Information Fusion*, *124*, 103332. https://doi.org/10.1016/j.inffus.2025.103332.