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Tradition meets technology: The role of Artificial Intelligence in Nahdlatul Ulama and Muhammadiyah's digital adaptation

Dwi Sufa Nada-Qisthina,[1]* Najahan Musyafak[2]
[1, 2] Universitas Islam Negeri Walisongo Semarang, Indonesia

Abstract

The rapid development of Artificial Intelligence (AI) in the digital media landscape has generated a duality of concerns and hopes among religious organizations such as Nahdlatul Ulama (NU) and Muhammadiyah. On one hand, AI is perceived as potentially eroding humanistic values; on the other, it offers the promise of accelerating the dissemination of Islamic teachings through digital platforms. This study aims to examine the adaptation process of AI technology within the digital media ecosystems of both organizations and to identify the key enabling and inhibiting factors. Employing a descriptive qualitative approach, data were collected through in-depth interviews with selected informants and institutional document analysis. The study adopts Everett Rogers' diffusion of innovation model, encompassing five stages: knowledge, persuasion, decision, implementation, and confirmation. Findings reveal that NU has adopted AI through platforms such as *Siskader*, *Kitab AI*, *Pandai AI*, and *sentiment analysis*, while Muhammadiyah has developed *Chat HPT*, *Goal Align Assessment*, and *AI-based customer service tools*. These adaptations are driven by pressures to modernize, the need for a progressive organizational image, cadre openness to innovation, and user enthusiasm. Conversely, limited financial resources, insufficient computational capacity, and prolonged training durations are significant barriers. The study underscores the importance of a collaborative approach that integrates Islamic values with digital innovation strategies to enhance the da'wah capacity and organizational transformation in the age of artificial intelligence.

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Keywords:
Artificial Intelligence; digital da'wah; innovation diffusion; technology adaptation; Nahdlatul Ulama; Muhammadiyah.

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***Corresponding author:**
Dwi Sufa Nada-Qisthina, email: dnada5126@gmail.com, Universitas Islam Negeri Walisongo Semarang, Jl. Walisongo No.3-5, Tambakaji, Kec. Ngaliyan, Kota Semarang, Jawa Tengah 50185.

Abstrak

Perkembangan pesat Kecerdasan Buatan (AI) dalam lanskap media digital telah menimbulkan dualitas kekhawatiran dan harapan di antara organisasi keagamaan seperti Nahdlatul Ulama (NU) dan Muhammadiyah. Di satu sisi, AI dipandang berpotensi mengikis nilai-nilai humanistik; di sisi lain, AI menawarkan janji untuk mempercepat penyebaran ajaran Islam melalui platform digital. Studi ini bertujuan untuk meneliti proses adaptasi teknologi AI dalam ekosistem media digital kedua organisasi tersebut dan untuk mengidentifikasi faktor-faktor pendukung dan penghambat utamanya. Dengan menggunakan pendekatan kualitatif deskriptif, data dikumpulkan melalui wawancara mendalam dengan informan terpilih dan analisis dokumen institusional. Studi ini mengadopsi model difusi inovasi Everett Rogers, yang mencakup lima tahap: pengetahuan, persuasi, keputusan, implementasi, dan konfirmasi. Temuan menunjukkan bahwa NU telah mengadopsi AI melalui platform seperti *Siskader*, *Kitab AI, Pandai AI*, dan *analisis sentimen,* sementara Muhammadiyah telah mengembangkan *Chat HPT, Goal Align Assessment*, dan *alat layanan pelanggan berbasis AI*. Adaptasi ini didorong oleh tekanan untuk modernisasi, kebutuhan akan citra organisasi yang progresif, keterbukaan kader terhadap inovasi, dan antusiasme pengguna. Sebaliknya, keterbatasan sumber daya keuangan, kapasitas komputasi yang tidak memadai, dan durasi pelatihan yang panjang merupakan hambatan yang signifikan. Studi ini menggarisbawahi pentingnya pendekatan kolaboratif yang mengintegrasikan nilai-nilai Islam dengan strategi inovasi digital untuk meningkatkan kapasitas *da'wah* dan transformasi organisasi di era kecerdasan buatan.

INTRODUCTION

The development of Artificial Intelligence (AI) technology has brought significant transformations across various aspects of human life, including industry, economy, education, and the sociocultural sphere (West & Allen, 2020). In recent years, AI has evolved from being merely perceived as a tool for production efficiency to becoming an integral part of the digital ecosystem that also influences religious activities (Adeni, 2024). Various AI-based religious applications, such as Qibla

direction finders, prayer time reminders, fatwa chatbots, and religious text analysis tools, have become commonplace in the daily practices of believers (Zulkifli et al., 2023). This phenomenon marks the emergence of a new body of literature at the intersection of religion and technology, sparking debates about whether AI enhances or undermines the essence of human spirituality.

Studies exploring the intersection between Artificial Intelligence (AI) and religiosity have grown rapidly over the past decade, reflecting the increasing integration of technology into the spiritual lives of religious communities. A significant contribution is Imaduddin's (2021) work. Using a sequential exploratory mixed-methods design, his study examined the motives behind Muslim millennials in Malang using apps like Muslim Pro and Umma, and their influence on religiosity. It found that AI promotes religiosity through theological motives, personal identity search, information-seeking, and social interaction. It also positively influenced dimensions of religiosity such as spirituality, religious knowledge, and community participation. Although this research provides important insights into the relationship between AI and individual religious expression, it does not explore institutional dynamics.

Another relevant study is the thesis by Indainanto (2020), which investigates how editorial routines change with the integration of AI in news gathering, processing, and distribution. Using a qualitative case study approach, the research reveals how AI enables automated data search, content generation, and large-scale dissemination, creating hybrid workflows between algorithms and human editors (Newman et al., 2020; Broussard, 2018). While the study focuses on secular media, its implications are highly relevant for digital religious content management, particularly for Islamic institutions such as Nahdlatul Ulama (NU) and Muhammadiyah.

A key theoretical contribution is offered by Faisyal (2023), which applies the Diffusion of Innovation theory (Rogers, 2003) to explore how AI is being used in worship practices such as prayer guidance, Qur'an recitation, and religious activity planning. Here, AI is seen as an agent of innovation diffused through social and cultural processes, but still incapable of replacing the spiritual connection between humans and God. It emphasizes that AI adoption in religion involves not just technical

considerations but also normative and theological ones, echoing Esposito & Finlay's (2020) call for "ethical literacy" in religious technologies.

Further insights are provided by Shadiqin et al. (2023). They advocate for a multidisciplinary approach to understanding the complex relationship between religion and AI. They argue that AI can facilitate access to sacred texts, spread *da'wah*, and enhance religious literacy, but must be contextualized within local cultures and values. Otherwise, AI risks replacing religious authority with data-driven automated interpretations (Campolo & Domingos, 2017; Tirosh-Samuelson, 2021). It opens critical space for examining how religious institutions respond to technology as both a tool and an epistemological challenge.

Aziz et al. (2023) emphasize the importance of involving parents, educators, and communities in guiding children to use AI ethically and responsibly. Although the study focuses on child education, it highlights the urgency for religious institutions to respond to technological change through holistic and value-based strategies. This perspective is particularly relevant for assessing how Islamic organizations such as NU and Muhammadiyah strategically adapt AI in managing inclusive and context-sensitive digital *da'wah* platforms (Nasr, 2006; Kraidy, 2020).

Nevertheless, a more recent study by Adeni (2024) on NU's and Muhammadiyah's responses to AI as a source of information constitutes a crucial reference for this article. Adeni concludes that both NU and Muhammadiyah perceive AI as both a challenge and a threat to Islamic authority. NU tends to adopt a more traditionalist and restrictive stance toward AI, viewing the technology as a potential threat to *pesantren* culture. In contrast, Muhammadiyah demonstrates a more open and adaptive orientation toward emerging technological developments.

These studies show that AI has become a significant agent in transforming religious practices at individual, media, and institutional levels. However, no research to date has specifically examined how mainstream religious organizations such as Nahdlatul Ulama and Muhammadiyah adapt AI within their digital media ecosystems. These five studies are complementary and demonstrate that AI integration in religious life is not merely about technological efficiency, but also concerns social structures, ideological values, and religious authority. The present

study addresses this gap by investigating how these major Islamic institutions manage AI adaptation in their institutional da'wah efforts.

While offering convenience in religious practices, the presence of AI raises concerns about the potential dehumanization of religious rituals and meanings. AI's ability to respond to theological inquiries prompts ethical and normative questions: To what extent can technology replace religious leaders who traditionally serve as the custodians of religious interpretation? (Campolo & White, 2020). This controversy becomes even more complex when AI is adopted within religious organizations that are ideologically rooted. Nahdlatul Ulama (NU) and Muhammadiyah, the two largest Islamic organizations in Indonesia, demonstrate differing approaches to AI adaptation. NU tends to be more conservative, questioning the religious legitimacy of AI, whereas Muhammadiyah takes a more progressive stance, viewing AI as an inevitable reality that must be managed wisely (Fadhli & Zulkarnain, 2023).

Globally, AI investment has seen a sharp increase. The AI Index Report 2023 by Stanford University notes that global investment in AI development reached USD 189.6 billion, with the United States, China, and the United Kingdom leading the way. Projects such as ASCAPE in Europe, which uses AI to improve the quality of life for cancer patients, and initiatives like AI for Social Good (AI4SG) that address social issues, illustrate how AI is not only a tool of production but also one for social advocacy (Zhang et al., 2021). In Indonesia, a Populix survey found that 45% of workers and entrepreneurs have adopted AI in their professional practices (Tempo, 2023). This penetration has also extended into the religious sector, particularly in the form of digital *da'wah* (Islamic proselytization) content and Islamic information systems.

The adoption of AI in religious contexts presents epistemological and methodological dilemmas. On one hand, this technology allows broader outreach to religious communities via digital media; on the other hand, it carries risks of algorithmic bias, disinformation, and an inability to comprehend the contextual and affective complexities of religious values (Yusoff & Mohamed, 2022). AI's incapacity to replicate the affective, contextual, and historical dimensions of religious texts makes it prone to misinterpretation. Some scholars argue that AI can never replace human beings in the experience of religion, while others see it as a *da'wah* tool that must be

integrated with ethical and theological considerations (Putra et al., 2022). These differing views reflect ongoing debates among Islamic scholars and the Muslim public in responding to technological advancement.

In the context of Indonesian Islam, NU and Muhammadiyah play strategic roles in shaping religious discourse and practice. NU, grounded in traditional pesantren values, adopts a cautious approach to new technologies, as reflected in the 2023 National Congress of Religious Scholars (Musyawarah Nasional Alim Ulama), which declared that AI should not be used as the primary source of religious knowledge. In contrast, Muhammadiyah has shown greater openness to AI by developing educational applications and AI-based *da'wah* content, integrated into teaching in Muhammadiyah schools, and legal considerations on modern technologies (Nashir, 2023). These divergent approaches represent unique ideological orientations worthy of analysis within the framework of innovation adaptation and diffusion.

Based on this background, the present study aims to examine the adaptation process of AI in the digital media ecosystems of NU and Muhammadiyah. It seeks to identify how both organizations are utilizing AI in their *da'wah* activities, to what extent the technology has been adopted and accepted, and what factors support or hinder its implementation. Employing a qualitative descriptive approach and drawing on Everett M. Rogers' Diffusion of Innovation theory (Rogers, 2003), this study seeks to offer both theoretical and practical contributions toward understanding AI-based digital *da'wah* transformation in Indonesia. Furthermore, the findings may serve as a reference for other religious organizations in developing ethical, adaptive, and contextually relevant *da'wah* strategies in the era of artificial intelligence.

METHODS

This study employs a descriptive qualitative approach, focusing on adaptive communication within religious organizations in the digital era, specifically the adaptation of Artificial Intelligence (AI) by NU and Muhammadiyah. This approach was chosen for its exploratory nature, enabling a deeper understanding of the social meanings behind institutional practices that cannot be captured through quantitative methods. Qualitative research prioritizes understanding social reality in its natural

context and emphasizes the subjective interpretation of meanings that emerge from researcher-participant interactions (Denzin & Lincoln, 2018).

The theoretical basis of this research is the Diffusion of Innovations theory developed by Rogers (2003), which emphasizes the social processes of innovation dissemination through five stages: knowledge, persuasion, decision, implementation, and confirmation. Using this framework, the study examines how AI is adopted and adapted within the structure, culture, and communication strategies of religious *da'wah* organizations. The research was conducted over five months, from September 2024 to February 2025, at two primary sites: Neuversity Space Sleman Yogyakarta, NU's AI-driven digital media center under the Central Agency for Strategic Innovation (BPIS), and the Muhammadiyah Digital Laboratory at Universitas Muhammadiyah Yogyakarta.

Data were collected using two main techniques: semi-structured interviews and documentation. Six key informants were interviewed using purposive sampling, a method that deliberately selects participants based on their relevance, experience, and alignment with the research topic (Palinkas et al., 2016; Patton, 2015). The interviews were flexible, allowing natural conversational flow in line with qualitative research characteristics (Creswell & Poth, 2018). Additional data were obtained from visual and digital documents, including field activity photographs, screenshots of digital applications, and archives of NU and Muhammadiyah's digital media publications that reflect AI adaptation.

The data analysis process followed the interactive model of (Miles et al., 2014) consisting of three main stages: (1) data reduction, selecting and simplifying raw data into meaningful information; (2) data display, organizing information systematically in narrative or visual form; and (3) conclusion drawing and verification, to formulate findings aligned with the study's focus. The entire analysis was conducted concurrently with data collection to ensure depth of interpretation and consistency with the diffusion of innovations framework. Through this approach, the study not only describes what is happening in AI adaptation but also explores how and why this technological transformation occurs within the digital ecosystems of modern Islamic institutions.

RESULTS AND DISCUSSION

The orientation of AI adaptation in NU and Muhammadiyah

NU, through its *Strategic Innovation Development Agency (BPIS),* has pioneered the integration of technology, including Artificial Intelligence (AI), for *da'wah* (Islamic propagation) and *pesantren* (Islamic boarding school) education. One of the informants said,

> *"We started developing it in early 2023, around February. Discussions have been ongoing since 2022. The first AI used was sentiment analysis for social media analysis. Furthermore, the development of Artificial Intelligence is very rapid, but one of the problems lies in education. So, this was created to accelerate the process of scientific development, especially in Islamic boarding schools (pesantren), because nahwu sorof (literacy) is usually the biggest challenge as a foundation for learning the yellow books"(personal interview, 2024).*

Meanwhile, Muhammadiyah initiated its AI initiatives through *LabMu* in mid-2024. AI is utilized for *da'wah* purposes, education, healthcare, and social services. In this regard, one of the informants stated,

> *"The plan to use Artificial Intelligence has actually been around for quite some time, but the main product directly from LabMu will be launched in mid-2024. Currently, it's still within the Muhammadiyah sphere, after which there are plans for collaboration within the general sphere (personal interview, 2024."*

The interview shows that both NU and Muhammadiyah have adopted AI through their internal institutions. NU is focused on *pesantren* education and strengthening Islamic digital content, while Muhammadiyah emphasizes institutional efficiency and technology-based public services. Despite technical challenges, both organizations display strategic and ethical readiness to utilize AI for the benefit of the ummah (community). This aligns with Adeni's (2020) analysis, which highlights that both NU and Muhammadiyah place strong emphasis on the ethical imperatives underpinning their use of AI technologies.

AI-based applications of NU and Muhammadiyah

NU's AI adaptation practices and tools

NU has made significant strides in AI adaptation through its digital ecosystem, particularly via *NU.ID* platform (see Figure 1). *NU.ID* serves as a unified digital identity system connecting various NU digital services. It enables users to securely and efficiently access AI-based products. User access is managed through an organized interface that supports systematic user data management, making *NU.ID* is a foundational component in NU's AI integration.

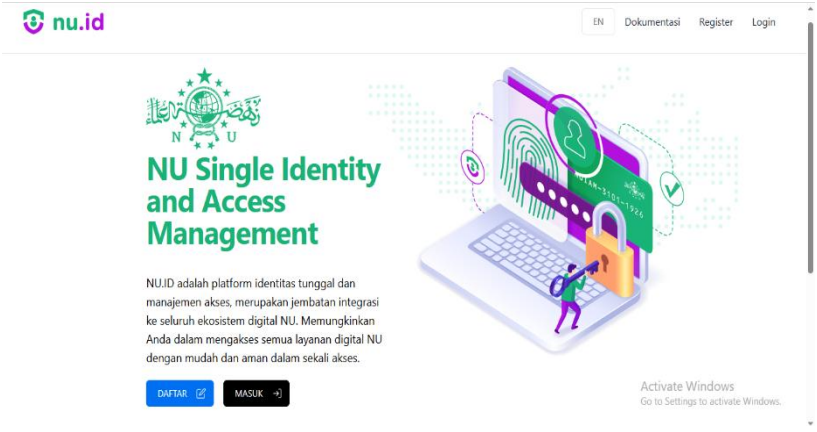

Figure 1. NU ID

Based on *NU.ID,* in addition to the development of *sentiment analysis tools* for social media analysis (to identify public debates related to NU), concrete forms of AI adaptation in NU can be seen in the implementation of *Siskader NU* (see Figure 2), a cadre development system launched in 2022. This system strengthens professional cadre formation through the use of AI-supported databases and integrated digital infrastructure. As an integrated cadre information system, *Siskader NU* is designed to manage NU's cadre development processes in a comprehensive, systematic, and coordinated manner.

Figure 2. Siskader application

Moreover, NU has also developed *Kitab AI,* an application designed to assist *santri* (students of Islamic boarding schools) in studying classical Islamic texts *(kitab kuning),* particularly Arabic grammar, by utilizing Natural Language Processing and Large Language Model (LLM) technology. Figure 4 presents an overview of the AI-based *Kitab* application.

Figure 2. KitabAI

KitabAI was initially publicly accessible, but over time, access became restricted to member logins. This limited its use due to the increasing number of accesses each day. The digitization of *kitab kuning* learning utilizes Large Language Model (LLM) technology to assist students *(santri)* in learning Arabic grammar. *Nahwu* and *Sharaf* (two branches of Arabic grammar), one of the challenges in the learning process at Islamic boarding schools, is packaged more effectively using this application as a bridge to learning the yellow books.

The development process of the AI-based kitab involved three months of data collection from *santri* to build an Arabic language dataset, achieving approximately 80% accuracy. Although time-consuming, NU has demonstrated ethical and strategic commitment in applying technology for the public good. Through this application, users can input Arabic text according to their needs, and the *Kitab AI* will automatically generate the corresponding analysis.

Moreover, to develop AI that is more inclusive across social groups, NU launched the *Perempuan Pandai AI (AI-Savvy Women)* program (see Figure 3), a free AI training initiative for Indonesian women managed by NU Care Global under *LazisNU.* This program reflects gender-inclusive digital empowerment through technological literacy. Participants take part in both online and offline training through webinars and social media, demonstrating NU's commitment to cultivating a digitally adaptive human resource base.

Figure 3. PandaiAI training

All these efforts indicate NU's strong commitment to leveraging AI for integrated religious education, *da'wah,* and social empowerment. NU has long been known for its focus on *pesantren*-based religious development, and the adaptation of AI has the potential to bring broader publics closer to NU values that are deeply rooted in *pesantren* traditions.

Muhammadiyah's AI adaptation practices and tools

Meanwhile, Muhammadiyah has adopted a progressive stance toward AI as part of its organizational digital transformation. This involves not only technical implementation but also the development of strategic AI products aligned with its values and institutional needs. One flagship product is *Chat HPT* (see Figure 4), a digital religious consultation platform developed by *Majelis Tarjih and Tajdid* in collaboration with *Muhammadiyah Software Labs (LabMu).* It employs OpenAI technology and integrates data from the *Himpunan Putusan Tarjih (HPT)* and *Berita Resmi Muhammadiyah (BRM).* The platform aims to provide fast, valid, and accurate religious guidance. A team of young *Tarjih* scholars ensures that the content remains consistent with official organizational sources.

Chat HPT is an AI-based chatbot trained on fatwas issued by the *Majelis Tarjih* to answer Islamic legal questions. This platform was developed to enhance the community's understanding of religious issues, which are often complex and require an in-depth understanding. The *Muhammadiyah Tarjih* Center formed a review team consisting of competent young members of the *Tarjih and Tajdid* Council. Validity testing was conducted in two phases, at the beginning and end of October 2023, with a primary focus on the *HPT* books, volumes 1 and 3. In this application, users can ask questions to get answers quickly with close to the level of accuracy.

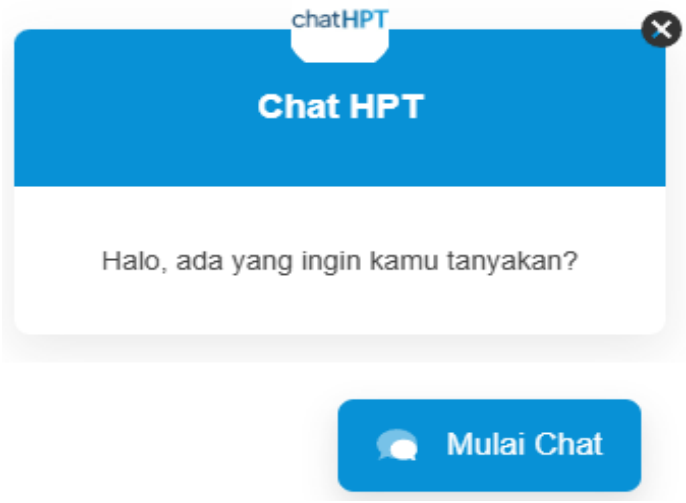

Figure 4. Chat HPT

Another notable innovation is *the Goal Align AI Assessment*, an AI-powered tool that measures individuals' psychological preferences and behavior, particularly in workplace and career development contexts. It is used by Muhammadiyah universities such as Universitas Ahmad Dahlan, Universitas Muhammadiyah Surakarta, and Universitas Aisyiyah Yogyakarta. The test helps institutions understand communication styles, work motivation, and stress responses, mainly for recruitment and training purposes. Access is provided through the Muhammadiyah Laboratory platform under MOU-based partnerships.

In addition, it is *the AI Assessment Tool*, an AI-powered instrument that is used to assess students' interests and suitability for academic majors, implemented in several Muhammadiyah-affiliated universities. Muhammadiyah plans to expand AI applications across its institutions (Amal Usaha Muhammadiyah/AUM), including schools, hospitals, and mosques. Currently, the adaptation remains internal, with a strategic plan for public implementation.

An upcoming project involves the development of an AI-based customer service system for Muhammadiyah hospitals, aimed at improving the efficiency of public services through AI. This initiative is intended to facilitate the diverse activities of Muhammadiyah's Amal Usaha across various sectors. Given that these Amal Usaha

are closely associated with public service delivery, the adoption of AI technology is considered essential to provide greater efficiency, accessibility, and responsiveness.

These initiatives show that Muhammadiyah is not merely following technological trends but actively shaping a strong and relevant digital ecosystem for the ummah. Internal collaboration between religious institutions and tech labs is crucial to ensuring AI use aligns with moderate Islamic values and serves broader societal needs.

Discussion: Multiple critical lenses in AI adaptation for religious organizations

The integration of Artificial Intelligence (AI) by NU and Muhammadiyah offers a compelling case of how religious institutions in Indonesia are navigating digital transformation. While their engagement aligns with Rogers (2003) in his *Diffusion of Innovations* framework, a more critical lens reveals complex socio-political, ethical, and epistemological implications that go beyond the linear adoption model.

Beyond Rogers: Negotiating power, knowledge, and ethics

Rogers' diffusion model assumes a rational progression of innovation through predictable stages. However, this model has been critiqued for overlooking power relations, cultural specificity, and institutional gatekeeping (Greenhalgh et al., 2004). The adoption of AI by NU and Muhammadiyah, while innovative, also reveals how religious elites mediate technological inclusion based on doctrinal legitimacy and institutional agendas.

In NU's case, the use of sentiment analysis not only serves technical monitoring purposes but also represents an exercise of discursive control in shaping public narratives about Islam and its institutions (Couldry & Mejias, 2019). The reliance on internal data and selective implementation may centralize information flows and reinforce hierarchical authority under the guise of modernization (Adeni, 2024).

In the case of Muhammadiyah, the development of institutional tools such as *Chat HPT* and AI-based assessment systems illustrates how technological inclusion is mediated through formal organizational structures and doctrinal authority. By limiting AI training data to officially sanctioned sources and deploying AI primarily within internal institutional contexts, Muhammadiyah exercises epistemic control

over religious interpretation and knowledge circulation. This approach reinforces centralized authority and bureaucratic rationality, positioning AI as an instrument for standardization and organizational discipline rather than open deliberation. As a result, AI functions not merely as an efficiency-enhancing technology but as a mechanism through which religious authority is digitally reproduced and stabilized, aligning technological modernization with institutional legitimacy and ethical containment.

AI Localization, epistemic plurality, and gender empowerment in NU

The digitization of *kitab kuning* through the use of Large Language Models (LLMs) by NU represents a deliberate move toward epistemic localization, namely the integration of indigenous Islamic knowledge traditions into contemporary technological infrastructures. This initiative aligns with calls by scholars such as de Sousa Santos (2014) for the recognition of "epistemologies of the South," which emphasize the legitimacy of non-Western knowledge systems within global digital frameworks. Through this approach, NU positions *pesantren*-based scholarship not as a peripheral tradition, but as a living epistemic resource capable of engaging meaningfully with advanced technologies.

Nevertheless, the incorporation of classical religious texts into AI systems also generates significant epistemological challenges. The complexity of *kitab kuning*, characterized by layered meanings and long-standing interpretive traditions, risks being oversimplified when processed through computational models. Issues of data accuracy, algorithmic misinterpretation, and interpretive reductionism may arise if technological development is not accompanied by sustained scholarly oversight. As cautioned by O'Neil (2016), algorithmic systems tend to produce deterministic outputs that obscure nuance, underscoring the importance of positioning AI as a tool that supports, rather than replaces, human hermeneutical reasoning and theological plurality.

Beyond textual digitization, NU's engagement with AI extends to the domain of social inclusion, particularly through the *Perempuan PandaiAI* program. This initiative seeks to address gender disparities in technological literacy by providing women with access to AI training and digital skills. In line with Warschauer's (2004)

argument, such efforts demonstrate that digital empowerment requires not only access to technology but also meaningful opportunities for participation within broader socio-technical ecosystems.

However, gender empowerment through technology cannot be assessed solely in terms of access or training. Critical questions remain regarding who defines the curriculum, which perspectives shape the narratives, and how participants' agency is constructed within the program. As Eubanks (2018) warns, inclusion risks becoming symbolic if women are positioned merely as end users rather than as active contributors to the design, governance, and strategic direction of AI initiatives. For NU, ensuring that AI-driven empowerment moves beyond tokenism necessitates stronger institutional commitments to participatory design and leadership representation.

Knowledge management and instrumental rationality in Muhammadiyah

Muhammadiyah's adoption of institutional AI tools such as *Chat HPT* and *Goal Align AI* reflects a strategic orientation toward instrumental rationality within a modern bureaucratic framework, as conceptualized by Max Weber (1922). Through the integration of AI into systems of knowledge management and human resource governance, Muhammadiyah has developed a technocratic model of religious service that emphasizes efficiency, standardization, and organizational coherence while simultaneously safeguarding doctrinal authority.

At the same time, the growing reliance on automated systems presents critical challenges. The use of AI in sensitive domains such as religious consultation and psychological assessment raises concerns regarding algorithmic bias, interpretive rigidity, and data determinism. As cautioned by Noble (2018), AI systems often inherit normative assumptions embedded in their training data and institutional contexts, thereby potentially reproducing ideological or social biases despite claims of neutrality.

Muhammadiyah's decision to initially limit AI implementation to internal organizational settings further demonstrates a measured and cautious approach to technological adoption. This phased strategy indicates efforts to manage ethical risks and maintain institutional credibility by ensuring that AI applications remain aligned

with Muhammadiyah's commitment to Islamic moderation *(wasatiyyah).* Nevertheless, this approach tends to frame ethics as an internal procedural concern, leaving limited space for broader user participation in shaping AI design, governance, and evaluation.

Overall, Muhammadiyah's AI trajectory represents a form of organizationally disciplined digital Islam, in which technology functions to reinforce institutional stability and service optimization. However, to prevent AI from being reduced to merely an extension of bureaucratic authority, this model would benefit from a more reflexive governance framework, one that emphasizes transparency, inclusivity, and ethical deliberation alongside organizational efficiency. Without such recalibration, the transformative potential of AI for religious and social empowerment risks remaining constrained by technocratic logics.

Ethical frameworks and Islamic digital governance

The efforts by both organizations (NU and Muhammadiyah) to align AI use with *maqashid shariah*, Islamic ethical objectives, highlight a valuable attempt to Islamize technological governance. However, the absence of formal ethical guidelines, shariah-compliant algorithm auditing, and transparency mechanisms suggests that the ethical integration remains aspirational.

Abidin et al. (2022) advocate for Islamic value-based management, but its practical application requires rigorous frameworks involving interdisciplinary collaboration among theologians, data scientists, ethicists, and legal scholars. Without this, the risk of ethical bypassing remains high, particularly when AI tools are deployed in health, education, or religious counseling. However, with specific regard to religious matters, Adeni (2023) suggests the need to integrate religious community identity, conventional religious authority, and primary religious sources (texts) with the presence of AI to prevent religious misdirection in the use of AI.

CONCLUSION

This case study illustrates that NU and Muhammadiyah are not merely passive adopters but active shapers of Islamic digital futures. Yet, their strategies, though

commendable, must be situated within broader critical frameworks that interrogate technological agency, institutional power, and ethical accountability.

Future research should conduct ethnographic studies to understand lived user experiences of AI in religious settings. Besides that, further study is needed to develop Islamic AI ethics frameworks grounded in *maqashid shariah* but responsive to contemporary digital risks. Exploring comparative cases from other Muslim-majority societies is also important to trace divergent paths of religious digitalization. The adaptation of AI by NU and Muhammadiyah is not just about catching up with the Fourth Industrial Revolution; it is about redefining what it means to be religious, ethical, and digitally sovereign in the algorithmic age.

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