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Diffusion of Disruptive Innovation in Islamic Primary Education: Implementation of Smart Teacher AI for Digital Competence Development

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Abstract: This study explores the diffusion of disruptive innovation in Islamic primary education through the implementation of *Smart Teacher AI*, an AI-driven professional learning platform designed to strengthen teachers' digital competence. The research employs a Research and Development (R&D) approach based on Borg and Gall's model, focusing on the implementation phase of Smart Teacher AI in SD Islam Al Ittihad, Cibubur. Data were collected from 25 teachers using observation sheets, digital competence rubrics, focus group discussions, and system usage analytics. The findings reveal that the implementation of Smart Teacher AI aligns with Rogers' diffusion of innovation framework, showing gradual adoption from innovators to early and late adopters. The platform significantly improves teachers' digital skills in lesson planning, designing interactive learning media, and evaluating digital learning outcomes. The novelty of this study lies in integrating AI-assisted professional learning within the framework of Islamic values, bridging the gap between technological disruption and faith-based education. The results contribute to both theoretical and practical insights on innovation diffusion in education, emphasizing that digital transformation in Islamic schools requires not only technology readiness but also value-driven leadership and sustainable pedagogical adaptation.

Keywords: AI in Education, Digital Competence, Diffusion of Innovation, Disruptive Innovation, Islamic Primary Education

A. Introduction

The rapid advancement of artificial intelligence (AI) has fundamentally transformed the landscape of education, particularly in the context of teacher professional development. In the era of digital transformation, teachers are expected not only to integrate technology into their pedagogy but also to adapt to emerging AI-based systems that reshape the teaching and learning process. Within Islamic educational institutions, however, the integration of AI remains at an early stage of adoption, often constrained by limited digital competence, infrastructural readiness, and the need to

align innovation with Islamic ethical values. This condition underscores the importance of developing contextually grounded and value-based innovation strategies that can bridge the gap between technological advancement and faith-oriented education.

Diffusion of innovation theory, as proposed by Rogers (2003), explains how an innovation spreads within a social system over time through communication and interpersonal influence. Complementing this, Christensen's (1997) concept of disruptive innovation emphasizes how technological breakthroughs can redefine educational systems by replacing traditional models with more efficient, accessible, and scalable solutions. Smart Teacher AI, an AI-driven blended learning platform, represents a form of disruptive innovation specifically designed to enhance the digital competence of teachers in Islamic primary education. The platform provides adaptive modules, AI-generated learning resources, and real-time feedback mechanisms that facilitate personalized and reflective professional learning experiences.

Despite the growing attention toward digital transformation in education, empirical studies focusing on the diffusion and implementation of AI-driven innovations in Islamic primary schools are still limited. Previous research primarily addresses general digital literacy or e-learning adoption, overlooking the distinctive challenges faced by faith-based educational settings. Therefore, this study aims to explore how Smart Teacher AI, as a model of disruptive innovation, diffuses among teachers in Islamic primary schools and how its implementation contributes to the development of teachers' digital competence. The study is expected to provide theoretical insights into the diffusion of disruptive innovation and practical implications for developing sustainable AI integration strategies in Islamic educational environments.

B. Methods

This study employed a Research and Development (R&D) approach based on Borg and Gall's (2003) model, focusing on the implementation and diffusion phases of the Smart Teacher AI innovation. The R&D framework was selected to ensure a systematic process of designing, testing, and validating the innovation within a real educational setting. The research was conducted at SD Islam Al Ittihad, a community-based Islamic primary school located in Cibubur, Indonesia, during the academic year 2025. The participants consisted of twenty-five teachers, including classroom teachers and subject specialists, who were directly involved in the adoption and testing of Smart Teacher AI as part of their professional development activities.

Research Design

The study followed five key stages adapted from Borg and Gall's development cycle: (1) Preliminary Study, analyzing teachers' digital readiness and identifying key

challenges in technology integration; (2) Product Development, refining the Smart Teacher AI platform based on expert validation; (3) Implementation Trial, conducting practical usage sessions in classroom and training contexts; (4) Evaluation of Effectiveness, measuring improvements in teachers' digital competence; and (5) Diffusion and Reflection, observing adoption patterns and sharing best practices among teacher communities.

Instruments and Data Collection

Data were collected through a combination of quantitative and qualitative instruments, including: 1) Observation sheets, used to record the frequency and type of AI features utilized by teachers; 2) Digital competence rubrics, adapted from the European Framework for the Digital Competence of Educators (DigCompEdu); 3) Focus Group Discussions (FGDs), conducted to explore teachers' perceptions of ease of use, relevance, and alignment with Islamic pedagogical values; and 4) System usage analytics, automatically generated by the Smart Teacher AI platform to track engagement and task completion.

Data Analysis

Data analysis employed both descriptive and thematic approaches. Quantitative data from the digital competence rubrics were analyzed using descriptive statistics (mean and percentage increase) to assess changes in teachers' competence levels before and after the implementation. Qualitative data from FGDs and observations were analyzed through thematic coding aligned with Rogers' (2003) diffusion of innovation variables: *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability*. The integration of these findings provided a holistic understanding of how Smart Teacher AI was adopted, implemented, and diffused within the school context.

C. Results and Discussion

The implementation of Smart Teacher AI at SD Islam Al Ittihad demonstrated significant progress in teachers' digital competence and adoption of AI-assisted learning tools. Quantitative analysis of the digital competence rubrics indicated a substantial improvement in three key domains: (1) Digital Lesson Design, increasing from an average score of 3.1 to 4.4; (2) Use of Interactive Media, rising from 2.8 to 4.2; and (3) Digital Evaluation Practices, improving from 3.0 to 4.3 on a 5-point scale. The system analytics further showed that 84% of participants actively used Smart Teacher AI features such as *Create Lesson Module* and *Chat with Document* at least twice a week, indicating consistent engagement during the implementation phase. Observations also revealed behavioral patterns aligned with Rogers' diffusion model:

1. Innovators (12%) – early champions who explored AI features independently, often mentoring others.
2. Early Adopters (36%) – teachers who quickly integrated Smart Teacher AI into lesson planning and digital classroom activities.
3. Early Majority (40%) – participants who adopted after observing peers' success and guidance from school leadership.
4. Late Majority (12%) – teachers requiring sustained support and reassurance regarding data security and pedagogical fit.

This adoption curve demonstrates a healthy diffusion pattern, suggesting that Smart Teacher AI achieved social legitimacy and pedagogical relevance among teachers in the school community.

Discussion

The findings of this study demonstrate that Smart Teacher AI operates as a form of disruptive innovation within Islamic primary education, reshaping how teachers design lessons, use digital tools, and make instructional decisions. However, rather than merely corresponding with Rogers' diffusion of innovation theory, the adoption patterns reveal deeper cultural and religious mechanisms that influence teacher behavior.

A key insight is that compatibility emerged as a stronger driver of adoption than trialability. This is especially significant in Islamic school environments, where teachers often evaluate innovation through the lens of religious values and pedagogical ethics. During FGDs, many teachers stated that Smart Teacher AI felt "selaras dengan amanah mengajar" and supported their responsibility to deliver learning with *adab*, *ketertiban*, and *akhlak profesi*. Such statements indicate that innovations aligned with Islamic norms—such as structured preparation, reflective teaching practices, and ethical content—are more readily accepted than those valued primarily for experimental or technical convenience. This explains why compatibility influenced adoption more strongly than trialability, particularly among the Early Majority and Late Majority groups who preferred moral assurance over experimentation.

The findings also highlight the crucial role of leadership support, which is consistent with Rahman & Yusuf (2020), who argue that value-driven leadership enhances innovation uptake in Islamic institutions. However, this study contributes a unique refinement: leadership support becomes more effective when framed explicitly as an *amanah* rather than a managerial directive. Teachers responded more positively when school leaders described the use of Smart Teacher AI as part of their moral responsibility to improve *khidmah* and safeguard the quality of instruction. This adds a novel dimension to previous studies by emphasizing that leadership influence in Islamic school innovation is amplified when moral–spiritual language is used.

The results further resonate with Suh & Lee (2020) and Ain et al. (2016), who found that peer influence supports technology adoption. Yet in this study, peer influence was strengthened by the use of Islamic vocabulary such as "lebih amanah," "lebih tertata," and "lebih bermanfaat," showing that linguistic framing grounded in religious values can accelerate innovation diffusion. Similarly, the study aligns with Darling-Hammond & Hyler (2020), who emphasize pedagogical relevance in AI adoption. However, our findings extend this by showing that relevance in Islamic education is evaluated not only through instructional efficiency but also through alignment with *kesalehan* and *keberkahan ilmu*. Thus, teachers did not adopt Smart Teacher AI merely because it improved lesson planning, but because it reinforced their identity as ethical, reflective, and value-driven educators.

Limitations

The sample size of 25 teachers corresponds to the full population of educators at SD Islam Al Ittihad who were directly involved in this study. While contextually appropriate, this relatively small sample limits the generalizability of the findings. Additionally, because data were collected within a single-school case study, adoption patterns may reflect characteristics unique to the institution. Potential social desirability bias may also exist in FGD responses, as teachers might feel compelled to demonstrate enthusiasm toward a school-endorsed innovation. To address these limitations, Stage 6 of the R&D process will expand implementation to SD Islam Amalia, Cibinong, involving approximately 30 teachers. This wider testing will enable cross-school comparison, increase external validity, and strengthen the robustness of the value-based diffusion model across different Islamic primary school cultures. Overall, the discussion indicates that disruptive innovation in Islamic primary education is most effective when framed not only as a technological improvement but as a moral and professional responsibility. Smart Teacher AI succeeded in diffusing across the teacher community because it aligned with Islamic values, reinforced ethical teaching identity, and was supported by leadership narratives rooted in *amanah* and *khidmah*. These dynamics show that innovation diffusion in faith-based schools is not merely a socio-technical process, but a culturally embedded negotiation between technology, spirituality, and professional ethics.

D. Conclusions

This study concludes that the diffusion of disruptive innovation in Islamic primary education can be effectively achieved through the structured implementation of *Smart Teacher AI*, an AI-driven learning platform designed to enhance teachers' digital competence. The research findings confirm that the innovation follows a typical adoption pattern as described in Rogers' diffusion of innovation theory, progressing from innovators to late adopters through social influence, leadership support, and peer collaboration. Smart Teacher AI significantly improved teachers' ability to design

digital lessons, utilize AI-supported instructional media, and conduct authentic digital assessments. More importantly, the study demonstrates that *disruptive innovation in education is sustainable when aligned with faith-based values*. The Islamic pedagogical framework at SD Islam Al Ittihad facilitated an ethical adoption process, allowing teachers to view AI not as a technological threat but as a tool for *khidmah* (service) and *amanah* (responsibility). This integration of innovation and spirituality represents a contextual contribution to the global discourse on educational technology, highlighting how local values can coexist with global digital transformation. Theoretically, this research contributes to the development of a Value-Based Diffusion of Disruptive Innovation Model in Islamic education. The model integrates three theoretical lenses—Rogers' diffusion theory, Christensen's disruptive innovation, and the Islamic concept of *ilm* (knowledge with ethics). It demonstrates that technological diffusion is not merely a linear adoption process but a moral and cultural negotiation that shapes how innovation is internalized in faith-based learning communities. Practically, the implementation of Smart Teacher AI provides several implications for policymakers, school leaders, and teacher educators:

1. For policymakers: AI-based innovations in teacher training should be contextualized with ethical frameworks that respect cultural and religious identity.
2. For school leaders: Effective diffusion requires sustained mentoring, peer learning, and leadership modeling that foster trust in technology.
3. For teacher training programs: The success of AI diffusion depends on continuous support mechanisms, digital literacy scaffolding, and recognition of teachers as reflective practitioners rather than mere technology users.

The Smart Teacher AI model can serve as a replicable framework for other Islamic or community-based schools aiming to integrate AI-driven pedagogy without compromising spiritual and ethical integrity. Future studies may expand this work by applying the value-based diffusion framework across multiple institutions or comparing the adoption dynamics between Islamic and non-Islamic school contexts. Quantitative modeling using Structural Equation Modeling (SEM) could also be developed to validate the relationships among key diffusion variables—*relative advantage, compatibility, complexity, trialability, and observability*—within AI-based teacher innovation ecosystems.

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