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## SHADOW EDUCATION IN THE ERA OF INDUSTRIAL REVOLUTION 4.0 ITS DISRUPTIVE IMPACT ON ISLAMIC RELIGIOUS EDUCATION INSTITUTIONS IN INDONESIA

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**ABSTRACT:** The Fourth Industrial Revolution has driven significant transformations in the world of education, including the emergence of the phenomenon of digital technology-based shadow education. Platforms such as Ruangguru, Zenius, and Quipper offer flexible, personalized, and technology-based non-formal learning models, thereby changing students' learning patterns in the digital age. This study employs a conceptual library research approach by analyzing various academic literature, scientific journals, and documents related to digital education transformation and Islamic Religious Education (IRE). The findings indicate that shadow education has implications for changes in the role of IRE teachers, the transformation of digital pedagogy, the development of adaptive curricula, and the digitization of institutional management in Islamic education. The literature analysis also indicates that the main challenges faced by PAI institutions include limited technological infrastructure, low digital literacy among educators, and the potential for religious misinformation in digital spaces. On the other hand, digital transformation opens opportunities for the development of PAI learning that is more interactive, flexible, and contextual, in line with the needs of the digital generation. The novelty of this research lies in an integrative analysis of the relationship between shadow education, digital transformation, and PAI institutional adaptation within the framework of the Fourth Industrial Revolution and



Society 5.0. This research contributes by developing a conceptual framework for PAI transformation that emphasizes integration. This study contributes by developing a conceptual framework for the transformation of Islamic Education that emphasizes the integration of digital technology, pedagogical innovation, and the reinforcement of Islamic values within the Islamic education system in the digital age.

**Keywords:** Digitalization of Education, Islamic Religious Education, the Fourth Industrial Revolution, Shadow Education, Institutional Transformation

**ABSTRAK:** Revolusi Industri Keempat telah mendorong transformasi signifikan dalam dunia pendidikan, termasuk munculnya fenomena pendidikan bayangan berbasis teknologi digital. Platform seperti Ruangguru, Zenius, dan Quipper menawarkan model pembelajaran nonformal yang fleksibel, personalisasi, dan berbasis teknologi, sehingga mengubah pola belajar siswa di era digital. Penelitian ini menggunakan pendekatan penelitian pustaka konseptual dengan menganalisis berbagai literatur akademik, jurnal ilmiah, dan dokumen terkait transformasi pendidikan digital dan Pendidikan Agama Islam. Temuan tersebut menunjukkan bahwa shadow education memiliki implikasi terhadap perubahan peran guru, transformasi pedagogi digital, pengembangan kurikulum adaptif, dan digitalisasi manajemen kelembagaan dalam pendidikan Islam. Analisis literatur juga menunjukkan bahwa tantangan utama yang dihadapi oleh lembaga antara lain infrastruktur teknologi yang terbatas, rendahnya literasi digital di kalangan pendidik, dan potensi misinformasi agama di ruang digital. Di sisi lain, transformasi digital membuka peluang pengembangan pembelajaran pendidikan Islam yang lebih interaktif, fleksibel, dan kontekstual, sejalan dengan kebutuhan generasi digital. Kebaruan penelitian ini terletak pada analisis integratif hubungan antara pendidikan bayangan, transformasi digital, dan adaptasi kelembagaan pendidikan Islam dalam kerangka Revolusi Industri Keempat dan Society 5.0. Penelitian ini berkontribusi dengan mengembangkan kerangka konseptual transformasi pendidikan Islam yang menekankan integrasi. Penelitian ini berkontribusi dengan mengembangkan kerangka konseptual transformasi Pendidikan Islam yang menekankan pada integrasi teknologi digital, inovasi pedagogis, dan penguatan nilai-nilai Islam dalam sistem pendidikan Islam di era digital.

**Kata Kunci:** Digitalisasi Pendidikan, Pendidikan Agama Islam, Revolusi Industri Keempat, Pendidikan Bayangan, Transformasi Kelembagaan

## INTRODUCTION

The changing times, marked by the advent of the Fourth Industrial Revolution, have had a significant impact on various aspects of human life. This era is characterized by the emergence of disruptive technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), robotics, big data, and cloud computing, which are blurring the boundaries between the physical, digital, and biological worlds.<sup>1</sup> Furthermore, the Fourth Industrial Revolution has emerged as a response to the dehumanization caused by technology, emphasizing collaboration between humans and machines to create harmony between efficiency and human values.<sup>2</sup> This major transformation demands that the education sector adapt quickly so as not to be left behind by the pace of progress.

<sup>1</sup> The Fourth Industrial Revolution, n.d.

<sup>2</sup> Saeid Nahavandi, "Industry 5.0 – A Human-Centric Solution," *Sustainability* 11, no. 16 (August 2019):



Studies on the transformation of Islamic Religious Education (IRE) in the digital age have actually been conducted extensively, yet they still tend to be fragmented. Ilmi (2023)<sup>3</sup> emphasizes the importance of integrating digital literacy into IRE instruction to address the challenges of the Fourth Industrial Revolution, particularly regarding the use of media and educational technology. Meanwhile, Mulyasa (2019) highlights the urgency of educational institutional reform through strengthening teacher competencies and curriculum innovation to ensure education remains relevant to contemporary developments.<sup>4</sup> On the other hand, Ni'am observes that the primary challenges in Islamic education lie in organizational cultural resistance and the uneven readiness of digital infrastructure within Islamic educational institutions.<sup>5</sup> Other studies have also begun to discuss the phenomenon of the digitization of Islamic education through e-learning, blended learning, and the use of online learning platforms, but most still focus on the pedagogical and technical aspects of learning.

However, these various studies still reveal areas of research that have not been explored in depth. To date, there have been few studies that specifically examine the institutional transformation of Islamic Religious Education in response to the Fourth Industrial Revolution in an integrated manner, particularly those that link pedagogical, structural, and managerial aspects, as well as the reinforcement of Islamic values, within a single analytical framework. Most previous studies have focused on innovations in teaching methods or the practical use of technology, so the dimension of comprehensive institutional transformation has not received adequate attention. Therefore, this article aims to fill this gap by offering a more comprehensive analysis of the challenges, opportunities, and direction of institutional transformation in Islamic Religious Education amidst technological disruption and the digital society.

The institutional transformation of Islamic Education (PAI) is urgently needed to ensure it remains relevant and competitive in the digital age. This includes adapting the curriculum and teaching methods, strengthening teachers' competencies, and digitizing the management system for Islamic education. Without such adjustments, PAI risks losing its strategic role in shaping students' character to be spiritually and intellectually outstanding amid the tide of globalization and technological modernization.<sup>6</sup>

However, the readiness of Islamic Education (PAI) institutions to face this revolution remains highly varied. In major cities and well-established institutions, the transformation has already begun through the use of Learning Management Systems (LMS), the integration of digital materials, and technology-based teacher training. However, in many regions, there remain infrastructure gaps, a lack of human resource training, and resistance to change due to concerns about the loss of traditional values in

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4371, <https://doi.org/10.3390/su11164371>.

<sup>3</sup> Irpan Ilmi et al., "Islamic Educational Values as the Core of Character Education," *EDUTECH: Journal of Education And Technology* 7, no. 2 (December 29, 2023): 406–71, <https://doi.org/10.29062/EDU.V7I2.633>.

<sup>4</sup> Enco Mulyasa, *Menjadi Guru Penggerak Merdeka Belajar* (Jakarta: Bumi Aksara, 2019).

<sup>5</sup> Syamsun Niam and Ahmad Muhtadi Anshor, "Islamic Character Education in the Era of Industry 5.0: Navigating Challenges and Embracing Opportunities," *Al-Hayat: Journal of Islamic Education (AJIE)* 8, no. 1 (2024), <https://doi.org/10.35723/ajie.v8i1.493>.

<sup>6</sup> Mulyasa, *Menjadi Guru Penggerak Merdeka Belajar*.



religious education.<sup>7</sup> This indicates that transformation is not merely a technological issue but also a matter of mindset, institutional leadership, and policy direction.

To preserve the Islamic spirit amidst the tide of digitalization, Islamic Education institutions must ensure that Islamic values remain the foundation of every innovation. Digitalization must not merely be an end in itself, but a tool for disseminating the values of tawhid, *akhlakul karimah*, and religious moderation. For example, the use of digital platforms can be directed toward character building through Qur'an-based educational content, or through pedagogical approaches that foster spirituality in virtual spaces.<sup>8</sup> In this way, the Islamic spirit is not only preserved but can also have its reach expanded globally. Furthermore, Islamic Education (PAI) can draw inspiration from Islamic values that are adaptable to change and technology, as exemplified by the concept of *ijtihad* in responding to the context of the times. This principle can serve as a philosophical foundation for Islamic Education institutions to not only embrace change but also to become pioneers in developing technology-based Islamic education that remains meaningful.<sup>9</sup>

This article links two industrial revolutions simultaneously namely, the Fourth Industrial Revolution and the institutional transformation of Islamic education – not only in pedagogical aspects but also in structural and managerial ones. Until now, studies on PAI have often focused solely on updating methods or curricula, whereas technological challenges demand a comprehensive transformation of its institutional framework. This article offers a new perspective on how Islamic Education can innovate systemically while maintaining the integrity of Islamic values. This topic is important to study because education is a cornerstone in shaping a future generation that excels morally and intellectually. In the midst of an era of disruption filled with uncertainty, Islamic Education (PAI) plays a vital role as a balancing force between technological progress and the need for humanistic values. Without structured and sustainable transformation, there is concern that PAI institutions will fall behind and lose their central role in shaping the nation's character in this digital and post-digital era. The objective of this study is to analyze the challenges and opportunities faced by PAI institutions in the era of the industrial revolution and to provide strategic recommendations for future transformation.

One of the most prominent phenomena is the emergence of shadow education – a non-formal learning system operating in parallel with formal education, often based on digital technology. In Indonesia, Platform Ruangguru, for example, has successfully reached tens of millions of users across Indonesia by offering a variety of learning features – ranging from interactive instructional videos and question banks to live teaching sessions aligned with the national curriculum, as well as artificial intelligence-powered support for personalized learning materials. Its popularity has surged during

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<sup>7</sup> Mulyasa.

<sup>8</sup> Ahmad Fauzi, "Pemanfaatan Teknologi Digital Dalam Pembelajaran Pendidikan Agama Islam Di Era Revolusi Industri 4.0.," *Jurnal Penelitian Islam* 11, no. 2 (2020): 55–68.

<sup>9</sup> Syed Muhammad Naquib Al-Attas, *The Concept of Education in Islam: A Framework for an Islamic Philosophy of Education* (Kuala Lumpur: Muslim Youth Movement of Malaysia (ABIM), 1980).



the pandemic, with a spike in users to over 22 million registered users according to company reports and national media publications.<sup>10</sup>

Meanwhile, Zenius offers a more conceptual learning approach that focuses on in-depth understanding, particularly for exam preparation such as the UTBK and national exams. Through systematic video lessons and practice questions, this platform has built a strong reputation among students who need to reinforce concepts independently. The existence of this “shadow education” indicates that students are now seeking alternatives that are more flexible, accessible anytime, and capable of accommodating personal learning styles.

This phenomenon presents both pressure and a significant opportunity for formal educational institutions—including Islamic Religious Education (PAI) institutions—to transform. PAI is required to adopt digital technology and design learning models that are more adaptive, innovative, and relevant so as not to be left behind in the midst of the surging wave of digital learning.

## METHOD

More specifically, this study falls under the category of conceptual library research, which seeks to develop a theoretical synthesis and critical analysis of various concepts, theories, and previous research findings related to the phenomena of shadow education, the Fourth Industrial Revolution, and the institutional transformation of Islamic Religious Education. This approach not only describes the literature but also interprets and constructs concepts regarding the relationships between the phenomena under study. Thus, this study does not use a systematic literature review (SLR) approach, which emphasizes quantification procedures and bibliometric mapping, but is instead oriented toward conceptual exploration and critical analysis of the main ideas in the literature.<sup>11</sup>

In the source selection process, this study employed inclusion and exclusion criteria to ensure the relevance and quality of the data. The inclusion criteria included: (1) literature discussing shadow education, the transformation of Islamic education, the Fourth Industrial Revolution, and the digitization of education; (2) sources from credible scientific journals, academic books, and institutional documents; (3) publications from the years 2015–2025 to align with contemporary developments; and (4) having a direct connection to the context of Islamic education in Indonesia and globally. Meanwhile, the exclusion criteria include popular sources without a clear academic basis, articles irrelevant to the research focus, and literature with repetitive content lacking new conceptual contribution.<sup>12</sup>

To ensure the reliability of the data, this study employed source triangulation, which involves comparing various sources of literature—including journals, books, and policy documents—to ensure consistency of information and strengthen the validity of the interpretations. In addition, the researcher implemented a simple audit trail by

<sup>10</sup> “Company Profile and User Statistics,” Ruangguru, 2021.

<sup>11</sup> Sugiyono, *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif Dan R&D.*, 2013.

<sup>12</sup> Glenn A Bowen, “Document Analysis as a Qualitative Research Method,” *Qualitative Research Journal Document Analysis as a Qualitative Research Method* 9, no. 2 (2009): 27–40, <https://doi.org/10.3316/QRJ0902027>.



documenting the source selection process, theme categorization, and analysis stages, thereby ensuring the research process is academically traceable.

The data analysis technique used in this study follows the interactive analysis model proposed by Miles, Huberman, and Saldaña, which comprises three main stages: data reduction, data presentation, and drawing conclusions/verification. During the data reduction stage, the researcher selected and focused on information relevant to the themes of institutional transformation in Islamic Education (PAI) and shadow education. The data presentation stage is carried out by organizing literature findings into conceptual themes such as the digitization of learning, institutional change, moral-spiritual challenges, and innovations in Islamic education. The verification stage is conducted by re-examining the relationships between concepts and the consistency of the arguments to produce a coherent and logical synthesis.<sup>13</sup>

Data obtained from the literature review were analyzed qualitatively using a descriptive-analytical approach. According to Ishihq in his review of Creswell's book, this analysis aims to categorize, interpret, and connect information from various sources to uncover the implications of Industry 4.0 technologies on changes in management and learning within Islamic Education institutions. This approach enables the researcher to provide a systematic and in-depth overview.<sup>14</sup>

Finally, the results of the analysis were synthesized into conclusions that describe the role of shadow education in the Fourth Industrial Revolution: Implications for Islamic Religious Education Institutions in Indonesia. This study also presents strategic recommendations for Islamic Religious Education administrators to address challenges and capitalize on opportunities in the digital age without compromising Islamic values.<sup>15</sup> This study also acknowledges the possibility of interpretive subjectivity, as literature-based research is heavily influenced by the researcher's perspective in reading and connecting the literature. Therefore, the researcher strives to maintain objectivity by utilizing diverse sources, conducting comparative critical readings, and avoiding the dominance of any single perspective in the analytical process.

## RESULTS AND DISCUSSION

### The Phenomenon of Shadow Education in the Era of the Fourth Industrial Revolution and Society 5.0

Advances in digital technology during the Fourth Industrial Revolution have given rise to new forms of non-formal education known as shadow education. Online platforms such as Ruangguru, Zenius, and Quipper have played a significant role in providing supplementary educational services outside the formal system. These platforms not only offer curriculum-based learning materials but also provide adaptive

<sup>13</sup> Diana Ridley, "A Step-by-Step Guide for Students," *A Step-by-Step Guide for Students*, 2012, 232, [https://books.google.com/books/about/The\\_Literature\\_Review.html?hl=id&id=WaNrAwAAQBAJ](https://books.google.com/books/about/The_Literature_Review.html?hl=id&id=WaNrAwAAQBAJ).

<sup>14</sup> Muhammad Ishtiaq, "Book Review Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th Ed.). Thousand Oaks, CA: Sage," *English Language Teaching* 12, no. 5 (April 6, 2019): 40, <https://doi.org/10.5539/ELT.V12N5P40>.

<sup>15</sup> Milles And Huberman, "Qualitative Data Analysis: A Methods Sourcebook | Enhanced Reader," SAGE, 2014, [moz-extension://2c390b0d-e3d9-4e6c-a431-b0fbd6c08fa7/enhanced-reader.html?openApp&pdf=https%3A%2F%2Fwww.metodos.work%2Fwp-content%2Fuploads%2F2024%2F01%2FQualitative-Data-Analysis.pdf](https://www.metodos.work/wp-content/uploads/2024/01/Qualitative-Data-Analysis.pdf).



learning features, interactive videos, real-time quizzes, and access to professional tutors. In this context, shadow education has emerged as an integral part of the modern student's learning ecosystem, bridging the gap between what is taught in school and what is needed to achieve higher academic performance.<sup>16</sup>

Students' motivations for participating in shadow education vary widely, but one of the main drivers is flexibility in terms of time and location. In this digital age, students are no longer confined to physical classrooms. They can access course materials anytime according to their needs and convenience, even while reviewing lessons they find difficult. This flexibility is crucial, especially for students with busy schedules or those who struggle to keep up with the uniform pace of formal classroom settings. Shadow education offers students the opportunity to learn at their own pace.

Beyond flexibility, a key appeal of shadow education lies in the use of cutting-edge technology in the learning process. Artificial intelligence (AI), big data, and adaptive learning algorithms enable platforms like Ruangguru to provide a personalized and measurable learning experience. This technology can analyze students' learning difficulties and provide recommendations for materials tailored to their needs. This is highly effective in enhancing learning outcomes and creating a more inclusive, data-driven educational experience.

Personal branding and the pressures of academic competition are also key factors driving students to choose shadow education. In a knowledge- and innovation-based Society 4.0, students and parents recognize the importance of academic excellence as an asset for the future. Shadow education is viewed as an additional investment to strengthen academic achievements, including in preparation for national exams, college admissions, or even academic competitions. Therefore, non-formal education through digital platforms is not merely a supplement but has become an integral part of an educational strategy that is consciously adopted and seriously designed by Indonesian families.

### **The Impact of Shadow Education on PAI Institutions**

The emergence of *shadow education* based on digital technology has disrupted the traditional role and authority of teachers, including Islamic Religious Education (PAI) teachers. Classical methods such as classroom lectures, memorization, and conventional question-and-answer are beginning to be found less attractive by students who are used to visual, interactive, and technology-based approaches. Religious teachers who are unable to keep up with these developments are prone to losing relevance, especially in the eyes of students who are already familiar with religious materials that are attractively packaged on platforms such as YouTube, Instagram, or special applications for Islamic learning. This phenomenon shows a shift in authority from the teacher as the only source of knowledge, to just one of the many learning references available online.

*Shadow education* It also changes students' learning patterns towards religious content. Islamic materials are now not only accessed from textbooks and teachers' teaching in schools, but also from digital platforms that present tafsir, fiqh, and hadith in a more contextual and dialogical form. This has implications for the emergence of a

<sup>16</sup> Jiangran Yu and Rui Zhang, "A Review of Shadow Education," *Science Insights Education Frontiers* 11, no. 2 (2022): 1579-93, <https://doi.org/10.15354/sief.22.re058>.



generation that is more critical and selective in understanding Islamic teachings, but also opens a gap for potential misinterpretations of teachings that are not accompanied by scientific authority. Students can choose material that they find interesting or in accordance with their views, without following the curriculum structure that has been systematically designed by formal institutions. This is certainly a new challenge for the PAI institution in maintaining the accuracy and integrity of teachings.<sup>17</sup>

On the other hand, competition between formal educational institutions and non-formal digital services is becoming more and more real. Digital platforms offer faster, cheaper, and on-demand learning, while formal schools are still constrained by national curricula and face-to-face hours. This forces PAI institutions to re-evaluate their teaching approaches and methods. If they do not innovate, formal institutions, including madrassas and public schools with PAI lessons, could fall behind in winning students' attention and interest. These institutions are required to transform the way they deliver religious materials to remain competitive and relevant amid the rapid flow of digitalization.

Table 1. Islamic Institutional Transformation in the Era of the Industrial Revolution 4.0

Transformation Aspects	Conventional Conditions	Changes in the Digital Age	Implications for PAI
Curriculum	Memorized and classical-based	Integration of digital literacy and adaptive learning	The PAI curriculum needs to be more contextual and flexible
Pedagogy	Lectures and face-to-face	Interactive video, LMS, AI learning	PAI teachers need to master digital pedagogy
The Role of the Teacher	The main source of knowledge	Facilitator and curator of knowledge	Teachers become value supervisors and information verification
Learning Media	Textbooks	Digital and multimedia platforms	Islamic content needs to be developed creatively
Learning Evaluation	Conventional exams	Data-driven learning analytics	More personalized and sustainable evaluation
Institutional Management	Manual administration	Digitization of administration and e-learning	Increased institutional efficiency and transparency

However, shadow education can also be a strategic opportunity for PAI institutions if used wisely. Collaboration between PAI teachers and digital platforms can open up space for the development of more creative, interactive, and accessible da'wah content. Religious teachers can be credible content producers and mentors in the digital world. In this case, the institutional role of PAI is not only as a material presenter, but also as a curator and guide in the process of healthy and responsible religious learning in the digital era.

<sup>17</sup> Maulidia Putri Aprillia and Shobah Shofariyani Iryanti, "Revitalisasi Pendidikan Islam Di Era Digital: Membangun Keseimbangan Antara Tradisi Dan Inovasi," *Al-Muaddib Jurnal Kajian Ilmu Kependidikan* 6, no. 1 (March 27, 2024): 25-39, <https://doi.org/10.46773/MUADDIB.V6I1.1111>.



## Challenges and Opportunities of the Industrial Revolution 4.0 in PAI Institutional Transformation.

The Industrial Revolution 4.0 requires PAI institutions to transform in managerial aspects to increase operational efficiency and effectiveness. Digitization of administration, such as the use of learning management systems and e-learning platforms, has been proven to improve transparency and accountability in education management. However, the main challenges faced are the limitations of technological infrastructure and low digital literacy among educators.<sup>18</sup> Although the potential of technology in education is huge, its implementation in PAI institutions faces various challenges. Some of the obstacles found include limited technological infrastructure, lack of training for educators, and resistance to changes from traditional learning methods. To overcome this, systematic efforts are needed in increasing the capacity of human resources and providing adequate facilities.<sup>19</sup>

Visionary and adaptive leadership is essential in driving digital transformation in PAI institutions. Leaders who have an understanding of technology and are able to inspire change can create an organizational culture that supports innovation and continuous learning.<sup>20</sup> This is in line with the need to prepare educational leaders who have leadership qualities and the ability to collaborate in the era of the industrial revolution 4.0. In the context of learning, the application of digital technology allows for more dynamic interaction between teachers and students. Research shows that the use of digital classrooms in PAI learning can improve students' life skills. Some studies have shown an improvement in students' problem-solving skills and life skills after the implementation of digital classrooms in PAI learning, although the rate of improvement may differ depending on the implementation context and technological readiness of each institution.<sup>21</sup> This shows that technology can enrich the learning experience and prepare students to face the challenges of the Society 5.0 era.

The development of a PAI curriculum that is adaptive to technological developments and the needs of the times is very necessary. A curriculum that integrates Islamic values with digital competencies and 21st century skills can prepare students to become competent and virtuous individuals.<sup>22</sup> This includes strengthening digital literacy, character education, and entrepreneurship based on Islamic values.

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<sup>18</sup> Wafi Ali Hajjaj, "Transformation Of Islamic Education Management In The Digital Era: Trends And Implications For Learning Quality," *Journal of International Multidisciplinary Research* 2, no. 10 (October 2024), <https://journal.banjaresepacific.com/index.php/jimr>.

<sup>19</sup> Arman Paramansyah et al., "Pengembangan Bahan Ajar PAI Pada Lembaga Pendidikan Madrasah Dan Pondok Pesantren Dalam Era Digital," *Religion Education Social Laa Roiba Journal* 6 (2024): 2756, <https://doi.org/10.47476/reslaj.v6i6.1711>.

<sup>20</sup> Abdullah Haq Reshufle and Moh Rofiki, "Management of Islamic Education in the Challenges of Society 5.0," *EDUKATIF: JURNAL ILMU PENDIDIKAN* 4, no. 3 (May 23, 2022): 4584–93, <https://doi.org/10.31004/EDUKATIF.V4I3.2820>.

<sup>21</sup> Winda Restalia et al., "Transformation of Islamic Education in the Digital Age: Challenges and Opportunities," *Tadibia Islamika* 4, no. 2 (January 2, 2024): 85–92, <https://doi.org/10.28918/TADIBIA.V4I2.8964>.

<sup>22</sup> Nur Afif and Adlan Nawawi, "Revolusi Industri 4.0 Dan Tantangan Pendidikan Islam: Meneguhkan Peran Guru Sebagai Khalifah Dalam Membentuk Generasi Berkarakter," *Religion Education Social Laa Roiba Journal* 6 (2024): 6284, <https://doi.org/10.47476/reslaj.v6i12.5155>.



Technology-based PAI learning models, such as the use and use of digital teaching materials, have shown effectiveness in improving the quality of learning. Technology not only serves as a tool, but also as a learning environment that can develop students' conceptual understanding of PAI material.<sup>23</sup> However, the success of this model is highly dependent on the readiness of the infrastructure and digital competencies of Education. To face challenges in the digital era, the development of the professionalism of PAI educators through continuous training and education is very important. Educators who have the ability to utilize information technology can create learning experiences that are innovative and relevant to the needs of students. It also supports the creation of an inclusive and value-based learning environment.

Policy Implications in PAI Transformation Education policies that support digital transformation in PAI institutions need to be formulated by considering aspects of technology, curriculum, and human resource development. Clear and directed policies can be a driver for PAI institutions to innovate and adapt to the times, so as to improve the quality of education and the relevance of PAI in the era of Society 5.0.<sup>24</sup> An Islamic education teacher in adapting to the Industrial Revolution 4.0, emphasizes the need for innovative teaching methods to develop students' skills, critical thinking, and emotional well-being, in line with their role as caliphs in shaping character. In addition, teachers in Islamic education must integrate character education into the curriculum, act as caliphs to instill Islamic values and strengthen the character of graduates, thus overcoming the challenges posed by the industrial revolution 4.0.

The results of this study show that the Industrial Revolution 4.0 has a significant impact on institutional management and PAI learning. The digitization of administration and learning allows for operational efficiency and more dynamic interaction between teachers and students. However, challenges such as limited infrastructure and low digital literacy of educators are still the main obstacles. These findings are in line with the theory of digital transformation in education which emphasizes the importance of technological readiness and human resources in facing change.

Based on the analysis of various literature that has been studied, digital transformation in PAI not only has an impact on the technical aspects of learning, but also affects institutional structures, pedagogical interaction patterns, and the orientation of human resource development. The literature shows that the success of Islamic education transformation is greatly influenced by the readiness of institutions in integrating technology with the spiritual values and culture of Islamic educational organizations. Therefore, the challenges and opportunities that arise need to be understood as part of the dynamics of institutional transformation, not just a matter of using technology.

<sup>23</sup> Dwi Setiawati Radjak, Syarifudin Jusuf, And Andi Darmawan Bongkan, "The Urgency Of Digitizing Learning For Madrasah Aliyah Islamic Boarding School Students In The Era Of Society 5.0," *Journal of Learning and Technology* 3, no. 1 (2024): 1–9, <https://doi.org/10.33830/jlt.v3i1.7896>.

<sup>24</sup> Ahmad Jamin and Heri Mudra, "Education: Strengthening Characters Of Graduates In Facing 4.0 Industrial Revolution And 5.0 Society Era," *Batusangkar International Conference* 4 (2019).



Figure 1. Transformation part of IRE Institutions in 5.0 Era

In the context of PAI, these findings indicate the need for a balanced integration of technology between spiritual and technological aspects. Digitalization can expand access and improve the quality of learning, but it must still maintain Islamic values that are at the core of religious education. Therefore, the development of curriculum and learning models must consider digital and spiritual aspects simultaneously.

The study by Radjak also found that digitalization in PAI presents challenges related to the digital infrastructure and competence of educators. However, they emphasize the importance of training and professional development for educators to overcome these barriers. The main difference lies in the focus of this research which emphasizes more on the integration of Islamic values in the digital transformation process.<sup>25</sup>

<sup>25</sup> Radjak, Jusuf, and Darmawan Bongkan, “The Urgency Of Digitizing Learning For Madrasah Aliyah



This research has limitations in terms of geographical scope and methodology used. The data collected are limited to the available literature and do not include the direct experience of PAI institutions in the field. This can affect the generalization of the findings and recommendations given. For further research, it is recommended to conduct field studies to obtain more comprehensive and representative data. Follow-up research should focus on evaluating the implementation of technology in PAI in various regions, taking into account local contexts and local cultures. In addition, it is important to develop a learning model that integrates technology and Islamic values holistically. Collaboration between educational institutions, governments, and the community is also needed to create an educational ecosystem that supports sustainable digital transformation.

This research confirms that digital transformation in PAI is a strategic step to improve the quality of education in the era of the Industrial Revolution 4.0. However, the success of this transformation is highly dependent on the readiness of infrastructure, the competence of educators, and the integration of Islamic values in the learning process. Therefore, there is a need for joint efforts from various parties to ensure that digital transformation in PAI can run effectively and still maintain the spiritual essence of religious education.

## CONCLUSION

This study shows that the phenomenon of shadow education in the era of the Industrial Revolution 4.0 has driven a significant transformation of the institution of Islamic Religious Education (PAI) in Indonesia. The presence of digital platforms such as Ruangguru, Zenius, and online-based learning media has changed students' learning patterns to be more flexible, personalized, and technology-based. These changes have an impact on the transformation of the curriculum, pedagogy, the role of teachers, and the learning management system in PAI institutions.

Literature analysis also indicates that digital transformation in PAI is not only related to technological adaptation, but also concerns the integration of Islamic values in the digital space. The main challenges faced include limited infrastructure, low digital literacy of educators, and the potential for religious misinformation in digital media. However, technological developments also open up opportunities for PAI to develop learning models that are more innovative, interactive, and relevant to the needs of the digital generation.

Therefore, PAI institutions need to take operational steps such as strengthening teachers' digital competence, developing technology-based learning media, and integrating digital literacy and Islamic values in the curriculum. This research has limitations because it is based on literature studies so it does not involve empirical field data. The next research is suggested to use a field approach to obtain a more comprehensive picture of the implementation of digital transformation in PAI institutions in various educational contexts.



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