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Sociotechnical Readiness for AI and Big Data-Based Educational Planning in PTKIS: A Case Study

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Abstract :

The rapid development of Artificial Intelligence (AI) and Big Data has reshaped educational planning in higher education, shifting the focus from mere technology adoption to sociotechnical readiness. This study conceptualizes sociotechnical readiness as the dynamic interaction between technical subsystems, social subsystems, and their alignment in institutional contexts. This research focuses on Islamic religious higher education institutions (PTKIS), a case study of STIT Rakeyan Santang Karawang. This study uses a qualitative approach with a case study design. Data was collected through interviews, observations, and documentation studies of university leaders, as well as academic managers, who were selected deliberately. Data analysis was carried out thematically by referring to the three dimensions of STS, namely technical system, social system, and socio-technical suitability. The results of the study show that technical systems are still at the basic digitalization stage, which is characterized by limited analytics infrastructure, weak data governance, the absence of formal standard operating procedures (SOPs) related to data protection and privacy, and data conditions that are still fragmented on various learning platforms such as Learning Management System (LMS), Google Classroom, and interactive quiz applications. In the social dimension, digital competencies and organizational culture have not been evenly distributed and have not been institutionalized in a sustainable manner. This condition has an impact on the low sociotechnical compatibility between user needs and technological capabilities. This study concludes that the implementation of AI and Big Data-based learning in PTKIS depends on technical social readiness, which requires an educational planning strategy that integrates technical subsystems, social subsystems, and their alignment through the principle of joint optimization within the framework of the Technical Social System (STS), as evidenced by the case of STIT Rakeyan Santang.

Keywords: *AI, Big Data, Digital Transformation Readiness, Sociotechnical Alignment*

Abstrak :

Perkembangan pesat Kecerdasan Buatan (AI) dan Big Data telah membentuk kembali perencanaan pendidikan di pendidikan tinggi, mengalihkan fokus dari adopsi teknologi belaka ke kesiapan sosioteknis. Studi ini mengkonseptualisasikan kesiapan sosioteknis sebagai interaksi dinamis antara subsistem teknis, subsistem sosial, dan penyelarasannya dalam konteks kelembagaan. Penelitian ini berfokus pada lembaga pendidikan tinggi agama Islam (PTKIS), studi kasus STIT Rakeyan Santang Karawang. Penelitian ini menggunakan pendekatan kualitatif dengan desain studi kasus. Data dikumpulkan melalui wawancara, observasi, dan studi dokumentasi pimpinan universitas, serta manajer akademik, yang diseleksi dengan

sengaja. Analisis data dilakukan secara tematik dengan mengacu pada tiga dimensi STS, yaitu sistem teknis, sistem sosial, dan kesesuaian sosial teknis. Hasil penelitian menunjukkan bahwa sistem teknis masih pada tahap digitalisasi dasar, yang ditandai dengan keterbatasan infrastruktur analitik, tata kelola data yang lemah, tidak adanya standar operasional prosedur (SOP) formal terkait perlindungan data dan privasi, serta kondisi data yang masih terfragmentasi pada berbagai platform pembelajaran seperti Learning Management System (LMS), Google Classroom, dan aplikasi kuis interaktif. Dalam dimensi sosial, kompetensi digital dan budaya organisasi belum merata dan belum dilembagakan secara berkelanjutan. Kondisi ini berdampak pada rendahnya kompatibilitas sosioteknis antara kebutuhan pengguna dan kemampuan teknologi. Penelitian ini menyimpulkan bahwa penerapan pembelajaran berbasis AI dan Big Data di PTKIS bergantung pada kesiapan sosial teknis, yang membutuhkan strategi perencanaan pendidikan yang mengintegrasikan subsistem teknis, subsistem sosial, dan penyelarasannya melalui prinsip optimasi bersama dalam kerangka Sistem Sosial Teknis (STS), terbukti dengan kasus STIT Rakeyan Santang.

Kata Kunci: *AI, Big Data, Kesiapan Transformasi Digital, Penyelarasan Sosioteknis*

Introduction

The rapid advancement of Artificial Intelligence (AI) and Big Data has reshaped educational planning in higher education, shifting the focus from mere technological adoption toward sociotechnical readiness. Artificial Intelligence (AI) and Big Data-based transformation is now the main strategy in the modernization of higher education learning and governance. The UNESCO report (2023) shows that more than 47% of the world's higher education institutions have integrated AI in learning, assessment, and academic management, with the educational AI market value projected to reach USD 47.1 billion by 2030. In line with that, the OECD (2024) reports that 71% of universities in developed countries have leveraged big data analytics for academic decision- making and institutional transformation. This phenomenon confirms that the modernization of education based on AI and Big Data is no longer an option, but a strategic imperative for higher education institutions to remain relevant and competitive (OECD, 2024).

Theoretically, the use of AI in education management systems contributes significantly to improving the quality of academic governance through service automation, lecturer and student performance analysis, and more objective and sustainable data-driven decision-making (Anshori et al., 2023). In addition, AI allows the development of adaptive assessment systems capable of improving the precision of measuring learning outcomes, although its implementation demands serious attention to ethical issues, such as algorithm transparency, data bias, and system decision accountability (Bulut et al., 2024). Therefore, the digital transformation of higher education needs to be directed towards a human-centered approach, where technology functions as a supporting tool, not a substitute for the role of humans in the academic process (Mahajan, 2025).

From the perspective of knowledge management, universities are knowledge-based organizations whose success is largely determined by the ability to manage, distribute, and utilize information systematically to support strategic planning and decision-making (Laal, 2011). The integration of AI and Big Data in this context strengthens *evidence-based planning practices*, allowing educational institutions to respond to academic dynamics more proactively and predictively (Rahardja et al., 2025).

However, the reality of Islamic religious higher education (PTKIS) in Indonesia shows that there is a significant gap between global demands and factual conditions on the ground. A report by the Ministry of Religious Affairs of the Republic of Indonesia (2024) reveals that only around 18% of PTKIS have implemented AI-based learning, while the use of Big Data in educational planning is still very limited. Limited technological infrastructure, human resource capacity, and organizational culture that is not fully adaptive are the main factors that hinder the modernization process (Hasan & Abdullah, 2020).

This condition is reflected more specifically at STIT Rakeyan Santang Karawang. Initial observations indicate that the use of learning technology remains limited to basic Learning Management Systems (LMS) and virtual face-to-face applications, without the support of integrated data analytics to systematically map lecturer performance, student development, or curriculum effectiveness. Educational planning practices are still dominated by traditional administrative procedures, are not supported by internal regulations governing the use of AI and Big Data, and are further constrained by uneven levels of digital literacy among educators and educational personnel.

Despite the growing imperative for AI and Big Data based educational planning, these empirical conditions reveal a persistent socio technical misalignment within the PTKIS context. At STIT Rakeyan Santang, digital technologies function primarily as administrative and instructional tools rather than as strategic instruments for data-driven planning. The absence of comprehensive data governance, coupled with limited human capacity and uneven organizational readiness, creates a disconnect between available technological systems and their effective utilization. As a result, educational planning remains procedural rather than strategic, reflecting an imbalance between the technical subsystem and the social subsystem as conceptualized in Sociotechnical Systems (STS) theory.

This shows that there is an imbalance between the technical system and the social system as described in the Sociotechnical Systems Theory (STS) developed by Emery and Trist (1960). STS emphasizes that the success of technological innovation in organizations is highly dependent on the alignment between technical components such as digital systems, data, and infrastructure with social components that include human competence, work culture, and organizational structure. Without harmonious integration between the two aspects, the implementation of technology has the potential to have no significant impact on improving the quality of learning (Emery and Trist, 1960).

Although studies on the modernization of technology-based education have been widely conducted, most of the research still focuses on technical aspects, such as the use of AI in digital learning or the use of Big Data for academic evaluation (Rahmawati, 2021; Suyanto, 2022). Studies that comprehensively integrate social and technical dimensions in educational planning, especially in the context of PTKIS, are still relatively limited. In fact, AI has strategic potential both reactively and proactively in predicting academic risks and student needs early (Mallik & Gangopadhyay, 2023).

Based on these conditions, this study identifies a two-layered research gap in AI- and Big Data–based educational planning. At the conceptual level, existing studies on digital transformation in higher education remain dominated by a techno-centric approach that emphasizes technological adoption while paying limited attention to sociotechnical fit and the principle of joint optimization between technical systems and social systems. As a result, the interaction

between technology, human actors, organizational culture, and institutional structures is often under-theorized, leading to fragmented analyses that fail to explain why technological initiatives do not consistently translate into meaningful educational improvement.

At the contextual level, this gap becomes more pronounced in Islamic religious higher education institutions (PTKIS), which operate within distinct organizational characteristics, cultural values, governance structures, and regulatory frameworks. Models and best practices developed for general or secular universities cannot be directly applied to PTKIS without adaptation, as these institutions face unique challenges related to resource constraints, academic culture, and institutional missions. However, empirical studies that explicitly examine sociotechnical readiness and alignment within PTKIS contexts remain limited, particularly at the institutional level.

The persistence of these conceptual and contextual gaps has practical consequences for educational planning in PTKIS. Without an integrated sociotechnical perspective, technology adoption tends to remain partial and administrative, with digital systems used primarily for efficiency rather than for data-driven planning or pedagogical enhancement. Fragmented data, limited analytical capacity, and uneven human readiness prevent institutions from leveraging AI and Big Data to improve learning quality, personalization, and strategic decision-making. Consequently, digital transformation efforts fail to produce substantive changes in educational outcomes, underscoring the urgency of examining sociotechnical readiness as a critical foundation for effective AI- and Big Data–based educational planning in PTKIS, particularly at STIT Rakeyan Santang Karawang.

It is in this context that this research offers novelty by providing an STS-based diagnostic assessment of sociotechnical readiness and alignment in AI- and Big Data–based educational planning within Islamic religious higher education. Rather than proposing a prescriptive or idealized model, this study systematically examines the interaction between technical subsystems, social subsystems, and their alignment by analyzing digital infrastructure, data governance, human resource competencies, academic culture, and organizational structures within their institutional context. By applying the Sociotechnical Systems (STS) framework as an analytical lens, this research extends theoretical discussions on digital transformation in religious higher education while offering empirically grounded insights that can inform strategic planning and institutional decision-making in PTKIS, particularly at STIT Rakeyan Santang Karawang.

Based on this background, this study addresses three interrelated research questions grounded in the Sociotechnical Systems (STS) perspective. It examines how the technical subsystem, social subsystem, and their alignment are manifested in AI and Big Data–based educational planning at STIT Rakeyan Santang, with attention to technological infrastructure, data governance, human competencies, and organizational practices. The study further investigates the factors that hinder joint optimization between technical and social subsystems, explaining why existing digital initiatives tend to remain administrative rather than transformative. Finally, it identifies feasible planning implications to enhance sociotechnical readiness in PTKIS by aligning technology, human capacity, and organizational structures. Through these inquiries, the study contributes an STS-based assessment of readiness and socio-technical alignment in Islamic higher education.

Result and Discusion

Result

In this study, Artificial Intelligence (AI) is defined as a digital system that has the ability to perform certain cognitive functions such as pattern analysis, learning from data, and providing semi-automated recommendations to support educational decision-making. AI in the context of educational planning does not simply refer to *rule-based automation*, but includes analytical capabilities that allow systems to interpret learning data and generate insights for academic managers and lecturers. This definition is in line with *Kaplan and Haenlein* (2019) who view AI as a system that is able to mimic human intelligence through the ability to learn, reason, and adapt in certain contexts.

Meanwhile, Big Data in this study is defined as a large-scale educational dataset characterized by volume, variety, and velocity, which requires specialized analytical infrastructure and methods to be processed into the basis for planning and decision-making. Operationally, Big Data is not only understood as the amount of data stored in the academic system, but also as data that is integrated across platforms (LMS, SIAKAD, and other administrative systems) and can be analyzed to identify learning trends, lecturer performance, and student academic risks. This definition refers to Chen, Chiang, and Storey (2012) who emphasized the role of Big Data analytics in generating strategic value for organizations through complex and integrated data processing.

Based on the operational definition, this study assesses the readiness and implementation of AI and Big Data at STIT Rakeyan Santang Karawang not only from the existence of digital technology, but from the extent to which the existing system has supported analytical functions, data integration, and evidence-based decision-making in educational planning.

Technical Subsystem

Based on the findings of the research on Thursday, November 13, 2025, it shows that in the dimension of the technical system, STIT Rakeyan Santang Karawang does not yet have a fully intelligent and integrated AI system, and has not yet reached the stage of using Big Data as the concept of modernizing technology-based education. The new ones are in the form of simple automation, such as WhatsApp bots for information delivery and Google Form response processing. The LMS used does provide a basic dashboard in the form of login statistics, module activities, and grades, but this cannot be categorized as *AI-based* learning analytics.

Regarding Big Data infrastructure, academic data is still spread across various platforms such as simple SIAKAD, Google Workspace, and LMS that run separately. The absence of *a data warehouse* makes it difficult for institutions to

conduct comprehensive analytics to support data-driven decision-making. This has a direct impact on the institution's limitations in reading student learning trends, mapping learning outcomes, or analyzing the risk of study delay.

The use of technology in learning planning is indeed starting to be seen, although it is limited to the use of simple data such as attendance and grades in the LMS to evaluate modules. However, this pattern is not yet systemic. Strategic decisions are still more determined by academic meetings, consideration of lecturers' experience, and the intuition of campus leaders than *evidence-based decision-making* based on analytics.

Hardware readiness also presents challenges. Network quality is often unstable, especially during peak hours, so synchronous learning is often disrupted. Not all classrooms are smart classrooms, and computer labs have limited units. Internal servers are small in capacity, so some services are forced to use external hosting. This condition shows that learning modernization still faces significant infrastructure barriers.

In terms of data security, there are no formal SOPs on data protection, encryption, or privacy policies governing how student data is processed for analytical purposes. Awareness of the importance of privacy exists, but its implementation is not yet standard. This is an important note because the use of AI and Big Data is very closely related to the aspects of data governance and security.

Social Subsystem

From the social subsystem perspective, digital competencies among lecturers and educational staff at STIT Rakeyan Santang Karawang are uneven. Younger lecturers tend to be more adaptive and actively utilize LMS, Google Classroom, and interactive quiz applications, while some senior lecturers continue to rely heavily on conventional teaching methods. This condition creates a visible digital gap among lecturers. As one study program head noted, *"Ada dosen yang sangat cepat adaptasi, tapi ada juga yang masih merasa teknologi itu beban tambahan."*

Training related to AI and Big Data has not been conducted systematically or in staged programs. Existing capacity building initiatives are sporadic and largely focus on basic LMS operation rather than on data-driven pedagogy, learning analytics, or AI-supported instructional design. As a result, social readiness for advanced technology utilization remains low. One lecturer emphasized, *"Pelatihan biasanya hanya teknis pakai LMS, belum pernah sampai membaca data pembelajaran."* This limitation weakens the social subsystem's ability to meaningfully engage with emerging technologies.

At the organizational level, institutional leaders generally demonstrate a positive attitude toward digital transformation and articulate it as a strategic direction. Several younger lecturers also function as informal innovation champions. However, this support has not yet been institutionalized through formal policies, incentive structures, or continuous professional development schemes. Consequently, the diffusion of digital practices remains uneven, and social change has not been fully internalized across the institution.

From the student perspective, most learners are able to access and use LMS and other online platforms, yet connectivity constraints and limited access to appropriate devices continue to pose significant challenges. Moreover, students

are not familiar with advanced features such as personal learning analytics or AI-assisted learning tools, reflecting the limited pedagogical depth of current digital implementation.

Culturally, a digital mindset has begun to emerge at STIT Rakeyan Santang Karawang, but it has not yet evolved into a strong institutional culture. Several administrative processes remain manual, and learning innovations have not been supported by clear formal incentives. In addition, there are no explicit internal policies governing the use of AI, algorithmic ethics, or student data protection. Existing regulations are limited to general academic ethics guidelines and have not been adapted to the demands of data-driven and AI-supported educational models. Overall, these conditions indicate that the organization remains in an early adoption phase rather than having achieved full digital institutionalization.

Sosioteknis (Socio-Technical Alignment)

In the sociotechnical dimension, the findings reveal a clear mismatch between available technological capacity and the actual needs of users, both lecturers and students. Existing technologies primarily support administrative efficiency but fail to generate pedagogical insights or adaptive learning support. Systems do not assist lecturers in diagnosing student learning difficulties or predicting performance risks, indicating that sociotechnical fit has not yet been achieved. As one lecturer stated, *"Sistem membantu administrasi, tapi untuk kualitas belajar tetap tergantung kreativitas dosen."*

Human–technology interaction is therefore concentrated on administrative functions such as digital attendance, material distribution, and assignment submission. Interaction at the pedagogical level—such as AI-based learning recommendations, personalized feedback, or predictive analytics—has not yet emerged. Moreover, several lecturers reported that routine digital tasks, including uploading materials and entering grades, remain time-consuming, suggesting that user experience and workflow integration are still suboptimal.

Collaboration among institutional units, including IT services, academic affairs, LPM, LP2M, and study programs, does exist but remains informal and unstructured. Technology-related initiatives are often implemented on an ad hoc basis, driven by short-term needs or specific projects rather than a shared institutional strategy. As noted by an institutional leader, *"Belum ada roadmap bersama, masing-masing unit jalan sesuai kebutuhan sesaat."* The absence of a unified roadmap for AI and Big Data integration undermines the sustainability of digital transformation efforts.

Consequently, the impact of technology on learning is observable mainly in terms of efficiency and access rather than in learning quality or personalization. While access to learning materials has improved, there is no mechanism to provide adaptive feedback or algorithm-based differentiated instruction. Data-driven learning practices remain dependent on individual lecturer initiative rather than being embedded in the system. System adaptation is also slow; although online learning guidelines were revised during the pandemic, curriculum integration of AI and Big Data competencies remains largely at the level of discourse, and academic SOPs have not been adjusted to explicitly support smart learning technologies.

Overall, this study demonstrates that the modernization of AI- and Big Data based learning at STIT Rakeyan Santang Karawang has not yet been implemented optimally due to an imbalance between the technical and social subsystems. Technological infrastructure remains basic and fragmented, human resource competencies and digital culture are uneven, and effective sociotechnical alignment has not been achieved. While transformation efforts have begun, they require strengthened policies, integrated data infrastructure, advanced digital competency development, improved technological infrastructure, and a coordinated cross-unit collaborative ecosystem to realize meaningful educational transformation.

Table 1 STS-Based Results Matrix

Indicator	Evidence	Impact on Planning	Intervention Needed
Data integration	Fragmented SIAKAD, LMS, Google Workspace	Planning not evidence-based	Develop data warehouse
Analytics capability	Descriptive LMS dashboard only	No learning trend analysis	Learning & predictive analytics
Digital competence	Uneven lecturer skills	Low technology utilization	Structured training program
Data governance	No SOP privacy/data use	Risk & unsustainability	Data governance SOP
Coordination	Ad hoc inter-unit collaboration	No long-term strategy	AI–Big Data roadmap

Discussion

This discussion integrates the results of field findings at STIT Rakeyan Santang Karawang with the *framework of Sociotechnical Systems Theory* (STS) developed by Emery and Trist (1960). STS emphasizes that the success of educational modernization is largely determined by the balance and harmony between the technical system and the social system, where both must support each other to achieve optimal organizational performance. In this context, the modernization of learning based on Artificial Intelligence (AI) and Big Data can only be effective if there is *an alignment* between technology, people, organizational structure, and institutional culture (Cherns, 1976). Therefore, this discussion relates research findings to three main dimensions in STS, namely technical systems, social systems, and sociotechnical suitability.

Technical Subsystem

In the technical system dimension, the research findings show that STIT Rakeyan Santang is still in the pre-adoption stage of intelligent technology, with very limited availability and utilization of AI. The technology used does not reflect the character of the adaptive technical system as emphasized in STS, which is a system that is able to provide dynamic feedback, support decision-making, and increase the effectiveness of organizational work (Emery & Trist, 1960). Within the framework of STS, technology should not only be physically present, but capable of creating responsive and participatory working conditions, as well as enabling meaningful interaction between users and systems (Trist & Bamforth, 1951). The finding that Big Data infrastructure is not yet available characterized by the absence of *data warehouses*, *learning analytics*, and centralized analytics systems suggests that the technical system of the campus is still mechanistic and

fragmented, not yet developed into an adaptive system as recommended by Emery and Trist.

The limitations of networks, hardware, and technology-based classrooms also indicate that the principle of *fit-for-purpose technology* (Cherns, 1976) has not been achieved. STS emphasizes that technology must be in accordance with the needs of the user's task and capacity, but in this context, the available technology is not yet able to support adaptive learning, personalization of learning, and data- based decision-making.

These findings distinguish this study from previous studies that generally placed AI and Big Data as stand-alone technical variables and assumed to have been supported by a mature data infrastructure. In contrast to this approach, this study shows that in the context of PTKIS, the main problem is not the availability of advanced algorithms or platforms, but rather the unpreparedness of technical foundations such as data integration, data warehouse, and learning analytics. Thus, the study expands the understanding that AI adoption failures often stem from structural problems in the early stages of digitalization.

Theoretically, these findings reinforce the STS concept that technology cannot be understood only as a technical artifact, but as part of a work system that must be adaptive and integrated. Practically, the implication is the need to prioritize the development of basic analytics infrastructure such as data warehouses and learning analytics dashboards before adopting more complex AI technologies, so that education planning can be truly evidence-based.

Social Subsystem

In the social system dimension, the findings show that the uneven digital competence of lecturers reflects the high social variability in the organization. Emery and Trist (1960) explain that an effective social system must be able to support individual adaptation to new technologies through clear division of roles, adequate training, and a conducive organizational culture. The relatively progressive attitude of campus leaders shows that there is structural support for digital transformation. However, from the perspective of STS, such support is not enough if it is not followed by the institutionalization of new behaviors through formal policies, SOPs, and sustainable competency development programs (Cherns, 1976). The findings that AI and Big Data training have not been systematically implemented show that social systems are not yet fully ready to become strategic partners for technical systems.

The relatively good readiness of students in receiving digital learning, but still hampered by limited internet access and devices, indicates that the capacity of the social system is not evenly distributed. In the framework of STS, this condition reflects the misalignment *of social subsystem capacity*, which is a situation when users are at different levels of readiness. In addition, organizational culture that has not fully supported digital innovation is also an inhibiting factor. Emery and Trist (1960) emphasized that work culture is an important element in the social system that must evolve along with technological advancement. The absence of AI SOPs, ethical guidelines, and data management policies shows that the social foundation for digital transformation has not been solidly built. Thus, socially, STIT Rakeyan Santang is still in the transition phase

and has not reached the *mature social system* stage as outlined in the principles of STS.

These findings differ from many previous studies that emphasized attitude, perception, or acceptance factors of technology as the main determinants of digital adoption. This research shows that in the context of PTKIS, a positive attitude alone is not enough to drive transformation. More decisive is the extent to which organizations build social structures that support continuous learning, equitable distribution of competencies, and institutional legitimacy of new digital practices.

Theoretically, these findings reaffirm STS's view that social systems must be consciously designed to allow adaptation to technology. Practically, the implication is the urgent need to design a structured and tiered digital competency improvement program, and integrate it into staffing policies and lecturer career development, so that the social system can become a strategic partner for the technical system.

Socio-Technical Alignment

The socio-technical dimension as the core of STS shows that STIT Rakeyan Santang has not reached the *condition of socio-technical fit*. The findings of the study show that there is a mismatch between the needs of users and the capabilities of available technology. Users need adaptive learning systems and predictive features to support academic decision-making, but existing technology is not yet able to provide these functions. Emery and Trist (1960) call this condition a *functional misfit*, which is when the technical system fails to meet the operational needs of the social system. The interaction between humans and technology is also still limited to administrative functions, while *the adaptive and two-way interactive feedback loop* as described by Trist and Bamforth (1951) has not yet been realized. Technology has not yet functioned as a system that dynamically recommends, personalizes, or adapts learning.

In addition, cross-unit collaboration between technology managers, academics, and management has not been strategically structured. In STS, this condition shows that the principle of *joint optimization*, which is the simultaneous alignment of technical and social systems (Emery & Trist, 1960) has not been applied. The impact of technology utilization is also still limited to administrative efficiency and has not touched the substantive improvement of learning quality. This indicates that institutions have not yet entered the real digital transformation phase. The slow process of system adaptation further confirms that technical changes have not been followed by structural changes, such as revisions to the curriculum, SOPs, and work culture, as recommended by Cherns (1976). This condition reflects the *low-alignment zone phase*, where technology adoption has begun, but has not been supported by adequate social and organizational readiness.

Overall, the findings of the study show that STIT Rakeyan Santang Karawang is still in the embryonic phase of digital transformation. Within the framework of STS, the technical system is still in the basic digitalization stage, the social system is just beginning to adapt but is not yet stable, and the socio-technical system has not reached optimal suitability. Modernization of learning

can be realized effectively if institutions apply the principle *of joint optimization* as recommended by Emery and Trist (1960), namely building harmony between technology, people, and organizational structures. This requires strengthening analytics infrastructure, sustainable development of digital literacy, drafting ethics and AI governance policies, strengthening cross-unit collaboration, and revision of digital-based curriculum that is still based on Islamic values. These findings confirm that STIT Rakeyan Santang has great transformation potential, but the success of learning modernization is highly dependent on the institution's ability to achieve overall social-technical conformity.

In contrast to previous studies that often assess the success of digital transformation based on the level of technology use or administrative efficiency, this study shows that high technology use does not necessarily reflect sociotechnical alignment. These findings highlight that administrative efficiency can be achieved without improving the quality of learning if technology is not designed in harmony with pedagogical practices and organizational structures.

Theoretically, these findings enrich the STS literature by showing that sociotechnical mismatches can be latent and persistent, especially in organizations that are in the early digital transition phase. Practically, the implication is the need for STS-based educational planning that explicitly aligns technology development, human capacity building, and organizational reform through the preparation of a cross-unit AI and Big Data roadmap within a span of 12–24 months.

Table 2 Roadmap Sociotechnical-Based Planning Implications for AI and Big Data Readiness in PTKIS

Tahap Waktu	Fokus Perencanaan	Intervensi Teknis	Intervensi Sosial & Organisasi	Output yang Diharapkan
Tahap 1 (0–6 bulan)	Fondasi tata kelola & kesiapan awal	• Pemetaan sumber data (SIAKAD, LMS, Google Workspace) • Penetapan standar data minimal • Penyusunan SOP perlindungan data dan privasi	• Sosialisasi kebijakan data & AI • Pembentukan tim lintas unit (IT, akademik, LPM, LP2M) • Penunjukan data steward institusional	• Dokumen SOP data & privasi • Peta arsitektur data institusi • Struktur koordinasi sosioteknis
Tahap 2 (6–12 bulan)	Integrasi data & dukungan keputusan	• Pengembangan data warehouse sederhana • Integrasi data LMS–SIAKAD • Dashboard deskriptif untuk pimpinan	• Pelatihan literasi data dasar bagi pimpinan & dosen • Penguatan peran unit penjaminan mutu berbasis data	• Dashboard perencanaan berbasis data • Keputusan akademik mulai evidence-based • Meningkatnya pemahaman data institusional
Tahap 3 (12–24 bulan)	Analitik pembelajaran & penguatan budaya digital	• Implementasi learning analytics dasar • Analitik risiko studi &	• Pelatihan bertahap (intermediate advanced) • Integrasi pemanfaatan data ke SOP akademik	• Perencanaan pembelajaran adaptif • Peningkatan kualitas pembelajaran

	keterlibatan mahasiswa	• Insentif inovasi pembelajaran berbasis data	• Tercapainya sociotechnical alignment

Conclusion

This study concludes that the integration of Artificial Intelligence (AI) and Big Data in educational planning at STIT Rakeyan Santang Karawang has not yet reached an optimal level when examined through the Sociotechnical Systems (STS) perspective. The findings indicate that the technical subsystem remains at an early stage of digitalization, characterized by fragmented data management, the absence of an integrated data warehouse, and limited analytical infrastructure, which collectively hinder evidence-based educational planning. Although digital platforms are already in use, the lack of data integration prevents institutions from utilizing AI and Big Data to support strategic decision- making related to learning quality, lecturer performance, and student development.

From the social subsystem dimension, the study reveals persistent gaps in digital competencies among educators and educational staff, compounded by the absence of systematic and continuous capacity-building programs. This condition weakens the social subsystem and limits the effective utilization of existing technologies, resulting in technology adoption that remains largely administrative rather than transformative. Furthermore, the absence of formal standard operating procedures (SOPs) for data protection and privacy, along with the lack of a clear planning roadmap, undermines the sustainability of AI- and Big Data–based initiatives, making implementation ad hoc, short-term, and vulnerable to organizational discontinuity.

These findings demonstrate weak socio-technical alignment, in which technological capabilities are not adequately aligned with user needs, institutional goals, or evidence-based planning practices. Accordingly, this study emphasizes that effective advancement of AI- and Big Data–based learning in Islamic higher education requires a holistic planning strategy grounded in the principle of joint optimization, where technological development, human resource readiness, and organizational structures are planned and developed simultaneously. Such an approach is essential to ensure that digital transformation contributes substantively to educational quality rather than merely enhancing administrative efficiency.

Limitations of Study

This study has several limitations. As a single-case study focusing on STIT Rakeyan Santang Karawang, the findings are context-specific and have limited generalizability to other PTKIS with different organizational and regulatory characteristics. The reliance on interviews with institutional leaders and academic managers also introduces the potential for social desirability bias, as respondents may present overly positive accounts of digital readiness. In addition, this study does not assess the impact of AI and Big Data implementation on learning outcomes or institutional performance, as it is intentionally positioned at the stage of sociotechnical readiness and alignment assessment.

Future research should therefore employ comparative and mixed-method approaches across multiple PTKIS, incorporate longitudinal designs to evaluate staged planning interventions over a 12–24month period, and examine how improvements in sociotechnical alignment translate into measurable educational and organizational outcomes.

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