Journal of
Sports Industry & Blockchain Technology
e-ISSN: 3023-8528
https://ndpapublishing.com/index.php/sibt

Readiness for Digitalization of Higher Education: A Comparative Study of Universities in Indonesia

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Article Info
Received: 30.11.2024
Accepted: 23.12.2024
Published:30.12.2024

Keywords
Readiness
Digitalization
University
Indonesia

ABSTRACT
This study aims to analyze the readiness of digitalization in higher education through a comparative analysis between three universities in Indonesia. The main focus of the study is to evaluate aspects of technological infrastructure, human resource competency, and institutional policy support in supporting digital transformation. The study uses a mixed-method method that combines quantitative and qualitative analysis. Quantitative data were collected through questionnaires distributed to lecturers, students, and education staff, while qualitative data were obtained from in-depth interviews and document analysis. The study subjects involved Universities A, B, and C, which were selected based on geographical variations and institutional characteristics. The results showed significant variations in digitalization readiness between universities. University A excels in technological infrastructure and cloud-based learning system integration. University B has mobile technology innovation but faces budget constraints, while University C shows a high commitment to HR development despite limited infrastructure. Factors influencing readiness include HR competency, organizational culture, budget, and policy support. In conclusion, the preparedness for digitalization in higher education in Indonesia still depends on the synergy of technology, policy, and HR. Universities with a combination of supporting factors tend to be more prepared to face digital transformation, while institutions with limited resources require significant external support. This research provides recommendations for inclusive and sustainable digitalization strategies.

1. INTRODUCTION

Digitalization in higher education has become a global agenda to improve graduates' quality of learning and competitiveness. Information and communication technology (ICT) development offers excellent opportunities for higher education institutions to improve the accessibility, efficiency, and effectiveness of their education systems. Global trends show that universities in various countries have adopted digital approaches, such as online learning, cloud-based academic data management, and implementing artificial intelligence technology in the curriculum [1]In Indonesia, the digitalization program for higher education continues to be pushed through initiatives such as Kampus Merdeka, which includes integrating digital platforms into learning. However, the level of readiness of universities to adopt this digitalization still varies, depending on each institution's infrastructure, policies, and human resources.

Although digitalization provides excellent opportunities, the challenges in its implementation are still significant. Several universities face limited access to technology, a lack of digital literacy among lecturers and students, and inadequate infrastructure [2]. This gap creates disparities in the quality of higher education in Indonesia. In addition, the COVID-19 pandemic, which forced the sudden adoption of online learning, shows that universities' readiness to support digital transformation is not optimal regarding policy, management, and technology acceptance by all stakeholders.

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How to cite this article
Widdo, H.K., Andrean, R., Purwaningsih, S.N., and Perdana, F. (2024). Readiness for Digitalization of Higher Education: A Comparative Study of Universities in Indonesia. *Int. J. Act. Health Aging, 1(2), 78-85*

Research Article/ DOI: 10.5281/zenodo.14555748

Studies on the digitalization of higher education in Indonesia are still limited to individual cases or specific universities. Previous studies have focused more on aspects of technology implementation in the classroom or the development of e-learning platforms without comprehensively exploring the level of institutional readiness [3]. In addition, few studies have compared digital readiness between universities in various regions in Indonesia. Understanding the patterns and factors influencing disparities in digital readiness and how policy strategies can be tailored to multiple institutional contexts is essential.

Previous studies have identified factors contributing to digital readiness in higher education, including technological infrastructure, digital competencies of teaching staff, and institutional policy support [4]. Other studies have highlighted the importance of change management and innovation in educational institutions to support the adoption of digital technologies [5]. In Indonesia, several studies have highlighted the role of the government in driving digitalization through national policies. Still, these policies are often not accompanied by adequate technical assistance and infrastructure support [6]. A comparative study covering various universities in Indonesia could complement the existing literature and provide a broader picture of the success factors and barriers to digitalization in higher education.

The urgency of this research is based on the urgent need to improve the global competitiveness of Indonesian higher education in the era of Industrial Revolution 4.0 and Society 5.0 [7]. Digitalization readiness is critical in measuring universities' quality in facing global challenges. This research is relevant in an academic context and contributes to developing national policies that are more adaptive to the needs of higher education institutions. By understanding the differences in the level of readiness between universities, the results of this study can be a basis for the government and stakeholders to design more targeted strategies for supporting digital transformation throughout Indonesia.

This research is expected to have theoretical and practical benefits. Theoretically, this research will enrich the literature on the digitalization of higher education, especially in the context of developing countries such as Indonesia. This research can also be a reference for further studies on technology adoption in higher education. Practically, the results of this study are expected to provide policy recommendations that can help universities improve their digital readiness. In addition, this research will guide educational institutions in identifying technology development priorities that suit their needs.

2. MATERIALS AND METHODS

This study uses a mixed-method approach, which combines quantitative and qualitative methods to obtain a comprehensive picture of digitalization readiness in higher education. Quantitative methods measure the level of digitalization readiness based on specific indicators, such as technological infrastructure, HR competency, and implementation of digital platforms. Quantitative data were obtained through questionnaires distributed to lecturers, students, and education staff at the three universities that were the subjects of the study.

Qualitative methods were used to explore factors influencing the success or challenges of digitalization. In-depth interviews were conducted with university leaders, heads of information technology departments, and lecturers involved in digitalization initiatives. In addition, document analysis was performed on institutional policies, university annual reports, and other relevant strategic documents. The universities that were the subjects of the study were the three best universities in Indonesia, and in this study, they were named anonymously A, B, and C.

This research has been approved by the Ethics Committee of UIN K.H. Abdurrahman Wahid Pekalongan, with approval number 2024/11. Participants gave informed consent using a voluntary form that included study details, risks, benefits, confidentiality, and participant rights. This study strictly adhered to the Declaration of Helsinki's ethical principles, prioritizing participants' rights and welfare in design, procedures, and confidentiality measures.

3. RESULTS

The results of this study indicate that there are variations in digitalization readiness between the universities studied. The analysis was conducted at three universities, namely Universities A, B, and C, focusing on technological infrastructure, human resource (HR) competencies, and institutional policy support.

University A has a superior technological infrastructure with a high-speed internet network and a cloud-based Learning Management System (LMS) integrated with the academic information system. In contrast, University B faces limitations in updating hardware and software despite having developed an innovative mobile application for learning. University C, located in eastern Indonesia,

is still constrained by internet access and outdated hardware. However, this university overcomes its limitations by developing creative solutions such as offline digital learning modules.

One of the determinants of digitalization's success is the competence of lecturers and education personnel in utilizing digital technology. University A routinely holds training on technology use, increasing human resources' capacity to support digital implementation. Although there is training at University B, limited funding causes a low level of participation. University C is highly committed to developing human resources despite limited facilities through collaboration with local governments and non-profit organizations for digital training.

Institutional policies and organizational culture play a significant role in the success of digitalization. University A successfully integrated technology into the institutional strategic vision, supported by a strong culture of innovation. University B highlighted flexibility in technology adoption despite budget constraints. On the other hand, University C, despite its limited infrastructure, successfully created a collaborative culture that supported the implementation of digitalization.

Budgetary factors are the main challenges in Universities B and C, especially in hardware procurement and HR training. In addition, resistance to technological change among lecturers, especially those accustomed to traditional learning methods, is a barrier in all universities.

Several factors supporting digitalization's success include 1) Adequate Infrastructure: High-speed internet access and cloud-based LMS systems. 2) Human Resource Competence: Regular training to improve the capacity of lecturers and education staff. 3) Consistent Policy: Government support through programs such as Kampus Merdeka facilitates digital transformation. 4) Innovative Academic Culture: Encouragement to adapt to new technologies.

This study's results confirm that digitalization readiness in Indonesian higher education depends on the synergy between technology, policy, and HR competency factors. Universities with a combination of the three tend to be more prepared to face digital transformation, while universities with limited resources require external support to accelerate technology implementation. This study provides important insights for policymakers to design inclusive and sustainable higher education digitalization strategies.

4. DISCUSSION

4.1. Concept and Basis of Digitalization of Higher Education

Digitalization in higher education involves applying digital technologies to improve university learning, administration, and research processes. This process includes integrating hardware, software, and network systems to create a more effective, efficient, and inclusive learning environment [8]. The main elements of digitalization in higher education include online learning platforms such as Learning Management Systems (LMS), cloud-based academic information systems, and data analytics to monitor and evaluate scholarly performance. The main objectives of digitalization in higher education are to increase the accessibility of education, expand participation, and create learning experiences relevant to the digital era's needs. Digitalization also aims to improve the ability of higher education institutions to innovate, accelerate responses to change, and support cross-disciplinary and cross-national collaboration. Thus, digitalization is a necessity and an important strategy to create an educational ecosystem that is more adaptive and responsive to global challenges [9].

The digitalization of higher education can be analyzed through various theories and frameworks. One relevant theory is constructivism, which emphasizes that effective learning occurs when learners actively construct their knowledge through interactions with the digital environment. In this context, technology is a mediator that enhances engagement and collaboration in learning [10]. In addition, technology-enhanced learning theory emphasizes the importance of technology design and implementation that aligns with learning objectives. Models such as Technological Pedagogical Content Knowledge (TPACK) provide a framework for understanding how technology, pedagogy, and content can be integrated to create optimal learning experiences [11]. Another frequently used framework is the Digital Capability Framework, which helps higher education institutions identify areas of development, such as teaching staff competencies, technology infrastructure, and institutional policies to support digital transformation [12].

The digitalization of higher education is a rapidly growing global trend, especially after the COVID-19 pandemic forced institutions worldwide to adopt online learning rapidly. Developed countries like the United States, the United Kingdom, and Australia have leveraged technologies such as artificial intelligence (AI), big data, and virtual reality to create immersive and

personalized learning experiences. Universities such as Harvard and MIT have even developed Massive Open Online Courses (MOOCs) to increase global access to quality education. However, digital transformation is not without its challenges. Many universities face limited infrastructure, resistance to change, and a digital competency gap between faculty and students. In a developing country like Indonesia, these challenges are compounded by disparities in technology access across regions, limited funding, and a lack of regulations supporting digital innovation [13]. Digital transformation also requires a strategic approach that includes human resource training and development, long-term investment in technology infrastructure, and collaboration between governments, universities, and the private sector. Digitalization's success depends heavily on institutions' ability to address these challenges with innovative and inclusive approaches.

4.2. Digital Infrastructure and Supporting Technology in Higher Education

Digital infrastructure readiness in higher education is the main foundation for supporting digital transformation. In Indonesia, the level of infrastructure readiness in universities still varies greatly. Several leading universities in big cities, such as the University of Indonesia, Gadjah Mada University, and the Bandung Institute of Technology, have developed adequate technological infrastructure, including high-speed internet networks, cloud-based servers, and online learning management systems [14]. However, universities in remote areas still face significant challenges. The main problems encountered are limited stable internet access, lack of hardware such as computers and servers, and lack of experts who can manage information technology systems [15]. This gap creates a disparity in universities' ability to implement digital technology effectively. In addition, the COVID-19 pandemic has exposed the weaknesses of digital infrastructure in many higher education institutions in Indonesia. The surge in the use of online platforms such as Zoom, Google Classroom, and Microsoft Teams often exceeds the capacity of existing infrastructure, disrupting the learning process. Thus, improving digital infrastructure is a priority and an urgent need to support the sustainability of technology-based learning.

Digital learning in higher education relies on a variety of supporting technology tools. One of the most commonly used technologies is the Learning Management System (LMS), which includes Moodle, Canvas, and Blackboard. LMS allows lecturers and students to manage learning content, conduct assessments, and interact online. In addition to LMS, cloud-based tools such as Google Workspace and Microsoft 365 are gaining popularity due to their flexibility and scalability. Cloud technology allows universities to store data securely, reduce operational costs, and increase user data accessibility [16]. Other technologies include tools for video-based learning, such as high-quality cameras and video editing software. Some universities also adopt artificial intelligence (AI) to provide academic performance analysis, support adaptive learning, and provide automated student support services through chatbots. These tools improve operational efficiency and enrich the student learning experience.

However, implementing this supporting technology requires adequate teaching and administrative staff training. Many lecturers still feel less confident using new technology, so a systematic and sustainable digital competency development program is needed.

The government has a crucial role in encouraging the development of digital infrastructure in higher education. In Indonesia, policies such as the Kampus Merdeka program launched by the Ministry of Education, Culture, Research, and Technology aim to accelerate the adoption of digital technology in the higher education sector. This program includes digital training for lecturers, development of online platforms, and investment in information technology infrastructure [17]. In addition, the government also collaborates with the private sector to provide technology services and expand internet access to remote areas through the Palapa Ring program. This initiative addresses the digital divide between regions and ensures that all universities have access to adequate technology infrastructure [18]. However, this policy often faces implementation challenges, primarily related to funding and coordination between agencies. Many universities have complained about lacking technical support and program sustainability since the policy was launched. Therefore, a more integrative approach is needed between the government, universities, and private partners to ensure that the higher education digitalization policy can have a significant and sustainable impact.

4.3. Factors Determining Readiness for Digitalization of Higher Education

Digital competence is one of the main factors determining the success of digitalization in higher education. This competence includes using technological devices for learning, mastery of digital platforms, and understanding ethics and

security in cyberspace. In Indonesia, the level of digital competence of lecturers and students varies greatly. A study by Roslinawati & Utama [19] only 35% of lecturers at state universities have high skills in utilizing the Learning Management System (LMS). Many lecturers are still limited to basic technology, such as presentation applications or online communication. This is a challenge in integrating advanced technologies such as learning analytics or adaptive learning based on artificial intelligence. On the other hand, millennial and Gen Z students tend to be more fluent in using technology. However, their skills are often limited to consuming information, not the ability to create or manage complex digital content [20]. Various universities have held training and certifications on technological competence for lecturers and students to improve digital competence. Programs such as training in using LMS, digital content development, and cybersecurity are priorities in the staff development curriculum. However, the success of this program depends on solid institutional support, including adequate incentives and technological facilities.

Organizational culture in higher education also influences digitalization readiness. Universities with a culture that supports innovation, collaboration, and continuous learning tend to be more ready to adopt digital technologies. Conversely, resistance to change is often the biggest obstacle in implementing digitalization. A study by García-Morales et al. [21]. shows that successful digital transformation in higher education requires changing the mindset of all stakeholders, from university leaders to students. Lecturers, for example, need to see technology as a tool to strengthen their teaching practices, not as a threat to their traditional roles. To encourage a digital culture, several universities in Indonesia have formed special teams tasked with managing digital transformation. This team usually consists of technology experts, lecturers, and administrators who work together to identify institutional needs and design appropriate implementation strategies. In addition, a participatory approach, such as involving lecturers and students in the technology decision-making process, can also help reduce resistance and increase technology adoption.

Visionary leadership and supportive institutional policies are crucial factors in digital readiness. University leaders need to deeply understand the importance of digital technology and the ability to integrate it into the institution's long-term vision. This support can be in the form of budget allocation for developing digital infrastructure, provision of training programs, and incentives for lecturers and students who actively use technology. In Indonesia, several universities have successfully developed institutional policies supporting digital transformation. Airlangga University, for example, launched a "Smart Campus" policy that includes creating an integrated information system, providing extensive internet access, and developing mobile applications to support learning. Initiatives like these show that proactive leadership can significantly impact a university's digital readiness [22]. However, many other universities still face obstacles in implementing similar policies. These obstacles are often related to budget constraints, lack of coordination between units, and institutional priorities that are not aligned with the demands of digitalization. To overcome these obstacles, universities must build strategic partnerships with the government and private sector, integrating digitalization into their long-term vision and mission.

4.4. Analysis of Digitalization Readiness in Higher Education: Case Study of Universities in Indonesia

The analysis of the digital readiness of higher education institutions in Indonesia shows significant variation between universities based on location, resources, and policy support. Universities in urban areas, such as the University of Indonesia and Universitas Gadjah Mada, tend to have better technological infrastructure, including high-speed internet networks and cloud-based online learning systems. These universities allocate adequate hardware, software, and HR training development budgets. In contrast, universities in remote areas, such as in eastern Indonesia, still face significant infrastructure constraints, such as poor internet connectivity and limited technological devices. However, commitment to improving the capacity of lecturers and students through digital training is beginning to be seen in several institutions.

The main factors influencing digitalization readiness include human resource competency, organizational culture, and institutional leadership support. Resistance to change and budget constraints are often obstacles, especially in private universities or outside Java. This study's findings indicate that universities in Indonesia have shown positive developments in adopting digital technology. However, they still need to improve synergy between the government, universities, and private partners to address the digital divide comprehensively.

The universities that are the subject of study are:

University A: A leading state university in Indonesia with relatively good access to technological infrastructure and a reputation as a pioneer in implementing online learning.

University B: A private university focusing on technological innovation but facing funding constraints for infrastructure development.

University C: A state university in eastern Indonesia with limited infrastructure access but highly committed to improving human resource capacity.

Data analysis techniques used content analysis for qualitative data and descriptive statistical analysis for quantitative data. A comparative approach was used to identify similarities and differences in digitalization readiness across the three universities [23].

University A has shown significant progress in digitalization. The university has a sophisticated online learning system, including implementing a cloud-based Learning Management System (LMS) integrated with the academic system. In addition, high-speed internet access is available throughout the campus, and regular training for lecturers in the use of technology has been conducted. However, some lecturers are reluctant to adapt to digital teaching methods despite adequate infrastructure due to limited competence or preference for traditional methods.

University B has an innovative approach to utilizing mobile-based technology to support learning. Students and lecturers use specially designed applications to access learning materials, class schedules, and discussion forums. However, the main challenge faced is the limited budget for updating hardware and software. In addition, students from low-income families often have difficulty accessing adequate technological devices to participate in online learning [24].

University C faces significant challenges in terms of technological infrastructure. Slow internet access and outdated hardware are major obstacles. However, the university's commitment to improving digital readiness is evident from its lecturer capacity development programs, such as digital competency training and collaboration with local governments to improve access to technology. Despite its limited infrastructure, the university has created creative solutions, such as digital module-based learning that does not require a real-time internet connection.

The analysis results show that several key factors influence digitalization readiness in Indonesian universities: a) Human Resources (HR): The competence of lecturers and education personnel in digital technology is very determining. Universities that have regular training programs tend to be more successful in adopting new technologies [25]; b) Budget: The availability of an adequate budget for hardware purchases, software development, and training is one of the biggest challenges, especially in private universities and colleges in remote areas; c) Academic Culture: Institutions with a culture that supports innovation and change adapt more quickly to digitalization. In contrast, universities that still maintain a traditional culture often experience resistance to technology adoption; d) Policy Support: Clear and consistent policies from the government and institutions are essential to drive the sustainability of digitalization initiatives. Collaboration with the private sector is also critical for increasing access to more advanced technologies [26].

The findings of this study confirm that digitalization readiness depends not only on technology but also on the synergy between various institutional, social, and economic factors.

5. Conclusion

This study concludes that digitalization readiness in Indonesian higher education institutions varies widely and is influenced by factors such as geographic location, resources, and institutional policy support. Analysis of Universities A, B, and C illustrates a complex pattern of readiness. With adequate technological infrastructure, University A shows significant progress in implementing digitalization, while University B faces budget constraints despite mobile technology-based innovations. Although limited in infrastructure, University C shows a solid commitment to human resource development. Key factors influencing digitalization readiness include: 1) Human Resources (HR): The competence of lecturers and education staff is the primary driver of successful digitalization. Regular training increases the ability to adapt to new technologies. 2) Budget: Limited funds for hardware, software, and training are the biggest challenges, especially in private universities and remote areas. 3) Academic Culture: Institutions with a culture of innovation adapt to digital technology more quickly than those that maintain traditional patterns. 4) Policy Support: Clear and consistent policies from the government and institutions are critical to the sustainability of digitalization. Collaboration with the private sector strengthens access to more sophisticated technology.

Digitalization of higher education in Indonesia shows positive developments, although significant challenges remain. With the support of technological infrastructure, policies, and a culture of innovation, universities are more prepared to

face digital transformation. Conversely, disparities in readiness are evident in universities with limited resources. This study emphasizes the importance of synergy between the government, universities, and private partners in addressing the digital divide in Indonesia. Investment in technological infrastructure, increasing human resource capacity, and developing long-term policies are strategic steps to accelerate digital transformation. With an integrated approach, digitalization can improve the quality, accessibility, and relevance of higher education in the era of Industrial Revolution 4.0 and Society 5.0. The results of this study can be a reference for universities and stakeholders in designing digitalization strategies that are appropriate to the needs and context of their respective institutions.

Acknowledgment

The authors would like to express their deepest gratitude to UIN K.H. Abdurrahman Wahid Pekalongan, the University of Utara Malaysia, and SDN Karangtengah Baru for their invaluable support in conducting this research. Special thanks to the lecturers, students, and education staff who participated in the study and provided insightful data. Appreciation is also extended to the Journal of Sport Industry & Blockchain Technology editorial team for their guidance. This study would not have been possible without the collaboration and dedication of all contributors.

Conflict of Interest

The authors declare no conflict of interest, and no financial or other support influenced the research, authorship, or publication of this article

Ethics Committee

This research has been approved by the Ethics Committee of UIN K.H. Abdurrahman Wahid Pekalongan, with approval number 2024/11.

Author Contributions

Study Design, AK, BÇ; Data Collection, AK, OB; Statistical Analysis, AK, NK; Data Interpretation, AK; Manuscript Preparation, AK, BÇ, NK; Literature Search, AK, KU, OB. All authors have read and agreed to the published version of the manuscript.

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