



The Utilization of Big Data in Higher Education Planning

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Abstract

Background. The use of big data in higher education planning is a strategic issue in the era of digital transformation, demanding data-driven decision-making. Purpose.

Aims. This research aims to analyze the characteristics and sources of big data, its use in national education planning, the challenges it faces, and the strategies for its strengthening.

Method. The research uses a qualitative, descriptive-exploratory design, employing interviews with resource persons from the National Development Planning Agency and documentation studies.

Results. The results of the study show that big data in higher education has complex characteristics, is large and diverse, and is dynamic. Its use has been employed in mapping human resource needs and policy formulation, but it remains descriptive. The main challenges faced are data fragmentation, limited system integration, human resource capacity, and data governance.

Conclusion. The ideal model emphasizes cross-sectoral integration based on analytics technology. Therefore, it is necessary to strengthen digital infrastructure, human resource capacity, data integration policies, and data-based culture to support more effective and sustainable higher education planning.

Keywords: Big Data; Higher Education Planning; Education Policy; Data Governance; Digital Transformation



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INTRODUCTION

The development of information technology in the digital era has led to the emergence of the big data phenomenon, one of the important pillars of decision-making across various sectors, including higher education. Big data is not only understood as a large collection of data, but also includes volume, velocity, and variety characteristics that allow for more comprehensive and in-depth data analysis (Decheng Zhang & Jinxin Chen, 2024). In the context of higher education, the use of big data is becoming increasingly relevant as the complexity of institutional management increases, demands for public accountability, and the need to produce evidence-based policies (Alenezi, 2023).

Higher education has a strategic role in national development, especially in producing quality and globally competitive human resources. Therefore, higher education planning can no longer be done conventionally, relying only on limited data and administrative approaches. A comprehensive, responsive, and data-driven planning system is needed. In this regard, big data offers great potential to improve planning quality through more in-depth, predictive, and real-time data analysis (Lutfiani & Meria, 2022).

The use of big data in higher education planning encompasses various aspects, including the analysis of labor needs, projections of student numbers, evaluation of institutional performance, and the development of curricula relevant to industrial needs. Data sourced from various digital platforms, such as academic systems, social media, alumni tracer studies, and job market data, can be integrated to produce more holistic information (Zhang et al., 2022). Thus, policymakers can formulate more targeted and sustainable strategies.

However, the implementation of big data in higher education planning in Indonesia still faces various challenges. One of the main problems is the fragmentation of data across institutions, which complicates system integration and interoperability. In addition, the limitations of technological infrastructure, human resource capacity, and regulations that do not fully support optimal data utilization are also significant obstacles (Decheng Zhang & Jinxin Chen, 2024). This results in the potential of big data not being utilized to the fullest in the higher education planning process.

Research on big data in higher education has evolved from a focus on academic data management to the use of data as a basis for strategic decision-making. Studies have shown that big data enables the analysis of labor needs, policy evaluation, curriculum development, and the alignment of higher education with industry and national development. In this context, big data is understood as a large, diverse, fast-changing, and strategically valuable data ecosystem. However, in practice in Indonesia, the use of big data in higher education planning still tends to be descriptive and not entirely based on predictive or prescriptive analysis

The novelty of this research lies in its focus on the use of big data in higher education planning from the perspective of Indonesian national policy. This research not only identifies the characteristics, sources, and challenges of big data, but also presents an empirical perspective from Bappenas and offers an ideal model for the use of big data based on cross-sector integration, advanced analytics, and multi-stakeholder collaboration.

Although many studies on big data in education have been conducted, there remains a research gap in its use for higher education planning aligned with national policies. Previous research has focused more on learning, administration, and institutional evaluation, while studies on the integration of big data to support predictive, cross-sectoral, and data-governance-based higher-education planning remain limited. In addition, there has been little research that holistically links technology, regulation, human resource capacity, and data culture within a single implementation framework aligned with the Indonesian context.

LITERATURE REVIEW

In a global context, various countries have adopted big data as an integral part of their education systems. This shows that the use of big data is no longer an option, but a must for higher education institutions that want to remain relevant and competitive (Edi Santoso et al., 2022). Therefore, Indonesia needs to immediately accelerate digital transformation in the higher education sector by leveraging the potential of big data. This study aims to analyze the use of big data in higher education planning, especially in the context of policy and implementation in Indonesia. This research also seeks to identify

challenges and opportunities faced in the application of big data, as well as formulate strategic recommendations to improve the effectiveness of data-based higher education planning. Thus, it is hoped that this research can contribute to the development of more adaptive, innovative, and evidence-based education policies.

The results of an interview with one of the resource persons from the National Development Planning Agency (Bappenas) at the Directorate of Higher Education and Science and Technology indicate that the government has actually recognized the importance of using data in education-sector planning. However, implementation in the field still faces challenges in inter-agency coordination and data synchronization across systems. The resource person emphasized that one key to the success of big-data-based planning is the integration of cross-sector data, supported by strong policies and commitments from all stakeholders.

This emphasizes the importance of developing a data ecosystem that focuses not only on data collection, but also on data quality, validity, and security. In this context, data governance is a crucial aspect that every higher education institution must consider. Without good governance, the available data can introduce bias and errors into decision-making (Alenezi, 2023).

On the other hand, the use of big data also opens opportunities for higher education to innovate across learning, research, and community service. With the right data analysis, institutions can identify student needs more accurately, increase the effectiveness of the learning process, and develop study programs that are in accordance with the times (Zhang et al., 2022). In addition, big data can be used to increase universities' competitiveness globally by leveraging data in international rankings and benchmarking.

RESEARCH METHODS

This research uses a qualitative, descriptive-exploratory design to understand in depth the use of big data in higher education planning. This approach was chosen because the research not only aims to describe the phenomenon, but also comprehensively explores the dynamics, challenges, and opportunities in the implementation of big data in the context of education policy in Indonesia (Sugiono, 2020). Through a qualitative approach,

researchers can more fully capture the meanings, perspectives, and experiences of stakeholders. The data sources in this study include both primary and secondary data. Primary data was obtained through in-depth interviews with resource persons from the National Development Planning Agency (Bappenas) of the Directorate of Higher Education and Science and Technology. Secondary data is obtained through documentation studies, including scientific journal articles, policy reports, and academic publications relevant to the research topic, particularly those related to big data and educational planning.

Data collection was carried out using two main techniques: in-depth interviews and documentation studies. The interviews were conducted in a semi-structured manner using pre-arranged interview guidelines, while still providing room for flexibility for researchers to gather broader information in line with developments in the field (Creswell, J. W.). This interview focused on aspects of the use of big data in the planning process, the challenges faced in its implementation, and the strategies carried out by the government in optimizing the use of data in policy making. On the other hand, documentation studies examine relevant literature to strengthen the conceptual framework and provide a theoretical basis for the research findings. The analysis process is carried out simultaneously from the data collection stage to the drawing of conclusions. The analysis stage begins with data reduction, the process of sorting, simplifying, and focusing on data relevant to the research objectives. Furthermore, the reduced data is presented as a descriptive narrative to make it easier for researchers to understand the patterns, relationships, and trends that emerge. The final stage is the drawing of conclusions and verification, which is carried out continuously to ensure the resulting findings are highly valid. Triangulation and member check techniques are used to ensure the validity of data, both source and method triangulation. Member checking is carried out to ensure that the interpretation of the data is consistent with the informant's intention and experience.

RESULTS AND DISCUSSION

Characteristics and Sources of Higher Education Big Data

Big data in the context of higher education has three main characteristics: large volume, speed of access (velocity), and diversity of data formats (variety). Higher education data is no longer limited to administrative data such as the number of students or graduates, but has developed to include academic data, digital learning activities, alumni tracer studies, to job market data and industry needs. This shows that big data in higher education is multidimensional and cross-sectoral.

Higher education data sources currently come from various scattered systems, such as higher education databases, the results of national human resource planning studies, and government policy publications. In addition, documents such as the white paper on mapping human resource needs towards a Golden Indonesia 2045 are also strategic sources in identifying future competency needs. However, the main characteristic that emerges is data fragmentation, with each institution or ministry having a data system that is not fully integrated. Thus, it can be understood that big data in higher education is not only voluminous but also complex in its management, so it requires a robust integration system.

The Utilization of Big Data in National Education Planning

The use of big data in national education planning shows a paradigm shift from assumption-based planning to data-driven planning. Big data is used to map labor needs, determine the priorities of study programs, and formulate education policies aligned with national development. BAPPENAS has begun to utilize data in planning preparation, especially in connecting development needs with higher education output. The data is used to project future human resource needs, including in the context of Indonesia Emas 2045. In addition, the data is also used in the evaluation of education policies and the preparation of roadmaps for the development of the education sector. However, the utilization is not fully optimal because it is still limited to aggregate data rather than in-depth predictive analysis. This shows that the use of big data is still in transition toward a more sophisticated and integrated system.

Challenges of Big Data Utilization

The main challenge in the use of big data in higher education planning is data integration and quality issues. Data fragmentation across agencies makes it difficult to obtain a complete and accurate picture. In addition, differences in data standards and information systems between institutions are also obstacles to interoperability. Based on interviews, another challenge is the limited capacity of human resources to manage and analyze data. Not all institutions have experts who can process big data into strategic information. In addition, regulatory and data governance aspects remain obstacles, especially regarding data security and confidentiality. Thus, the challenges faced are not only technical but also structural and cultural, requiring a systemic approach to their solution.

Ideal Big Data Utilization Model

The ideal model of big data utilization in higher education planning is one that is based on cross-sector integration and supported by sophisticated analytics systems. This model emphasizes the importance of interconnectedness between education data, industrial data, and national development data. In the perspective of the research results, the ideal model includes several main components, namely: (1) data integration between institutions through a national platform; (2) the use of analytical technologies such as artificial intelligence and machine learning for predictive analysis; (3) multi-stakeholder involvement, including government, universities, and the industrial sector; (4) the implementation of a real-time data-based monitoring and evaluation system. This model enables higher education planning to be more adaptive, responsive, and grounded in real needs in the field. Thus, the resulting policies are not only reactive but also proactive and anticipatory to global changes.

Strategies to Strengthen Data Governance and Capacity

Strengthening data governance and capacity is the main key to optimizing the use of big data. Good data governance encompasses data quality, data standards, security, and data-sharing mechanisms between institutions. Strategies that can be implemented include strengthening national data integration policies, developing digital infrastructure, and

increasing the capacity of human resources in data analytics. In addition, it is necessary to strengthen data culture in educational institutions and the government so that data-based decision-making becomes a sustainable practice.

Another strategy is the development of an integrated platform that can integrate various sources of higher education data into a single system that is easily accessible and analyzable. With this platform, the planning process can be carried out more effectively and efficiently. Thus, strengthening data governance and capacity not only focuses on technical aspects but also encompasses policy, institutional, and organizational culture.

Characteristics and Sources of Higher Education Big Data

Big data in higher education has main characteristics that go beyond volume and include velocity, variety, and value generated from data processing. The large volume of data is reflected in the large amount of data generated by academic, administrative, and digital interaction activities in the university environment (Setyowati & Nasir Ahmad, 2021). The speed of data processing is important because data is constantly updated in real time across various systems, such as learning management systems (LMS), academic information systems, and other digital platforms. Meanwhile, the diversity of data includes various formats, both structured and unstructured, such as numerical data, text, audio, and video derived from learning activities and user interactions (Alenezi, 2023).

In addition to these characteristics, big data in higher education also has a high level of complexity. Data is not only quantitative, but also qualitative, so it requires a more sophisticated analytical approach to generate meaningful information (Arya Satya Pratama et al., 2023). For example, student activity data in online learning platforms can be analyzed to identify learning patterns, levels of engagement, and potential academic risks. This shows that big data not only serves as a documentation tool but also as a strategic instrument in supporting evidence-based decision-making. In the context of data sources, higher education big data comes from various interconnected systems, both internally and externally. Internally, data is sourced from academic information systems, financial data, research data, and digital learning activities (Adelakun, 2022). Externally, data can come from alumni tracer studies, the job market, industry data, and government policies. The

integration of internal and external data is essential for producing a comprehensive analysis, especially in the context of higher education planning oriented toward national development needs.

However, in the Indonesian context, higher education data sources remain scattered across various institutions and have not been fully integrated. Based on interviews with the National Development Planning Agency, the data used in education planning include higher education databases, the results of human resource needs assessments, and national strategic documents, such as mapping human resource needs towards a Golden Indonesia 2045. However, each of these data sources is still managed sectorally, resulting in data fragmentation that hinders optimal integration and utilization (Zakaria et al., 2025).

This data fragmentation reflects the phenomenon of a silo system, where each institution or ministry has its own data system that is not interconnected. This condition causes difficulties in obtaining a complete picture of the condition of higher education nationally (Widiasanti et al., 2023). In addition, differences in data standards, formats, and data management mechanisms pose obstacles to system interoperability. These findings are in line with research that states that heterogeneity of data sources and lack of interoperability are major challenges in the implementation of big data (Glushchenko, 2023).

Another characteristic of big data in higher education is the high dependence on technological infrastructure and human resource capacity. Data management at scale requires adequate storage systems, advanced analytics technology, and experts who can process data into relevant information (Setyowati & Nasir Ahmad, 2021). Without this support, big data has the potential to become just "big data" without adding value to the decision-making process. On the other hand, technological developments such as artificial intelligence and machine learning open new opportunities for the use of big data in higher education. This technology enables more in-depth data analysis, including pattern identification, trend prediction, and the automatic provision of policy recommendations (Fadillah, 2025). Thus, the characteristics of big data lie not only in the size of the data but also in its ability to generate insights of strategic value.

By considering these characteristics and sources, it can be concluded that higher education big data is a complex, multidimensional system. Therefore, an integrated approach is needed in its management, both from technological, policy, and institutional aspects. Without strong integration, the great potential of big data will not be optimally utilized in supporting effective and sustainable higher education planning.

The Utilization of Big Data in National Education Planning

The use of big data in national education planning reflects a paradigm shift from a conventional approach to data-driven decision-making. In this context, big data not only functions as an administrative support tool, but has developed into a strategic instrument in formulating education policies that are more adaptive and responsive to development dynamics (Edi Santoso et al., 2022). Big data allows governments to process information on a large scale to map labor needs, align educational output with industry needs, and design more targeted policies (Bo Tang, 2025).

Operationally, the use of big data in national education planning can be seen from its ability to project the number of graduates, analyze competency needs, and identify gaps between the world of education and the world of work (Do&Duong, 2024). Through the integration of various data sources, the government can identify priority sectors that need to strengthen human resources, enabling education policies to support these sectors. In addition, big data enables a more objective and sustainable evaluation of education policies, as it is based on empirical data. The use of big data in education planning has begun to be implemented, especially in connecting the education sector with national development needs. The data is used to support the preparation of medium- and long-term development plans, including human resource development towards a Golden Indonesia 2045. This shows that big data has become an important part of national-level strategic planning.

These findings are reinforced by research that states that the use of big data analytics can improve the quality of decision-making in the public sector, including education, through the provision of more accurate, fast, and relevant information (Adelakun, 2022). In addition, big data also plays a role in improving planning efficiency

through the use of predictive analytics that can anticipate future needs, such as labor trends, technological developments, and changes in economic structure (Zhang et al., 2022). Thus, educational planning is no longer reactive, but can be proactive and anticipatory. Furthermore, the use of big data also opens up opportunities for the development of simulation- and scenario-based planning systems (Efgivia, 2020). Through this approach, the government can test various policy options based on available data, thereby minimizing the risk of errors in decision-making. In addition, big data enables integration between education planning and other sectors, such as industry, employment, and the economy, resulting in more holistic policies.

However, despite its enormous potential, the use of big data in higher education planning in Indonesia still faces various limitations. One of the key findings of the study is that data use remains dominated by descriptive analysis, such as statistical reporting and monitoring of performance indicators. The use of data for predictive and prescriptive analysis remains suboptimal, so the potential of big data has not been fully realized in supporting strategic decision-making.

This condition indicates a gap between data availability and the ability to process and use it. Limited analytical capacity, both in terms of technology and human resources, is the main factor hindering the optimal use of big data. In addition, the lack of a strong data integration system prevents the available information from being utilized optimally. Thus, it can be concluded that the use of big data in national education planning in Indonesia is still in the transition stage to a more advanced system. Efforts are needed to strengthen analytical capacity, develop technological infrastructure, and integrate data systems to enable optimal use of big data. If this can be realized, big data has great potential to improve the quality of education planning, making it more aligned with national development needs and better equipped to face global challenges in the future.

Challenges of Big Data Utilization

The use of big data in higher education planning faces multidimensional challenges, including technical, institutional, and cultural aspects. One of the main challenges is the problem of data integration (Himeur et al., 2023). Higher education data in Indonesia

remains scattered across various institutions and systems, leading to data fragmentation. This condition gives birth to a phenomenon *Silo System*, where each institution manages data independently without adequate connectivity. As a result, the flow of information is hampered, and coordination between sectors does not run optimally (Widiasanti et al., 2023). In addition, differences in data standards, formats, and information systems pose obstacles to achieving the interoperability needed for national data integration.

In addition to integration, data quality is also an equally important challenge. The available data often does not meet the criteria of accuracy, consistency, and completeness, which can result in biased or inaccurate analysis. In the context of educational planning, the quality of the data greatly determines the validity of the resulting policies. Therefore, data quality management is the main prerequisite for effective use of big data (Bibri, 2023). Another challenge is the limited availability of human resources, especially experts in data analytics. Big data processing requires specialized competencies, such as data science, data engineering, and data analytics, which remain limited to government and university environments. This limitation prevents the available data from being optimally processed into strategic information to support decision-making.

The regulatory and data governance aspects are also a significant challenge. Policies governing data management and utilization are still not fully integrated and comprehensive. This has an impact on the limited data sharing mechanism between institutions, as well as the lack of uniform standards in data management (Holmlund et al., 2020). These findings are consistent with research indicating that the success of big data implementation is strongly influenced by organizational readiness, including infrastructure availability, policy support, and human resource competence (Cheng, 2025). Another challenge that is increasingly important in the digital era is the security and privacy aspect of data. Higher education data, particularly student-related data, is sensitive and requires strict protection. The risk of data leakage, information misuse, and cybersecurity threats is an issue that must be anticipated when using big data. Therefore, strong policies and reliable security systems are needed to ensure that data can be used optimally while protecting privacy.

Cultural challenges also affect the use of big data. An organizational culture that is not completely data-driven often still bases decision-making on intuition or experience alone. The shift towards a data-driven culture requires a well-defined process, including increasing data literacy among stakeholders and changing decision-making mindsets. The challenges of using big data in higher education planning are not only technical but also institutional, regulatory, and organizational cultural. Therefore, a holistic and integrated approach is needed to address these challenges. These efforts include strengthening data system integration, improving data quality, developing human resource capacity, and formulating policies that support effective and sustainable data governance. If these challenges can be overcome, big data will be able to make a significant contribution to improving the quality of higher education planning in Indonesia.

Ideal Big Data Utilization Model

The ideal model for the use of big data in higher education planning is an integrated, collaborative, and advanced analytical technology-based system. This model emphasizes not only the availability of large amounts of data but also the system's ability to integrate, process, and produce information of strategic value for decision-making. Cross-sectoral data integration is a key element of this model, in which data from the education, industry, and government sectors are integrated into a single national platform (Susanti et al., 2024). With this integration, higher education planning can be carried out more comprehensively and in line with development needs. In an ideal model, the use of big data does not stop at descriptive analysis that merely describes past conditions, but develops towards predictive and prescriptive analysis. Predictive analytics enable education planners to forecast future trends, including labor needs, developments in areas of expertise, and changes in learning patterns (Alenezi, 2023). Meanwhile, prescriptive analysis provides policy recommendations that can be taken based on the results of data analysis. Thus, big data is not only an evaluation tool, but also a proactive strategic planning instrument.

The use of technologies such as artificial intelligence and machine learning is an important component of this model. The technology enables large-scale data processing with high accuracy and the ability to identify complex patterns. Through the application of

this technology, the data analysis process can be carried out automatically and continuously, resulting in real-time and relevant information for decision-making (Edi Santoso et al., 2022). In addition, analytics technology enables the integration of various types of data, both structured and unstructured, thereby enriching the information base used in planning.

The ideal model of big data utilization also emphasizes the importance of a collaborative approach involving various stakeholders. The results of the study show that the involvement of universities, the government, and the industrial sector is a key factor in ensuring the relevance and sustainability of data utilization (Efgivia, 2020). Universities play a role as data producers and centers for scientific development, the government as a regulator and policymaker, and the industrial sector as a graduate user and provider of information related to labor needs. This collaboration creates an interconnected data ecosystem and supports the development of policies grounded in real needs in the field.

The ideal model also needs to be supported by a strong data governance system. This governance includes data management standards, data sharing mechanisms, and data security and protection systems. Without good governance, cross-sector data integration will be difficult to achieve and potentially pose risks, such as data leakage or misuse of information (Asbari & Nurhayati, 2023). Therefore, governance is an important foundation for building a sustainable big data system. The ideal big data utilization model must also be adaptive to technological developments and global dynamics. Rapid changes in the world of work, technological advancements, and the demands of globalization demand a flexible and responsive educational planning system (Turnip, 2023). With the support of big data, higher education institutions can make rapid adjustments to these changes across the curriculum, study programs, and learning strategies.

Thus, the ideal big data utilization model for higher education planning not only focuses on technology but also encompasses system integration, stakeholder collaboration, and robust data governance. This model is expected to produce a more adaptive, evidence-based, and future-oriented planning system. If implemented optimally, this model will significantly improve the quality of higher education and support the achievement of national development goals in a sustainable manner.

Strategies to Strengthen Data Governance and Capacity

Strengthening data governance and capacity is a crucial strategic step in optimizing the use of big data in higher education planning. Effective data governance not only ensures data availability but also the quality, security, accessibility, and integrity of the data used in the decision-making process. In this context, data governance includes the development of uniform data standards, reliable security systems, and transparent and coordinated inter-agency data sharing mechanisms (Bo Tang, 2025). Data standardization is an important element in creating interoperability between systems. Without clear standards, data from various institutions will be difficult to integrate due to differences in formats, definitions, and data structures. Therefore, a national policy is needed that regulates higher education data standards so that all institutions have the same reference in data management (Miedema et al., 2025). In addition, data security must be a top priority, given that higher education data often contains sensitive information that requires special protection.

The strategy to strengthen data governance and capacity can be carried out through several main steps, namely developing digital infrastructure, increasing human resource capacity, and strengthening coordination between institutions. The development of digital infrastructure includes the provision of adequate data storage systems, national data integration platforms, and analytics technologies that support data processing at scale. This infrastructure is the main foundation for supporting an integrated big data ecosystem. Furthermore, increasing the capacity of human resources is a key factor in the successful use of big data. Big data management requires special competencies, such as data science, data analytics, and information systems management. Therefore, a continuous capacity-building program is needed, either through training, education, or collaboration with other institutions that have expertise in these fields. These findings are consistent with research indicating that the successful implementation of big data is highly dependent on organizational readiness, including human resource competencies and strong policy support (Edi Santoso et al., 2022).

In addition to the technical aspect, strengthening coordination between institutions is also an equally important strategy. Good coordination allows for effective data exchange

and policy synchronization between sectors (Fadillah, 2025). In this context, a clear collaboration mechanism is needed among the government, universities, and the industrial sector, so that the generated data can be optimally utilized in higher education planning. Development of a data-driven culture (*Data-driven culture*) is a fundamental factor in ensuring the sustainability of the use of big data. This culture emphasizes the importance of using data as the primary basis for decision-making, replacing approaches that are based solely on intuition or experience. Higher education institutions need to build awareness and data literacy among leaders, lecturers, and education staff, so that the use of data becomes an integral part of the organizational management system.

Strengthening strategies also need to include policy and regulatory measures that support national data integration. The policy must encourage data disclosure (data sharing) while ensuring the protection of privacy and information security. With clear regulations, the use of big data can be carried out more targetedly and under greater control. Thus, strengthening data governance and capacity requires a holistic and integrated approach that covers technology, policy, institutions, and human resources. These four aspects are interrelated and must be developed simultaneously to create an effective and sustainable big data ecosystem. If this strategy can be implemented optimally, then big data has great potential to improve the quality of higher education planning and support the achievement of national development goals more effectively and evidence-based.

Aspects	Description
State of the Art	Big data has become a strategic tool in data-driven higher education planning, but its implementation in Indonesia remains predominantly descriptive and has not been optimal for predictive and prescriptive analysis.
Novelty	This research highlights the use of big data in Indonesian higher education planning from the perspective of Bappenas policies and offers an analytics-based, cross-sectoral model.
Research Gap	There are still a few studies that examine big data for higher education planning at the national policy level, especially those that integrate technology, governance, human resources, and data culture in the Indonesian context.

CONCLUSION

The use of big data in higher education planning is an important need in the era of digital transformation that demands data-driven decision-making. This study shows that big data in higher education has complex characteristics, including large volume, diverse sources, and a dynamic nature. The data source comes from the internal system of universities as well as external data such as the needs of the job market. However, there is still data fragmentation between institutions that hinders information integration. In practice, BAPPENAS has used big data, especially to map human resource needs and inform policy formulation. However, its use remains descriptive rather than optimal for predictive analysis. The main challenges include data integration, limited human resources, and weak governance. Therefore, an integrated model based on analytics technology and cross-sector collaboration is needed. Strengthening strategies include infrastructure development, human resource capacity building, data integration, and a data-based culture to make education planning more effective and sustainable.

BIBLIOGRAPHY

- Adelakun, N. (2022). Impact of digital technology and the need for periodical review of educational curriculum in Nigeria tertiary institutions. *iKSP Journal of Computer Science and ...*, (Query date: 2026-04-03 11:12:27). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4062135
- Alenezi, M. (2023). Digital Learning and Digital Institution in Higher Education. *Education Sciences*, 13(1), 88. <https://doi.org/10.3390/educsci13010088>
- Arya Satya Pratama, Suci Maela Sari, Maila Faiza Hj, Moh Badwi, & Mochammad Isa Anshori. (2023). The Influence of Artificial Intelligence, Big Data, and Automation on Human Resource Performance in the Digital Era. *Journal of Management Science Publications*, 2(4), 108–123. <https://doi.org/10.55606/jupiman.v2i4.2739>
- Asbari, M., & Nurhayati, W. (n.d.). *Outcomes-Based Education in Indonesian Higher Education: Empowering Students' Learning Competencies*.
- Bibri, S. E. (2023). Data-Driven Smart Eco-Cities of the Future: An Empirically Informed Integrated Model for Strategic Sustainable Urban Development. *World Futures*, 79(7–8), 703–746. <https://doi.org/10.1080/02604027.2021.1969877>
- Bo Tang. (2025). Big Data Technology and Machine Learning for Strategic Planning in College Administration. *IEEE International Conference*. <https://doi.org/10.1109/ICCBE65177.2025.11255871>

- Cheng, T. (2025). The impact of professional education programs on career development. *Higher Education Evaluation and Development*, 19(1), 87–100. <https://doi.org/10.1108/HEED-10-2024-0046>
- Creswell, J. W. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- Decheng Zhang & Jinxin Chen. (2024). Research on the Deep Integration of CDIO and Maker Education to Promote the Cultivation of Innovative Talents in Emerging Engineering Disciplines. *Journal of Learning and Development Studies*, 4(3), 66–75. <https://doi.org/10.32996/jlds.2024.4.3.9>
- Do, L. H. T., & Duong, H. T. T. (2024). A Research Review on Curriculum for English Language Teacher Education: A Bibliometric Analysis from Scopus Database. *Vietnam Journal of Education*, 218–227. <https://doi.org/10.52296/vje.2024.454>
- Edi Santoso, R., Prawiyogi, A. G., Rahardja, U., Uganda, F. P., & Khofifah, N. (2022). The Use and Benefits of Big Data in Digital Content. *ADI Interdisciplinary Digital Business Journal*, 3(2), 88–91. <https://doi.org/10.34306/abdi.v3i2.836>
- Efgivia, M. G. (2020). *The Utilization of Big Data in Educational Technology Research*. 5(2).
- Fadillah, Z. I. (2025). *Integration of Big Data Analytics in the Education Curriculum*. 3(3).
- Glushchenko, V. V. (2023). Theoretical Foundations of The Creation of a Curriculum in Higher Project IT in Education. *Indonesian Journal of Teaching in Science*, 3(2), 161–170. <https://doi.org/10.17509/ijotis.v3i2.61451>
- Himeur, Y., Elnour, M., Fadli, F., Meskin, N., Petri, I., Rezgui, Y., Bensaali, F., & Amira, A. (2023). AI-big data analytics for building automation and management systems: A survey, actual challenges and future perspectives. *Artificial Intelligence Review*, 56(6), 4929–5021. <https://doi.org/10.1007/s10462-022-10286-2>
- Holmlund, M., Van Vaerenbergh, Y., Ciuchita, R., Ravald, A., Sarantopoulos, P., Ordenes, F. V., & Zaki, M. (2020). Customer experience management in the age of big data analytics: A strategic framework. *Journal of Business Research*, 116, 356–365. <https://doi.org/10.1016/j.jbusres.2020.01.022>
- Lutfiani, N., & Meria, L. (2022). *Utilization of Big Data in Educational Technology Research*. 1(1).
- Miedema, D., Taipalus, T., Ajanovski, V., & ... (2025). Data systems education: Curriculum recommendations, course syllabi, and industry needs. ... *Science Education*, (Query date: 2026-04-03 11:12:27). <https://doi.org/10.1145/3689187.3709609>
- Setyowati, L., & Nasir Ahmad, D. (2021). The Utilization of Big Data in the Era of Technology 5.0. *ABDINE: Journal of Community Service*, 1(2), 117–122. <https://doi.org/10.52072/abdine.v1i2.205>
- Suggestion. (2020). *Quantitative, Qualitative and R&D Research Methods*. D San. Alfabeta.
- Susanti, S., Reniati, R., & Warlina, L. (2024). *Analysis of service quality on consumer satisfaction data from the central statistics agency of Belitung Regency*. 2(1).
- Turnip, H. (n.d.). *The Use of Big Data for Optimizing Decision Making in Schools*.
- Widiasanti, I., Zahra, S., Sholikhah, A. N., Waluny, A., & Nazhelya Najva, M. A. (2023). *The Utilization of Big Data in Distance Learning (PJJ) during the Pandemic in 3T*

- Areas (Frontier, Remote and Disadvantaged). *Cetta: Journal of Educational Sciences*, 6(2), 398–410. <https://doi.org/10.37329/cetta.v6i2.2391>
- Zakaria, A. A., Amr, T., & Ragheb, A. A. (2025). IoT in Smart Urban Planning: A Comprehensive Review of Applications, Developments, and Engineering Perspectives. *IEEE Access*, 13, 135316–135335. <https://doi.org/10.1109/ACCESS.2025.3594019>
- Zhang, Q., Saharuddin, N., & Aziz, N. (2022). The analysis of teachers' perceptions of moral education curriculum. *Frontiers in Psychology*, (Query date: 2026-04-03 11:12:27). <https://doi.org/10.3389/fpsyg.2022.967927>