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Harnessing Data Analytics for Smart Academic Management

Memanfaatkan Analitik Data untuk Pengurusan Akademik Pintar

Hamimah Ujir[1]*, Majina Sulaiman[2], Irwandi Hipiny[1] & Shanti Faridah Salleh[3]
[1]Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak, Sarawak, Malaysia
[2]Tun Abang Haji Openg Digital Centre, University Malaysia Sarawak, Sarawak, Malaysia
[3]Faculty of Engineering, Universiti Malaysia Sarawak, Sarawak, Malaysia
*Corresponding author: uhamimah@unimas.my

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Abstract

In today's rapidly evolving educational landscape, higher education institutions (HEIs) must adopt data-driven strategies to improve efficiency, decision-making, and student success. Collecting diverse data types is essential for developing a holistic understanding of students and institutional operations. Student-related data, such as academic performance, attendance records, demographic details, and socio-economic factors, provide valuable insights into learning progress and support needs. Meanwhile, institutional data, which includes accreditation reports, research outputs, and stakeholder satisfaction scores, helps institutions refine curricula, enhance administrative processes, and strengthen industry partnerships. By leveraging data analytics, HEIs can develop intelligent academic management systems that optimize learning pathways, streamline administrative tasks, and foster deeper collaboration with internal and external stakeholders. This paper presents a hub-and-spoke framework for smart academic management, incorporating data analytics, along with relevant data metrics for HEIs and their corresponding hub-spoke pairings. Through automation, adaptive learning, and continuous feedback, HEIs can create a seamless, student-centered ecosystem that enhances academic achievement and operational efficiency. Furthermore, key innovations, challenges, and strategic approaches involved in implementing data-driven academic transformation are critically explored.

Keywords: Data-Driven Education; Academic Management Systems; Data Analytics; Higher Education Transformation

Abstrak

Dalam landskap pendidikan yang berkembang pesat pada hari ini, institusi pendidikan tinggi (IPT) perlu mengadaptasi strategi berasaskan data untuk meningkatkan kecekapan, pembuatan keputusan, dan kejayaan pelajar. Pengumpulan pelbagai data adalah penting untuk membangunkan pemahaman holistik mengenai pelajar dan operasi institusi. Data yang berkaitan dengan pelajar, seperti prestasi akademik, rekod kehadiran, butiran demografik, dan faktor sosio-ekonomi, memberikan perspektif berharga mengenai kemajuan pembelajaran dan keperluan sokongan pelajar. Sementara itu, data institusi, yang merangkumi laporan akreditasi, hasil penyelidikan, dan skor kepuasan pemegang taruh, membantu institusi memperbaiki kurikulum, meningkatkan proses pentadbiran, dan mengukuhkan kerjasama dengan industri. Dengan memanfaatkan analitik data, IPT dapat membangunkan sistem pengurusan akademik pintar yang mengoptimumkan laluan pembelajaran, memperkemaskan tugas pentadbiran, dan menggalakkan kerjasama yang lebih mendalam dengan pemegang kepentingan dalaman dan luaran. Kertas kerja ini membentangkan rangka kerja hub-and-spoke untuk pengurusan akademik pintar, yang menggabungkan analitik data, bersama dengan metrik data yang relevan untuk IPT dan pasangan hub-spoke mereka. Melalui automasi, pembelajaran adaptif, dan maklum balas berterusan, IPT dapat mewujudkan ekosistem berfokuskan pelajar yang lancar, meningkatkan pencapaian

akademik dan kecekapan operasi. Dalam masa yang sama, inovasi utama, cabaran, dan pendekatan strategik dalam melaksanakan transformasi akademik berasaskan data dapat diteroka secara kritis.

Kata kunci *Pendidikan Berasaskan Data; Sistem Pengurusan Akademik; Analitik Data; Transformasi Pendidikan Tinggi*

INTRODUCTION

As the educational landscape continues to evolve, Higher Education Institutions (HEIs) are under growing pressure to respond to the changing needs of students, industry stakeholders, and society. To remain relevant and competitive, HEIs must embrace adaptive strategies and systemic innovation, where technology integration and data-driven decision-making are no longer optional but essential.

However, current academic management practices are often hampered by challenges such as fragmented data, limited interoperability between systems, and resistance to digital transformation (Tasmin and Tan, 2020; Saydullaev, 2023). Decision-making tends to be reactive due to delayed access to reliable information, while misaligned policies, low data literacy, and inadequate infrastructure further constrain HEIs strategic planning. These limitations reduce institutional agility, transparency, and the ability to sustain academic quality improvements.

In this context, the increasing complexity of higher education underscores the urgent need for data-informed approaches. Serving as the foundation of a smart academic ecosystem, data drives strategic functions across all levels. It informs curriculum design, program offerings, and learning outcomes, while also enabling evidence-based decisions in human resource management, including staffing, professional development, and workload allocation (Cheng, 2024). Data also enhances student support by monitoring academic progress, engagement, and well-being, facilitating timely interventions (Hasan et al., 2020; Saydullaev, 2023). Furthermore, it plays a critical role in institutional self-review, benchmarking, quality assurance and support continuous improvement in all aspects.

Smart academic management refers to the strategic use of data, digital technologies, and intelligent systems to enhance the planning, operation, and continuous improvement of academic processes within HEIs. It involves integrating real-time analytics, predictive tools, and evidence-based practices to support decision-making in areas such as curriculum design, student performance, resource allocation, faculty workload, and institutional efficiency.

This paper proposes a data-informed HEI ecosystem through a hub-and-spoke framework, powered by advanced analytics. The central hub oversees institution-wide data standards and infrastructure, while faculties, departments, and administrative units function as interconnected spokes that generate, share, and utilize data insights. Section two reviews recent works in academic management system that incorporates data analytics. Section three discusses higher education data and section four presents proposed data metrics. The final section discusses higher education dashboard and examples of analytics from Universiti Malaysia Sarawak (UNIMAS)

BACKGROUND STUDY

A comprehensive understanding of both student experiences and institutional operations requires the collection of diverse data types. Student-related data include academic records, attendance, learning styles, socio-economic backgrounds, mental health indicators, and demographic profiles. These data help institutions identify learning gaps, personalize support, and improve retention. On the other hand, operational data consist of accreditation documentation, curriculum feedback, faculty performance (i.e. research, publications), infrastructure utilization, financial reports, industry trend analyses, and employer satisfaction surveys. Together, these data types form the backbone of informed decision-making that can significantly elevate educational quality and institutional performance.

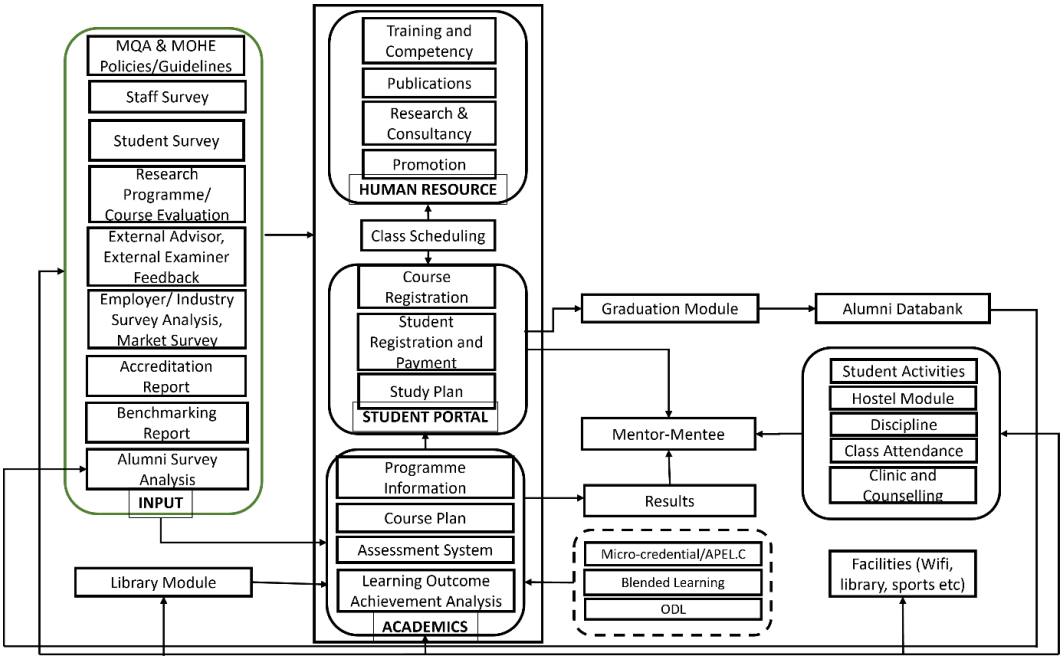

Figure 1 Integrated framework to capture data from various departments (Ujir et al., 2024)

To understand data flows within higher education institutions (HEIs), Ujir et al. (2024) proposed an integrated system that coordinates academic and administrative components through interconnected modules. Figure 1 illustrates the integrated data ecosystem within a HEI, emphasizing inputs from both internal and external stakeholders. Starting from regulatory frameworks and surveys, the data feeds into various institutional functions such as human resources, student portals, academic planning, and support services. The arrows show the flow of information between modules, highlighting the system's efficiency, comprehensive structure, and support for continuous quality improvement.

HEIs generates vast amounts of data, but existing studies typically focus on specific data types to explore how they can support decision-making processes within HEIs. Gaftandzhieva et al. (2022) developed a data analytics tool to enhance decision-making in Bulgarian HEIs. The tool aggregates student data across various levels (programme, faculty, and field) to monitor retention and success rates, thereby aiding in data-driven decisions for improving educational services and institutional planning. Gaftandzhieva et al. (2022) also presents model for monitoring student success with two levels of indicators, and they are are developed correspondingly for the needs of three different levels of the university decision making bodies – programme managers (PM), deans (D) and rector (R). While Yang et al (2024) analyzed key factors and constraints in the decision-making process for school teaching quality and integrating optimization algorithm. Among experimental content includes analyzing the satisfaction evaluation on different teaching modes such as flipped classroom, project-based learning, and blended learning. Their results indicate significant differences in satisfaction and resources matching among different teaching modes, revealing the strengths and weaknesses of each mode in practical applications

One effective way to provide stakeholders with a comprehensive overview of a HEI is by an analytics dashboard. Mustamir et al. (2024) introduce a dashboard system designed to monitor Key Performance Indicators (KPIs) in digitalized HEIs. The study emphasizes understanding user requirements, followed by prototyping and testing, culminating in a robust visualization of performance data across faculty, field, and department levels. By presenting information at multiple tiers, the system enables stakeholders to easily access essential data and gain comprehensive insights.

The ADHE dashboard, developed by Patino-Rodriguez (2023), is an academic analytical tool designed to visualize relationships between student dropout and demographic, academic, and social factors in higher education, aiding administrators in decision-making processes regarding student retention and dropout dynamics. The findings emphasize the complexity of the dropout phenomenon, which is influenced by a combination of academic, socioeconomic, and personal factors. On the other

hand, Thailand higher education DashBoard (TheDB) is a proposed framework designed to support decision-making in higher education by integrating various functions. It has been implemented in nursing colleges to enhance education quality assurance and meet organizational goals. TheDB focuses on specific metrics such as graduate performance, research output, academic services, art and culture preservation and quality assurance.

The higher education dashboard at Singapore University of Social Sciences (SUSS) provides stakeholders with real-time access to application data, enabling informed decision-making (Tang et al. 2022). It includes features like predictive analytics for academic performance, enhancing support for students and streamlining the application and selection process. Their work also emphasizes the importance of data quality, noting that the effectiveness of the dashboard is highly dependent on the accuracy and completeness of the underlying data.

In conclusion, a comprehensive view of HEI requires integrating diverse student and operational data to support informed decision-making and improve institutional performance. Recent studies have developed analytics dashboards and tools that visualize key metrics, monitor performance, and reveal insights into areas such as student retention, teaching quality, and organizational effectiveness.

HIGHER EDUCATION DATA

Evidence-based decision-making is a critical practice that enables institutions to make informed, transparent, and accountable choices by integrating diverse data sources collected from a wide range of internal and external stakeholders. By incorporating a broad range of perspectives, HEIs ensure that decisions are not only data-driven but also contextually relevant and aligned with stakeholder expectations. Together, these internal and external data sources form a comprehensive evidence base that supports strategic planning, continuous quality improvement, and accountability in higher education governance.

HEIs operate in increasingly complex environments that demand data-informed decision-making to ensure academic quality, student success, and institutional accountability. With advancements in digital infrastructure and institutional management systems, the volume and diversity of data available to HEIs have expanded significantly. Understanding the various types of data within these institutions is essential for effective strategic planning, performance evaluation, and continuous quality improvement. Figure 2 illustrates the minimum scope of data typically managed by HEIs. These categories encompass student data, academic data, faculty and staff data, operational and administrative data, quality assurance data, graduate and alumni data, library and resource access data, as well as ICT and digital learning data.

Student data lies at the heart of higher education operations. It includes information about student demographics such as age, gender, nationality, and socioeconomic background. Academic performance records, such as grades, GPA, and progression status, are also a central part of this data category. Institutions gather behavioral data related to class attendance, co-curricular participation, and disciplinary history, alongside information from health and counselling services. Furthermore, feedback collected from students through surveys, course evaluations, and mentor-mentee engagements contributes to a holistic understanding of the student experience. This category of data enables universities to monitor student progress, identify at-risk learners, and implement early interventions to enhance retention and academic achievement.

Academic data encompasses all information related to curriculum, instructional delivery, and learning outcomes. Institutions maintain comprehensive records of programme structures, including credit hour requirements, course prerequisites, and expected graduate attributes. Course descriptions, teaching methods, and delivery modes—whether face-to-face, blended, or online—are documented to ensure consistency and quality. Assessment-related data, such as examination results and project scores, supports the evaluation of both student performance and pedagogical effectiveness. Furthermore, academic data includes analyses of how well students achieve intended learning outcomes, which are vital for curriculum review and alignment with national qualification frameworks. These insights inform continuous improvement initiatives in teaching and learning practices.

Faculty and staff data form another crucial domain within HEIs. This includes professional and academic profiles of faculty members, detailing their qualifications, areas of expertise, and employment

history. Institutions also track teaching assignments, workload distribution, research productivity, and involvement in academic governance. Research outputs, such as journal publications and citations, conference presentations, and grant funding, are essential indicators of scholarly performance. In addition, information related to staff development activities, such as participation in training programs, industrial attachment and performance appraisals, supports career progression and institutional capacity building. Managing faculty data enables institutions to ensure equitable workload distribution, plan for succession, and uphold academic standards.

Operational and administrative data underpins the day-to-day functioning of an institution. This data includes records of student admissions, enrolment trends, and application processing, which are used to analyze recruitment strategies and project future intake. Financial data covers tuition payments, scholarships, and budgeting allocations, helping institutions to manage resources efficiently and equitably. Facilities management data captures the utilization of classrooms, laboratories, sports complexes, and other infrastructure, contributing to informed planning and maintenance. Additionally, data from student support services, such as hostel accommodation, medical clinics, and career guidance, enhances institutional capacity to deliver a holistic educational experience.

Quality assurance data plays a fundamental role in institutional governance and accreditation. Institutional documents such as programme evaluations, accreditation reports, and benchmarking studies are part of the quality assurance data which guide institutional self-reflection and planning. These formal reports provide structured and systematic evaluations of academic offerings, compliance with regulatory requirements, comparisons with peer institutions, internal reports such as programme reviews and self-assessment documents. Institutions also collect data from external sources, such as accreditation agency evaluations, external examiner reports, and benchmarking exercises against peer institutions and stakeholder feedback, including input from students, employers, and industry advisors. Quality assurance data ensures that the institution meets national and international standards and fosters a culture of continuous improvement.

Graduate and alumni data reflects the long-term outcomes of an institution's educational mission. Graduate employment statistics, including job placement rates and the industries in which graduates are employed, serve as indicators of academic program relevance. Institutions also monitor alumni who pursue further studies, as this information contributes to understanding the success and aspirations of graduates. Alumni engagement data, including participation in institutional events, mentoring initiatives, and philanthropic contributions, supports relationship-building and institutional advancement efforts. Tracking the achievements and feedback of alumni helps institutions evaluate their impact beyond graduation and adapt to evolving labour market needs.

Library and resource access data offer insights into how students and staff engage with academic resources. Data on the borrowing of books, journals, and other materials supports decisions related to acquisitions and resource allocation. The increasing use of digital resources necessitates the monitoring of access to e-books, online journals, and academic databases. Additionally, institutions often track the utilization of study spaces and laboratory facilities to optimize scheduling and infrastructure development. This type of data is essential for maintaining an effective and responsive academic support system.

Finally, ICT and digital learning data have become increasingly vital in the modern higher education landscape. Learning Management Systems (LMS) collect data on student activity such as login frequency, content access, forum participation, and assignment submissions. Online assessments generate detailed records of student responses, completion times, and scoring patterns. Moreover, data on the use of instructional videos, interactive learning modules, and adaptive learning technologies contributes to understanding learner behavior and engagement. Institutions also track broader technology infrastructure metrics, such as Wi-Fi usage, system uptime, and access to institutional platforms. These data sources support the development of learning analytics and adaptive learning environments, enabling data-informed teaching strategies and institutional digital transformation.

In conclusion, the diverse types of data available in HEIs are interrelated and collectively support the mission of delivering quality education, ensuring operational excellence, and maintaining accountability to stakeholders. When managed effectively, this data enables institutions to respond proactively to emerging challenges, innovate pedagogically, and enhance student outcomes. As the role of data becomes increasingly central in institutional planning and governance, the capacity to integrate,

analyze, and apply these data types will be a defining characteristic of successful HEIs in the 21st century.

DATA METRICS

Table 1 consists of various data metrics that can be used to monitor key aspects of HEIs within the hub-and-spoke model. In this framework, the central unit (hub) is responsible for managing and coordinating institution-wide data governance and analytics, while faculties, departments, students, administrative units and external stakeholders (spokes) serve as both data providers and users, leveraging insights to support informed decision-making

Table 1 Example of Data Metric in HEIs

Data Metrics Categories	Data Metrics Detail	Hubs			Spokes		
		I	F	P	L	S	EP
Student Performance (Individual and group)	Grades, attendance, participation, test scores, assignment completion, learning outcomes achievement, health flag			√	√	√	
Academician Performance	Number of lecturers, student feedback, lecturer's workload, student performance, training hours, number of publications, number of grants, number of consultations, number of commercialisations, number of IPs		√	√	√		
Course Analysis	Course enrolment, course completion rates, student feedback, areas of difficulty, course outcomes achievement, course demand forecasting, workload analysis			√	√		
Program Effectiveness	Student enrollment numbers, Student outcomes, graduation rate, student-staff ratio, programme outcomes achievement, program satisfaction, graduate employability	√	√	√			√
Retention	Attrition rates, reasons for leaving, at-risk students		√	√			
Quality Assurance	Accreditation status, average time (in years) between programme reviews, stakeholders' satisfaction	√	√	√			√
Human Capital	Percentage of lecturers with PhD, percentage with professional certifications, supervision load per postgraduate supervisor, number of full-time staff per programme offered, staff turnover rate, percentage of research-active staff, training hours per staff	√	√				
Resources Utilization	Classroom seat capacity utilization, lab/computer access ratio, bandwidth per student, digital service satisfaction score, percentage of green building compliance, LMS usage rate	√	√				
Research Funding	Number of internal and external grants, number of partnerships with industries	√	√				
Research Output	Number of WOS/SCOPUS publications, number of citations, number of IPs, number of spin-off companies, number of commercialized products,	√	√		√		
Internationalization	Percentage of total students who are international, number of students involved in exchange	√					

continued

	programmes (inbound/outbound), number of MoUs/MoAs with foreign institutions, number of joint research projects						
Governance and Institutional Development	Number of governance audits passed per year, percentage of strategic goals achieved annually, number of strategy reviews conducted per year, percentage of KPIs with positive performance trend, number of internal audits conducted	√					
Institutional Performance	QS/Times Higher Education/SETARA ranking position, financial sustainability, total revenue (including tuition, grants, donations), percentage income from non-government sources, capital expenditure per year on facilities and technologies	√					

I – Institutional; F – Faculty; P – Programme; L- Lecturer; S- - Students; EP – External Parties

A robust data infrastructure needs to be established within the hub, laying the foundation for data-driven transformation. The emphasis is on creating centralized data sources, ensuring data quality, and initiating data-informed decision-making. The spokes retrieve data from the hub using views or extracts and can also incorporate their own data or apply additional transformations. Different spokes may require tailored data analysis based on their specific needs. For instance, when analyzing Student Performance, lecturers within the same academic program might focus on various data metrics, while a mentor (who is also a lecturer), may have distinct areas of concern.

The spokes can utilize the data for various purposes, including reporting, analytics, or machine learning. Additionally, they can provide feedback or updates to the hub, enabling a two-way flow of data. The hub is responsible for ensuring data is standardized, validated, and secured across the organization. Spokes can be added or removed as needed, allowing the system to adapt to evolving business needs without impacting the hub. This hub-and-spoke data architecture enhances data quality and governance, offers greater scalability and flexibility, improves performance and efficiency, and reduces both cost and complexity.

ANALYTICS FOR ACADEMIC EXCELLENCE

The implementation of data-driven academic transformation in HEIs involves a dynamic interplay of key innovations, challenges, and strategic approaches, each playing a pivotal role in reshaping how institutions function and deliver education. One of the most significant innovations lies in the integration of real-time data analytics through intelligent dashboards. By making data visible and accessible, dashboard encourage data-informed culture and foster collaboration across units.

By translating raw data into clear information, dashboards enhance strategic decision-making in higher education institutions. As data flows in from various sources, a centralized dashboard provides a visual and interactive interface to synthesize this information. Visualization techniques help stakeholders quickly interpret complex data, enhancing strategic planning and operational efficiency (Leitner & Ebner, 2017, Sarikaya, 2019). Effective dashboards integrate diverse data sources, allowing for comprehensive analysis of student enrollment, course performance, and institutional metrics (Sharma and Josni, 2022). Rather than navigating through multiple reports, stakeholders can use dashboards to access real-time, integrated data briefly. A dashboard is not only used to monitor institutional performance, track progress toward strategic goals, but respond quickly to emerging issues. It can also be tailored and enhanced with AI and machine learning to enable predictive analytics capabilities (Chudra et al., 2023).

Dashboards serve distinct functions depending on the stage of analytics they support. Descriptive analytics provide static or real-time summaries of institutional activity, offering a clear picture of key metrics. Diagnostic analytics dive deeper to uncover patterns, causes, or correlations, for instance, through heatmaps that reveal course performance by assessment type. Predictive analytics pull historical data and statistical models to generate future-focused visions, aiding in strategic planning and early interventions, such as forecasting enrollment trends by academic programs. Finally, prescriptive analytics recommend specific actions based on data models and business rules. Examples include

optimizing course offerings based on projected student demand and available resources. Prescriptive analytics often use AI, scenario simulations, or decision trees. Data metric in Table 1 belongs to one or more types of analytics depending on the needs of the stakeholders.

Figures 2-4 illustrate UNIMAS Data Analytics in action, demonstrating its application in both descriptive and diagnostic analysis. This system extends beyond academic performance monitoring, supporting various aspects of higher education management. Figure 3 displays the academic performance dashboard, which tracks examination results and student attrition while allowing institutional and faculty-level management to correlate performance with student backgrounds. Figure 4 presents an example of teaching load monitoring, while Figure 5 showcases hostel room availability data.

Figure 2 UNIMAS Data Analytics: academic performance dashboard

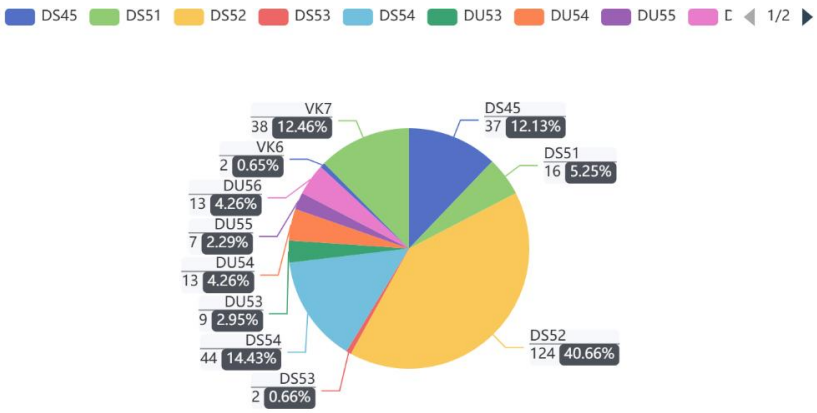

Figure 3 UNIMAS data analytics: Percentage of lecturers with below minimum credit hours

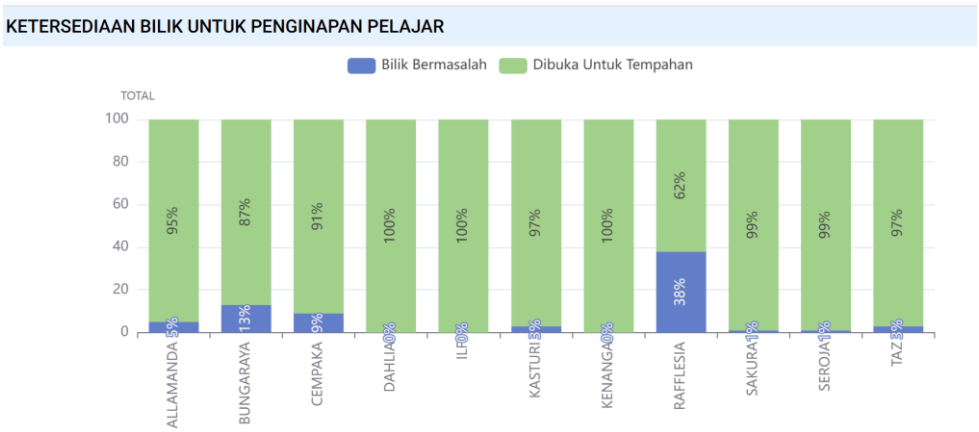

Figure 4 UNIMAS data analytics: Availability of rooms for student accommodation

Dashboards should cater to various stakeholders, including administrators, faculty, and students, by providing relevant insights tailored to their needs (Leitner & Ebner, 2017). For instance, academicians can monitor programme performance trends, identify gaps in learning outcomes, and adjust course offerings accordingly. Human resource departments can track staff development needs and workload balance, while student affairs personnel can monitor attendance, academic risks, and engagement levels to offer targeted support. Dashboards also assist senior management in conducting institutional self-reviews and benchmarking exercises by aggregating KPIs across departments. The dashboard design, guided by Table 1, adapts to different user groups by displaying the most appropriate data visualizations for each.

However, the transition to a data-driven model is not without challenges. Like other organizations, HEIs face data silos, where information is fragmented across departments, making integration and consistency difficult. There are also concerns regarding data quality, data privacy, ethical use, and the digital readiness of staff and faculty. Furthermore, the lack of data literacy among users can hinder the effective interpretation and use of dashboard insights.

To overcome these challenges, strategic approaches are required. These include the development of robust data governance policies, investment in professional development to build data competencies, and fostering a culture of evidence-based decision-making across all institutional levels. Equally important is the customization of dashboard designs to suit the needs of different stakeholders, from academic leaders and faculty to administrative staff and external partners.

Ultimately, dashboards function as both the technological foundation and the visual interface driving data-informed transformation in academia. When properly designed, they can be customized to deliver descriptive, diagnostic, predictive, and prescriptive insights. Effectively implemented, dashboards bridge the gap between data collection and strategic decision-making, empowering institutions to become more responsive, accountable, and aligned with the changing demands of higher education.

CONCLUSIONS

The application of data analytics in academic management offers HEIs a strategic advantage in making informed, timely, and impactful decisions. This paper emphasizes the importance of adopting a hub-and-spoken model as a framework for effective data governance and integration. With this framework, HEIs can gain a holistic view of institutional operations. The model promotes data transparency, enhances accountability, and supports evidence-based planning across academic and administrative domains. This framework enables agile responses to institutional challenges and external evaluation demands to realize the full potential of smart academic management, HEIs must invest in interoperable systems, staff training, and a culture that values data-informed decision-making. In conclusion, data analytics, when structured through a robust internal framework, empowers HEIs to improve educational quality, operational efficiency, and long-term sustainability.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest

AUTHOR CONTRIBUTIONS

(Hamimah Ujir): Conceptualization, Writing, Reviewing and Editing. **(Majina Sulaiman)**: Data curation, Visualization, Investigation. **(Irwandi Hipiny)** Reviewing, Editing. **(Shanti Faridah Salleh)** Supervision.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the author(s) used ChatGPT to enhance the clarity of the writing. After using the ChatGPT, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

RUJUKAN

Tasmin, R., & Huey, T. (2020). *Determinants of Big Data Adoption for Higher Education Institutions in Malaysia*. *1*(1), 254–263. https://publisher.uthm.edu.my/periodicals/index.php/rmtb/article/download/520/225

Saydullaev, S. (2023). Exploring Big Data Applications for Knowledge Management in Higher Education Administration. *Yashil Iqtisodiyot va Taraqqiyot*, *1*(11–12). https://doi.org/10.55439/ged/vol1_iss11-12/a374

Cheng, E. C. K. (2024). Strategic Use of Data in Higher Education Institutions for Quality Enhancement. *Advances in Higher Education and Professional Development Book Series*, 535–562. https://doi.org/10.4018/979-8-3693-6915-9.ch023

Hasan, R., Palaniappan, S., Mahmood, S., Naidu, V. R., Agarwal, A., Singh, B., Sarker, K. U., Abbas, A., & Sattar, M. U. (2020). *A Review: Emerging Trends of Big Data in Higher Educational Institutions* (pp. 289–297). Springer, Singapore. https://doi.org/10.1007/978-981-15-2329-8_29

Gaftandzhieva, S., Doneva, R., & Bliznakov, M. (2022). Data Analytics, Students' Academic Performance and Decision-Making in Higher Education. *Educ. Res. Inf. Soc*, *3372*, 59-68.

Yang, Y., Xia, N. (2024). Harnessing Educational Big Data Analytics for Decision-Making in Enhancing School Teaching Quality. International Journal of Interactive Mobile Technologies (iJIM), 18(16), pp. 142–157. https://doi.org/10.3991/ijim.v18i16.51007

Ujir, H., Marzuki, A. S., Alias, A.A., Sivabalan, T., Arabi, R and Hipiny, I. 2024. *Leveraging Digital Technologies: Innovating the Quality Assurance Framework at the Institutional Level*, In the Proceedings of Malaysian Qualifications Agency International Conference.

Mustamir, A. Nasikun and S. Wibirama, (2024). *Design and Implementation of a Dashboard System for Monitoring Key Performance Indicators in Digitalized Higher Education Institutions: A Case Study*. 16th International Conference on Information Technology and Electrical Engineering (ICITEE), Bali, Indonesia, 2024, pp. 392-397, doi: 10.1109/ICITEE62483.2024.10808311.

Patino-Rodriguez, C. E. (2023). ADHE: A Tool to Characterize Higher Education Dropout Phenomenon. *Revista Facultad De Ingenieria-Universidad De Antioquia*. https://doi.org/10.17533/udea.redin.20230519.

Denwattana, N., & Saengsai, A. (2016). *A framework of Thailand higher education dashboard system*. International Computer Science and Engineering Conference, 1–6. https://doi.org/10.1109/ICSEC.2016.7859883.

Tang, Y. W., Toh, S. S. H., & Leow, A. S. (2022). Dashboards for Decision Making in Higher Education. *ASCILITE Publications*, 321–329. https://doi.org/10.14742/apubs.2019.279.

Leitner, P., and Ebner, M. (2017). *Development of a Dashboard for Learning Analytics in Higher Education* (pp. 293–301). Springer, Cham. https://doi.org/10.1007/978-3-319-58515-4_23

A. Sarikaya et al., "What Do We Talk About When We Talk About Dashboards?", *IEEE Transactions on Visualization and Computer Graphics*, vol. 25, no. 1, pp. 682-692, Jan. 2019.

Sharma, H. S. and Joshi, H. D. (2022). *Pooling Business Intelligence and Dashboard Technology for Decisions Making in Higher Education Institutions*. Research Square. https://doi.org/10.21203/rs.3.rs-1905128/v1

Chudra, G., Yohannis, A., & Setiawan, R. (2023). Development of streamlit-based higher education ranking instrument boards. *Jusikom : Jurnal Sistem Informasi Ilmu Komputer*. Vol. 7 No. 1. https://doi.org/10.34012/jurnalsisteminformasidanilmukomputer.v7i1.3813