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DATA-DRIVEN EDUCATION MANAGEMENT: MORE INFORMED DECISION-MAKING

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Abstract

Data-driven education management is an advanced breakthrough that enables educational institutions to collect, analyse and utilise information to improve the decision-making process and the quality of learning. This study was conducted using the literature review method. The results show that data can help educators identify students' strengths and weaknesses and design appropriate interventions for individual needs. In addition, data analysis also makes it easier for educational institutions to manage budget allocations, teacher assignments and curriculum planning based on facts and details. However, the implementation of data-driven education management is not free from obstacles. One of the main obstacles is the lack of adequate technology infrastructure, especially in remote areas or in schools with limited budgets. Many educational institutions do not have the hardware and software needed to collect and analyse data efficiently. In addition, the lack of skills and knowledge of educators and administrative staff in the use of data analysis tools is also a significant obstacle. This often leads to resistance to change due to the added burden of new technology that has not been properly recognised. Another important challenge is the issue of data security and privacy. The collection and storage of sensitive student data requires strict security systems to prevent information leakage and data misuse. Educational institutions must ensure that they adhere to strict data security standards and rules, and utilise advanced encryption technologies to protect students' personal data. In addition, the integration of data from various sources and changes in organisational culture require the adaptation of new work processes and the collaboration of all parties involved. Through effective co-operation between the government, educational institutions and the private sector, these challenges can be overcome so that the implementation of data-driven education management can be more successful and provide optimal benefits in improving the quality of education.

Keywords: Education management, data-driven, more informed decision-making.

Introduction

Education is one of the main pillars in building an advanced and highly competitive society. Good quality education is expected to produce competent, creative and innovative generations. Effective education management is the key to improving the quality of education (Sitopu et al., 2024); (Guna et al., 2024). As a complex system, education requires good management in various aspects ranging from planning, implementation to evaluation. Adequate management ensures that resources, both human and material, are optimally utilised to achieve education goals

(Hairiyanto et al., 2024). For example, proper budget allocation can support the provision of adequate learning facilities; appropriate curriculum development can ensure relevant and adaptive learning; and training and professional development for educators can improve teaching quality. With good management, the education process can be more structured and systematic, helping to create a conducive learning environment for students (Hong, 2023).

Good education management also plays a role in creating transparency and accountability in educational institutions. With data-driven management and continuous evaluation, stakeholders, including parents, students and the government, can see the extent to which educational institutions are working to improve their quality (Deng & Zhao, 2022). Clear and open performance reporting allows for constructive feedback and continuous improvement. This not only increases public trust in educational institutions but also promotes continuous quality improvement (Zhang, 2023). In the era of globalisation and increasing competition, effective education management is a critical factor that determines the success and competitiveness of a nation in creating competent and highly competitive human resources. Education management faces new challenges in meeting these needs. One approach that is now getting more attention is data-driven education management (CEMALOĞLU & DUYKULUOĞLU, 2022).

In the digital era, data has become an important asset that can be utilised for various purposes, including in education. Data can help in understanding trends, evaluating performance, and making more rational and evidence-based decisions. For example, data on student learning achievements can be used to assess the effectiveness of teaching methods and curriculum, so that improvements can be made more targeted (Guan, 2023). In addition, data can also be used to manage resources, such as finances and infrastructure, more efficiently and transparently. Furthermore, data can be used to predict future trends, such as the number of learners who will enrol or the need for teaching staff, so that planning can be done more accurately. With accurate and relevant information, decisions are no longer based on instinct or assumptions, but on empirical evidence that can be accounted for (Zhou, 2021).

In addition to providing accurate information, data utilisation also allows for continuous evaluation and improvement. Routinely collected data can be used to monitor performance and assess the impact of policies or programmes that have been implemented. For example, data on learner absenteeism rates can help identify the causes of absenteeism and design strategies to improve learner attendance at school (Jing et al., 2021). In addition, the data collected also enables benchmarking, i.e. comparing performance between schools or educational institutions, so that best practices can be identified and implemented more widely (Qi, 2023). Thus, the utilisation of data not only helps in making more informed decisions in the present but also promotes sustainable quality improvement in the long run.

However, the implementation of data-driven education management is not barrier-free. The limited technological context and infrastructure in some areas, data privacy and security issues, and cultural and organisational resistance are some of the obstacles that need to be overcome. Therefore, an in-depth understanding of the potential benefits and challenges of implementing data-driven education management is needed.

With the growing need for quality and effective education, the present study aims to examine the existing literature on data-driven education management. This review is expected to provide a more comprehensive view of how data can support the decision-making process in education management.

Research Methods

The study conducted in this research uses the literature research method. The literature research method is one approach in conducting research by collecting, identifying, compiling, and analysing data derived from various written sources which can be books, scientific articles, research reports, and other reliable sources. This method allows researchers to explore relevant and in-depth information on the topic under study without having to conduct experiments or surveys directly. (Fadli, 2021); (Setiowati, 2016); (Syahran, 2020).

Results and Discussion

Education Management

The process of education management is a systematic action to control the human, material, and financial capital resources in the teaching and learning environment in order to achieve optimal study results and improve the effectiveness of teaching and learning (Zhou, 2021). It encompasses a variety of activities including planning, organising, directing and supervising, all of which are interrelated and contribute to the achievement of the educational institution's goals. The main role of education management is to create and maintain a conducive learning environment that can motivate, develop and evaluate educators and learners on an ongoing basis. Thus, education management is a key element in efforts to improve the quality and efficiency of the education system as a whole (Wang, 2023).

The scope of education management includes various aspects related to the administration and operation of educational institutions. This includes curriculum management, where the curriculum is developed, implemented and evaluated to ensure compliance with educational standards and learners' needs. It also includes human resource management, which involves the recruitment, training and development of educators and staff (Zhu, 2021). Financial management is also included in this scope, which includes budgeting, allocating funds, and transparent and accountable financial reporting. Facilities and infrastructure management is also

important, including the management of educational facilities, equipment and technological resources to ensure that all elements support the educational process effectively (Meng, 2021). Education management also plays a role in fostering relationships with the community, parents and other relevant parties to create collaborative support in achieving education goals (Tubagus et al., 2023).

In summary, education management is a systematic process that controls various resources in an educational environment to achieve optimal learning outcomes and improve educational effectiveness. This task includes planning, organising, directing and supervising various activities related to the operation of educational institutions. The scope of education management is very broad, including the management of curriculum, human resources, finance, and facilities and infrastructure. In addition, education management also plays an important role in establishing collaborative relationships with various stakeholders to create a conducive and sustainable learning environment. Thus, the success of education management greatly affects the overall quality and efficiency of the education system.

Data and Information in Education

Data are raw facts and figures obtained from various sources related to information collection. The nature of data is unstructured and requires further processing to be interpreted. Examples of data include the number of daily sales, a day's air temperature, or the number of participants attending an event. Initially, data has no meaning or relevance until it is further processed and analysed (Zhang, 2023).

Information is the result of interpreting, organising, and analysing data that has been processed so that it provides meaning and context. In other words, information is data that has been processed and presented in a form that can be understood and useful for decision makers (Zhou, 2021). For example, from the daily sales data of a particular store, the information generated may be the sales pattern for a month or the best-selling products. This information is very important as it provides deeper and relevant insights, which can be used for effective decision-making and business strategies (Yu, 2023).

In the context of education, there are various types of data used to support the learning process and administrative decision-making. One type of data is demographic data, which includes information on student characteristics such as age, gender, ethnic background, and socioeconomic status (Peña-Ayala, 2023). This data is important for understanding class composition and planning inclusive teaching strategies that cater to the needs of each category of students. In addition, attendance data records students' presence or absence in each learning session, which can be used to monitor student engagement and identify potential problems such as repeated absences (Lewis, 2024a).

Another type of data in education is academic data, which includes test scores, assignments and projects collected during the learning process. This data is important for assessing students' academic progress, identifying areas for improvement, and providing constructive feedback (Carter et al., 2020). Qualitative data, such as interview results, student satisfaction surveys, or classroom observations, also play an important role in understanding the learning experience from the perspective of students and faculty. This data is used to improve teaching methods, curriculum, and other support services in the educational environment. With the combination of quantitative and qualitative data, educational institutions can conduct thorough analyses for strategic planning and overall improvement of education quality (Zhang, 2023).

Data-driven Management Framework

In data-based data management, there are several models and frameworks that can be used to organise and utilise data effectively. One model that is often applied is the DIKW (Data-Information-Knowledge-Hikmah) Model (Pratiktio et al., 2023). This model explains the process of transforming raw data into meaningful information, then information into knowledge, and finally knowledge into wisdom or insight that can be used for decision making. In the first stage, the data collected is processed and analysed to produce relevant information. Next, this information is contextualised into deeper knowledge, which is finally used to make wise strategic decisions (Ji, 2021).

Another recognised framework in data-driven data management is the DAMA (Data Management Association) Framework which covers ten areas of data management: Data Governance, Data Architecture, Data Modelling and Design, Data Storage and Operations, Data Security, Data Integration and Interoperability, Documents and Content, Reference and Master Data, Data Repository and Business Skills, and Metadata (Ana, 2023). The framework provides an overarching guide to organising data in a structured and systematic way. By following the steps in the DAMA framework, organisations, including educational institutions, can ensure that data is managed efficiently, accurately and securely, and fully utilised to support operations and strategic decision-making. In the context of education, the framework helps integrate various data sources to monitor student performance, curriculum effectiveness, and faculty performance, thereby improving the overall quality of education (Peña-Ayala, 2023).

Data-driven decision making (DDDM) in education is an approach that uses data to make more informed and effective decisions in the context of learning and education management. In DDDM, accurate and relevant data are collected from various sources, such as test scores, attendance rates, teacher assessments and student feedback. This data is then analysed to identify trends, patterns and areas that require special attention (Shang, 2022). For example, test score data can be used to identify students at risk of falling behind and design more appropriate interventions. Using DDDM, schools can

make better decisions about teaching strategies, resource allocation, curriculum development, and individualised treatment of students (Campenhout et al., 2023).

Furthermore, DDDM also enables more objective measurement of the effectiveness of educational programmes and school policies. With the help of data analysis and visualisation tools, education managers can evaluate the impact of various initiatives, such as literacy improvement programmes or career guidance programmes. Data from these evaluations can be used to make adjustments and continuous improvements (Nie, 2022). In addition, data-driven management also promotes transparency and accountability, as all decisions are based on auditable and verifiable evidence. Thus, DDDM improves the quality of education by ensuring that every decision is made based on accurate, relevant and in-depth information.

Benefits of data-driven education management

Education management based on data analysis offers significant benefits, one of which is improving the quality of teaching and learning. With accurate data analysis, educators can identify learning gaps and formulate more effective learning strategies (Abbas et al., 2022). For example, student academic achievement data can be used to identify subjects or topics where many students have difficulty. With this information, teachers can adjust teaching methods, introduce additional materials, or provide specialised guidance to students who need it (Dong et al., 2022).

In addition, data analysis can help in formulating professional development programmes for teachers, based on areas that need improvement. Optimising resource allocation is another benefit of education management based on data analysis (Kai et al., 2023). Using data, schools and educational institutions can optimise the use of budgets, manpower and facilities. For example, data on attendance rates and the use of school facilities can assist management in ensuring that limited resources are used in the most efficient way (Liu, 2021).

This information can be used to allocate funds to areas that have the greatest impact on student achievement, such as extra tutoring programmes, classroom technology updates, or teacher training. In addition, the data can assist in long-term strategic planning, including infrastructure planning and curriculum development (Lewis, 2024c). Another benefit is increased transparency and accountability within educational institutions. By using data as the basis for every decision, the decision-making process becomes more transparent and accountable. All stakeholders, including students, parents, teachers and school management, can see the logical basis of each decision taken (Lewis, 2024b).

For example, a data-driven admission policy can reduce bias and increase fairness in the selection process. In addition, the existence of auditable data allows for objective evaluation of school performance and educational initiatives, enabling continuous improvement and strengthening public trust in the education system (Wang, 2023).

Thus, education management based on data analysis provides a range of benefits that cannot be ignored, from improving the quality of teaching and learning processes, optimising resource allocation, to increasing transparency and accountability.

With careful application of data analysis, schools can provide more appropriate and effective interventions, ensure every decision is based on accurate information, and empower all stakeholders in the education process. In addition, the use of data strengthens advocacy for the improvement of education policy and resource allocation, ensuring that real needs on the ground receive proper attention (Chen & Xu, 2020). Thus, implementing management based on data analysis has great potential to improve the education system as a whole, creating a more effective, efficient and inclusive learning environment.

Challenges in implementing data-driven education management

Despite the benefits offered by a data-driven education management system, there are various obstacles that need to be anticipated. One of the obstacles is related to the inadequate technological infrastructure in various educational institutions. Many schools, especially those in remote areas, lack the hardware and software to manage data effectively (Wu, 2024). Another obstacle comes from the lack of internet connectivity, which can hinder the integration of data management systems. For this reason, the large initial investment in the development of digital technology and infrastructure is an obstacle for a number of educational institutions in moving to a data-driven system (Qian, 2020).

Beyond technical constraints, the low competence and knowledge of teaching and administrative staff is also a significant obstacle. Many teachers and staff may not have received adequate training in the utilisation of data analysis tools and techniques. This can lead to resistance to change as they struggle to adjust to new technologies. A comprehensive capacity-building programme is therefore needed to empower educators to utilise data for decision-making (Liu, 2021).

Other challenges include learner data security and privacy issues. The collection and storage of sensitive information requires reliable security systems to prevent leakage and unauthorised use of data. Doubts about who can access data, how data is stored, and protection from cyber threats need to be addressed with strict privacy policies and sophisticated encryption. Failure to safeguard personal data can undermine the trust of students and parents and potentially even lead to serious legal issues (Zhang, 2024).

The fourth challenge in organising data-driven education is integrating information obtained from various sources. Education data can come from academic records, learner attendance, exam performance, and input from parents and students. Unifying and harmonising this diverse data requires complex processes and sophisticated information processing technology to create an interconnected system.

In addition, it is also necessary to maintain data reliability so that it is consistent, accurate and free from repetition (Zhu, 2021).

Furthermore, the culture of educational institutions and management transformation can also complicate things. Institutions with conventional practices may struggle to adjust their organisational culture to accept data-driven governance. This requires a change in outlook and adaptation of new processes, which usually takes time, energy and effort. All elements must understand the importance of information and be willing to co-operate in this change (Lewis, 2024c).

To overcome these challenges, cooperation between the government, educational institutions and the private sector is needed to provide the necessary infrastructure and technology support. The government can help by increasing the education technology budget and subsidising schools in need. In addition, educational institutions can collaborate with technology companies to get customised solutions at affordable costs (Bai & Jiang, 2021).

It is also important to improve the competence of educators and administrative staff through continuous training. Education and training on data use and analysis should be part of the professional development of teachers and staff. Workshops, seminars and certifications can help build their capacity to utilise data effectively (Jia, 2022).

To address concerns related to student privacy and information security, educational institutions must ensure they adhere to strict data security standards and rules. The use of encryption technology and strong identity systems can help protect students' personal data. In addition, there should be clear policies on who has access to the data and how the information will be utilised (Hong, 2023).

Regarding information integration, the use of a comprehensive data management platform can help bring together data from various sources into a unified system. Tools such as online learning systems (LMS) and educational analytics software can turn raw data into valuable knowledge (Liang, 2021). To overcome barriers of organisational culture and administrative change, school leaders and education stakeholders must clearly communicate the benefits of data-driven management to the entire body. Active participation and input from all parties involved in the education process should be valued and considered in decision-making, so that the changes can run more smoothly and receive full support (Jingyi, 2020).

With adequate attention to these challenges and appropriate strategies to overcome them, data-driven education management can be implemented successfully and provide enormous benefits in improving the quality of education.

Conclusion

Data utilisation in education management has led to a variety of significant benefits that can improve the quality of learning implementation. One of them lies in

the ability to monitor and assess student achievement more objectively. Through insights gained from data, educators can recognise the capabilities and weaknesses of each learner, so as to provide interactions according to their individual needs. In addition, data also allows educational institutions to maximise resources; for example, the allocation of funds, the assignment of teaching staff, and the design of syllabuses are done more precisely based on detailed and accurate information.

However, the implementation of data-based education management is also faced with various obstacles. The lack of adequate technology infrastructure is still a major obstacle, especially in remote areas or schools with limited budgets. Not all educational institutions have the hardware and software needed to collect and analyse data. In addition, there is a lack of expertise and knowledge of teaching staff as well as administrative staff in the use of data analysis tools. Untrained teaching staff will feel overwhelmed and will most likely experience resistance to this change.

In addition, the issue of data security and privacy is also a significant challenge. The collection and storage of sensitive learner data requires strict security systems to prevent information leakage and data misuse. Concerns about data access and protection need to be addressed through clear policies and advanced encryption technologies. Other challenges include the integration of data from various sources and the transformation of organisational culture, which requires the adaptation of new work processes and the collaboration of all relevant parties. With solid cooperation between the government, educational institutions and the private sector, these challenges can be overcome, allowing data-driven education management to be implemented more successfully and provide optimal benefits.

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