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The Use of Data Analytics in Managing Education Information: A Conceptual Review

Masyitah Abu[1*], Nurul Maziah Mohd Barkhaya[1] and Hafirda Akma Musaddad[2]

[1] Centre for Instructional Technology & Multimedia, Universiti Sains Malaysia, 11800 Penang, Malaysia
[2]Faculty of Business & Management, Universiti Teknologi Mara (UiTM), 18500 Machang, Kelantan, Malaysia

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ABSTRACT

The integration of technology into the education sector has opened new pathways for more efficient educational management, particularly through the use of data analytics or nowadays it calls as learning analytics to manage educational data. Data analytics enables the collection, processing, and analysis of large volumes of data, providing valuable insights into student performance, teaching resource allocation, and institutional effectiveness in decision-making. These insights can support educators and administrators in improving academic programmed and institutional practices. This paper explores how data analytics is used to monitor student performance, support administrative decision-making, and assist in curriculum planning and improvement in schools and higher education institutions. A review of previous studies indicates that data analytics can significantly enhance the efficiency of educational management. In addition, a bibliometric analysis was conducted using Research Rabbit to examine research trends in data analytics within the education field. Research Rabbit extracts data from Semantic Scholar and organises it based on key findings provided by the user. The platform offers several built-in functions in its free version, allowing researchers to identify trends, key authors, and related studies in the field. By exploring connected research nodes and influential authors, deeper analysis can be conducted based on the relationships between studies and core findings.

Keywords: Curriculum Planning, Data Analytics, Data-driven Decision-Making, Educational Technology, Student Performance

1. INTRODUCTION

The revolution of digital technology has brought a major transformation in various sectors like industry, medical and also education. This revolution not only impacted the delivery of learning and teaching procedure, but it also impacted the educational institutions management in student data, documentation and make strategic decisions for class planning. Data analytics is one of the technologies that has been identified as a powerful tool in strengthening the efficiency and effectiveness of educational management through data-driven practices (Rundquist et al., 2024; Victor & Omotola, 2020). Data analytics refers to the process of collecting, processing, and analysing large amounts of data or it also known as big data processing.

In the context of modern education, data analytics allows administrators and educators to gain a deeper understanding in many aspects such as student performance in examination and class assessment, student and teacher classroom engagement, and the effectiveness of curriculum and teaching strategies. Others previous study have explore the effectiveness of data analytics in education, for example, data analytics allow teachers and administrators to detect inconsistent

*Corresponding Author: masyitah_abu@usm.my

attendance patterns during classroom session and outside activity, identify student weaknesses in certain topics based on their examination and class assessment, and others that relate between student and educator.

Study done by Amran et al. (2023), shown how mobile applications integrate with data analytics can facilitate real-time monitoring of student performance; by providing these opportunities, early intervention can be done before problems become serious. Besides that, student monitoring process during intervention process using data analytics contribute significantly to curriculum planning and pedagogical improvements. According to Latif et al. (2022), educators who use data analytics can plan their teaching more effectively, from a deeper understanding of student needs and feedback given during class. The data analyse, show the level of student understanding of a particular topic, the effectiveness of assigned tasks like quizzes or assignment, and the relationship between teaching methods and student engagement levels are the main data for the analysis process (Latif et al., 2022).

In addition, data analytics also supports various administrative functions, including scheduling classroom time and teacher or lecturer slots, faculty management, registration process and number of active students, resource allocation, budgeting related to academic and co-curricular activities, and programme evaluation for improvement purpose. Through predictive analytics approaches, administrators can anticipate grade repetition rates, dropout rates, or additional resource needs in an academic programme (Arafiyah et al., 2021; Martin & Ndoye, 2016). Meanwhile, descriptive analytics allow administrators to identify trends in data such as student attendance levels, course selection patterns, and overall academic achievement this usually applied for high-level institution (Wise, 2018).

In the past decade, there has been an increasing of popularity in the application of data analytics in educational contexts, especially as educational institutions establishments work to improve student learning outcomes and strengthen decision-making processes (Kovanovic et al., 2021). According to Mukred et al. (2024), data literacy is now considered a fundamental professional competency among educators in both school and high institution, enabling them to properly evaluate the collected data and use it for curriculum planning and class activity implementation. Their study emphasises the importance of incorporate the use of data into the daily operations of educational institutions to support continuous improvement and the ability to respond and give feedback more effectively.

This study aims to explore many applications aspect of data analytics in educational management, specifically in three main domains: monitoring student performance, supporting administrative decisions, and planning and improving class curriculum. By examining previous studies, this paper will demonstrate how data-driven approaches using data analytics can help educational institutions move towards more responsive, efficient, and sustainable management systems. Therefore, the concept of data analytics that related to students, teachers, and management institutions will be reviewed.

2. DATA ANALYTICS FOR EDUCATIONAL MANAGEMENT

Data analytics is the process of collecting, processing, and analysing data to support predictions and decision-making at various levels of an educational institution from school to high institution. Various processes can be carried out through data analytics, and each process has a different purpose. Descriptive analytics involves summarising current performance indicators such as students' attendance, test scores, and student engagement in class. Diagnostic analytics, on the other hand, delve into the root causes of observed trends or issues, for example, the relationship between students' attendance and low academic performance. Meanwhile, predictive and prescriptive analytics expand the capabilities of data systems by predicting future outcomes based on past trends and suggesting targeted interventions to improve those outcomes. These

analytical techniques enable educators and administrators to implement more proactive, strategic, and evidence-based educational practice (Aristizábal, 2018; Murithi & Wamalwa, 2022; Wise, 2018).

3. APPLICATION IN EDUCATIONAL MANAGEMENT

In education field, data analytics has become a transformative tool that enables educational institutions to make evidence-based decisions to improve student performance, simplify administrative operations, and improve curriculum planning. By analysing data obtained from student attendance, academic achievement, and feedback, educators and administrators can identify learning patterns, detect at-risk students where the performance reduce by getting low mark in assessment and examination, and implement more targeted interventions. Studies such as those by Shogbesan and Adeoye (2025) emphasise the importance of data analytics in supporting effective administrative decisions, while Honson et al. (2024) and O'Farrell (2017) show how data can be used to align curriculum content with student needs. This approach also reinforces a culture of continuous improvement within institutions, as data-driven feedback enables continuous adaptation to changing pedagogies, industry needs, and levels of student engagement. Thus, the use of data analytics not only improves the effectiveness of teaching and learning, but also ensures that the education system remains responsive, sustainable, and competitive in the digital age.

3.1 Monitoring Student Performance

Data analytics are important tools in identifying students that have problem in academic performance or inconsistent attendance at an early stage. Arafiyah et al. (2021) emphasised the important role of continuous monitoring in education to prevent academic failure among students. Their study highlighted the issue of grade repetition in Indonesia, where a large proportion of students face academic challenges due to inadequate monitoring of learning progress. Using machine learning techniques, researchers sought to develop a predictive model that could predict students' learning progress in a private high school in South Jakarta over a one-semester period, focusing on cognitive and psychomotor aspects of learning. The study concluded that incorporating additional features such as student background and learning environment can enhance the predictive capabilities of the model. The results showed that the accuracy of the model improved throughout the semester, thus helping educators revise teaching strategies and address the alarming grade repetition rate in Indonesia.

Murithi and Wamalwa (2022) examined the impact of regular monitoring by school principals on academic performance in secondary schools in Kenya. They used a correlational research design involving a sample of 186 participants selected through stratified random sampling from a total of 930 schools. The findings showed that there was a significant relationship between regular monitoring and academic performance, with 40.2% of the variance in student performance attributed to this monitoring practice. The study concluded that effective monitoring by principals is important for improving academic achievement, as it encourages teachers and students to be more actively involved in the educational process. With the use of data analytics, the relationship between student monitoring and academic performance can be linked and further strengthened through data-based insights.

3.2 Supporting Administrative Decision-Making

Data analytics can also support the administrative decision-making process in the field of education. Mukred et al. (2024), focused on the use of Learning Analytics Tools (LATs) in Higher Education Institutions (HEIs). Through the proposed method, their study found that LATs can improve the decision-making process related to teaching strategies and learning outcomes. In the

study, data were collected through the distribution of a validated questionnaire to staff in public HEIs. The study findings indicate that various aspects need to be considered by HEIs administrations when making decisions, especially matters involving teaching strategies and student learning outcomes (Mukred et al., 2024).

Shogbesan and Adeoye (2025), explored the important role of administrative support in enhancing the effectiveness of secondary school teachers in Oriade Local Government Area of Osun State. Their study aimed to assess how perceived administrative support influences resource allocation and classroom management, using correlational methods to analyse the relationship. The findings of the study showed that strong administrative support was positively correlated with teacher job satisfaction and effectiveness, thus creating an environment that supports excellence in teaching. The study also emphasised that effective communication and trust between principals and teachers are essential for collaboration and student achievement. In addition, continuous professional development among teachers is considered important to enhance their impact on student learning outcomes.

3.3 Curriculum Planning and Improvement

Curriculum development in education is essential to ensure that students acquire the desired knowledge and skills. In this regard, McEneaney and Morsink (2022) introduced Curriculum Modelling and Learner Simulation (CMLS) as a method for designing and evaluating curriculum structures based on student learning. CMLS uses robust modelling theory and specialised software to produce representations of existing or planned curricula, focusing on estimating the effectiveness of curricula through student learning outcomes. The method considers several important factors including curriculum characteristics, student profiles, and natural variation among students. In their study, CMLS was tested on two versions of college-level curricula, and the simulation results were used to guide curriculum improvements. This approach has become a useful tool for curriculum developers and education stakeholders, providing data-driven insights to support more informed decisions and improve student learning outcomes.

Other study done by Lee and Cho (2023), aimed to identify measures that can improve curriculum effectiveness and student engagement during learning sessions. The study findings showed that factors such as interest in the class and understanding of the content played an important role in students' learning experiences, while the level of difficulty of the tasks had a smaller impact. The study concluded that continuous analysis and improvement of the curriculum is necessary and recommended that educational institutions adopt a data-driven approach to align the curriculum with student needs. By establishing a basis for assessing the level of popularity and relevance of subjects, the study provides useful insights for improving underperforming courses, thereby contributing to the improvement of the overall quality of education.

While others implementing a system, Amran et al. (2023), introduced a mobile application that aims to improve secondary education by addressing key issues in student performance monitoring and curriculum management. The application seeks to overcome these challenges by centralising student information, enabling real-time performance monitoring, and creating a more efficient learning environment. This approach is well suited for medium-scale projects and allows for careful planning throughout the development period. The application has two main objectives: first, to improve student performance by providing insights into individual progress, and second, to facilitate curriculum management by teachers so that they can adapt teaching methods to the needs of students. The application not only empowers educators but also supports a conducive learning environment, thus contributing to the advancement of secondary education.

4. BIBLIOMETRIC ANALYSIS FOR DATA ANALYTICS IN MANAGING DATA EDUCATION

In this study, a bibliometric analysis was conducted using Research Rabbit to examine journal publication that related to data analytics in managing data education. Research Rabbit is a free online discovery tool that helps researchers find, explore, and organise the academic papers more easily since all the academic manuscript can be pulls automatically from multiple open scholarly data source mainly from Semantic Scholar (Sharma, 2022). To begin using the Research Rabbit, previous study between 2020 until 2025 related to data analysis in student performance analysis, curriculum analysis and management decision-making were selected as indicator to identify trends in educational data analytics.

A total of 10 journal articles were chosen from find in library using 'data analytics in education' search keyword (Cheung & Tai, 2023; Dong, 2023; Villegas-Ch et al., 2020). Based on the selected benchmark journals, approximately 1,433 similar works were found in the Research Rabbit database. The criteria for next paper will be filtered based on the benchmark paper inserted based on search keywords. Figure 1 shows the number of similar works identified. This will serve as the search strategy using Research Rabbit.

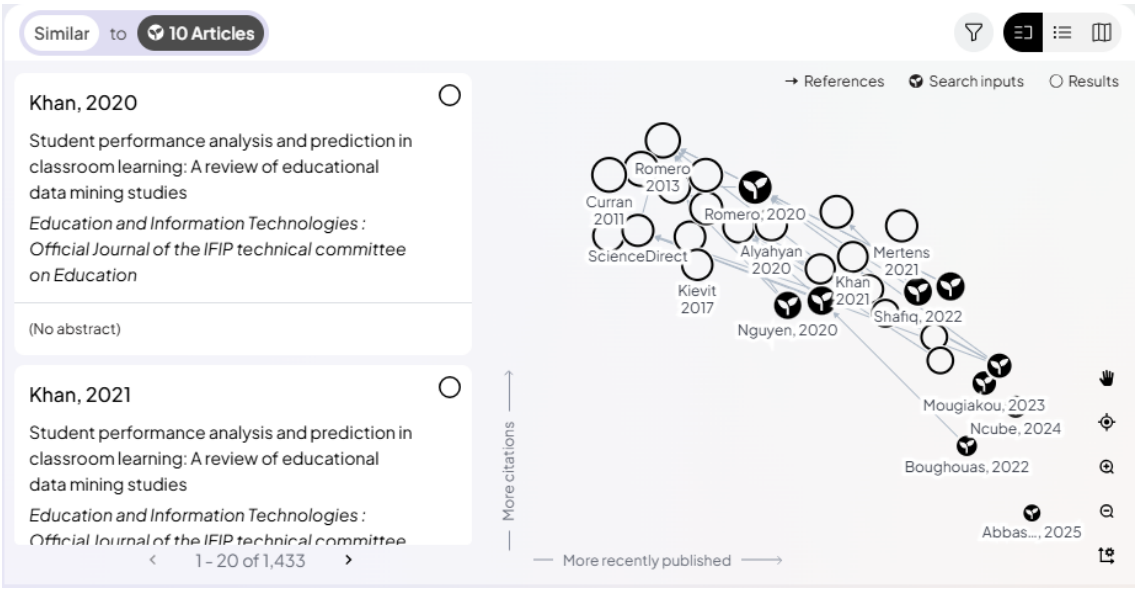


Figure 1. Similar Works found in Research Rabbit Databased

From the 1,433 journals identified that were linked to the 10 journals initially selected from the library, covering publications from 1950 to 2026, Research Rabbit was used at the early stage of the study to analyse the literature based on article similarity, references, and citation counts. After identifying the initial set of 10 journals through the library search, author analysis was conducted by filtering for specific authors and their related collaborators. In this study, the filtering process focused primarily on these authors to identify trends among researchers who are commonly active in this research field.

This study relied entirely on the free version of Research Rabbit to evaluate its suitability for conducting bibliometric analysis. However, several limitations were identified when using the free version, including the inability to adjust publication year ranges, identify journal quartiles, and group similar journals based on keyword-based clustering, as these features are available only in the paid version. Consequently, the available settings were limited to grouping articles based on similarity, references, and citation relationships, as well as grouping authors based on

selected authors and their related collaborators to identify research trends. Figure 2 illustrates the search and analysis settings used within Research Rabbit.

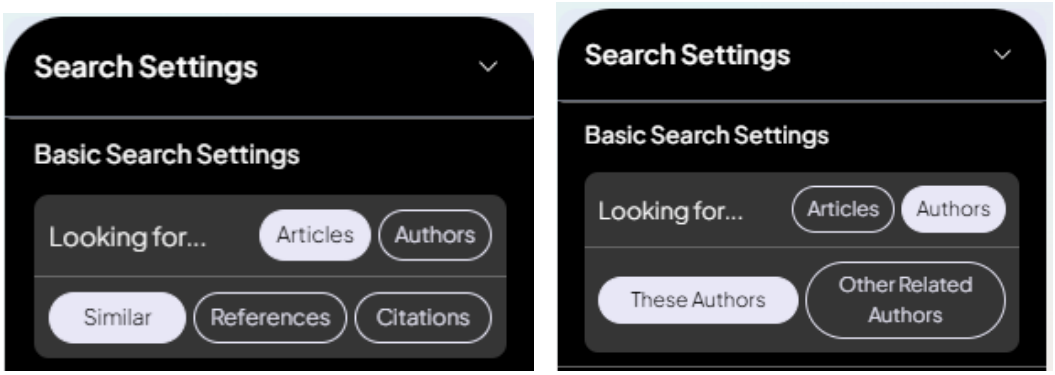


Figure 2. Search Setting

After applying the author filtering, 10 common authors were identified from the 10 selected journals as frequently publishing in this research topic. In Research Rabbit, the node graph is divided into Search Inputs, which represent the papers related to the 10 selected authors, and Results, which represent the common authors identified by the system. Among these authors, Sebastian Ventura published the highest number of articles, with 404 publications and 17,600 citations. Cristobal Romero ranked second, with 157 publications and 12,800 citations, followed by Rebeca Cerezo, who published 125 articles with 2,500 citations. In contrast, Boughouas et al. (2022) published only one article related to data analytics in education and recorded one citation. It should be noted that citation counts may vary across different indexing platforms, as Research Rabbit relies primarily on Semantic Scholar for citation data. Figure 3 shows the common authors found from 10 main articles.

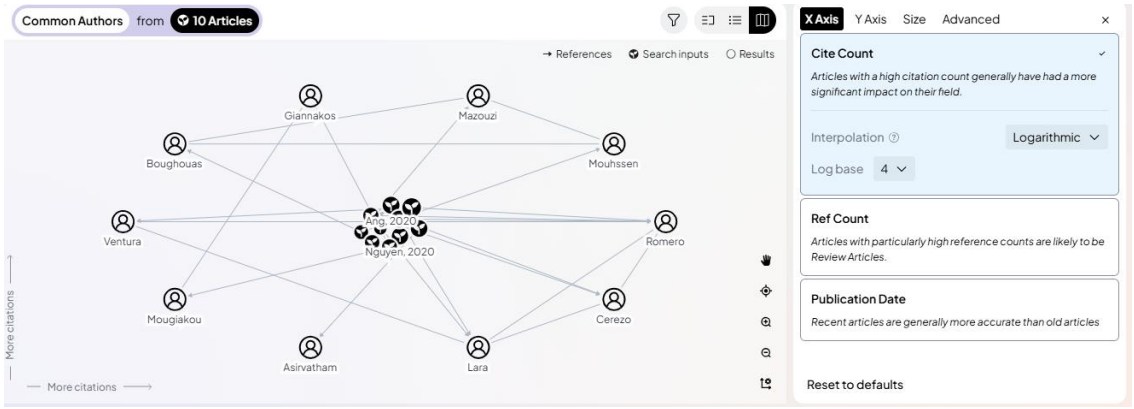


Figure 3. Bibliometric Analysis of These Author

Based on the identified authors, the system enables deeper exploration of each author's published papers, journals, and collaborative networks, following the 'rabbit hole' analogy used by Research Rabbit, as illustrated in Figure 4. From the journals identified within the Research Rabbit database, several key research keywords were extracted, including learning analytics, educational data, data mining, multimodal data, multimodal learning, big data, machine learning, and data analytics. Accordingly, all papers and journals examined in this study were filtered and analysed within the scope of these identified keywords. It should be noted that keyword-based filtering has been available only in the paid version of Research Rabbit since 2026. Each author

node in the graph is interactive, allowing users to examine related publications, reference counts, and citation relationships.

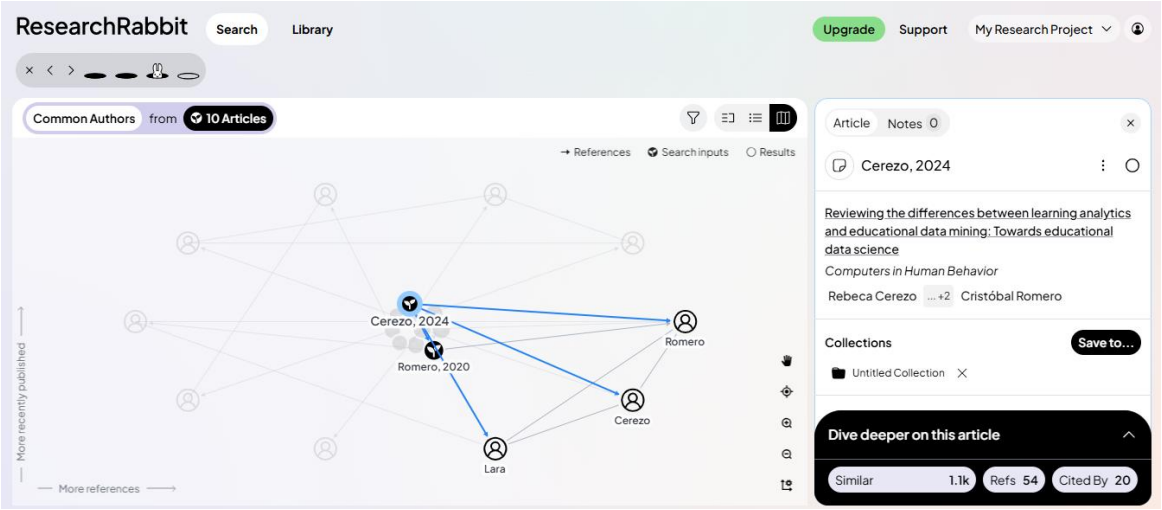
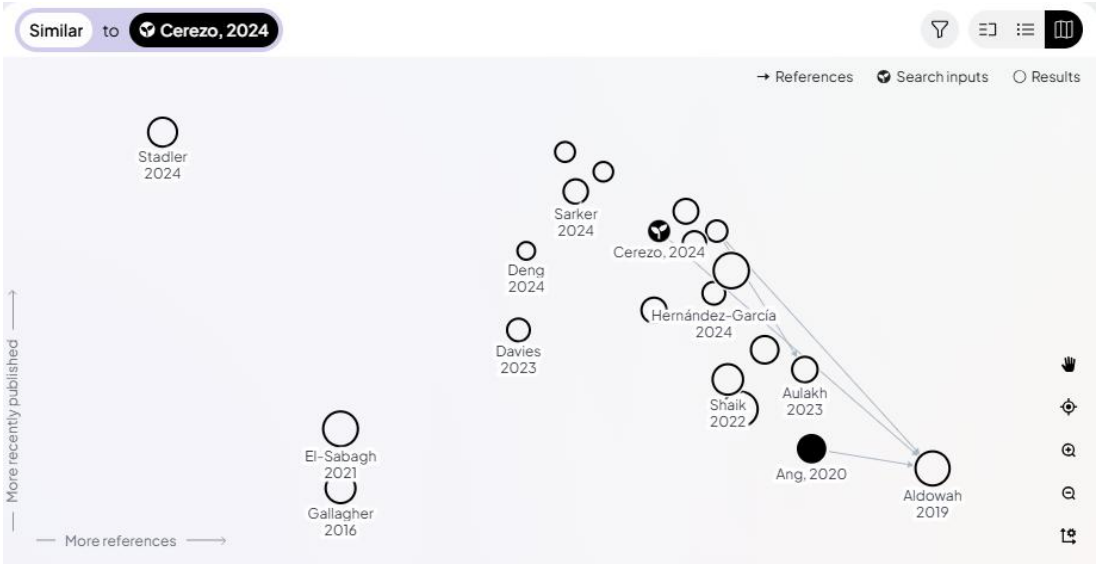
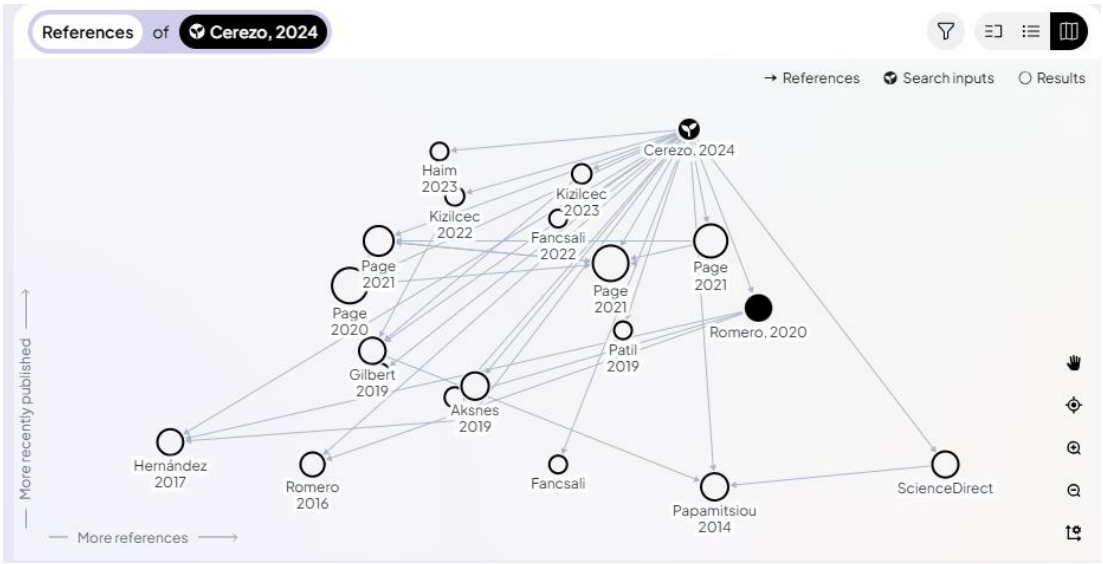


Figure 4. Deep Exploration of These Author

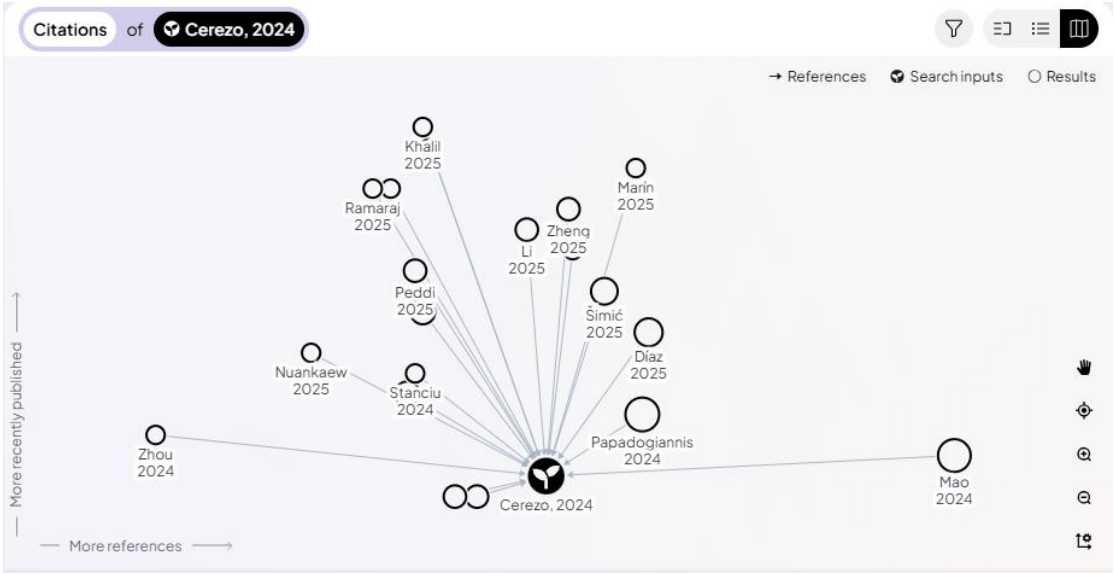
After selecting an author for deeper exploration, the system displays the number of similar articles, references, and citing papers at the bottom of the interface. For example, the work by Cerezo et al. (2024) identified 1,100 similar studies exploring the area of data analytics in education. The study by Cerezo et al. (2024) referenced 54 papers, and the published article has been cited by 20 other studies. The paper, titled 'Reviewing the Difference Between Learning Analytics and Educational Data Mining: Toward Educational Data Science', has served as a foundation for subsequent research. Among the 20 citing studies, several extended the topic toward educational data management and student performance analysis, including early student performance prediction by Shaikhanova et al. (2025), curriculum revision research by Li (2025), and other studies related to education management data analytics. Figure 5 shows deep exploration of Cerezo et al. (2024) bibliometric analysis.



a. Similar Work



b. Referred Paper



c. Cited by

Figure 5. Deep Exploration of Cerezo et al. (2024)

Based on the findings of this study, the free version of Research Rabbit is suitable for early-stage bibliometric analysis and literature exploration, particularly for identifying key authors, influential publications, and citation relationships within a research domain. Using article similarity, reference networks, and citation counts, Research Rabbit effectively supported the identification of research trends in educational data analytics, including learning analytics, educational data mining, and educational data science.

Therefore, the free version of Research Rabbit is best suited for exploratory bibliometric studies and early-stage research planning, rather than for formal evaluation or performance-based bibliometric reporting. Overall, the findings indicate that most studies in data analytics in education primarily focus on algorithm-based approaches, particularly deep learning and machine learning techniques. Many studies emphasise how educational data; such as student examination results, behavioural data, and institutional decision-making information are processed using computational algorithms to generate predictions or insights. However, there is lack of research examining how educational theories are integrated into the data analytics

process. While numerous studies focus on analysing student data and measuring impact, few explicitly incorporate established educational theories into the analytical framework.

Specifically, limited attention has been given to aligning algorithmic processes with established educational theoretical frameworks, such as behaviourism (de Lourdes, 2012), cognitivism (de Jong, 2010; Van Merriënboer & Sweller, 2005), and constructivism (Fosnot & Perry, 2005). Ideally, the conceptual design of data analytics algorithms should be guided by educational theory to ensure that data management, interpretation, and decision-making processes are pedagogically meaningful. Integrating theoretical foundations into analytics models could enhance the educational relevance and interpretability of algorithm-driven outcomes.

5. DISCUSSIONS

Based on previous literature studies, the emerging of data analytics in education has shown many positive impacts on educational data management. Data analytics has also created many new chances to improve the quality and standard of education delivery as a whole. Data analytics has proven to be a powerful tool in helping educational institutions by understanding student learning patterns during class. It also identifies many hidden learning issues during the analysis process and predict possible problems in student performance based on historical data from previous student. Given the availability of numerous 'machine learning' or 'deep learning' models and analytical tools such as CMLS, educators and administrators can now make more accurate decisions based on valid evidence.

One of the primary applications of data analytics in education is in monitoring student performance. Through descriptive and predictive data analysis, educational institutions can identify students at risk of dropping out from institution or getting worse in academic performance. Attendance patterns, examination and assessment results, and levels of engagement in learning activities can be used to identify students who need early intervention like additional tuition. The data analytics approach is not only reactive, but also proactive as it allows teachers or counsellors to create specialised teaching or guidance strategies adapted to the individual needs of students.

In addition to the student aspect, data analytics also makes a significant contribution to supporting the administrative decisions of educational institutions. Administrators can assess the effectiveness of teaching strategies, determine how efficiently resources are being used, and adapt academic policies to current needs based on the use of structured data. Previous studies such as those conducted by Mukred et al. (2024), show how the use of analytics tools in higher education institutions can help in designing more focused teaching strategies based on real data collected from previous students in the institution. The analytics tools can directly strengthen the governance of educational institutions by delivering relevant information to the senior management.

In terms of curriculum planning and development, the use of analytical data allows curriculum to be continuously reviewed and improved based on previous data. By understanding student performance patterns on existing curriculum content, curriculum coordinators can identify topics that require restructuring or more appropriate teaching approaches by analysing the existing data and predicting outcomes. By using the data-driven process, decisions can be proven, making them easier to justify. In addition, data on student understanding levels, interests, and teaching feedback can also be used to ensure that curriculum content is aligned with 21st century learning needs that emphasise soft skills, critical thinking, and problem-solving. Besides that, student engagement and understanding can be improved. Table 1 summaries the literature review discuss in this work.

Table 1 Summary of Literature Review found Using Research Rabbit Tools

Review	Author	Findings
Student Performance	Arafiyah et al. (2021)	Using a machine learning technique to emphasise the important role of continuous monitoring in education to prevent academic failure among students.
	Murithi & Wamalwa (2022)	Using a correlational research design to examine the impact of regular monitoring by school principals on academic performance in secondary schools in Kenya.
	Mukred et al. (2024)	Focusing on the usage of Learning Analytics Tools (LATs) in Higher Education Institutions (HEIs) to improve the decision-making process related to teaching strategies and learning outcomes.
Administration	Shogbesan & Adeoye (2025)	Study aimed to assess how perceived administrative support influences resource allocation and classroom management, using correlational methods to analyse the relationship between teacher job satisfaction and environment effectiveness (based on questionnaire).
Teaching Planning	McEneaney & Morsink (2022)	Design and evaluate curriculum structures based on student learning using Curriculum Modelling and Learner Simulation (CMLS). CMLS uses robust modelling theory and specialized software to produce representations of existing or planned curricula, focusing on estimating the effectiveness of curricula through student learning outcomes.
	Lee & Cho (2023)	Improve curriculum effectiveness and student engagement during learning sessions based on students' learning experiences.
	Amran et al. (2023)	Use mobile application to improve secondary education by addressing key issues in student performance monitoring and curriculum management.

To support these findings, a bibliometric analysis using Research Rabbit was conducted to examine publication trends in the application of data analytics in education. The analysis identified 1,433 related publications, with a strong concentration of studies focusing on learning analytics, educational data, data mining, multimodal data, multimodal learning, big data, machine learning, and data analytics. These results indicate that the use of data analytics in education has been widely explored and continues to gain momentum, reinforcing its relevance and practical importance.

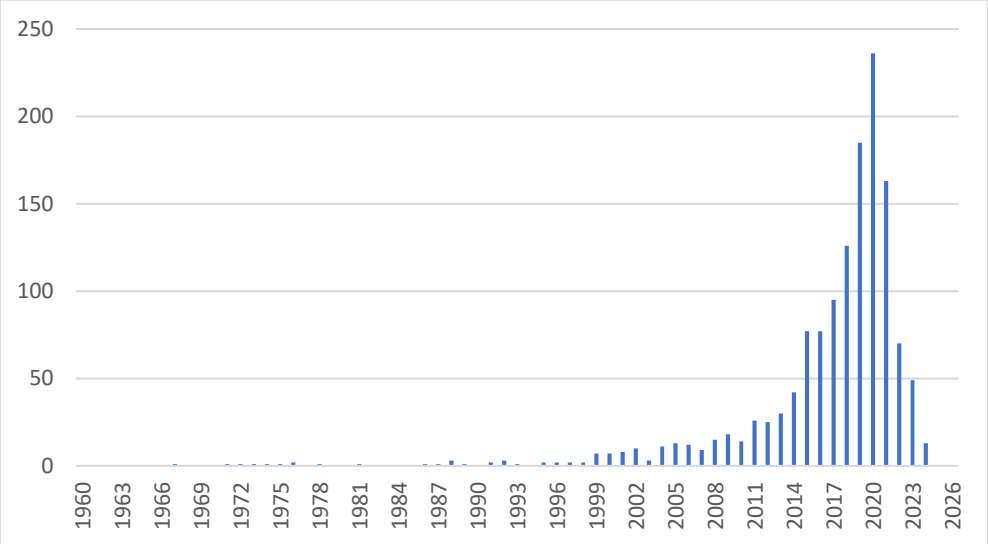


Figure 6. Data Analytic Publication

As shown in Figure 6, the number of publications spans from 1960 to 2026. However, publication data in Research Rabbit are limited to 2025. The findings indicate that research on data analytics in education began as early as 1966, experienced gradual growth from 2000 onwards, and reached a peak around 2020. Following this peak, a declining trend in the number of publications is observed in the Semantic Scholar database.

However, in order to fully utilise data analytics, several issues and challenges need to be addressed. Data privacy and security issues are major concerns, as the data collected often involves personal information of students such as family background, academic achievement, and health history. Therefore, educational institutions need to develop strict data privacy policies, including informed consent, implementation of data security protocols, and compliance with data protection regulations such as the Personal Data Protection Act (PDPA). In addition, low levels of data literacy among educators can affect the effective use of data analytics. Ongoing training and professional development are essential to ensure that educators have the understanding and skills to properly interpret data and use it in a pedagogical context.

Finally, system integration between analytics platforms and Learning Management Systems (LMS), as well as institutional databases, needs to be properly addressed to ensure that data collection and analysis processes are automated, accurate, and easily accessible. Such integration would reduce educators' workload by streamlining data processing tasks. Failure to implement proper integration may lead to data errors, loss of critical information, or duplication of effort, which could ultimately reduce the effectiveness of data analytics implementation. Overall, this discussion demonstrates that although several challenges remain, the benefits of using data analytics in education are substantial. A significant research gap has also been identified in the limited integration of educational theory within data analytics models, as most existing approaches are primarily algorithmic or statistical in nature. Incorporating educational theoretical frameworks into data analytics processes could serve as a foundation for developing a more effective and sustainable data-driven learning approach, thereby enhancing educational quality and addressing current and future educational demands.

6. CONCLUSION

All things considered, the application of data analytics in education has created a new dimension in more efficient, systematic and evidence-based education management that is importance in education field. This technology gives educational institutions the advantage of analysing different kinds of student data such as attendance, academic performance, level of engagement in class, and learning behaviour towards making more accurate and effective decisions. Through data analysis, the administration can identify students at risk of low academic achievement at an early stage and subsequently plan appropriate support interventions in a timely manner. This not only helps improve overall student performance but can also reduce dropout rates among students who need attention.

Data analytics also plays a key role in supporting evidence-based administrative decisions. By using descriptive, diagnostic, predictive, and prescriptive analysis techniques, institutional administrators can understand student achievement patterns, identify factors that influence teaching performance, and plan resource allocation more efficiently. For example, the use of tools such as LATs in higher education institutions helps assess the effectiveness of teaching strategies and the relevance of curriculum content to student needs. In addition, this approach contributes to the process of continuous curriculum improvement based on real-time feedback and empirical data.

In terms of curriculum planning, data analytics provides a solid foundation for ensuring alignment between learning objectives and student needs and abilities. Through tools such as CMLS, curriculum planners can simulate the effectiveness of a curriculum structure before it is implemented. This allows for proactive modifications to be made to ensure that each learning

element has maximum impact on students' cognitive, affective and psychomotor development. Furthermore, mobile applications and digital platforms that integrate student performance monitoring systems allow teachers and parents to access student progress directly, thereby improving communication and overall support.

However, there are several challenges that need to be addressed in integrating data analytics comprehensively into the education system. Key challenges include issues of student data privacy and security, low levels of data literacy among educators, technological infrastructure constraints, and the need for ongoing professional training. Therefore, a holistic effort needs to be implemented to ensure that all stakeholders have sufficient knowledge, skills, and ethics to manage and analyse data responsibly.

In conclusion, the use of data analytics strategies in education is a relevant and high-impact approach in addressing the challenges of today's education. Through systematic and continuous data analysis, educational institutions can not only improve student performance, but also strengthen overall educational governance. Therefore, investments in data capacity development, increased awareness of the importance of data, and the establishment of comprehensive policies are important steps towards preserving the quality and effectiveness of the national education system in this digital era.

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