Big Data in Education and Student Learning Analytics

Xuye Wang, Qihao Dong

Shenyang Aerospace University, Liaoning, China

ABSTRACT

The application of big data in education and student learning analytics brings unprecedented opportunities and challenges to the education system. By collecting, analysing and mining student learning data, educators are able to gain a more comprehensive understanding of students, provide personalised learning support and optimise the teaching and learning process. However, this trend also raises a number of issues, including data privacy and security, fairness of algorithms, and reliability of academic predictions. To address these issues, educational institutions need to establish robust data privacy policies, strengthen data quality management, promote research on the fairness of algorithms, and improve the data literacy of educators and students. At the same time, broad social participation and transparent communication are key to ensuring the success of big data applications in education. Taking into account technical, ethical and social factors, the application of big data in education offers new possibilities for enhancing student learning outcomes and promoting educational innovation.

Keywords: Big Data; Education Sector; Student Learning Analytics; Personalised Learning; Data Privacy

1 INTRODUCTION

With the rapid development of science and technology, big data technology has been widely used in various fields, and the field of education is no exception. The application of big data in education has gradually become a trend, providing more scientific and accurate management and support for education. Among them, student learning analytics, as an important application direction of big data in education, can provide educators with in-depth insights by collecting, analysing and mining student learning data, helping to optimise the teaching and learning process and improve student learning outcomes [1].

The application of big data in education, especially student learning analysis, covers several aspects. First, by collecting student learning data, it is possible to understand students' performance at the academic and behavioural levels, including subject grades, study habits, and active participation in the classroom [2]. The analysis of these data can reveal students' subject strengths and weaknesses, helping educators to better understand the learning needs of each student and develop targeted teaching plans.

Second, big data can also provide real-time monitoring and feedback on students' learning process. By collecting real-time data from students in the learning process, educators can identify students' learning difficulties and problems in a timely manner and intervene with appropriate teaching strategies. This personalised monitoring and feedback mechanism helps to help students better understand subject knowledge and improve their learning efficiency.

In addition, big data has a predictive function in student learning analysis. Through in-depth analysis of historical learning data, students' future learning trends and possible problems can be predicted, providing educators with a scientific basis to develop more effective

personalised teaching plans. This predictive student analysis not only helps to identify in advance the learning difficulties that students may face, but also provides schools with better resource allocation and management solutions [3].

All in all, the application of big data in education, especially student learning analytics, brings unprecedented opportunities and challenges to education. By making full use of big data technologies, educators are able to gain a more comprehensive and in-depth understanding of their students, provide more personalised and effective education services, and promote innovation and development in the field of education. However, at the same time, attention needs to be paid to issues such as data privacy and security to ensure that the rights and interests of students and educators are fully protected. In the era of big data, the education sector needs to find a balance and give full play to the advantages of big data, while safeguarding the fairness, equity and sustainable development of education.

2 RELEATED WORK

There has been a lot of work related to the use of big data in education and in analysing student learning at a number of levels and directions. Many schools and educational organisations have adopted learning management systems and student information systems that record data on students' academic performance, attendance records, test scores, etc. Big data technologies are being applied to perform in-depth analyses of these data to understand information such as students' study habits, subject preferences, and so on, in order to provide students with more personalised learning support [4]. By analysing historical student performance and other relevant data, researchers and educators can use big data technologies to predict students' future academic performance. This can help in early identification of academic problems and appropriate interventions to improve students' academic performance. The use of big data in personalised teaching and learning is significant. By collecting data generated by students during the learning process, intelligent education systems can optimise the learning process by providing personalised learning materials and advice based on students' learning styles, progress and needs [5]. Big data technologies can be used to track and analyse students' learning trajectories, including the time they spend on their learning paths, the use of learning resources, and so on. This helps educators to better understand the challenges and success points of students in their academic journey and thus adjust teaching strategies By analysing text, voice or image data of students during the learning process, sentiment analysis can be performed to understand the emotional state of students. This helps in identifying possible student emotions such as anxiety and frustration in advance so that timely support can be provided [6]. Online education platforms generate a large amount of data, including data on student interactions, clicks, and study time on the platform. By analysing this data, educators can better understand students' learning behaviours in the online environment and improve online teaching methods. Big data technologies can be used to analyse student interactions and information flows in social networks to understand relationships, and patterns of collaboration among students, thus facilitating the creation of more effective learning communities.

These works show that significant progress has been made in the use of big data in education and in analysing student learning, offering more possibilities and innovations in the

education system. However, the accompanying challenges include data privacy protection, ethical issues, and ensuring the impartiality of algorithms, which also require adequate attention.

3 PROBLEM ANALYSIS

While the application of big data in education with student learning analytics brings many potential benefits, it is also accompanied by a number of problems and challenges. The field of education involves a large amount of personal student data, including grades, attendance records, and learning behaviours. Ensuring the privacy and security of this data is crucial in big data analytics. Misuse or disclosure of student information can lead to serious privacy concerns, thus the need for robust data protection and privacy policies [7]. Big data analytics may introduce potential biases that can lead to unfair treatment of students. If algorithms rely on prior data that is inherently discriminatory or biased, the results of the analyses may perpetuate or exacerbate these inequalities. Ensuring that algorithms are unbiased and avoid improperly evaluating students based on gender, race, or other sensitivities is an important concern. Data quality is key to effective analyses. If education data are incorrect, incomplete, or inaccurate, then the results of the analyses may be unreliable. Ensuring the accuracy and completeness of data is a challenging task that requires meticulous data cleaning and validation processes. Models for big data analytics are often complex, and the workings of these models may be opaque to the layperson [8]. This makes it difficult for educators and students to understand why certain decisions or recommendations are being made. In education, explanatory and transparency are crucial, especially when these decisions affect student outcomes and future learning paths. Educational institutions may face a lack of technical capacity to apply big data technologies. Educators and policymakers may need training to better understand and apply big data tools to ensure their proper use. Students, parents and educators may have concerns about the use of big data analytics in education, especially as it relates to privacy and the collection and use of personal information. Ensuring social acceptance and establishing transparent communication and engagement mechanisms is crucial [9]. The application of big data analytics requires long-term support and maintenance. Lack of long-term commitment and support may lead to stagnation of the system and failure to realise its full potential. Therefore, ensuring the sustainability of the project and a long-term development plan is an important issue.

Taking these issues into consideration, educational institutions need to develop sound policies, effective technical and managerial measures in adopting big data analytics and student learning analytics in order to minimise the impact of potential problems.

4 COUNTERMEASURE RESEARCH

In order to cope with the problems that may arise from the application of big data in education and the process of analysing student learning, there are a number of countermeasures and research directions that can be taken to develop a clear data privacy policy to ensure that students' personal information is adequately protected. This includes stipulating guidelines for data collection, storage and sharing, and adopting advanced data

encryption and security technologies. Implement strict data quality management strategies, including data cleansing, validation, and error correction. Ensure the accuracy and integrity of education data to increase the credibility of analyses Conduct research to improve the fairness of algorithms and reduce potential bias and discrimination. Also, work to improve the interpretability of the algorithms so that educators and students can understand how the analyses are generated. Improve the data literacy of education practitioners and students through training and education to enable them to understand and engage in the process of big data analytics [10]. This helps to build a more open and collaborative data culture Conduct public research to understand the community's views and concerns about the use of big data in education. Establish transparent communication channels and promote social engagement in order to incorporate diverse perspectives in educational decision-making. Establish specialised ethics committees or review bodies to review and evaluate projects on the application of big data in education. Ensure that all research and applications comply with ethical standards and pay attention to potential ethical and social implications. Develop a big data governance framework to ensure the sustainability of the project. This includes establishing clear project goals, a long-term development plan, and mechanisms for maintaining and updating the big data system. Use a combination of quantitative and qualitative evaluation methods to conduct a comprehensive assessment of the use of big data in education. Consider the needs and feedback of different groups to better understand the effectiveness of the application and potential problems [11]. Collaborate with educational institutions in other countries and regions to share experiences and best practices. Learn from global experiences to promote the sustainable and healthy development of big data in education.

These responses can help educational institutions and policy makers to better address issues in the application of big data in education and in analysing student learning, so as to more effectively promote education reform and enhance the student learning experience.

5 CONCLUSION

The application of big data in education and the analysis of student learning brings many opportunities and challenges to the education system. By making full use of big data technology, educators are able to gain a more comprehensive and in-depth understanding of students, provide more personalised and effective education services, and promote innovation and development in the field of education. However, with this progress comes a series of problems that need to be approached with caution to ensure that the rights of students and educators are adequately protected.

Protecting data privacy and ensuring security are crucial when applying big data to student learning analyses, and robust data privacy policies and security measures need to be established. At the same time, it is important to focus on the fairness and transparency of algorithms to avoid introducing unfair bias. The data literacy of students and educators also needs to be improved to ensure that they are able to understand and engage with the process of big data analytics.

Social acceptance is key to the successful implementation of big data analytics, hence the need for active public engagement and transparent communication. The establishment of ethical review and assessment mechanisms can ensure that big data applications meet ethical and social standards. In addition, the establishment of a sustainable big data governance mechanism that focuses on a long-term development plan can help ensure the sustainability and healthy development of the project.

Overall, big data applications in education offer new possibilities for personalised education, student support and teaching optimisation. By integrating technical, ethical, social and educational considerations, educational institutions can make better use of big data to

promote educational innovation, improve student learning outcomes and help foster more creative and adaptable future talents.

6 DISCUSSION

The use of big data in education and the analysis of student learning has generated a lot of discussion. The topic involves a number of technical, ethical and social aspects, and big data analytics offers the possibility of personalised learning. By tracking students' learning trajectories and behaviours, the system is able to provide teaching resources and support tailored to individual needs, thus better meeting students' learning needs. However, this also raises concerns, including invasion of personal privacy and the potential for personalised learning to lead to information cocooning. Big data analytics can be used to predict student achievement and academic performance, providing schools with timely intervention opportunities. Such interventions could include providing additional academic support or counselling. However, the accuracy, fairness and transparency of predictive models are areas of concern to prevent inappropriate academic labelling from negatively impacting students. Big data analytics can help to understand the use of teaching and learning resources, leading to better resource allocation and optimisation. This includes the choice of teaching materials, adaptation of teaching methods, etc. However, in this process, there is a need to ensure that educational decisions are based on rational analyses of objective data rather than relying too much on algorithms to prevent potentially misleading results. By analysing text, voice or image data generated by students in the learning process through big data, sentiment analysis can be conducted to understand the emotional state of students. This can help to identify student distress and problems early, but it has also led to discussions about the rationality and ethics of sentiment analysis. Students and education practitioners need to be sufficiently technologically and data literate to fully understand and engage with the process of big data analytics. Educational institutions need to consider how to integrate training and education in this area to facilitate wider participation. The use of Big Data in education requires broad social acceptance, which involves concerns about privacy, fairness and transparency. Ensuring that the application of big data does not introduce or exacerbate inequalities in society and in the education system is a crucial topic. The application of big data analytics in education needs to be considered for its long-term impact and sustainability. This includes long-term planning of projects, technological upgrades and maintenance to ensure that the system operates efficiently and continuously adapts to changing needs.

Overall, the application of big data in education with student learning analytics offers both great potential and a range of issues that deserve in-depth research and solutions. In promoting the use of big data technologies, there is a need to weigh the relationship between innovation and protection of interests to ensure that their eventual implementation can truly benefit students and the education system.

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