ISSN: 1813-4890

Promoting Balanced Development of Education through Big Data Application

Qianyi Gu

School of Computer Science, Sichuan Normal University, Chengdu 610101, China.

qianyigu@foxmail.com

Abstract

With the implementations of the informational infrastructure in many k-12 schools, it becomes practical to collect huge amounts of educational data from those schools. Big data brings many opportunities in the educational processes and becomes a scientific force that drives disruptive innovations and changes in the education. Big data technology enables the capture and analysis of massive amounts of data generated during the teaching process, providing the possibility for a deeper understanding of education . The paper explores how to design a smart service based on educational big data application that would promote the balanced development of education. The paper proposes four implementing strategies for the service to achieve this goal. Educational big data technology including data collection, data fusion and data analysis are discussed. The application of educational big data includes optimizing classroom teaching, transforming learning styles, changing education management, and promoting teachers' professional development.

Keywords

Big data, data mining, educational resources, smart service.

1. Introduction

With the continuous improvements of informational infrastructure in various educational systems, it is predictable that the generation of educational data will be constantly growing. The convergence of massive education data provides new visions for education. Big data is becoming a scientific force that drives disruptive innovations and changes in the education system. Big Data refers to data which is fundamentally too big and moves too fast, exceeding the processing capacity of conventional database systems[1]. With the development of big data technology, the education systems are able to monitor teaching quality by capturing and analyzing massive amounts of data generated during the teaching process[2]. The monitoring results give the education department a deeper understanding of teaching processes and possibilities to make a more scientific decisions leading balanced education development.

To achieve improved education from this new trend, it is necessary to recognize the meaningful knowledge from raw educational data and make educational decision based on these knowledge and predictions[3].This paper proposes a smart service for education systems based on the support of big data. Through collecting and analyzing educational big data, the service accurately grasps the dynamics of regional education development and students' individual differences. With big data technology, the service provides the insight of four aspects of the educational systems: education resources, education quality, teachers' career development and students' knowledge states. The service promotes balanced development of education through these aspects.

ISSN: 1813-4890

2. Implementation Strategies

The smart service promoting balanced development of education is completed by three layers of organization. At the first layer, it implements the digitization and collection of the education process. The digitization process is realized with the help of online learning system, offline education data collection platform, and national resource platform. After acquiring the data, at the second layer, the learning analysis engine, educational cloud computing services, educational big data mining tools, and personalized resource promotion services are used at the technical level to realize the integration of resources. Data services and teaching management applications are provided through the results of mining. It includes the learning path planning services, learning space services, adaptive learning systems, and teaching resources allocation systems. At the third layer, the smart service realize the construction and pushing work of high-quality resources, provide learning resources and strategies for the development of teachers' capacity enhancement, and make a basis for the next step of the relevant institutions to formulate the corresponding scientific decisions. The three layers of is implemented with four strategies described below.

2.1. Digitization Strategy

The digitization strategy is to implement the transformation of physical education process to digital data. Students' behavioral characteristics are stored in the form of images, videos and sounds, which is one of the conditions for the formation of big data[4]. The strategy proposes the acquisition of educational data from a wide range of sources. With the vigorous implementation and promotion of the informational infrastructure in k-12 schools, they have deployed numerous digitized teaching and management systems which include learning management systems, teaching management systems, equipment and asset management systems. At mean while, vast amount of educational resources are developed by teachers and publishers. The educational resources are important carriers of the process of teaching and learning, which contain a wealth of potential educational data that may carry great educational value. The strategy uses the big data and cloud computing technologies to build a smart education environment, through which it collects and integrates dynamic and heterogeneous data on people, devices, and educational applications.

2.2. Data Mining Strategy

The data mining strategy is to realize the improvement of learning based on big data. The analysis of students' activities data aims at designing better teaching methods and is committed to providing students with personalized learning experiences. The mining results verifies whether the learning plans developed by teachers are effective in helping students enhance their learning. The service intends to benefit from learning analytic through analyzing student-specific data from mobile learning applications and online platforms. The strategy can provide students with the support that meets their learning needs to improve academic performance and learning efficiency.

2.3. Forecasting Strategy

The forecasting strategy uses big data in education to predict education outcomes. The strategy uses big data to diagnose students at risk of dropping out of school, to explore the relationship between education spending and student achievement improvement, and to explore the relationship between student absenteeism and achievement. With sufficient data support, more relationships between teacher characteristics and student performance are examined, thus providing better references for teacher training and development. The strategy gives suggestions about equipping teachers with sufficient resources based on the forecast.

ISSN: 1813-4890

2.4. Balance Strategy

The balanced development of education requires a balanced allocation of education funding, physical resources, and quality teacher resources. The coordinated allocation of these educational resources often requires policy guidance. Because of the objective conditions, the people in charge of allocating educational resources do not always accurately grasp the dynamic changes in the region. They may lack prediction of the changes, and do not accurately judge the expected effects of policy making. They may also add subjective experience to the process of policy making, resulting in a certain degree of bias, which restricts the process of balanced development of regional education. The balanced strategy uses big data technology to obtain dynamic data in the learning process. It reflects the real education process which is more comprehensive compared to traditional education data. By studying the timely and accurate understanding of education and teaching through data, the people in charge of allocating educational resources are able to grasp the current situation of regional education development more accurately and predict future development trends. It can help education policy to be more scientifically and rationally formulated. Thus, the balanced development of education can be achieved through objective data analysis, instead of subjective experience.

3. Educational Big Data Technology

The promotion and application of the internet of things, cloud computing, and mobile technology provide the underlying technical support for constructing intelligent learning environments, collecting intermediate data in the educational process, and providing educational resources tailored to the needs of each individual. The continuous improvement of data mining and artificial intelligence technology can be used to promote discovering valuable information from the educational big data. The big data technology supports the smart service to achieve effective analysis of data generated in the education process and provides effective education activities based on the heterogeneity of learners.

3.1. Big Data Collection

The collection of educational big data provides a data foundation for balanced education development.. The owners of educational data are often organizations and large enterprises who have an inherent data advantage and generally do not provide an effective methodology for data aggregation. Educational data have unique characteristics compared to data in other domains. One of the important characteristics is the unstructured nature of the data. Various interactive learning processes in the classroom and online learning environments generate vast amount of heterogeneous data. It creates more opportunities to explore the characteristics of student learning, but it also creates technical challenges for sharing the data. The smart services proposes an ontology based technique to collect these heterogeneous data. The smart service develop an education activity ontology to describe the framework of all activities in the educational systems including online and offline. The heterogeneous data are mapped and labeled based on these activities and are ready to be collected into one system.

The ontology based approach also address the data clean, structure process, data correlation by collecting and labeling the non-precise and unstructured educational big data from various physical learning environments. The data collection technique provides a data foundation for the later analysis of the educational big data.

3.2. Educational Data Fusion

One of the major research question of the big data application in education is the fusion of data. If the heterogeneous education data can not be integrated, the value of big data cannot be realized. Due to the diversity and complexity of the nature of each field, educational process has its own data format. The format of a variety of massive data analysis has also brought many

ISSN: 1813-4890

difficulties. Due to the dispersion of educational information, there is no formation of a unified information resource. There is no effective communication between the educational resources from different domains, which makes it impossible to share the information cross fields. This brings difficulty to analyze and build understandings from big data. To address the data fusion issue, the smart service design the unified information standard and data exchange standard in order to realize the integration and interoperability of heterogeneous educational data. The standards bring the composition, development, and management of educational data resources.

3.3. Educational Data Analysis

The solution to the problem of balanced development of education involves a number of factors, such as educational policies, conditions of schooling, teachers' qualifications, supply of resources, and level of management. These factors are intertwined and affect each other in an exceptionally complex way. In addition, balanced development of education is not egalitarianism in the simple sense, and the solution to the problem will also present various characteristics such as uncertainty, dynamics and differences. Therefore, the problem of balanced development will never be solved automatically just because there is big data in education.

The smart service utilize machine learning techniques to analyze integrated big data from different educational process and areas to make scientific prediction. Previous research have shown that the prediction generated from educational big data can be used to facilitate teachers and students interaction and improve learning outcomes[5]. Educational big data analysis includes intermediate data of educational process and individual educational resources as well as other basic data, and the work involves the collection, organization and management of data of teaching process and intelligent analysis.The main idea is to define major dimensions for education perspectives in different areas. The historical data is collected and used as training data to establish a neural network predictor. The predictor can be used to provide an effective basis for education policy, improve the effectiveness of schooling conditions, and improve the level of teacher staffing and resource supply are the key issues in solving the problem of education balance.

4. Application of Educational Big Data

The application of education big data involves education prediction, scientific decision-making and research on strategies for balanced development of teachers' competence supported by education big data. The smart service provides a scientific education decision support system that uses big data to help education departments formulate education policies more scientifically. The system mainly realizes the following functions. It provides the education department with accurate data on the basic status of students, schools and teachers, including data on student mobility, basic data on rural teachers and basic data on remote areas, so as to provide a scientific basis and support for the planning of financial allocations for education. For example, the school can locate a lost student by receiving abnormal behaviour warning identified from educational data[6]. The warning can be generated by analyzing the student's educational data includes work habits, social interactions and study outcomes. It also provides the education department with data on students' academic performance, growth records and changes in different regions and schools, so as to provide data support for the reform of examination and enrollment systems[7]. Taking advantages of the characteristics of big data, such as unstructured, distributed, huge data volume and personalization, the smart service comprehensively implement the balanced development of education by seven paths:

The first path is to optimize classroom teaching with big data. On the basis of analyzing the basic processes and problems of existing classroom teaching, the smart service focuses on the construction of classroom teaching models supported by big data. The model includes the

ISSN: 1813-4890

teacher preparation supported by big data, the implementation and management of classroom teaching supported by big data, and the learning evaluation supported by big data. Using big data to optimize classroom teaching is the core and key to achieving balanced education.

The second path is to transform learning styles with big data. This path focusing on the construction of learning environments that use big data to support personalized learning and promote the transformation of learners' learning styles. The smart service provides personalized learning models based on big data, personalized learning resources pushing, and learning trajectory records based on big data. Using big data to transform learning styles is the future and trend of realizing balanced education.

The third path is to promote scientific management education by big data. The smart service improves education management based on big data from multiple levels. It includes educational decision-making with the support of big data, collaborative innovation in regional education with the support of big data, school education management with the support of big data, and research on the rationing of educational resources with the support of big data. Using big data to change education management is the condition and guarantee for realizing education balance.

The fourth path is applying big data for teachers' professional development. The smart service utilizes the advantages of big data in massive unstructured data processing, constructs a model of teachers' professional growth and promotes teachers' professional development. This includes the establishment of a database of outstanding teachers' characteristics based on big data, the building of an intelligent teacher professional development system, and the study of automation of teacher professional development. Using big data to promote teachers' professional development is fundamental and key to achieving a balanced education.

The fifth path is developing a high quality education resource library and an adaptive resource intelligent push system to realize the popularization and equalization of education resources. This includes building a large number of high-quality educational resources adapted to different levels of educational development and customizing learning resources according to learners' learning behaviors and styles, and realizing adaptive pushing of resources through the developed resource pushing system. The smart service also establishes a personalized education classification guidance to provide implementation plans for personalized classroom teaching for different courses in primary and secondary schools in different regions and at different levels.

The sixth path is to develop teaching analysis software and teacher ability prediction system. It collects data on the teaching process in the classroom, discovers teachers' educational abilities and deficiencies through intelligent data analysis and data mining technology. Thus, the service provides a basis for the balanced improvement of teachers' educational abilities.

The seventh path is to develop quality educational resource standards, quality educational resource sharing mechanism, personalized educational resource design and adaptability of educational resources. The smart service proposes a sharing mechanism of quality educational resources. It includes automatic evaluation of teaching attributes of educational resources, automatic evaluation of matching attributes, integration and sharing mechanism of high-quality educational resources.

5. Conclusion

The paper proposes a smart service for education systems based on the support of big data. The smart service establish a scientific understandings of students, teachers, educational resources and regional education quality by collecting and analyzing educational big data with support of artificial intelligence technology. With these understandings, the smart service promotes the balanced development of education for different regions. The description of the smart service

starts with four implementation strategies such as digitization, data mining, forecasting and balance. Then the paper explains how big data technology are utilized to collect, semantically integrate and analyze the data from heterogeneous educational process. The mechanism of applying educational big data to achieve the balanced development of education are discussed.

The smart service based on big data technology promote the aggregation, storage and processing of educational data. It applies artificial intelligence and data mining technology to many aspects of education and teaching factors, and gains some original scientific and technological achievements of prospective significance in the areas of teaching analysis, intelligent teaching decision support, and so on. The application of educational big data can greatly promote the enhancement of curriculum and teaching, the transformation of learning styles and the development of teachers' professional abilities in less developed areas, and will contribute to the overall improvement of overall education level and reach the balanced development of education.

References

[1] B. Daniel, R. Butson: Technology enhanced analytics in higher education, International Association for Development of the Information Society, 2013 (1), 89–96.

[2] L. Yang, H. Zhang: Big data technology for teaching quality monitoring and improvement in higher education --joint K-means clustering algorithm and Apriori algorithm, Systems and Soft Computing, Volume 6, 2024.

[3] X. Bai, F. Zhang, J. Li,et al: Educational Big Data: Predictions, Applications and Challenges, Big Data Research, 2021(26-):26.

[4] S. Huang: Big data processing and analysis platform based on deep neural network model, Systems And Soft Computing, 2024, 6.

[5] S. Mckenney, Y. Mor: Supporting teachers in data-informed educational design, British Journal of Educational Technology 46 (2), 265–279.

[6] S. Ge, C. Bai, Q. Wan: Hadoop based college student behavior warning decision system, IEEE International Conference on Big Data Analysis, 2018, pp. 217–221.

[7] Y. Meier, J. Xu, O. Atan, M. V. D. Schaar: Personalized grade prediction: A data mining approach, IEEE International Conference on Data Mining, 2016, pp. 907–912.