ORIGINAL ARTICLE

School-Based Practice Based On Supplemental Instruction of Big Data In Education

Xiaoyu Li,[1] Jianping Xia[2]

1. *Chengdu Xichuan Experimental School, Chengdu 610041, Sichuan, China*
2. *Zhenjiang Experimental School , Zhenjiang 212000, Jiangsu, China*

***Abstract**: The rise of big data technology provides direction and support for the reform and development of education. Big data technology can realize the inventory management and effective dynamic monitoring of schools, students, and teachers. It is conducive to comprehensively and accurately controlling the development of teaching activities, injecting new ideas and working ideas into teaching activities, and providing essential guidance for personalized teaching. This paper reviewed the detailed process of applying big data in education to teaching practice based on the case of a middle school in China. Furthermore, it pointed out the factors hindering the large-scale development of big data in the education field, aiming to provide directions for applying big data in education.*

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***About Author :** Xiaoyu Li, Vice Principal, Chengdu Xichuan Middle School, Wuhou District, Chengdu 610041, Sichuan, China. Email: 1005711634@qq.com.*

Question

WITH the innovation and development of information and communication technology, the fourth technological revolution with big data as the core has changed all aspects of people's life, work, and study in an unprecedented situation. In the context of big data, various phenomena and social behaviors can be "digitized." Big data technology can accurately identify individual needs and then provide targeted public services. This also applies to education.

The United States is a pioneer in research and the application of big data in education. As early as 2002, the U.S. government issued the "Science Education Reform Act," proposing the use of educational data as supplemental instruction decision-making. In 2009, the United States implemented the School of One program, which proposed learner-centered learning to provide learners with a personalized learning environment. In 2012, the U.S. Department of Education proposed promoting the reform of the U.S. education system by mining and analyzing big data in education, analyzed typical cases, made recommendations for implementation, and guided schools to apply big data (Zhang, 2019) effectively. Besides, big data used in education is also attracting attention in other countries. For example, Japan advocates using big data and other information technology to achieve efficient education reforms and optimize its talent structure. The European Union proposes a strategic policy of using big data in education to increase the penetration rate of education; Singapore regards big data as one of the country's key technologies and tries to adopt big data in education realizes the individualization of education.

The development of big data in education in China began with practice, and the strong support of relevant policies also laid the foundation for the growth of big data. Zhou (2020) et al. gave a detailed introduction to the development of China's education informatization. Through a series of policy formulation and resource construction measures, the Chinese government has made big data essential support for education modernization, providing the possibility for personalized learning and differentiated management, and promoting precision teaching (Xu, 2020).

However, looking at the relevant research on big data in education in China, it is found that China still has some problems with the application of big data in education. Zang (2017) mentioned that principals and other teaching managers with advanced con-

Correspondence to: *Jianping Xia, Principal, Zhenjiang Experimental School, Zhenjiang 212000, Jiangsu, China. Email: xwph123@163.com.*

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cepts dare not implement the big data in education model on a large scale; there is no specific practice in the front line of education and the disconnection between the experts and the front line of teaching will lead to the inability and low efficiency of big data in Chinese education. Liu et al. (2016) believed that due to the uniqueness and complexity of the education system itself, big data in China education faces many challenges such as application landing, data security, data governance, and operation.

To effectively solve these problems, many schools in China have spontaneously explored the teaching application of big data in education and have accumulated some experience in the process of school-based practice. This paper took the school-based practice of a middle school in China as an example, discussed the integration path of big data in education and education and teaching, and tried to summarize the detailed process of big data in education applied to teaching, with a view to the integration of education technology and teaching to provide education with direction and support.

Practical Application Based On Big Data

In the context of big data, various learning resources and methods provide learners with learning convenience, but due to the network's intricacies, they often cause learners to lose their direction in knowledge. Therefore, this requires teachers and other educators to summarize and organize related teaching resources, adjust corresponding strategies and methods, and guide learners accordingly. In the school's teaching practice, the school cooperates with technology companies to help the school achieve personalized teaching and learning through the big data analysis platform. The actual application mainly includes the following three modules: the collection and storage of big data, the analysis and presentation of big data, and personalized learning.

Collection and Storage of Big Data in Education

The Steps of Big Data in Education Collection

The U.S. Department of Education pointed out in the bulletin "*Improving Teaching and Learning through Educational Data Mining and Analysis*" that the application of big data in the field of education mainly includes Educational Data Mining (EDM) and Learning Analytics (LA), two significant directions (Bienkowski et al., 2012). Among them, EDM is the premise of learning analysis. It is extensive use of mathematical statistics, machine learning, and data mining techniques and methods to process and analyze big data in education; through data modeling, it discovers the correlation between learners' learning results and learning content, learning resources, and teaching behavior variables, and finally predict the future learning trend of learners (Xu et al., 2013).

In school-based practice, student learning data collection is the first step and the most critical necessary work. When collecting data, teachers first need to standardize the amount and type of questions in the homework, and the knowledge points for

each question should be accurately equipped to cover the level of ability that each student can achieve. Teachers should also standardize the homework style and guide students to use A4 size loose-leaf answers on both sides to improve daily scanning work efficiency. Third, teachers should select high-precision scanning equipment to extract information to ensure that scanning accuracy reaches 100% without any omissions or errors. Among them, teachers can flexibly use various homework correction methods, which can scan first and then review online to complete the review work anytime and anywhere. Teachers can also manually review and then scan, keeping the marks of corrections so that students can review the teacher's correction ideas and summarize the improvement methods. To ensure the normalization of educational data collection, the daily, weekly, and semester phased test data can be included in the collected ranks and effectively classified according to the test's date. Let students have traces of homework completion in each period and form corresponding trends to help teachers better predict students' development in future learning activities.

Use of Big Data Related Technical Tools

In the era of big data, collecting student learning data is long-term and continuous, and the various types and complex structures of data involved in the teaching process have also become a collection trend. Therefore, traditional data storage and reading tools are difficult to adapt to more extensive data volumes, and big data technology can solve this problem. In collecting student learning data, mobile apps, WeChat applets, and online reading systems have high practicability and pertinence. They have excellent performance in diagnosing students' academic conditions, and they are potent assistants in accurately assisting teaching.

• *Mobile App and WeChat Applet*

Mobile phones have gradually become the most commonly used electronic tools in people's lives. Therefore, many technology companies develop software into mobile Apps to facilitate users' operations anytime and anywhere. Therefore, some mobile Apps have added a student learning big data system based on the digitization of textbooks independently selected by the school. A test system for student homework and test papers is prepared, systematically collecting student daily learning data, especially homework and test question data. Provide a basis for teachers' precise guidance and students' personalized learning (Jiang, 2016).

Also, in the existing related software, in order to facilitate the convenience of data collection, many companies have simplified the App into a WeChat applet, so that users can use it without downloading and installing, such as "Smart Question Book (Zhi Ti Ben)" and "Homework Helper (Zuo Ye Bang)."

In the specific operation of the school, the above two collection methods are usually shared. For example, when collecting student's protocol-guided case preview

data, students can either log in to the mobile App or use the WeChat applet to take pictures and upload the assignments. Teachers can log in to the teacher review system through a computer or mobile phone to view so that teachers can understand the students' preview in time to achieve targeted teaching.

- ## *Online Reading System*

This method is mainly for the collection of test scores. The scoring teacher distributes the scoring tasks through the online scoring system and efficiently completes correcting the scoring system's answers. Simultaneously, teachers' marking habits, i.e., objective questions do not need to be reviewed by teachers, subjective questions follow the original marking habits, and traditional methods such as a cross, tick, underline, and writing comments (Wu & Gao, 2019).

This operation method helps the teacher's marking work, and to no small extent, avoids marking errors or score statistics errors due to the teacher's negligence.

- ## *Collection Examples of Big Data in Education*

In a middle school teaching practice in China, data collection can combine "online data collection" and "offline data collection." The former collected "electronic data," and the latter collected "paper data." The freshest and creamiest real data in students' learning process can be obtained through data collection, such as traces of students' answers and teachers' corrections.

Online data collection mainly uses digital online classroom teaching platforms and learning terminal equipment to record students' questioning interaction, acquisition feedback, online homework, and other situations in online classrooms, and then generate relevant learning data. For example, to adjust the teaching progress to understand the students' mastery of knowledge points in time, teachers can publish questions on the intelligent learning platform, and the platform can quickly collect student answers after students answer on the terminal.

Offline data collection mainly reflects the entire process of students' after-school study and learning effect by recording the traces of each student's homework, weekly practice, and each exam. There are two modes of offline data collection: the data collection mode of "correction before scanning" for daily homework. Based on not changing the original learning and working mode of students and teachers, normalized data collection can be carried out, and even traces of teachers' corrections and students' corrections can be retained. The whole process is to collect students' daily homework or practice papers based on the formal review and use high-speed scanners to collect student answers and teacher's correction traces and save them to the cloud. Teachers can view the collection on the teaching diagnosis cloud platform at any time through mobile phones, computers, and other terminal apps. Moreover, students can also check their homework feedback through mobile phones and computer terminal App. The other is

that the online scoring system does not change students' original answering mode and adopts the "scan first and then correct" method for the more extensive school exams, organizing teachers to conduct centralized online scoring and synchronize the test data.

Analysis and Presentation of Big Data in Education

Analysis of Big Data in Education

• *Purpose of Analysis*

As a significant branch, big data in education has the same function as big data. The most important thing is to draw corresponding conclusions by mining and analyzing the collected data. The big data obtained through the online learning platform is massive and fragmented. Therefore, it is necessary to use technical means to summarize and filter the big data and generate valuable teaching information. In this regard, suitable analysis tools can be selected from the basic framework of distributed systems, Hadoop, Hadoop-based Hbase, Hive, Maowt, Zookeeper, Pig, and Sqoop, and data mining can be performed using classification analysis, cluster analysis, and recommendation systems. Then coordinate all kinds of related education data and extract the hidden data value (He, 2019). The analysis of big data in education analyzes the dynamic changes in students' daily behaviors from teaching data according to different scenarios and levels and promotes students' overall development. By integrating students' historical data and current data to predict their future development, education practitioners can understand students' conditions in real-time, make predictions and warnings about possible situations, and provide teachers and students with personalized resources.

• *Big Data in Education Analysis Application*

Big data in education, as education-related data, can find the weak links and deficiencies of students in the learning process after analyzing the students' learning activity data. It can also allow teachers to make better use of the situation and make more targeted suggestions to improve their learning efficiency. The information collected through the big data platform can be used to profile learners. Learner portraits are designed to finely portray each learner's individual characteristics such as strengths, preferences, and motivations, and then conduct a more objective analysis of students, thereby helping students establish more effective learning methods. Meanwhile, after big data in education analyzes teachers' teaching behavior, it can also discover teachers' advantages and problems in the teaching process and encourage teachers to improve their teaching methods.

The report "Promoting Teaching and Learning Through Educational Data Mining and Learning Analysis" (Ren & Wang, 2016) pointed out that the analysis of educa-

tional data can be applied to learner's knowledge modeling, experience modeling and behavior modeling, learner modeling and teaching strategy analysis, trend analysis, the realization of adaptation and individualization.

In school-based practice, through the analysis of big data in education, building a learner's knowledge model requires collecting interactive data between the learner and the online learning system, such as the correct answer rate, the time spent, and the error answer repeat rate. Through the data analysis of the student's online learning time, the completion of courses and exercises, the changes in learning behavior in the classroom or school environment, and the data analysis of students' online and offline test scores, the relationship between students' learning behavior and learning effect is established to help students adjust and improve the existing learning rhythm. Through the analysis of fundamental information algorithms in student online learning systems and offline, sorting out individual learning characteristics, clustering and grouping learners with similar characteristics, and finally achieving a personalized environment for different types of learners and promoting effective learning (Zhang, 2016). The establishment of this model also provides a direction for analyzing teaching strategies and student learning trends.

- ## *Presentation of Big Data in Education*

(i) Presentation Method

With the help of visualization technology, education data's characteristics and rules can be revealed more intuitively and clearly, and it can help discover the inherent laws implicit in the data, thereby providing a basis for decision-making. In daily teaching and management, students' learning status, corresponding behavior preferences, behavior patterns, and other information will appear quite abstract in conventional tabular or text-based displays, making it difficult for observers to clearly and thoroughly understand the importance of data transmission. However, graphical and visual displays are particularly suitable for presenting this type of data. Teachers can make in-depth and intuitive interpretations of the characteristics displayed by these data, and even without too much thinking, they can accurately judge students' status and determine guidance plans or suggestions for improvement in time (Wang, 2019).

(ii) Results are Presented in Layers

The visual presentation link can present students' information obtained through big data analysis to different followers-students, education managers, and teachers in the form of intuitive graphs or charts to understand the deep meaning of the information.

1) Presentation to Education Managers

Within the scope of the whole year, the progress analysis of the scores of the students in each class, the analysis of the average score of each class, and the statistics of the error rate of the knowledge points of the students in each class can be used as a ruler to help education managers measure their academic performance and make decisions. According to the visual chart of the performance analysis of the entire grade, education managers can clearly and intuitively read the average test score of each class, the gap between the average score of each class and the average score of each grade, and the average score of each class is in the middle of the entire grade. This is an inspection of students' learning effects and an invisible test of teachers' teaching level in each class. As shown in **Figure 1**, the education manager can conclude that the average score of classes 11, 8, 7, 4, 10, and 1 exceeded the average score of the entire grade, while the average score of classes 2, 3, 6, 9 and 5 all lagged behind the average score for the entire grade.

According to the visualization chart of the progress analysis, the education manager can examine the proportion of students in each class in each grade level and can judge the distribution of the top, middle and general students in the grade at a glance. Each class's learning tasks can be designed according to actual needs, and online courses of different gradients can be provided to each class through the network learning platform. For example, the top students' class mainly provides training to expand thinking, while the teaching of classes with more general students is still based on basic knowledge. As shown in **Table 1**, education administrators can see that although class 9 had a relatively high proportion of students in the top 10%, the proportion of students in the top 30% and 60% was deficient, indicating that the polarization within the class was relatively profound. Education administrators can use comparative data to find weak subjects where students in this class generally did not perform well in the test and can coordinate curriculum resources in a more targeted manner, adjusted the teaching rhythm, and let more general students keep up with the overall progress of school teaching activities. For another example, the top 10%, 3deficient60% of students in class 11 were among the best in the grade. Education administrators can use this class as a pilot to try innovative teaching models with higher thinking content and promote students' autonomy and creativity in learning.

2) Presentation to the Teacher

Through the visual presentation of big data analysis results, class teachers can clearly and intuitively understand their classes' scores on all question types and compare them with the grade scores. Therefore, teachers can master the current level of knowledge and ability of the students in the class and the weak areas of knowledge and ability. As shown in **Table 2**, teachers can see how each student in the class he teaches scores and loses points from questions 1 to 25. As shown in **Figure 2**, the teacher can understand that the two major knowledge points of triangle and integral form are not stable at this stage, and the scoring rate is lower than the average of the whole grade. Therefore, in future learning activities, priority should be given to the replenishment training for these two knowledge points. Under the orientation of precise teaching and research, teachers

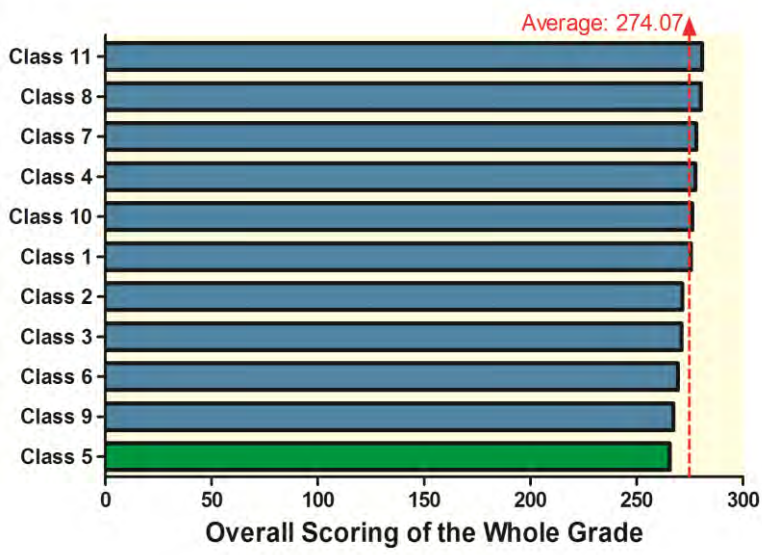

Figure 1. The Distribution Chart of the Average Grade Distribution of the Final Exam Scores of the 8th-Graders in the Second Half of the Semester of a Middle School in China.

Table 1. An Analysis Table of the Final Exam Results for the Second Half of the Semester of the Eighth Grade of a Middle School in China.

Class	Ref. #	Top 10%				Top 30%				Top 60%			
		St. #	Δ	Rate	Δ	St. #	Δ	Rate	Δ	St. #	Δ	Rate	Δ
1	44	1	-	2.27%	-	9	-	20.45%	-	30	-	68.18%	-
2	42	1	-	2.38%	-	13	-	30.95%	-	21	-	50.00%	-
3	40	3	-	7.50%	-	14	-	35.00%	-	19	-	47.50%	-
4	46	6	-	13.04%	-	21	-	45.65%	-	31	-	67.39%	-
5	43	2	-	4.65%	-	9	-	20.93%	-	20	-	46.51%	-
6	43	8	-	18.60%	-	15	-	34.88%	-	28	-	65.12%	-
7	43	6	-	13.95%	-	15	-	34.88%	-	28	-	65.12%	-
8	44	6	-	13.64%	-	14	-	31.82%	-	32	-	72.73%	-
9	41	3	-	7.32%	-	8	-	19.51%	-	18	-	43.90%	-
10	43	4	-	9.30%	-	16	-	37.21%	-	26	-	60.47%	-
11	45	14	-	31.11%	-	21	-	46.67%	-	38	-	84.44%	-
Total	474	54	-	11.39%	-	155	-	32.70%	-	291	-	61.39%	-
Max Diff.	-	13	-	-	-	13	-	-	-	20	-	-	-

Ref: Reference Student; St: Student; Δ: Change; Diff: Difference.

Table 2. Detailed Score Table of Seventh Graders' Mathematics Monthly Test in Tangquan Middle School.

C	ID	N	S	CR	GR	1	2	3	4	5	6	7	8	9-18	19	20	21	22	23	24	25
2	01	LW	78	3	21	2	2	2	2	2	2	2	2	14	15	8	3	8	6	8	0
2	02	PX	85	1	7	2	2	2	2	2	2	2	0	18	18	8	3	8	6	8	2
2	03	ZD	77	4	24	2	2	2	2	0	2	2	0	18	15	3	3	8	6	8	4
2	04	CM	61	17	65	2	2	2	2	0	2	0	2	10	6	8	5	4	6	8	2
2	05	CJ	82	2	12	2	2	2	2	2	2	2	0	14	18	8	3	8	6	8	3
2	06	MC	68	11	44	2	2	2	2	2	2	2	0	14	9	8	3	4	6	8	2
2	07	WR	68	11	44	2	2	2	2	2	2	2	0	16	15	4	3	0	6	8	2
2	08	PZ	64	13	52	2	2	2	2	2	2	2	2	10	12	4	3	4	6	8	1
2	09	CY	72	8	33	0	2	2	2	2	2	0	2	16	15	8	3	4	5	8	1
2	10	WH	72	8	33	2	2	2	2	2	2	2	0	16	15	2	5	4	6	8	2
2	11	YR	71	10	36	2	2	2	2	2	2	2	0	16	12	4	5	8	2	8	2
2	12	ZZ	53	20	76	2	2	2	2	0	2	2	0	6	6	8	3	8	0	8	2
2	13	ZS	74	6	28	2	2	2	2	2	2	2	2	14	9	8	3	4	6	8	6
2	14	GZ	62	15	59	0	2	2	2	2	2	2	0	10	12	4	3	6	6	7	2
2	15	ZJ	77	4	24	2	2	2	2	2	2	0	2	14	18	8	3	4	6	8	2
2	16	CD	63	14	57	2	2	2	2	2	2	2	0	12	6	8	3	8	2	8	2
2	17	TX	51	22	78	0	2	2	2	2	2	2	0	10	6	8	3	4	2	4	2
2	18	WY	62	15	59	2	2	2	2	0	2	2	0	12	9	8	3	4	6	4	4
2	19	YJ	54	19	75	2	0	2	0	0	0	0	2	16	9	8	3	4	4	2	2
2	20	QY	47	23	84	2	2	0	2	0	2	2	0	12	3	2	3	6	6	4	1
2	21	CY	40	24	88	2	2	2	2	0	2	2	0	5	4	4	3	4	0	7	1
2	22	LG	74	6	28	2	2	2	2	0	2	2	2	15	12	8	3	4	6	8	4
2	23	ZJ	53	20	76	2	2	2	2	2	2	2	0	10	9	4	3	4	4	3	2
2	24	LW	60	18	66	2	0	2	2	2	2	2	2	14	3	8	3	6	6	6	0
2	25	SQ	37	25	90	2	2	2	2	0	2	2	0	10	6	2	3	2	2	0	0
2	26	CD	18	26	98	0	0	0	2	2	0	0	2	7	3	2	0	0	0	0	0

Note: C: Class; ID: Student ID; N: Name; S: Score; CR: Class Ranking; GR: Grade Ranking
For the privacy, only the arbitrary ID and name are presented here.

can know their highest score, lowest score, average value, and a difference in teaching design and implementation by obtaining visual charts of relevant data from the big data in education platform.

Among them, in the student classroom learning evaluation statistics chart, teachers can not only see the scores of the class they teach but also the average scores of the entire grade and school. In the statistical map of teaching design evaluation, teachers can compare their specific scores in each teaching module to summarize each teaching evaluation's general orientation or click on the specific sections to view the specific scores. This way, it provides a basis for adjusting the teacher's next teaching method and developing the students' after-class supporting exercises. When it comes to each

Multiple Choice	Grade Score Rate	Class 2
1	88.46%	84.62%
Triangle	Wrong: 12	Wrong: 4
2	89.42%	88.46%
Power and Product Power	Wrong: 11	Wrong: 3
3	88.46%	92.31%
Propositions and Theorems	Wrong: 12	Wrong: 2
4	95.19%	96.15%
Power and Product Power	Wrong: 5	Wrong: 1
5	74.04%	65.38%
Integral	Wrong: 17	Wrong: 9
6	88.46%	92.31%
Parallel Lines	Wrong: 12	Wrong: 2
7	77.88%	80.77%
The Nature of Parallel Lines	Wrong: 23	Wrong: 5

Figure 2. Statistics of Single-Question Error Rate in a Middle School Class (Partial).

Q #	Q Type	Points	Score	S Rate	Grade Score Rate	Class Score Rate
3	Language Use	3.0	0.0	0.0%	24.0%	19.2%
9	Reading	3.0	0.0	0.0%	44.2%	42.3%
13	Reading	2.0	0.0	0.0%	57.7%	57.7%
14	Reading	3.0	1.0	33.3%	51.9%	56.4%
11	Reading	3.0	2.0	66.7%	61.9%	56.4%
4	Classic Reading	8.0	6.0	75.0%	67.3%	67.3%
8	Reading	8.0	6.0	75.0%	55.9%	60.6%
5	Silent Writing	10.0	8.0	80.0%	78.6%	84.6%
17	Composition	30.0	24.0	80.0%	69.2%	68.7%

Note: Q: Question; S Rate: Score Rate.

Problems to be Worked On

Language Use: 3

Reading: 9, 14

According to the student's performance in the exam, these incorrectly answered questions are relatively difficult and require targeted efforts by the student.

Questions to be Careful

Reading: 13

According to the student's performance on the exam, these incorrectly answered questions are relatively not difficult. The reason for the wrong answer may be that the student was careless or lacked attention.

Figure 3. Analysis Chart of the Individual Scores of a Middle School Student.

student's learning data in the class, big data shows the student's scoring situation and scoring rate for each question type to summarize the knowledge points and ability points involved. Finally, a personalized comment report for individual students is generated, which then reminds students to consolidate based on the cognitive shortcomings reflected in the data and strive to grasp all knowledge points firmly.

3) Presentation to Students

According to the visual presentation of significant data analysis results, students can understand their scoring rate and loss of points in each subject, to compare with the scoring rate of the class and the entire grade, and clarify the weak subjects that they need to work hard and check for missing points. With the system's assistance, a more targeted and personalized training plan is formulated, aiming at the error-prone and easy-to-miss knowledge points outside the scope of achieving the maximum practice effect in a limited time. As shown in **Figure 3**, the student can accurately find that his language ability and reading ability are far below the grade average and need to be strengthened; then, he will be diligent in future exercises to effectively improve his weaknesses.

Develop Personalized Teaching and Learning Plans

Using big data analysis and processing technology, it is possible to construct a student model, including student preview, classroom performance, homework, mastery of various knowledge points, and interactive communication. Teachers and parents can provide students with personalized learning strategies through the analysis of learning models. By observing their learning model, students can also discover their deficiencies and promote their ability (Jiang, 2013).

Personalized Teaching

Through data collection in the whole process of teaching and learning, big data analysis and processing technology are used to sort out the different cognitive characteristics, learning styles, and mastery of each student's knowledge points. According to students' different learning characteristics and knowledge weaknesses, individualized learning strategies and methods are formulated to achieve individualized teaching.

Teachers can classify knowledge points according to different levels of difficulty. By learning data collection and analysis technology, fully considering each student's homework test and the mastery of knowledge points, students are grouped and matched according to the three excellent, medium, and qualified levels. In class, teachers can give students questions of different difficulty at corresponding levels to meet students' individual needs, which dramatically improves teaching efficiency and truly achieves personalized teaching. Teachers can also gather students who have misunder-

stood the same knowledge point according to their understanding of the knowledge point and conduct targeted explanations and training to help students improve effectively and make rapid progress. According to the labeling of knowledge points and the analysis technology of big data, teachers can record micro-classes around high-frequency wrong knowledge points and provide them to the corresponding students so that students can "complement learning" in a targeted manner after class and solve their learning difficulties (Liu, 2020).

Each teacher will be equipped with a pad connected to the school's teaching practice's electronic whiteboard. First, teachers can use the Pad to control the electronic whiteboard content anytime and anywhere freely. For example, control the playback of PowerPoint, present electronic documents, and call electronic textbooks. Second, teachers can send teaching materials to students in class through the big data platform. For example, provide content for students to read independently, send screenshots to students, and share screens and documents. Third, the Pad can display the teacher's content and can be used to display the exercises completed by the students in the classroom and the operation process in the hands-on practical activities. For example, the objective question test in the classroom allows students to judge all multiple choice questions through the terminal and upload them directly. In the end, the system generates a statistical chart of academic conditions based on the test results of the students, showing students' common error-prone points; at the same time, teachers can also take pictures of students' problem-solving process and project them on a large screen to facilitate group commentary.

Personalized Learning Interaction

Traditional teaching can only satisfy the one-way interaction between teachers and students, and it is difficult to stimulate students' interest in learning. Therefore, it is easy to feel bored and feel lonely while studying. Moreover, the personalized learning interaction design based on big data can collect feedback information between teachers and students, students and students in time. This will make the communication and interaction transition from simple one-way communication to two-way information exchange.

- ### *Teacher-Student Interaction*

Teachers use big data analysis and processing technology to give students quick feedback on the difficulties encountered in the learning process to help them grow, prevent fear of learning, and increase their learning initiative. As for students' common problems, teachers can explain them synchronously or asynchronously according to the schedule. For individual issues, students can communicate individually. According to different knowledge points, explaining to students is also different so that any questions can be answered (Xu, 2020).

- ## *Student-Student Interaction*

By collecting the whole process of student learning activities and learning analysis technology, teachers can organize students with close learning styles, cognitive characteristics, and knowledge points to form an online learning group, thereby promoting student cooperation and progress. In addition to the discussion and exchange of knowledge, students can also communicate with each other emotionally, share anecdotes in life and learning experiences and insights, thereby promoting students' non-intellectual abilities.

- ## *Interaction between Students and Resources*

The interaction between students and learning resources is also called personality interaction. Massive online learning resources are the basis of personality interaction. However, facing the interaction of massive learning resources, students will be dazzled and lost in the world of resources. The personalized teaching of big data can collect and analyze the whole process data of students' learning activities and recommend personalized learning resources for students in line with their learning style and cognitive characteristics. It aims to help students break a clear path in the loss of resources, let students become active knowledge builders, and improve teaching quality (Wang, 2019).

In the school's teaching process, teachers can analyze students with similar academic abilities based on big data and divide them into groups. Each group has its discussion block. In class, teachers can use Pad to roll out random names and group responses to design classroom interactions; students can use Pad to ask questions, whether, in doubt or question the teacher's teaching content, they can ask. In this way, equal dialogue between teachers and students can be achieved. Besides, teachers raise the main issues for discussion in class, and students can express their opinions and opinions on the discussion platform provided by Pad on this issue, and others can refute them. Of course, students can have face-to-face discussions in class and finally upload the discussion results on the platform, and then the teachers and students can comment together. After class, the full-time teacher or group leader decides the topic and time of discussion in real-time, and the group members make adequate preparations offline and enter the discussion block to participate in the discussion within the specified time. For example, the first group discussed the topic "Group Weekly Study Plan." The group leader is responsible for notifying the other group members to discuss on time at 7:00 pm. Each group member will enter the network discussion area at 19:00. The group leader controls the entire discussion process; each member takes turns to express their opinions, and finally, the group leader supplements and summarizes the members' opinions.

Personalized Exercises for Students

Personalized exercises are different from traditional offline paper exercises. It has the following salient features: diversified practice environment, digitized knowledge carrier, hierarchical practice content, initiative in practice, high efficiency in practice, and three-dimensional process evaluation.

After studying in class, the teacher will assign homework to the students' new learning content and then assign homework to know that they do not master well and often do wrong. After a while, a particular review of the knowledge that has been learned will be conducted, and homework will be assigned according to the review content. Based on this, students' homework can be roughly classified into three categories: practice for new knowledge points, practice for error-prone knowledge points, and practice for consolidation of knowledge points.

- *The practice of New Knowledge Points*

After class, students can enter the practice system classified by knowledge points to complete the corresponding exercises. The new knowledge point is the starting point of the whole exercise. Through practice, students can consolidate the knowledge points learned in class. Simultaneously, teachers can understand each student's learning situation according to each student's work and provide targeted exceptional guidance to each student in time. The goal of the knowledge point exercise is to do all the test questions enough times. In the actual process, each student is continuously learning new content, new knowledge points and question banks are always open, and teachers are continually expanding new questions, so students will continue to have questions to do, so they are in a virtuous circle (Wang, 2019).

- *The practice of Error-Prone Knowledge Points*

After the answer is completed, the answering error will automatically enter the wrong question bank, and the attribute of the test question will change. The next time the system selects test questions, it will first select from the wrong question bank and then from the regular test question bank. By allowing students to repeat the exercises on the wrong question bank often, the system will automatically judge the question as mastered and delete the question from the wrong question bank after a certain number of correct answers to each wrong question in the wrong question exercise. If the student continues to answer incorrectly, the system will punitively increase the number of times the question needs to be answered correctly. After the students have completed all the new knowledge point exercises and wrong question exercises, it can be considered that the students have mastered the knowledge content in a short time.

- *Knowledge Point Consolidation Exercises*

When the review time arrives, the big data system will automatically select the review range and randomly select 20% of the test questions to form a test, allowing students to complete all exercises within the specified time. Among them, the questions that students make mistakes will automatically enter the wrong question bank, and the questioning mechanism is the same as the common wrong questions above (Dai, 2017).

In teaching practice, the smart learning terminal on the Pad can compare the student's loss of each item type in the exercise with other students in the class, thereby showing the weak knowledge points that confuse students and track their mastery in real-time. In addition, the personalized recommendation system on the smart terminal can capture the most straightforward points for each student and evaluate the training value of a test question in a scientific and quantitative form. After screening high-quality unit practice questions, monthly exam questions, mid-term exam questions, final exam questions, high-error questions, high-scoring questions, and other targeted and personalized questions from well-known schools and well-known tutorial books in recent years, it helps students to play steadily and quickly improve test scores. Besides, the flexible use of the personalized guidance book "One Person One Practice," which is generated based on student reports, can accurately formulate targeted high-quality remedial exercises based on students' abilities and error-prone knowledge points, freeing students from traditional problem tactics. In this way, the maximum practice effect can be achieved within the limited practice time.

Personalized Evaluation

• *The Significance of Personalized Evaluation*

Personalized evaluation is a crucial factor running through big data personalized teaching. It aims to achieve the purpose of evaluation and promotion of learning and cultivate the spirit of students who dare to learn, love learning, enjoy learning, and know-how to learn. First, through the collection and analysis of learning process data, students can adjust their own learning pace concerning their classmates' learning conditions. They can even break free from the shackles of "teacher teaches, students, learn" in the traditional sense, thereby evaluating teachers' teaching methods or making suggestions for different views of teachers' teaching strategies. Second, big data provides technical support for the development of a variety of personalized evaluation methods. Through the evaluation of groups, classes, teachers, and students, students can be evaluated in pairs. Finally, expand the space of evaluation learning, mobilize students' enthusiasm for participating in the evaluation, help students adjust learning methods, enlighten learning thinking, eliminate learning contradictions, and further promote students' personality development (Li & Li, 2020).

• *Classification of Personalized Evaluation*

In personalized teaching based on big data, the evaluation methods used include rubric evaluation, performance evaluation, and electronic evaluation plan (Zhang, 2017).

Rubric evaluation refers to a structured quantitative evaluation standard. The evaluation indicators are delineated from multiple aspects of the evaluation objectives, which are accurate, practical, and unified subjectively and objectively. In personalized teaching based on big data, rubric evaluation of related resources and knowledge helps students clarify learning objectives and requirements.

Performance evaluation is the process of creating results or completing required tasks. Personalized evaluation based on big data allows students to choose slides, electronic assignments, and videos to demonstrate their performance fully. It can help students master and consolidate knowledge better and cultivate students' practical ability and innovative spirit.

E-learning archives refer to the management of digital archives of students' homework, drawings, and grades, as well as teachers' comments. With the tracking and analysis of big data technology, we can observe and record students' learning behavior to realize adaptive learning feedback and provide personalized learning guidance. The collection and management of student learning process data can encourage students to reflect and make students more active in self-evaluation (Wang, 2019).

• *Analysis of Individualized Evaluation Examples*

In school-based practice, teachers mainly use the four aspects of curriculum content learning evaluation, participation in interactive communication analysis evaluation, examination and learning work evaluation, and extracurricular resource learning evaluation to make a comprehensive and multi-angle personalized evaluation. It aims to make sure that students can achieve the required level of learning.

The curriculum content learning evaluation standard mainly comes from the curriculum content in the personalized evaluation system and the recording and analysis of the learning database. The student's study's length, the knowledge points learned, the number of knowledge points learned, and the study notes' content.

The analysis and evaluation of interactive communication is an assessment of students' Q&A in class and the frequency of extracurricular interactions. The information points it evaluates to learners include the number of questions posted and answered on the Q&A platform, the number of questions asked by the reply, the number of selected questions obtained through evaluation, and the number of high-quality questions.

Evaluating examinations and learning works principally based on the unit exercises and examinations students usually carry out and evaluate students' learning works based on the learning content carried out in class. In the evaluation and examination modules, the evaluation elements of objective questions include: statistics on the knowledge points that students have a firm grasp and vague concepts, and score statistics on different gradient questions; subjective questions mainly review students'

knowledge group scores and content integrity. The evaluation of learning works is divided into individual work evaluation and group work evaluation. The individual works mainly evaluate students' performance and content design, while the group works evaluate students' task participation, achievement contribution, and collaboration and communication among members.

Finally, the evaluation of extracurricular resources learning mainly evaluates learners' curriculum development resources in the informal learning process. It refers to the knowledge points of text courses, the number of on-demand video courses learned on the students' extracurricular learning platform, and the frequency of online reading and resource download to comprehensively inspect the intensity of students' independent learning after class.

Concluding Remarks and Perspectives

Studies have shown that information technology has played a certain role in students' academic performance (Fang & Huang, 2019; Li, 2019). Based on the understanding and application of big data, this article conforms to the actual needs of teaching activities and points out the supplemental role of big data in actual teaching. With the advent of the significant data era, large-scale online education data can be refined through data collection and analysis, and massive data can be collected, processed, analyzed, mined, predicted, and presented. In turn, it promotes the reform and development of education and teaching practice, brings high-quality feedback and personalized customization to learning and education that are different from traditional models, and realizes the all-round development of students in the real sense. In general, big data in education can meet online user management and learning needs and provide an indispensable supplemental role for education, teaching, and research.

However, the promotion of big data in the education field has also ushered in a number of opposition or doubts. First of all, big data technology requires an exceptionally high quality of people themselves. Data science is a subject that spans multiple fields. Big data practitioners must also possess intricate knowledge in multiple disciplines, such as Internet technology, informatics, and statistics, which is extremely difficult to train and has a high entry barrier. Therefore, in the basic education stage, the combination of schools and big data technology companies has become a trend, but the integration under this trend has become another dilemma in developing education.

Secondly, large-scale data analysis and processing are usually challenging to complete with personal power but need to be carried out in the form of a multi-person division of labor under a team system's constraints. In school practice, to complete a school-wide student data analysis requires the cooperation of teaching groups and information technology teachers in all grades. Especially in data collection, many teachers complained a lot because of the heavy collection workload at the beginning of school practice. In the later practice, through continuous improvement attempts, a data collection method with multiple collection methods coexisting gradually formed, and the situation has improved.

Data interoperability difficulties, lack of data format standards, data security, and privacy leakage technical issues will also hurt big data technology. At present, big data still has significant defects in the collection, storage, management, and use of user information. Therefore, if you are not careful, you have to hide or terminate the use. These shortcomings cause significant data development costs in education to be too high, so it is not suitable for large-scale promotion and use (Zhang, 2016). This is also an issue that the school has always emphasized in its cooperation with educational technology companies. It is necessary to strengthen the information protection in collecting, storing, managing, and using student data to ensure student information safety to the greatest extent.

The integration of big data technology and education is considered an effective way of education reform and development. Excellent application cases continue to appear during the integration process. In the school-based practical process, they use new ways of thinking and methods to break through the traditional teaching model's bottleneck. These excellent school-based practice cases also provide references and a basis for the application and development of big data education.

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