



Research on the Analysis and Quality Improvement of University Students' Learning Behavior from the Perspective of Big Data

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Abstract. The era of big data is not only a technological revolution, but also a revolution in thinking and paradigm. The essence of teaching quality in universities is to analyze the learning behavior of university students and improve the quality of learning. This research uses big data to track and investigate the learning behavior of S university students in the four academic years of 2016–2020, through the study activities, extracurricular learning, academic activities and graduation thesis/design, etc. Investigation and analysis, using quantified data to present the status and problems of university students' learning behavior, and proposing to establish a learning quality support system with a “three-in-one” learning behavior data collection system, a learning quality evaluation system, and a learning quality continuous improvement system. The refined teaching in the data age provides a kind of reference and reference.

Keywords: Big Data · Learning Behavior · Quality Improvement

1 Introduction

The era of big data of “data-driven schools, analysis and reform education” comes here. In 2011, <<Science>> launched its “Big Data” column, which was regarded as a major opportunity for big data generation. In 2012, the United Nations issued the White Paper on Big Data, predicting that the impact of big data will surely penetrate into all sectors of society [1]. In 2011, the United States Department of Education issued a report on Big Data Education Application, arguing that mining educational data and developing learning analysis technology is the latest application of big data on learning, pointing out the direction for the application of big data from an educational perspective [2]. In 2015, Mayer, V S. and Cukier, K. co-authored *Walking with Big Data*, explaining the impact of big data on the field of education, and causing more scholars to work on deep research on the impact of big data on the education system. In 2015, China's “Outline of Action for Promoting the Development of Big Data” pointed out that to improve the public service platform for education, promote the construction of big data in education and culture, and give full play to the supporting role of big data technology in education reform,

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marking that the application of big data in the field of education has risen to the national strategic level. In 2016, the Blue Book on Big Data Development of Basic Education in China was released, as the first education big data development report in China, in which the basic theory, development concept and application paradigm of education big data are sorted out. Therefore, it can be seen that it has become the trend of educational development in the future to use educational big data mining technology and learning analysis technology to explore the relevant relationship between educational variables and provide support for educational and teaching decision-making.

Throughout the current research results, 1,146 papers were retrieved with the themes of “Big Data” and “Learning Behavior”, including 693 academic journal papers and 316 degrees. To be specific, first, the research theme of *The Times* is not clear, most researchers focus on the background of the new curriculum reform or new media to study students’ learning behavior and quality improvement, to discuss the new problems in the era of big data era is only beginning to emerge; Second, the existence of downtime in the use of research methods, most of the research of learning behavior and quality improvement focus on theoretical speculative demonstration, and relatively few empirical investigation and research; Third, the research objects are relatively single. Most of the research takes primary and middle school students, or focuses on the learning behavior research of a single subject, which does not pay enough attention to the learning behavior and quality improvement of university students. Therefore, this study uses big data to track the study behavior of S university students from 2016–2020, using study activities, extracurricular learning, academic activities, graduation paper and the design, and is helpful to provide effective reference for the analysis and quality improvement of university students in the era of big data.

2 Research Design

2.1 Learning Behavior Definition

Learning behavior is the main behavior of university students, by collecting and analyzing different stages of learning behavior and feedback during school, can understand learners inner characteristics, predict learning effect, etc., the analysis results in visual technology to teaching stakeholders, can make learners clear self-learning, adjust learning progress and learning mode, and help teachers find the deficiencies in teaching [3]. From the perspective of the form of learning behavior, online learning behavior can be divided into two types: explicit behavior and implicit behavior. Explicit learning behaviors are behaviors that can be directly recorded or observed through learners’ external performance in the learning process, including learning methods, learning content, learning results, etc., such as reading books, recording content, watching videos, discussing problems, publish posts, upload resources, and submit assignments, etc. Implicit learning behavior is mainly manifested as learners’ internal characteristics, such as learning input, learning satisfaction, learning motivation, learning social network, etc. It is helpful to discover and improve the problems in the process of teaching and training. Learning behavior analysis mainly includes learning activities, extracurricular activities, academic

activities and graduation thesis/design, among which the learning activities mainly analyze the learning initiative, the frequency of the main learning activities and the proportion of high-frequency class absence, etc.; Extra-curricular study mainly analyzes the extracurricular learning time, academic activities mainly analyze the participation of various academic activities, graduation thesis/design mainly analyzes the graduation thesis/design completion time, frequency of communication between students and students' satisfaction with instructors, etc.

2.2 Data Acquisition Situation

This study provides answer links to university students at the end of the school semester 2 of S University 2016–2017, 2017–2018, 2018–2019 and 2019–2020, where students log into the questionnaire and online answer questions for about 10–20 min. The system will automatically record the answer time, behavior and other relevant information of each respondent, and the recorded answer information will be checked, and mark the sample with abnormal answer behavior, so as to better ensure the authenticity of the data. At the same time, the questionnaire design of data tracking and evaluation fully considers the logical relationship of the problem, the different paths of the respondents and the voluntariness of the answer. The answer process is presented in real time, data transparent, the whole process monitoring.

2.3 Sample Cover Condition

Table 1 shows the total number of students in each grade of S University and the sample recycling situation. In addition, the distribution of the recycled samples of each grade, university and major at the grade, university and major levels is roughly similar to that of the actual school students. According to statistical principles, the sample is representative when the distribution characteristics of the sample are roughly close to the overall distribution characteristics. Therefore, the representative of the recovered samples is strong, which can objectively reflect the actual situation of the students.

Table 1. Number of students in each grade and sample recovery

School year	Total number of students (person)	Number of questionnaires returned (pieces)	Sample ratio (%)
2016–2017	21640	10033	46.36%
2017–2018	21421	13736	64.12%
2018–2019	20065	13209	65.8%
2019–2020	20088	14092	70.2%

sample ratio = number of questionnaires returned/total number of students

3 Study Finding

3.1 Learning Activities

Learning initiative refers to the students' learning consciously and voluntarily under the control of self-consciousness. This study measures students' learning initiative from 10 aspects, respectively, to treat homework seriously, reasonably allocate study time, review notes after class, concentrate on class, draw lessons from other's learning methods, discuss problems with classmates, discuss problems with teachers, collect/read references, summarize the knowledge learned, and formulate a short-term learning plan. The evaluation results are divided into four level, among which the people who choose "always" and "often" belong to the active learning behavior. According to Table 2, the overall learning initiative of freshman to junior students in S universities is lower than that of similar universities. There are differences in the overall learning initiative of students from various universities and majors. The high-frequency behavior of the main learning activities is "taking homework seriously", "discussing problems with teachers" and "reviewing notes after class" are the two weakest links of students' learning initiative. Students feedback that the class often or always lacks less classes than that of similar universities. In addition, the survey on the learning problems of students from freshman to junior year in 2019–2020 is mainly reflected in three aspects: "lack of self-study methods" (50%), "lack of motivation for learning content" (48%), and "not strong learning atmosphere" (42%). From the perspective of the learning assistance effect of S universities and universities, the support to students of all grades is 60% and above. Therefore, teachers need to pay attention to these three aspects, strengthen the guidance of students, mobilize students' enthusiasm for learning with innovative teaching content, and constantly create a good learning environment.

3.2 Extra-Curricular Learning Aspects

Extracurricular learning time is the most intuitive manifestation of college students' extracurricular learning investment. It can be found from Table 3 that the average first to junior students in S universities have a long extracurricular learning time per week, and it is basically the same with the increase of similar colleges. According to the specific survey, the after-school learning time is mainly invested in the completion of homework and self-study, while the time to receive off-school tutoring and training is relatively less.

Table 2. Student learning activities in the 2016–2020 school year

Institutional comparison (Similar universities)	2016–2017	2017–2018	2018–2019	2019–2020
Proportion of students' learning initiative	53.33% (63.00%)	58.33% (63.67%)	64.00% (68.00%)	71.00% (—)
Proportion of students absent from class	12.00% (13.00%)	8.33% (10.67%)	12.00% (13.00%)	—

Table 3. Extracurricular study of students in the 2016–2020 school year

Institutional comparison (Similar universities)	2016–2017	2017–2018	2018–2019	2019–2020
Students' extracurricular study time	26.3 (27)	26 (28.67)	26.33 (28.33)	27.67 (28.33)

In addition, from the “after-class discussion”, “cooperation” and “sharing learning experience” 3, investigated the enthusiasm of students' communication, found that students in each grade in 2019–2020 academic year overall communication enthusiasm is more than 70%, and improved with the increase of grade, indicating that the learning environment of S college students is better. Therefore, in terms of extracurricular learning, it is necessary to expand students' extracurricular learning space, strengthen extracurricular tutoring and training, and encourage students to enhance their own practical ability.

3.3 Academic Activities

Participating in academic activities can help students understand the cutting-edge dynamics of their professional field, exercise students' scientific research ability and academic literacy, but also provide students with various after-class learning choices, feeding back classroom learning, is one of the important learning activities of students in school. In participating in academic activities, the proportion of “academic lectures” activities is the highest, followed by participating in the “Academic Science and Technology Competition”. In addition, students believe that the most needed improvement of academic activities is “lack of teachers' participation and guidance”, followed by “not enough publicity of academic activities”, “academic activities are not organized” and “less academic activities”. Although the goal of the S university is to be a regional high-level applied university with teacher education as its characteristic, agriculture and engineering as its development advantages, and coordinated development of multiple disciplines, from the survey, the S university needs to enrich the types of academic activities, To guide university students to participate in academic activities (Table 4).

3.4 Graduation Thesis/Design

Graduation thesis/design completion and time reflect the quality of graduation thesis/design writing and possible problems in the production process, which can provide reference for the targeted improvement of graduation thesis/design guidance. From Table 5, it can be seen that the time spent by senior graduation thesis/design is mainly concentrated in 6 months, and some students only 2 weeks, so they need to pay attention to the quality of graduation papers of some groups and give targeted guidance and help. The frequency of communication between the students and the instructor is mainly “several times a week and several times in January”. In general, the students' satisfaction with the instructor has reached more than 95%. However, the S university students still need to work hard on the quality of the graduation thesis/design. Each teacher instructs the

Table 4. Academic activities of students in the 2016–2020 academic year

Institutional comparison	2016–2017	2017–2018	2018–2019	2019–2020
Academic lecture	78%	77%	85%	76%
Academic Technology Competition	45%	38%	36%	31%
Teacher-led research projects	29%	28%	29%	23%
Student Technology Project	17%	16%	16%	12%
Other academic activities	2%	2%	2%	—
Did not participate in academic activities	8%	10%	7%	13%

Table 5. Students' graduation thesis/design situation in the 2016–2020 academic year

Institutional comparison	2016–2017	2017–2018	2018–2019	2019–2020
Overall situation of graduation thesis/design	94%	92%	94%	—
Completion time (within 6 months)	93%	91%	91%	91%
Frequency of communication (a few times a week, a few times a month)	86%	88%	90%	90%
Student satisfaction with the instructor	95%	95%	96%	97%

university students to carry out the graduation thesis/design. There is a large gap between different majors, and there are too many to ensure the quality.

4 Conclusion and Suggestion

4.1 Establish a Learning Behavior Data Collection System

Big data analysis of learning behavior, as the product of a new stage of educational information development, is an all-round and digital reshaping of learning behavior. Big data has 4V characteristics such as massive data scale, fast data circulation and dynamic data system, various data types, and huge data value [4]. From the macro level, the big data analysis of learning behavior is conducive to promoting the transformation of education management mode from extensive management to fine management, and education management mode from static to dynamic management, so as to provide a scientific basis for educational decision-making; From the perspective of middle view, it is conducive to promoting teaching from experience perception and computing aided teaching to data-driven precision teaching, teaching and research from theory-based deductive reasoning to data-based inductive reasoning; From the micro level, through the collection of learners' all-round and large-scale learning process data, education is guided to return to "teaching students in accordance with their aptitude", to provide

precise support for personalized teaching. Therefore, establishing a learner-centered learning behavior data analysis system and quality improvement is the basic condition to develop a deep-level, intelligent and comprehensive learning analysis system.

4.2 Improve the Whole-Process Evaluation System of Learning Quality

The era of education big data should focus on “teaching” to “learning”, pay more attention to the learning process, learning effect and learning quality output of university students, and return to the essence of higher education cultivated by high-quality students. Based on this, “the core dynamics of big data development comes from the human desire to measure, record, and analyze the world” [5]. However, this motivation comes from the monitoring and accurate evaluation of university students’ learning quality. In the traditional sense, it is used to evaluate students’ learning quality with examination scores, focusing on the assessment of learning results, while ignoring the learning process and development evaluation of university students, which is manifested as the one-way evaluation of university students. Relying on the support of big data, it has changed from learning conclusive evaluation to process and developmental evaluation, and from a single examination evaluation to a diversified comprehensive evaluation. Therefore, the core content of the learner-centered analysis and quality improvement of university students is to establish the whole-process evaluation system of learning quality and pay attention to the cultivation of students’ knowledge acquisition and integration and self-evaluation.

4.3 Improve the Continuous Improvement System of Learning Quality

“Data-driven decision-making” has become a popular language in education. The big data is used to conduct learning behavior analysis and quality improvement of university students, the purpose is to timely and effectively find the problems of learning quality, provide learning improvement services for university students from technical, social, teaching and other dimensions, and effectively solve the learning difficulties of groups with learning difficulties. On the one hand, teachers use big data feedback results to observe students’ learning situation, which can have a more comprehensive understanding of students’ learning situation, so as to help university students adjust their learning state, formulate scientific and reasonable learning improvement plans, and carry out the application according to their materials. On the other hand, what students get is no longer only a transcript of score and ranking, but a “learning evaluation report”. Through big data, they can understand their personalized learning characteristics such as learning path, learning style and learning preferences, and can clearly understand their own problems and deficiencies, carry out accurate learning and improve learning performance. Therefore, the establishment of a learner-centered learning quality continuous improvement system, which has become the common appeal of teachers, students and other groups, is the fundamental guarantee for university students’ learning behavior analysis and quality improvement (Fig. 1).

To sum up, in the era of big data, learners center, establish learning behavior data collection system, learning quality evaluation of learning quality system and learning quality continuous improvement system “trinity” learning quality support system, can

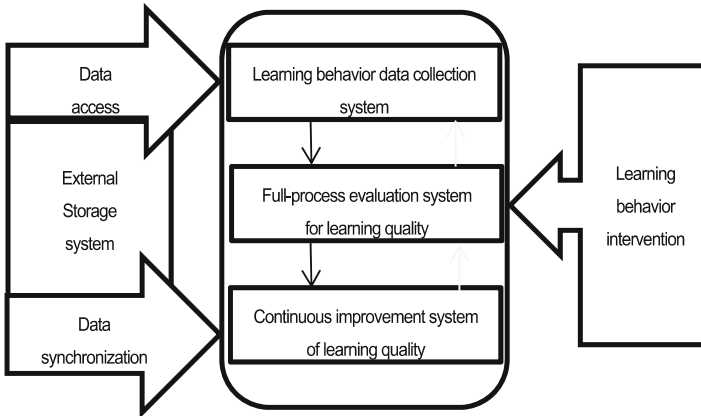


Fig. 1. The “trinity” learning quality support system

effectively realize circular feedback teaching reform, provide “three-dimensional” support for university students to learn, to ensure that university students truly become the master of learning.

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