Advances in Educational Technology and Psychology (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/aetp.2023.070906
ISSN 2371-9400 Vol. 7 Num. 9

Research on Smart Teaching Based on Online Learning Data

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Keywords: Online learning data, Visual research, Psychological anxiety, Emotional fluctuations

Abstract: The addition of online platforms has a positive impact on both sides of the teaching and learning. Compared to traditional offline classrooms, the addition of online platforms can provide richer learning support for both sides of teaching and learning. The online platform can record the entire learning process data of learners. The software tools of SPSS and Origin can be used to compare and analyze the learning data such as learning frequency, duration, etc. Based on visual data analysis, teachers can intuitively and accurately understand learning behaviors of learners during their learning process. The teaching methods and organization can be optimized, which can make the learning process "Smart".

1. Introduction

At present, online teaching and mixed online and offline teaching have gradually become the new normal in Chinese university teaching. The integration of information technology and education has made teaching situations increasingly diverse and brought about large-scale, multi-modal learning data. It has become a hot spot for innovation in university that the teaching transformation is driven by learning data. It has been proposed to accelerate the educational transformation in "China's Education Modernization 2035". The most important part of the transformation is to promote the transformation of educational governance methods, including accelerating the formation of a modern educational management and monitoring system, and promoting precise management and scientific decision-making. In the key points of Ministry of Education's work during 2022, it has been also proposed to implement the strategy of digitalizing education, strengthen data mining and analysis, and construct a new mode of educational governance based on data.

Although the promotion of online learning in data analysis has become a consensus among most university teachers, the subjective judgment is still the main basis for analyzing teaching strategies, teaching processes and implementing teaching evaluation, which makes the results usually lack objective basis. There still exist certain difficulties in understanding, acquiring and efficiently using learning data. By combining with the practice of online and offline mixed teaching in recent years, this paper makes research and practice on smart teaching such as accurate teaching diagnosis through the classification, arrangement and analysis of learning data.

2. Definition of Online Learning Data

Online learning has distinct digital characteristics and generates a large amount of learning data in teaching stages such as before, during, and after class. The learning data includes learning time and frequency, online practice, testing, Q&A communication, etc., which can be recorded in real-time by online platforms. These learning data, combined with the data collected as needed during teaching process, constitute the collection of online learning data. Strictly speaking, these data is not big data but falls under the category of "learning analytics" or "learning experience" data [1, 2]. However, it still has important guiding significance for optimizing teaching to collect and analyze such learning process data [3,4].

From the perspective of learning big data, Mo zhijia et al. [5] used educational data analysis to analyze the performance effects of learners in the learning process and established a prediction model for learning outcomes; Wang Xiaonan et al. [6] combined with professional course teaching to study the process evaluation based on big data. Wu Suling [7] used the mental health course for college students as an example and combined learning data from blended learning to study the diagnosis of learners' learning psychology and behavior. Wu Yan et al. [8] analyzed the evaluation mechanism of blended teaching modes based on online open courses from the perspective of university management. Considering the large amount and dynamic nature of learning data, it is still the research focus for current blended teaching reforms to select feature data, which is the key factor to quantify the process assessment and construct a smart teaching system.

3. Misunderstandings in Data-Driven Teaching Based on Online Learning

3.1. Lack of Understanding of Online Learning Data

Although online learning data may not strictly be considered big data, it still exhibits distinct 5V characteristics, namely volume, variety, velocity, veracity, and value [9]. At the same time, according to hierarchical features, online learning data can be divided into multiple levels such as individual, school, and regional. According to data types, the online learning data includes various types, such as student information data, management data, teaching data, and service data. Currently, whether it is online MOOC teaching or blended online and offline teaching, learning data is still not well understood in terms of types, characteristics, and security to many teachers [10].

3.2. One-Sided Use of Online Learning Data

Online teaching and blended online and offline teaching have gradually become the new normal of college teaching. The promoting role of learning data in teaching has been recognized by many teachers. However, the learning data is habitually used basing on traditional educational concepts. For example, the static data is more focused while the dynamic changes of data are overlooked. And the learning data is one-sidedly understood as learning outcomes, such as students' ranking, excellence rate, pass rate, and so on[11]. Many times, the learning data is only used as a means to reduce workload. The adjustment of teaching process and strategies mostly comes from subjective experience judgment, while the analysis of learning data is neglected.

4. Psychology Diagnosis Practices Based on Online Learning Data Analysis

4.1. Research on the "Virtual Personality" in Online Learning based on Behavior Data Analysis

Emotional communication plays an important catalytic role in teaching. Teaching is a bilateral

activity involving both teachers and students, where teachers optimize teaching and feedback based on students' different needs, and the learners solve hard problem in learning. Rich emotional exchanges are involved during the learning process. Different students will exhibit different learning habits and thinking styles. And even the same student often shows different learning behaviors during different stages learning and different learning tasks. Based on online platforms, "one-to-many" teaching mode can be achieved through simultaneously obtaining all the learners' process data, including learning time, number of learning sessions, practice tests, Q&A discussions, etc. By comparing stage data and individual to overall data, learning habits, and behaviors can be visualized through data charts and other means. Then the individual learning portraits can be achieved.

As shown in figure 1, the portrait of online learning habits in a certain class is given. It can be seen that some students' data items, whether they perform well (as shown in dashed box 1) or poorly (as shown in dashed box 2), all show a certain degree of consistency. However, there were also a considerable number of students who exhibited individual differences in the three data items. Special attention was paid to a small number of students (indicated by the red short arrow) whose learning rates (video learning duration, frequency) and other data were at a low level, but other data, including interaction, homework, were well completed. There had a clear contradiction in the data. Similar data is distributed across different grades and classes. The communication with this group of students indicated that their low learning progress was due to learning tendency issues. Their acceptance of video learning methods was relatively low, and it brought about abnormal learning emotions.

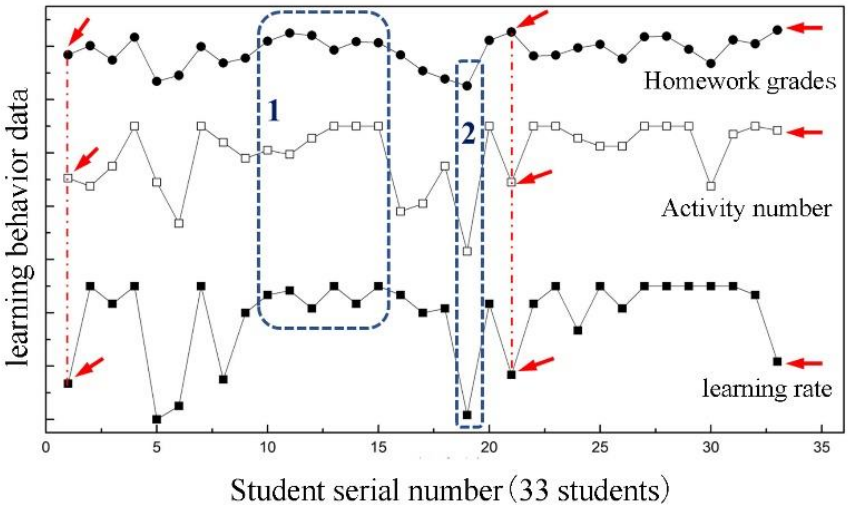

Figure 1: Learning personality portrait based on learning behavior data (University Physics I, 2022 Spring/Summer Semester)

Figure 2 shows the video learning data for chapters 1-2 of the online course "University Physics I" from a certain college in the spring and summer semesters of 2020. The data shows that the cumulative number of views for sections 2.2 and 2.3 is significantly lower than that of the previous three sections. And the viewing time (13.8 minutes) for the application of Newton's law in section 2.3 is lower than the actual video duration (13.94 minutes), which is distinct from the situation where viewing time is higher than the video duration in other sections. Through the analysis of the video learning data, interactive Q&A is released for timely feedback. And it was discovered that on the one hand, students show a certain interest in physics history, but on the other hand, they encountered significant difficulties in learning the application of Newton's law. Targeted exercises and real-time Q&A interaction are provided to facilitate students' self-directed learning, which were beneficial to improve the learning efficiency of this chapter material.

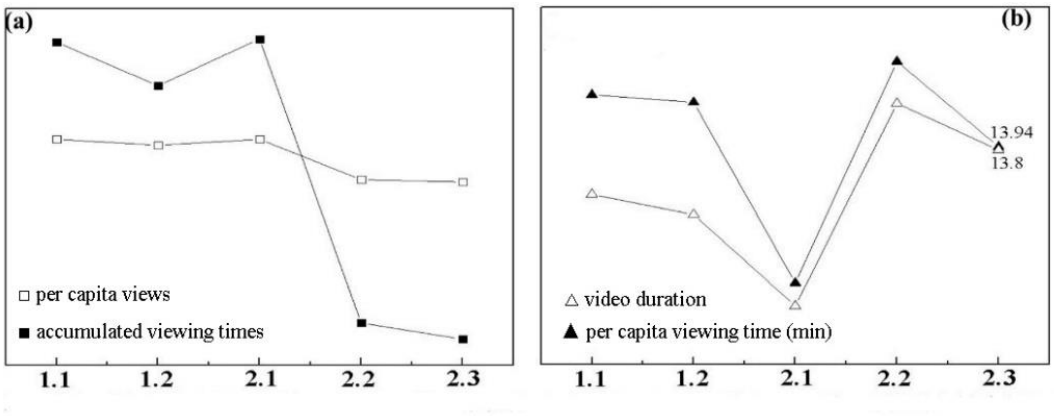

Figure 2: Comparison of online video learning attendance data (University Physics I, 2021 Spring/Summer semester)

4.2. Identifying Inconsistencies between Preset and Output

Different learners have different knowledge backgrounds and ability levels, which results in different speed of knowledge acquisition and understanding. Even the same learner may have different learning rhythms when faced with different content. In actual teaching process, there is often a contradiction between teaching expectations and learning outcomes.

One of the most common problems is that the teaching plan progress and the students' mastery level are not synchronized. The teaching plan progress is usually set by teachers based on their teaching experiences with the requirement of pre-designed and uniformity. However, in actual teaching, especially for large class courses, due to individual differences, it is easy to have a discrepancy between students' mastery level and the outline progress, even to the point of serious deviation. Whether it is online MOOC or online-offline hybrid teaching, based on the online platforms, teachers can conveniently obtain their students' periodic learning data, such as learning progress, learning resources preview, homework review, and forum interaction data. By analyzing the periodic learning data, it is beneficial for teachers to promptly follow up on the students' mastery level and make appropriate adjustments to the teaching progress.

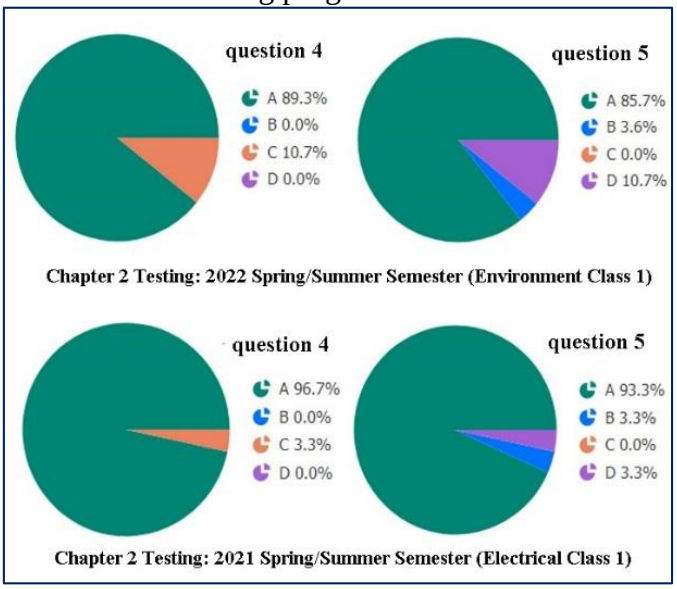

Figure 3: Online test data analysis (University Physics I, 2021 Spring/Summer semester)

As shown in Figure 3, the data analysis of the two exercise questions for the unit test of Newton's Law of Motion in chapter 2 of the online course "College Physics I" for the spring and summer semesters of 2021 and 2022 is presented. For the two test questions, the 4th question is an intensive exercise on fundamental problems in Newton's law of motion and dynamics, while the 5th question is an analysis of instantaneous acceleration in Newton's law of motion. The initial difficulty values for the two questions were set to 3 and 2 respectively. However, from the results of the answers, it can be seen that in different classes with different teaching cycles, the score rate for the 5th question, which has a lower preset difficulty value, is lower than that for the 4th question. And the interference items for both questions also show consistency.

4.3. Comparative Analysis of Smart Teaching Effectiveness based on Online Learning Data

Figure 4 shows a comparison of the overall evaluation scores of College physics courses in the textile major of the certain college for two semesters, 2019-2020-2 and 2020-2021-2. The 2019-2020-2 semester was conducted through offline teaching, while the 2020-2021-2 semester was conducted through a hybrid model of online and offline teaching. As a featured major of the university, the students of textile mayor come from different provinces and cities with significant differences in their basic learning abilities. Figure 4 shows a box scatter plot of the distribution of those students from 2018 and 2019 grade of textile major in the certain college. From figure 4, it can be seen that there is not much difference in the student number of high segment between the two grades, while in the low segment, there is a significant improvement in the blended teaching class.

The result confirmed that after adopting the hybrid model of online and offline teaching, hotspots and difficulties in learning processes can be promptly discovered through online learning data analysis. And the problems can be identified and targeted measures can be taken, which made the teaching process smart. Compared to the traditional offline classroom model, the smart teaching based on online platforms has significantly improved various aspects of teaching, including addressing difficulties and promoting excellence, resulting in good teaching effects.

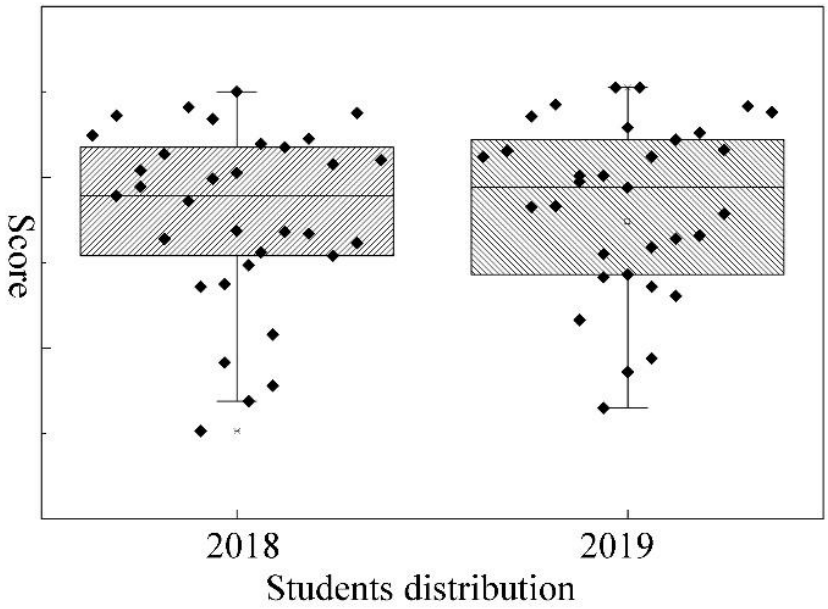

Figure 4: Comparison of teaching effects between 2018 and 2019 textile mayor

5. Conclusion

In this article, online learning data is visualized by combined software tools of SPSS and Origin. The results indicate that learning data analysis is of great significance for psychological diagnosis during the learning process. By analyzing process data such as participation, a learning personality portrait of learners can be formed, which is beneficial for teachers to timely detect emotional fluctuations such as psychological anxiety in individuals. And then appropriate intervention can be provided, which promotes "Internet + Education = Smart Education".

Acknowledgement

The research is supported by the Provincial Teaching and Research Project of Higher Education Institutions of Hubei Province (2021326) and Foundation project of National Demonstration for Experimental College Physics Education (NCHU, SY2110).

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