Application of Big Data in the Online Resource Construction of Course Teaching

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Abstract: Over the past decade, the integration of big data into the higher education system has revolutionized the way teaching resources are used. Educational institutions are increasingly leveraging data-driven approaches to improve the teaching and learning experience. This paper discussed the application of big data in the construction of online resources. By analyzing the current situation and challenges faced by students under big data technology, this paper put forward some strategies to improve the quality and effectiveness of online education resources construction. This paper discussed in detail how to collect and analyze data, how to integrate personalized resources, how to establish feedback mechanism and how to help students to carry out collaborative learning. The implementation steps of strategy and method in course signal detection and processing were given. The paper also discussed the potential benefits of big data in personalized learning, resource optimization, and educational evaluation.

Keywords: Big Data; Online Resource Construction; Course Teaching; Strategy

1. Introduction

In the era of digital transformation, big data has emerged as a powerful tool in education reform [1], classroom teaching [2], teacher resource management [3], and distance education [4]. Several studies have highlighted the importance of big data in higher education in applications and challenges [5-7], online teaching status [8], teaching mode [9], and construction of curriculum resources [10]. When discussing special course learning, Purdue university's course signals system [11] was a prime example of how big data could be used to enhance educational outcomes. Zhang [12] discussed the key applications and practical paths of big data in driving digital transformation in education. Liu et al. [13] explored the impact of big data on higher education, emphasizing the need for educational institutions to adapt to the data-driven environment. Additionally, research by Dong and Lin [14] on weak signal detection in optical communication based on big data mining provides insights into the technical applications of big data in signal processing. Although these researches were helpful for us to understand the big data in the higher education, few papers could focus on how to get data in online course constructions.

In this paper, some reasonable strategies were proposed according to students' analysis and the design of the course outcome target. This paper aimed to provide an in-depth analysis of how big data could be applied to enhance the online resources constructions.

2. Preparation of the Study

2.1 Analysis the Status of the Student

Here, signal detection and processing course was selected to implement how to organize the online resource construction with the big data. Because it is a key and compulsory course for postgraduate students in Dalian polytechnic university. The students who learn the course are from the major control science and control engineering. The contents of the course are boring and difficult to be understand. In view of the need for online resource construction, a questionnaire was designed to measure the difficulty of the course and how to improve the learning efficiency and content. The questionnaire survey showed that 75% of 200 students thought that the course was difficult and they needed help to understand and master the knowledge after class. Therefore, when constructed online resources, depth and width

of the contents were considered. And what strategies and how to grab the information that students wanted were carefully selected.

2.2 Design of the Course Outcome Target

According to the Bloom education Method [15], online classroom resource construction hopes that students can not only master and understand the knowledge, but also learn to use the knowledge in their own research field through the integration of online resources, so as to achieve the ability to analyze and solve problems. There are two learning outcomes:

On one hand, the basic purpose of online resource construction is to help students continue to deepen their understanding and mastery of knowledge. Using big data help students achieve their learning goals. Therefore, big data is used to create a dynamic learning environment that adapts to the learning requirements of students. To this end, the construction of online resources needs to provide immediate feedback, recommend resources, and adjust the difficulty of tasks according to students' performance.

On the other hand, in order to improve students' problem analysis and problem solving, big data needs to be able to use relevant technologies to carry out deep data mining according to the course content, provide practical application cases that best meet the content requirements, and provide students with a bridge from theory to practice.

3. Implementation Strategies and Ways

Recommend resources based on individual student data, ensuring that each student receives content that is most relevant to their learning needs. The first step in personalized resource customization is the collection of vast amounts of data.

3.1 Data Collection

Here two ways were used to collect data on student interactions with course materials, assessment results, and engagement levels in the course online construction.

3.1.1 Web scraping

Web scraping [16] was used to extract data from websites. Tools like BeautifulSoup and Scrapy in Python can be used. They can parse HTML and XML pages, extract specific information such as text, images, and links. For example, a student wants to collect information about signal process chip. Keyword was input in the search block, these tools can extract chip names, prices, descriptions, and customer reviews.

3.1.2 Application programming interfaces

Many online platforms provide application programming interfaces (APIs) for data access. For instance, social media platforms like Wechat and QQ have APIs that allow developers to retrieve user data, post content, and interaction data. By using the Wechat API, students can collect information related to a specific topic, analyze user sentiments, and track trending hashtags.

3.2 Resource Personalization Customization

Data can be sourced from various channels such as user behavior logs, social media interactions, and online transactions. By employing sophisticated data mining techniques, patterns and preferences of individual users can be discerned. For instance, analyzing the browsing history and purchase records of a user can reveal their interests in specific product categories or content genres.

3.2.1 Machine learning algorithm

Machine learning plays a pivotal role in processing big data for personalized customization. Algorithms such as collaborative filtering can be utilized to recommend resources based on the preferences of similar users. If students with similar browsing patterns have shown a preference for a particular type of resource, the algorithm can predict that a new user with a similar profile may also be interested in that resource. Additionally, content-based filtering can analyze the attributes of resources and match them with the user's known preferences.

3.2.2 Descriptive analysis strategy

This method summarizes and describes the features of the collected data. For example, calculating the mean, median, and mode of a dataset can provide insights into the central tendency. Analyzing the frequency distribution of data can reveal patterns. In a sales dataset, descriptive analysis can show the average sales per month, the most popular products, and the sales distribution across different regions.

3.2.3 Predictive analysis strategy

Predictive analysis uses statistical models and machine learning algorithms to forecast future trends. Regression analysis can be used to predict continuous values. For example, based

on historical sales data and marketing expenditure, a linear regression model can predict future sales. Classification algorithms like decision trees and support vector machines can be used for categorical predictions. In a customer churn prediction scenario, these algorithms can analyze customer behavior data and predict which customers are likely to churn.

3.2.4 Cluster analysis strategy

This method groups similar data points together. It is useful for segmenting customers, identifying patterns in large datasets, and discovering hidden structures. For example, in a signal dataset with features like volume, frequency, and phase, cluster analysis can group signals into different segments such as low frequency signals, high frequency signal, ultra frequency signals, etc. This helps students arrange learning strategies for each type of signal data.

3.3 Feedback Mechanisms

Implement real-time feedback systems that allow students to understand their progress and areas for improvement. This can be particularly useful in complex courses like "Signal Detection and Processing" where understanding builds upon previous knowledge.

3.3.1 Real-time data processing

To ensure the timeliness of personalized recommendations, real-time data processing is essential. With the aid of big data technologies like Apache Kafka and Spark Streaming, data can be processed as it is generated. This allows for immediate updates to the user's profile and resource recommendations. For example, when a user clicks on a new article or watches a video, the system can instantly analyze this action and adjust the subsequent recommendations to better align with the user's current interests.

3.3.2 User feedback integration

Incorporating user feedback is crucial for refining personalized resource customization. Users can provide explicit feedback through ratings, reviews, or direct input. This feedback can be used to train and fine-tune the machine learning models. Moreover, implicit feedback such as the duration of time spent on a resource or the frequency of revisiting a particular content can also offer valuable insights into user satisfaction and preferences.

3.4 Collaborative Learning

Use big data to facilitate collaborative learning by grouping students with similar learning styles or needs, enhancing peer-to-peer interaction and support.

3.4.1 Foster a collaborative learning culture

First, Cross-functional Teams was built. Form teams comprising members from different departments such as data science, business operations, and IT. Each member brings unique perspectives and expertise. For instance, a data scientist can provide insights into data analysis techniques, while a business expert can offer domain knowledge to contextualize the data.

second, open communication channels. Encourage open and transparent communication among team members. Utilize collaboration tools in the web of the university to facilitate real-time discussions, sharing of data insights, and problem-solving. Regular team meetings and workshops can also enhance the collaborative learning process.

3.4.2 Implement collaborative learning platforms

One is learning management systems (LMS) that supports big data modules. LMS were integrated for data-driven learning courses. These courses can teach team members how to analyze big data and apply it to their respective roles.

Another is knowledge sharing portals. Create internal knowledge sharing portals where team members can upload and access data-related resources such as research papers, case studies, and tutorials. This portal can also include discussion forums for members to share their experiences and learn from each other.

3.5 Course Ideology and Politics

These methods were usually implemented, such as, case questions, celebrity anecdotes, and current events, done by big data technology in the online resource construction.

For case questions, case questions are simple but powerful. Examples are the most relevant to the course content, and the use of big data to capture the most relevant examples to the course content.

For celebrity anecdotes, this old saying is very suitable The Tao gives birth to the One; the One gives birth to Two; Two gives birth to all things.

For current events, using big data to collect the

newest news to explain the course ideology. This event is most convincing.

4. Course Teaching Case

Here, signal detection and processing online course construction was done by the strategies discussed above, and the steps were following. Step1, identify data sources was done. In this step, the sources of the relevant data signals and information would be determined, such as different websites, social media platforms, IoT devices, etc. Step 2, data collection parameters were set. Here, usually keywords were needed. Keywords were used to define the specific data fields, time ranges, and other criteria for the data to be collected. For this course, singles type, chips, process method, and circuit could be selected. Step 3, web crawlers/APIs was used to fetch data. Web crawlers were used to scrape data from web pages first. Then APIs provided by data sources to retrieve data in a structured format. Step 4, data was transmissed via network. The collected data over the network in step 3 was transferred to a centralized location for further processing temporarily. Step 5, data was stored in databases. Needs from the students are different and complex. Therefore, the data should be stores in databases that can handle large volumes of data and support efficient querying. Step 6, data was cleaned. Data stored in databases need to be removed duplicate records, corrected errors, and handled missing values to ensure the quality of the data. Step 7, data from different sources was combined into a unified dataset, resolving any inconsistencies or conflicts in online course construction. Step 8, after data collected already, statistical analysis, machine learning algorithms, or other analytical techniques were applied to extract meaningful insights from the data. When a student searches some contents, he or she can be easy to get what he or she wants. Step 9, data was visualized. Here, the analysis results were created in visual representations, such as charts, graphs, and dashboards, to make it easier to understand the data patterns and trends. Step 10, results were interpretated. The visualized data in step 9 was interpreted to draw conclusions and identify key findings. Step 11, at the last, there is a decision making based on insights. The insights gained from the data analysis were used to make informed decisions and take appropriate actions. After all the steps done, the information that collected and analysis will display on the screen correctly according to the key words. These steps were illustrated in Figure 1.

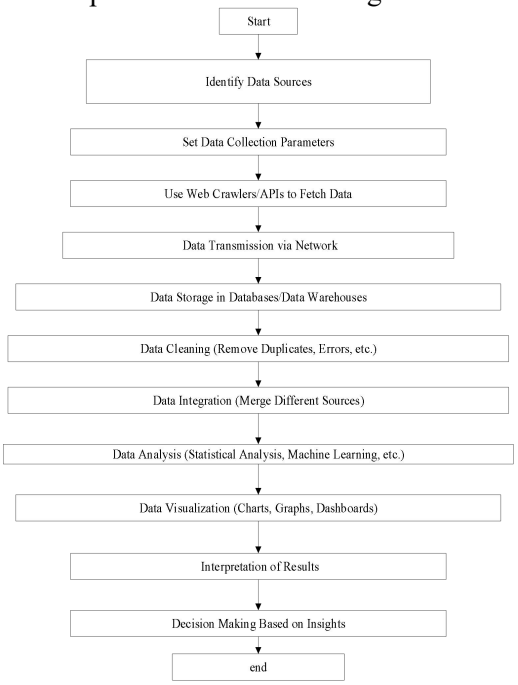

Figure 1. Flowchart of Big Data in Online Resource Constructions

5. Conclusion

Big data played a very important role in higher education. It has revolutionized the way we acquire and analyze network-related information. Based on the status of the students and the big data technology in the course signal detection and processing, web scraping and APIs were two useful methods in data collecting. Machine learning algorithm, descriptive, predictive, and cluster analysis was for resource personalization. Realtime data processing, user feedback and collaborative learning are the best way to create a feedback mechanism system. For the course ideology and politics, case questions, celebrity anecdotes, and current events were introduced. Big data technologies enabled us to extract valuable insights from the vast amounts of data generated on the internet. However, it is crucial to navigate the challenges and ethical considerations associated with big data to ensure that the acquisition and use of network-related information are conducted in a responsible and beneficial manner.

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