A Case Study on The Application of Artificial Intelligence in Education Industry

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Abstract. In recent years, with the development of the internet, the application of artificial intelligence has gradually expanded, particularly in the field of education. In China, where the internet has been rapidly growing, the online education industry has been flourishing. This emerging industry cannot be ignored. However, most of the current research on the application of artificial intelligence in education focuses on offline classrooms and theoretical studies, leaving a gap in empirical research. Therefore, to fill this gap, this study is based on case analysis to explore how artificial intelligence is applied in the online education industry. The conclusions of this research will provide valuable insights for both the academic community and the online education industry.

Keywords:artificial intelligence,application,education industry, recommendation algorithms

1 INTRODUCTION

Artificial intelligence has become an increasingly important topic in today's digital age. With the explosion of digital information, businesses and organizations are now able to collect vast amounts of data from various sources,which enhances the developement of artifical intelligence in China.

China has experienced tremendous growth in its internet industry over the past few decades, with over 989 million internet users, making it the country with the largest number of internet users in the world. The internet infrastructure in China is highly developed, with fast internet speeds and widespread connectivity. As a result of this booming internet industry, a massive amount of user data has been generated, providing companies in China with access to extensive data on consumer behavior, preferences, and trends.By utilizing tagging tools and big data, Chinese companies applicate artificial intelligence on education industry.

The education system in China comprises 6 years of primary school, 3 years of junior school, and 3 years of high school. During the transitions from junior school to high school and from high school to university, students have to take exams that can significantly impact the trajectory of their lives, such as the entrance examination for high

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school and the college entrance examination. To excel in these exams, students study diligently and practice previous exam questions to prepare. However, a common challenge for students is identifying their weaknesses and strengths among the knowledge they have learned in school and allocating their time effectively to overcome their weaknesses and maximize their scores in limited time.

Some Chinese companies, such as Yuanfudao and Zuoyebang, have keenly recognized this problem and have addressed it by applying artificial intelligence techniques. Firstly, they collect exam questions and build a comprehensive database. Next, they provide free online services for searching and practicing previous exam questions. Subsequently, they process the behavioral data and question data to generate personalized learning performance analysis reports. Lastly, they generate personalized learning plans by applying recommendation algorithms. These learning plans automatically highlight the knowledge points that are in the students' weakness zone, and suggest where students should focus more effort to overcome their weaknesses. Additionally, if students have a goal of entering a top university in China, the recommendation algorithms can generate a tailored plan to help them achieve that goal.

This thesis aims to use case study to explain:

i)The technique way:How Chinese companies applied artificial intelligence in education industry.

ii)The implications:What could we learn from the case.

2 METHODOLOGY

This article utilizes a case study method as the primary approach to study the application of artificial intelligence in learning analytics. While much of the current academic research on this topic remains in the conceptual stage, there is a lack of empirical evidence on implementation cases in real-world settings. The case study method is well-suited to fill this gap by providing in-depth insights into how companies actually implement learning analytics and summarizing their practical experiences in this area.

3 LITERATURE REVIEW AND THEORETICAL BASIS

3.1 Literature Review

There are several different perspectives in the academic community regarding the application of artificial intelligence in education. Some are based on its application in offline classrooms, such as research on the integration of artificial intelligence education with kindergarten teaching [1] and research in primary and middle school stages. For example, Zhu Zhe et al. conducted research on how the era of artificial intelligence can be integrated with classroom teaching in the context of mathematics education [2]. Zhou Yajian et al. proposed suggestions for advancing the integration of artificial intelligence into teaching [3]. Some studies focus on adult education. Meng Yuanhang explores the implementation of artificial intelligence in adult lifelong education [4],

while Xu Xuetian researches the combination of vocational education and artificial intelligence [5]. There is also research on the opportunities and challenges of integrating ideological and political education for university students with artificial intelligence[6]And some research on the implications it can reveal for future of schools[12].However some people fears about AI and its use in education[11].

In terms of theory, most of the literature on the application of artificial intelligence in education mentions value logic, goal logic, and practice logic [7][8]. Based on these logics, three main practical directions are virtual and real-world applications, personalized education and learning assessment, and data and natural language-based processing. Zhang Huifeng et al. conducted a detailed analysis of the application of artificial intelligence in teaching based on educational learning assessment and proposed recommendations for precision teaching [9], including features like image-based question search. Du Juan et al. [10] mentioned in their article that the integration of technologies such as natural language processing and image recognition into teaching has made greater progress compared to traditional teaching methods.

Since the aforementioned articles are primarily based on research in offline classrooms or adult and vocational education, and the theoretical research lacks empirical studies to some extent, the significance of this study lies in exploring the application of artificial intelligence in online education teaching based on educational learning assessment. The study aims to fill the research gap in empirical studies by investigating actual company cases in the rapidly developing field of online education in China.

3.2 Theoretical Basis

Artificial Intelligence (AI) refers to the development and implementation of computer systems or machines that can perform tasks that typically require human intelligence. AI aims to simulate and replicate human cognitive processes, such as learning, reasoning, problem-solving, perception, and decision-making, using algorithms and computational models.

Artificial intelligence can be classified according to different methods. Here is a common classification, including the concept of labeling:

1.Weak AI (Narrow AI): Also known as specialized artificial intelligence, it refers to AI systems designed and trained for specific tasks or domains. These systems can exhibit human-like intelligence in specific tasks but may perform weakly in other tasks. Labeling and simple recommendations fall into the category of weak AI as they are designed to handle specific datasets or user needs.

2.Strong AI (General AI): Refers to AI systems that possess human-level intelligence and can exhibit human-like intelligence across a wide range of tasks and domains. The goal of strong AI is to mimic human cognitive abilities and wisdom, including understanding, learning, and reasoning capabilities.

3.Machine Learning: It is a branch of artificial intelligence that uses algorithms and models to enable machines to learn and improve performance from data without explicit programming instructions. Machine learning can learn and make predictions from training data and can be used for tasks such as classification, regression, and clustering. In the context of labeling, machine learning algorithms can learn the associations between

keywords and labels from annotated data, enabling automatic labeling of new unlabeled data.

4.Deep Learning: It is a subfield of machine learning that mimics the structure and functioning principles of the human brain's neural networks. Deep learning utilizes multi-layered neural networks for learning and decision-making, and through training on large-scale datasets, it can acquire more complex and advanced representation and pattern recognition capabilities. Deep learning has achieved significant advancements in areas such as image processing, speech recognition, and natural language processing and can be applied in labeling for automated feature extraction and learning label associations.

In labeling, artificial intelligence can automate the process of assigning labels by utilizing machine learning and deep learning techniques. It can learn to extract features from input data and map them to corresponding labels. This automated labeling process improves efficiency and reduces the manual workload.

4 ANALYTICAL REVIEW OF THE SELECTED CASES

This case study presented here is based on the application of Narrow AI and try to study how Chinese online education companies utilize tagging tools to achieve intelligent recommendations.

4.1 Case Background

Yuanfudao and Zuoyebang are two prominent online education platforms in China that utilize AI technology to assist students in their learning, particularly in artificial intelligence homework tutoring.

Yuanfudao, founded in 2012, has grown rapidly to become a valued over $15 billion company. Its platform offers personalized online courses, AI-powered homework tutoring, and one-on-one online tutoring services for K-12 students. Through adaptive learning algorithms, Yuanfudao's AI technology tailors course content to each student's learning style and progress, providing a personalized learning experience in subjects such as mathematics, English, physics, chemistry, Chinese language arts, and extracurricular classes in painting, piano, and chess. Yuanfudao aims to make quality education accessible to everyone and has become one of the most popular and influential online education companies in China.

Zuoyebang, founded in 2015, has quickly become one of the largest online education platforms in China, valued at over $10 billion. Its main service is artificial intelligence homework tutoring, where students can take a photo of their homework question and receive a step-by-step explanation from a virtual tutor. The platform also offers online classes and one-on-one tutoring in subjects such as math, English, physics, as well as exam preparation courses for major standardized tests. Zuoyebang focuses on using technology to improve access to education and has become a popular resource for students seeking academic support in China.

4.2 Overview of Functions

The popular features mentioned above are based on artificial intelligence applications:

1)artificial intelligence homework tutoring:students who take a photo of their homework question will receive a step-by-step explanation from a virtual tutor.

In this application scenario, students upload exam questions by taking photos with their smartphones. The backend system first performs semantic analysis on the questions and matches them with the corresponding keyword tags in the tag library. Then, the system retrieves the relevant exam questions by querying the corresponding tags (in this process, it follows an exact-to-fuzzy search method).

2)Personalized online courses: develop adaptive learning algorithms that personalize course content to each student's learning style and progress.

In this application scenario, when students use the app to do exercises,the app will automatically captures the user's behavior, such as the time spent on answering questions and the number of times the answer option is revised. After the user submits the answers, the system calculates the user's error rate and the error rate of different specific knowledge points based on the tags of the exam questions. Using recommendation algorithms, the system analyzes the student's weak knowledge points and provides personalized improvement plans accordingly.

Figure 1 organizes the implementation logic of the entire core technology. Tags and algorithm recommendation are the key technical aspects that enterprises utilize to apply artificial intelligence in education. Enterprises collect a large amount of exam question data and assign relevant tags to each exam question when storing the data in the database. These tags may include subject, grade, specific knowledge points, year of examination, and other relevant information.

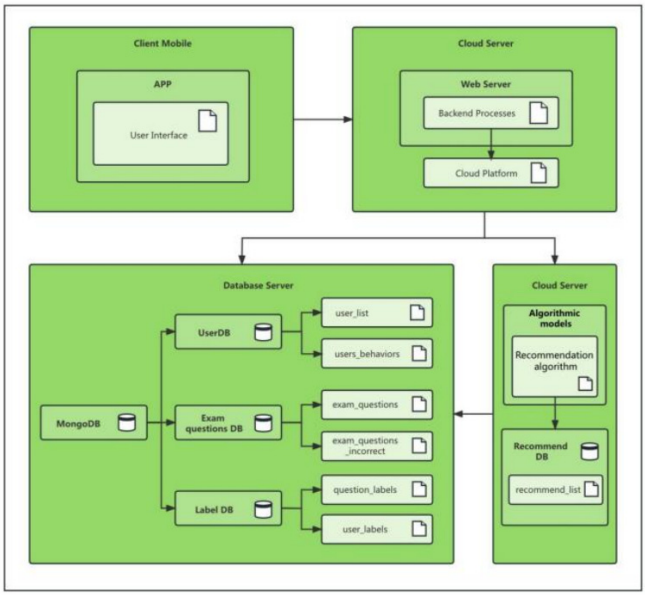

Fig. 1. Exam Questions Recommendation System Deployment Diagram.

4.3 Technical Implementation Details

Here is the database design and recommendation process.

1)Database and Table Design

In the realm of database design, it is common practice to establish separate data marts for user-related, exam-related, and tag-related data. Corresponding tables are then stored within their respective data marts.

For instance, taking the user profile data mart as an example, it is customary to create a data table for user profile data(Figure 2) and another data table for user behavior-related data(Figure 3) within this data mart. Here are some exemplary fields that could be included in these data tables:

i)User Profile Table:.

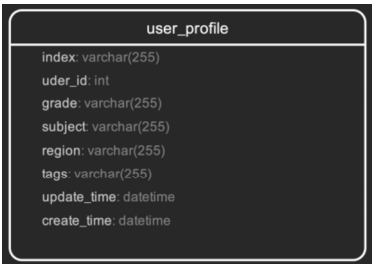

Fig. 2. User Profile Data Table.

Field 1: Index - Index number for the user record
Field 2: User ID - Unique identifier for the user
Field 3: Grade - Grade level of the user
Field 4: Subject - Subject of study for the user
Field 5: Region - Geographic region associated with the user
Field 6: Tags - Tags or labels associated with the user
Field 7: Update Time - Time of last update for the user record
Field 8: Create Time - Time of creation for the user record

ii)User Behavior Data Table:.

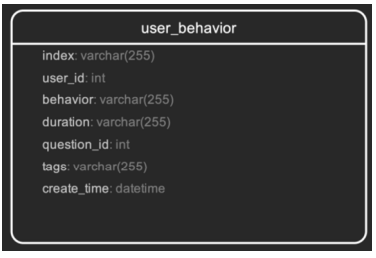

Fig. 3. User Behavoir Data Table.

Field 1: Index - Index number for the behavior record
Field 2: User ID - User ID linked to the User Profile Table
Field 3: User Behavior - Type of user behavior, such as browsing, liking, etc.
Field 4: Duration - Duration of the behavior (if applicable)
Field 5: Question ID - ID of the question associated with the behavior
Field 6: Tags - Tags or labels associated with the behavior
Field 7: Create Time - Time of creation for the behavior record

Taking the exam question data mart as an example, it typically houses data tables such as the question data table(Figure 4) and the user's mistaken questions data table(Figure 5). Example fields for these data tables are as follows:

iii)Question Data Table:

Fig. 4. Questions Data Table.

Field 1: Index - Index number for the question record
Field 2: Question ID - Unique identifier for the question
Field 3: Subject - Subject of study for the question
Field 4: Grade - Grade level of the question
Field 5: Knowledge - Specific knowledge point of the question
Field 6: Question Content - Content of the question
Field 7: Options - Multiple-choice options for the question (if applicable)
Field 8: Answer - Correct answer for the question
Field 9: Difficulty Level - Difficulty level of the question
Field 10: Tag ID - Unique identifier for the tags or labels associated with the question
Field 11: Create Time - Time of creation for the question record

iv)User's Mistaken Questions Data Table:.

Fig. 5. User's Mistaken Question Data Table.

Field 1: Index - Index number for the mistaken question record
Field 2: User ID - User ID linked to the User Profile Table
Field 3: Question ID - ID of the mistaken question linked to the Question Data Table
Field 4: Mistake Time - Time when the user made the mistake
Field 5: Mistake Type - Reason or explanation for the mistake
Field 6: Tags ID - Unique identifier for the tags or labels associated with the mistaken question
Field 7: Create Time - Time of creation for the mistaken question record

Using the tag data mart as an example, this data mart typically involves cross-referencing users and exam questions, and therefore categorizes tags based on categories. There would have exam question tags data table(Figure 6) and user tags data table(Figure 7).Example fields for the data tables are as follows:

v)Exam Question Tags Table:

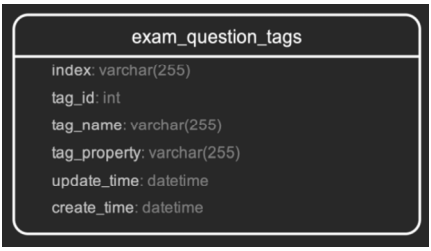

Fig. 6. Exam Question Tags Data Table.

Field 1: Index - Index number for the tag record
Field 2: Tag ID - Unique identifier for the tag
Field 3: Tag Name - Name of the tag
Field 4: Tag Property - Properties or attributes associated with the tag
Field 5: Update Time - Time of last update for the tag record
Field 6: Create Time - Time of creation for the tag record

vi)User Tags Table:

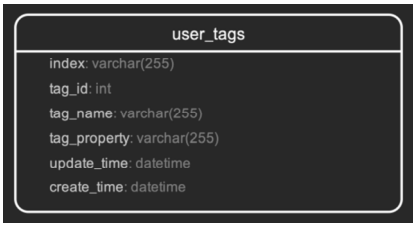

Fig. 7. User Tags Data Table

Field 1: Index - Index number for the user tag record
Field 2: Tag ID - Unique identifier for the tag
Field 3: Tag Name - Name of the tag
Field 4: Tag Property - Properties or attributes associated with the tag

Field 5: Update Time - Time of last update for the user tag record
Field 6: Create Time - Time of creation for the user tag record

2)Recommendation Process

i)Tagging Exam Questions:Exam questions are batch-entered by staff in the backend, and tags such as grade level, subject, region, knowledge point, and difficulty are added to the exam questions.

ii)Collecting Behavioral Data:When users use the question answering function in the app, the app records their behaviors and sends them to the cloud server, which then records them in the user behavior data table.

iii)Insert Performance Data:After users complete their questions, the app sends their performance to the cloud server and records it in the user error question data table.

iv)Tagging Users:At this point, the server will use a set of rule-based algorithms to automatically tag users based on their behaviors and error question situations, such as weak foundation in English, weak in relative clause knowledge, strong in gerunds, and so on.

v)Recommendation:After tagging, the system will automatically match the relevant tags associated with the exam question data table based on the user's tags, and generate a study plan and an output plan based on rule-based algorithms, which will include the exam questions that need to be reviewed and mastered for each module.

5 DISCUSSION

This case study is solely based on the analysis of two Chinese online education companies. There is a limitation in the number of case samples available. However, as these two companies are leading players in the domestic online education industry in China, this study considers the case to still be somewhat applicable. Moreover, the learning objectives of users differ across different stages of education. For instance, in the stage of quality education, the ultimate assessment goal is not solely based on scores, rendering AI recommendation algorithms based on incorrect answers inapplicable. In the future, research will be conducted on the application of artificial intelligence based on different stages of learning as a topic to continuously improve the overall research content.

6 CONCLUSIONS

The successful experience of Chinese enterprises in applying artificial intelligence to education indicates that artificial intelligence will become an important tool in the education field, expected to help educational institutions better meet the needs of students and the market, and improve the quality and efficiency of education. This also suggests that the application prospects of artificial intelligence in the education field are vast.

Starting from user needs, it's not always necessary for users to require very detailed or high-end learning reports. The first step in applying artificial intelligence to education is to provide basic statistics on the user's learning situation by integrating existing data. Next, we can collaborate with teachers to integrate content related to knowledge points and examination outlines, and use algorithms to calculate different learning plans and breakthrough plans for different students at different stages.

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