

# Design and Research of an Intelligent Learning System for University Physics

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**Abstract:** In order to break through the limitations of traditional teaching, realize the integration of online and offline teaching, and optimize the intelligent learning experience of university physics, this paper proposes the design of an intelligent learning system for university physics based on cloud computing platforms, and applies this system to teaching environment of university physics. It successfully integrates emerging technologies such as cloud computing, machine learning, and situational awareness, integrates learning context awareness, intelligent recording and broadcasting, resource sharing, learning performance prediction, and content planning and recommendation, and comprehensively improves the quality of university physics teaching. It can optimize the teaching process and deepen intelligent teaching reform, aiming at providing references for the teaching practice of university physics.

**Keywords:** University; Physics; Intelligent learning; System design

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## 1. Introduction

In the context of the smart Earth strategy, based on the powerful functions of high-tech such as the Internet, artificial intelligence, and cloud computing platforms, the global science and technology, resources, technology, and other fields have a full range of interaction and integration, and have a profound impact on various industries and fields. In recent years, smart education has been increasingly accepted and understood by the public, and governments, educational institutions, and information technology industries have also begun to increase their investment, research, and practice in the field of smart education, providing convenient conditions and space for rapid development of smart education and practical construction<sup>[1]</sup>. The rapid development of intelligent education also has a great impact on the traditional education system and learning systems. How to optimize the intelligent education and learning system on campus and improve the overall teaching quality and learning efficiency has become an important topic and long-term development strategic goal of contemporary education<sup>[2]</sup>. Some scholars believe that “intelligent learning is the learning that supports and promotes people’s personality development, characteristic development, all-round development, lifelong development, internal drive development, and innovative development in the information age. It is the learning that is accompanied

by the stimulation of ideas and the collision of wisdom, and is the learning that promotes and serves the development of society”<sup>[3]</sup>. According to the research, the true meaning of intelligent learning is to build a learning environment that integrates technology, allowing teachers to implement efficient teaching methods, and learners to receive appropriate personalized learning services and a positive developmental experience. This transformation enables students to progress from the impossible to the possible, and from limited abilities to greater capabilities. The goal is to cultivate talents with strong values, robust action abilities, high-quality thinking, and deep creative potential<sup>[4]</sup>. With the application of new technologies such as artificial intelligence in various fields, scholars define the intelligent learning environment through the technical level: Intelligent learning is the application of new era technologies such as artificial intelligence, Internet of Things, cloud computing, big data, and virtual reality/augmented reality to analyze and explore the interaction and connection between the learning process and the external environment, and deeply understand the causes of learning, so as to further provide better learning conditions for learners<sup>[5]</sup>. Although the above views have different definitions of intelligent learning, they all reflect the essence of intelligent learning that takes learners as the core and aims to better serve personalized learning. Based on this, the next research will be carried out on the design of an intelligent learning system for university physics.

## 2. Design requirements

There is imperfect construction of the existing intelligent learning system, where intelligence is only reflected in one aspect of teaching, resources, and assessment, and cannot cover the defects of the whole process of teaching and learning, this paper designs the framework structure and function model of the intelligent learning system based on cloud platform by closely focusing on the five characteristics of intelligent learning: comprehensive perception, self-adaptation, personalization, interaction, and resource correlation. Through the use of cloud computing, big data, situational awareness, machine learning, and other new-generation information technology, integrating learning situational awareness, intelligent recording and broadcasting, resource sharing, learning performance prediction, learning planning, and recommendation, etc.<sup>[6]</sup>, we build a comprehensive intelligent learning environment for teachers and learners, so as to break through the traditional teaching mode and optimize the teaching process, thus stimulating the full potential of teaching and learning.

## 3. System design

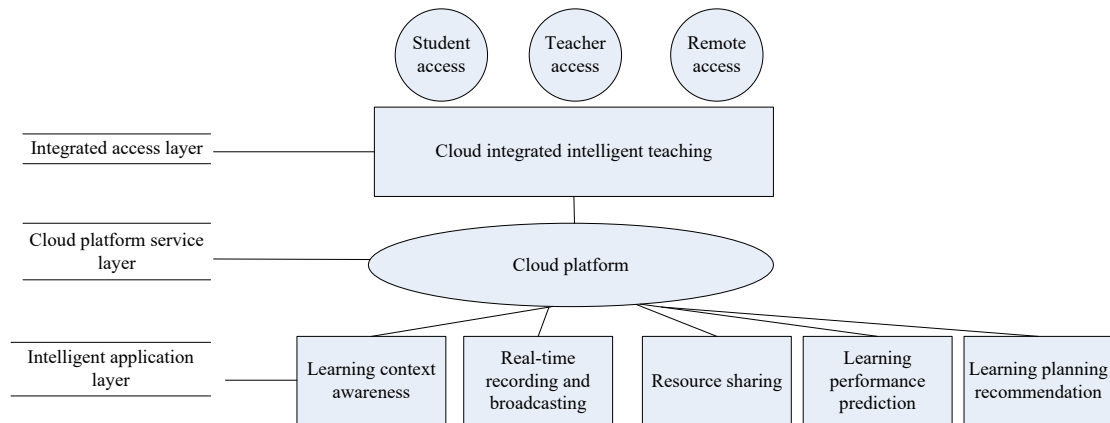
### 3.1. System architecture

The architecture of the intelligent learning system for university physics based on the cloud platform is designed (**Figure 1**). The system architecture design can effectively reduce the configuration requirements of terminal equipment, powerful cloud computing and storage functions provide efficient and stable services for the system, and integrate teaching, resources, assessment, and recommendation to achieve the best combination of teaching<sup>[7]</sup>.

First of all, the integrated access layer allows learners, teachers, and administrators to access the intelligent learning system in a unified manner. Users in different roles operate corresponding spaces independently, facilitating the use and management of resources and services.

Secondly, the cloud platform service layer integrates cloud hardware and software facilities to provide services for data generated during the teaching process, personal network spaces for teachers and learners, learning content resources, as well as school-based and external resources. It enables unified storage, management, and real-time scheduling of these resources, improving the previous online learning platform for data storage and processing capabilities.

Lastly, the intelligent application layer is the core of the entire learning system, including the learning context awareness subsystem, the intelligent recording and broadcasting subsystem, the resource sharing subsystem, the learning performance prediction subsystem, and the learning planning recommendation subsystem.



**Figure 1.** The architecture of intelligent learning system for university physics based on cloud platforms

## 3.2. System functions

### 3.2.1. Learning context awareness

The learning context awareness system comprehensively perceives the characteristics of learners according to the four dimensions of knowledge acquisition and internalization process, namely, information awareness, information input, information processing, and information understanding. By capturing the characteristic information reflecting the above four-dimensional context for modeling, clustering, and grouping learners, and calculating through the hybrid learning context mining algorithm, the learning context is quickly, comprehensively, and accurately constructed, thus providing adaptive learning services during the whole process of learners' knowledge acquisition, and truly achieving the goal of providing learners with a full set of personalized learning assistance and achieve both process and result-oriented learning effect<sup>[8]</sup>.

The learning context awareness system collects 40 items of learners' online behavior information, including learners' reading content, content type, browsing time, operation behavior order, activity, test results, etc. This method perceives and understands learners' unique learning tendency and their characteristics, and self-organizes and provides learning experiences adapted to individuals, so as to conform to their learning rules, meet their learning expectations, and improve learning efficiency.

### 3.2.2. Real-time recording and broadcasting

The real-time recording and broadcasting system uses intelligent recording and broadcasting technology to record the local smart classroom, and the recorded content is intelligently fragmented according to the knowledge point, and transmitted to the learner's terminal and the smart classroom through the cloud synchronously or asynchronously, so as to realize the automatic production of resources. Compared with traditional information platforms, teaching courses can be carried out simultaneously online and offline in real time. Learners can use mobile terminals to perform on-demand courses, watch real-time live courses, interact with teachers in class, and solve learning problems in time. Among them, intelligent fragmentation is

the automatic real-time fragmentation of recorded and broadcast courses into micro-courses at the granularity of each page of courseware or whiteboard. This process integrates corresponding audio and video, notes, courseware, and interactive information for enhanced learning experiences. After class, learners can review asynchronously on mobile devices <sup>[9]</sup>. These fine-grained learning courses allow learners to study without requiring significant time commitments. They can be accessed and completed efficiently from any location, requiring only a small amount of time to engage with the material. This provides learners with highly flexible time and space, greatly improves the flexibility of learning, and conforms to the application situation of ubiquitous learning.

### **3.2.3. Resource sharing**

The resource sharing system stores the courseware uploaded by learners and teachers and the courses transmitted by the real-time recording and broadcasting system and provides a search interface. Through the interface of public resources, supporting resources, and shared resources, learners and teachers can download the required courseware according to their permissions. In addition, users can view and save resource information on the resource page. Users can interact with other users by commenting and replying to resources to realize resource sharing and communication among users. Users can also quickly locate courseware by viewing resource descriptions, as well as resource-associated resources, and keyword retrieval.

### **3.2.4. Learning performance prediction**

The learning performance prediction system uses IRT (item reflection theory) to evaluate the difficulty of knowledge points and learners' mastery ability and uses the Bayesian principle to predict the future answers of each learner for different knowledge points. The system workflow is mainly divided into the following steps. The first step is to obtain students' online learning behavior data from the cloud, including learner characteristics obtained from the learning context awareness system and learning status in the learner's personal database. The second step is to use the prediction engine to create a learner model to diagnose and predict the learner's future performance. The third step is to visually provide the predicted results to the teachers and provide them with teaching plan guidance. At the same time, the results are sent to the learners to help them accurately understand the current learning situation, stimulate learning motivation, and improve learning efficiency <sup>[10]</sup>.

### **3.2.5. Learning planning recommendation**

The learning planning recommendation system first establishes the subject knowledge map. In this system, the natural language processing technology is not used to automatically construct the subject knowledge map, but the subject expert experience is used to construct the map. Since, in the actual teaching process, a subject expert has many years of accumulated teaching experience, the purpose of this system is to use advanced information technology to assist the existing teaching based on expert experience. The construction of a knowledge graph is divided into two steps: (1) Subject experts divide the concepts in the subject, sort out the relationship between them, and connect the learning content with the knowledge graph; (2) The knowledge graph is digitalized, and the structure of the directed acyclic graph is used to describe the knowledge graph. The nodes in the graph represent knowledge points, and the edges in the graph represent the relationship between knowledge points. The learning planning recommendation system then trains the knowledge graph with transition probability. Probabilistic Graphical Models, including Bayesian neural networks and Markov random fields, are used to correlate the learner's ability and knowledge point difficulty obtained from the learning performance prediction system with the knowledge graph to obtain the knowledge graph with transition probability. It is used for in-depth insight into learners' weak knowledge points and learning path planning.

## 4. Conclusion

Intelligent learning is the product of the development of education informatization and an inevitable trend. Intelligent learning takes learners as the center and provides personalized services in a full range so that learners can actively and effectively invest in learning. The intelligent learning system proposed in this paper, which is based on the cloud platform and big data and integrates situational awareness, machine learning, and other technologies, can instantly obtain huge cloud resources, effectively predict and plan the learning content of learners, meet the personalized learning needs of huge online learning groups, and easily obtain the resources they need through the system, thereby improving the efficiency of teaching and learning.

## Disclosure statement

The author declares no conflict of interest.

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