Intelligent Assistive Technology Empowers Middle School Physics Teaching

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Abstract: This article explores the important strategies of intelligent assisted high school physics teaching for improving teaching quality in the context of rapid development of artificial intelligence (AI) and various new intelligent technologies. With the updating of information technology and educational concepts, traditional teaching methods are no longer able to meet the needs of modern teaching. Therefore, this article proposes a series of intelligent technology-based teaching strategies, including the use of modern multimedia teaching technology, virtual reality VR technology, and intelligent management technology, covering the three links of teaching management, learning, and teaching, providing teaching strategies, and conducting in-depth analysis of the application of these intelligent auxiliary technologies in the field of education.

Keywords: Middle School Physics; Intelligent Assistive Technology; Teaching Quality Improvement

1. Introduction

With the continuous integration of information technology and teaching, "artificial intelligence+education" has become a research hotspot in current education reform. In recent years, China has attached great importance to the application of artificial intelligence technology in the field of education [1]. On March 5, 2017, Premier mentioned in the " Work Report" that efforts should be made to accelerate the cultivation and growth of emerging industries, and to fully implement the development plan for strategic emerging industries. Including the artificial intelligence industry, this is the first time that "artificial intelligence" has been included in the Work Report [2]. In the same year, the "Development Plan for the New Generation of Artificial Intelligence", which proposed "intelligent education" to accelerate the innovative application of artificial intelligence. This measure clarified the direction of development for "artificial intelligence+education". Nowadays, artificial intelligence systems integrate scientific applications such as artificial intelligence science, computer science, and education. So far, they have been widely used in industries such as healthcare, medicine, and education, especially in the education industry[3]. Combining artificial intelligence technology can optimize teaching management, effectively improve teaching quality, alleviate teachers' teaching burden, and provide new possibilities for exploring new teaching methods. This article presents some intelligent assisted strategies, clarifying the important role of intelligent assisted teaching in optimizing the physics teaching process and improving teaching quality, providing feasible strategies for physics teaching innovation.

2. Theoretical Basis

2.1 Theory of Intelligent Assisted Teaching

In the teaching process, the theory of intelligent assisted teaching can be divided into three parts: teaching management, student learning, and teacher teaching. Firstly, in terms of teaching management. We have adopted various intelligent methods to monitor students' learning status, including access control systems, electronic class signs, monitoring, etc. These tools, driven by artificial intelligence, can further enhance campus security, improve learning environment, and enhance management efficiency. Secondly, in terms of student learning, we can establish an intelligent analysis platform based on big data and learning data, and tailor personalized learning plans according to the learning characteristics and needs of different students. In addition, in terms of laboratory based teaching, we will organically combine multimedia teaching technology and related software (such as Adobe After Effects, COMSOL Multiphysics, NoBook virtual laboratory, etc.) to construct an immersive virtual

experimental environment, where students can complete the learning of complex physical processes under the guidance of visual senses. By simulating unimaginable spatial problems through animation and vividly showcasing complex and unimaginable processes, students can avoid errors caused by imagination from a visual perspective, deepen their sensory understanding, facilitate their analysis of the process, and achieve twice the result with half the effort [4]. While students are learning, use a Learning Management System (LMS) to achieve intelligent learning progress tracking, real-time tracking of students' learning progress, and provide detailed learning reports. In terms of teaching, we have established an intelligent feedback mechanism for teachers. Intelligent systems monitor students' learning status in real-time and optimize teaching strategies based on learning results and feedback to ensure the effective achievement of teaching objectives. At the same time, the teaching team will receive professional training, including the use of AI tools to conduct teaching activities and cultivate teachers' intelligent teaching abilities. This comprehensive and systematic teaching management model not only ensures teaching effectiveness, but also enhances teachers' professional level and teaching literacy. Artificial intelligence assisted teaching in education refers to the use of artificial intelligence technology to provide intelligent and personalized assistance and support for education and teaching[5]. By combining advanced artificial intelligence technology, it provides strong support for the innovation of teaching modes, ensuring both teaching effectiveness and meeting teaching needs (as shown in Figure 1).

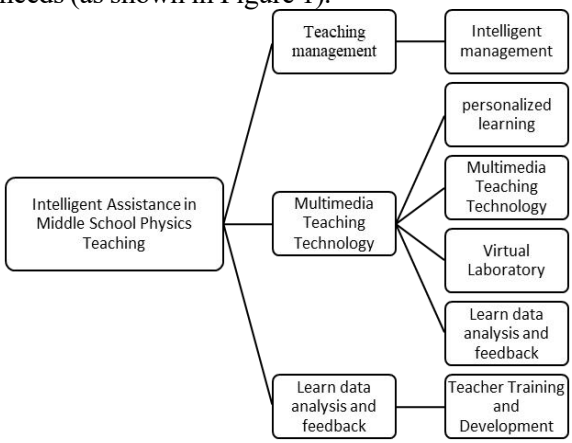

Figure 1. Theoretical Diagram of Intelligent Assisted Middle School Physics Teaching

2.2 Constructivist Learning Theory and Distributed Cognitive Theory

Constructivism believes that students acquire knowledge as a process of discovering problems and exploring, and the growth of knowledge is based on existing knowledge and experience [6]. In intelligent assisted high school physics teaching, intelligent learning devices can better equip each student with knowledge reserves and learning habits, push personalized learning materials, and create a more suitable learning environment for students through the use of intelligent assisted analysis. In addition, the theory of distributed cognition points out that distribution is the foundation of human cognition, and cognitive phenomena can not only exist in people's minds, but also in the interaction and communication between people and tools, as well as in the environment, media, culture, and other aspects. Based on this theory in physics teaching, we can design learning environments and teaching methods accordingly.

2.3 Advantages of Intelligent Assisted Teaching

Intelligent assisted teaching integrates artificial intelligence technology with education, demonstrating significant advantages. The traditional education model often focuses on one-way teaching by teachers and passive acceptance by students, while AI assisted teaching uses intelligent and personalized teaching methods to enable students to learn independently according to their own learning characteristics and needs, thereby stimulating their learning interest and potential [7]. It can provide customized learning plans based on students' personalized needs, significantly improving learning efficiency, Real time feedback mechanism helps students adjust their learning strategies in a timely manner and enhance their interactive experience, Big data analysis provides scientific basis for teaching decisions, enriching diverse teaching resources and flexible learning methods to further stimulate learning interest and promote self-directed learning. Meanwhile, AI assisted teaching can provide teachers with scientific and accurate teaching assistance, helping them better understand students' learning situations and develop more reasonable teaching plans and strategies [7]. With the assistance of intelligent technology, teachers can also enhance their teaching abilities. It is worth noting that AI assisted teaching can not only enhance teachers' educational abilities, but also play an important

role in teaching management.

3. Intelligent Assisted High School Physics Teaching Strategies

3.1 Personality Chemistry Analysis

Based on constructivist theory, intelligent systems guide students to actively explore through personalized learning paths, in line with the principle of 'knowledge construction'. A key aspect of personalized learning experience is intelligent learning path planning. Unlike traditional "classroom courses" teaching models, intelligent tutoring systems can tailor personalized learning roadmaps for each student, ensuring learning efficiency while also accurately matching learning content with individual needs[8]. For example, based on the constructivist principle of 'active exploration', intelligent systems guide students to independently discover problems through personalized learning paths, such as pushing exploration tasks related to students' existing knowledge. Smart devices design the most suitable learning path for students based on their individual characteristics, interests, and ability levels. For students who lack basic knowledge, basic exercises can be prioritized, while for students who need to expand deeply, they will focus on breaking through the more difficult parts. At the same time, teaching assessments are carried out according to the teaching objectives, such as unit quizzes, stage assessments, etc., collecting student performance data and drawing teaching situation analysis charts (as shown in Figure 2), analyzing students' scores in different parts, judging their strengths and weaknesses, and exploring possible reasons for student performance fluctuations. Intelligent devices remind students of their shortcomings based on the analysis results, and push targeted learning content to students (such as AI generated detailed learning videos and related exercises based on weak knowledge points) to achieve accurate matching between learning content and individual needs, enabling students to learn more efficiently. At the same time, smart devices can also provide feedback on these evaluation data to teachers, allowing them to have a deeper and more accurate understanding of students' learning situations, and to promptly care about students or adjust teaching strategies.

3.2 Intelligent Classroom Monitoring

The use of artificial intelligence in learning can provide data-driven analysis of students' learning behavior, providing scientific data support for improving and perfecting learning efficiency [9]. By using audio and video AI teaching methods, monitor classroom situations and collect classroom data (such as students' expressions, movements, speech data, etc.). Using AI algorithms to evaluate classroom quality. For example, analyzing indicators such as students' focus and participation, predicting the overall situation of the class based on these indicators, and proposing teaching plans that are more in line with the actual teaching of the class to the teacher, forming a virtuous cycle (as shown in Figure 3). If in teaching, it is found that a certain class generally has difficulties in understanding a certain knowledge point, it can be suggested that the teacher adjust the teaching method for that knowledge point, such as adding more examples or interactive segments. At the same time, intelligent monitoring needs to take into account both class commonalities and individual differences, such as adjusting the teaching pace of the whole class while pushing differentiated exercises for specific students. In addition, with the help of intelligent classroom monitoring, we can optimize teaching management.

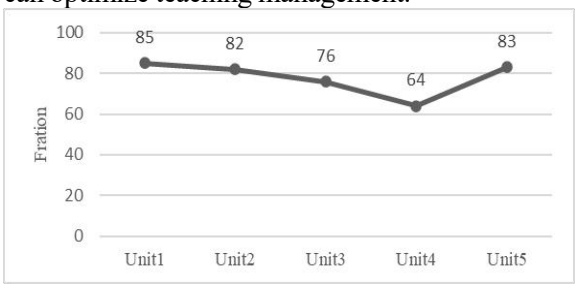

Figure 2. Analysis of Teaching Situation of Student a This Semester

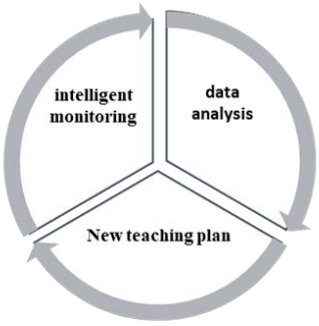

Figure 3. Intelligent Monitoring Cycle Diagram

3.3 Intelligent Q&A and Promoting Interdisciplinary Learning

Building an intelligent question bank based on big data technology, students can input questions

in the form of graphics and text. After inputting, the intelligent system matches the corresponding problem-solving ideas and answers through big data, and uses AI technology to generate relevant problem-solving videos as needed, ensuring that students can learn more easily and intuitively. For example, if a student inputs a question about an electron accelerator, the system can push detailed problem-solving steps based on the question bank and synchronously generate a demonstration video to help students solve the problem more intuitively. While ensuring that students have answers to their questions, the system can also use a multidimensional review mechanism to ensure the accuracy of their answers, and students can share their problem-solving ideas and corresponding steps on the student end, providing an interactive platform for all teachers and students. Overall, the intelligent tutoring system has broken through the bottleneck of imbalanced teacher-student ratio and lagging Q&A services in traditional teaching, providing personalized and high-quality Q&A assistance for each student, thereby better eliminating learning barriers and enhancing the effectiveness of middle school physics teaching [10]. At the same time, the rapid development of artificial intelligence has provided technical support for interdisciplinary learning [11]. With the help of artificial intelligence, we can efficiently and quickly search for information and integrate it quickly. Providing a convenient and comprehensive interdisciplinary learning platform for teachers and students can promote the development of their overall quality.

3.4 Stereoscopic and Intuitive Teaching

In the process of physics teaching, it is common to encounter the construction of models (such as flat throwing motion, the motion of charged particles in electromagnetic fields, etc.), and the quality of a model construction directly determines whether students can understand and master the relevant knowledge points. In this case, we can use multimedia technology and animation production software (such as Adobe After Effects (AE), COMSOL Multiphysics, etc.) combined with artificial intelligence technology to create animations that intuitively display the motion trajectory and force situation of objects. By simulating through animation, abstract physical processes can be subjectively presented, which can effectively reduce students' difficulty in understanding and increase their interest in learning.

3.5 Virtual Laboratory

In middle school physics learning, we will encounter many physics experiments such as exploring the relationship between acceleration, force, and mass, estimating the size of molecules using the oil film method, and conducting experiments on light interference. Virtual experiments break through the spatial limitations of traditional experiments, such as allowing students to freely adjust the wavelength of light to observe interference phenomena. We can use virtual reality (VR) technology and network resources to build a virtual experimental platform or use existing physical experimental platforms (such as NoBook virtual laboratory). By wearing VR devices to enter the virtual laboratory, one can personally conduct experimental operations and observe experimental phenomena, such as adjusting parameters such as light wavelength and slit spacing, and observing changes in interference fringes of light. Let every student experience the experimental process firsthand. This not only breaks the traditional conclusion based teaching mode, enhances students' hands-on ability, but also ensures the safety of the experiment. At the same time, smart devices can effectively summarize experimental conclusions and guide students to think about the problems in the experiment through questioning.

3.6 Intelligent Assistance for Teachers to Improve Their Teaching Level

In the integration of new technologies and teaching, we cannot ignore the enhancement of teachers' self generated teaching power. Teaching is a process of teaching and learning, and leveraging artificial intelligence technology is both an opportunity and a challenge for educators. With the help of artificial intelligence technology, teachers can greatly improve teaching efficiency, but the technical barriers that exist cannot be ignored. Teachers need to develop new teaching skills and create a new teaching approach that combines existing teaching styles. This is a significant challenge for teachers, especially those who are older and find it difficult to adapt to new teaching models. We can design basic classes (tool operation) and advanced classes (AI teaching design) for teachers with different levels of technology acceptance, provide relevant skill training for teachers, record the usage of relevant equipment, and create a sharing platform to train teachers in new skills. Intelligent systems can not

only provide teaching suggestions and reference data for teachers, help them optimize teaching strategies, improve their self-directed teaching level, but also explore new teaching evaluation methods.

4. Summary of Teaching Quality Optimization

Through the above intelligent assisted teaching strategies, personalized learning plans can be tailored for students, creating suitable learning environments, providing efficient Q&A services, and improving teachers' teaching abilities. At the same time, three-dimensional teaching greatly enhances students' understanding and learning enthusiasm, opens up new paths for experimental teaching, ensures that experimental conditions are not limited by environmental factors, and guarantees the safety of the experimental process. These strategies not only improve students' learning outcomes, but also provide valuable suggestions and reference data for teachers. In addition, these strategies have opened up new possibilities for changing traditional teaching and laid a solid theoretical foundation for future new educational models. However, the above is only the tip of the iceberg in exploring future educational models. Through continuous improvement, education will be promoted towards a more personalized, intelligent, and efficient direction in the future.

5. Case and Effect Analysis (Taking Friction Teaching in Junior High School by People's Education Press as an Example)

Case: Next, I will use Chapter 8, Section 3 Friction in the People's Education Press 8th Grade 2 as an example to demonstrate how to combine intelligent systems with teaching. This teaching session lasts for one class hour. Of course, we need to teach students in advance how to use the virtual experiment platform correctly and require them to have a basic preview of the teaching content.

5.1 Teaching Preparation

Preparation of teaching resources:
Time: One day in advance
Steps:
(1) Research the teaching syllabus, clarify teaching objectives and requirements.
(2) Analyze the content of the textbook, determine the teaching focus and difficulties.
(3) Collect teaching materials related to friction, including animations, experimental videos, etc. (we can entrust this part of the content to artificial intelligence to help us search and organize, and then we can filter according to our needs).
(4) Prepare appropriate classroom questions and post class test questions
Preparation of teaching aids:
Prepare VR devices and corresponding virtual experimental platforms (taking the NoBook experimental platform as an example, if the ability allows, you can also build your own virtual laboratory). Electronic whiteboards, markers, and other auxiliary teaching aids, along with a simple experiment report.

5.2 Teaching Objectives

Knowledge objective:
(1) Understand the concept of friction and its conditions for generation. Master the factors that affect the magnitude of friction force, such as pressure and roughness of the contact surface.
(2) Be able to apply the laws of friction to explain practical problems in daily life, and provide several examples of the application of friction in daily life.
Ability objective: Through virtual experiments, cultivate students' observational, analytical, and experimental skills. Improve students' ability to use intelligent technology to solve physics problems.
Emotional goals: Stimulate students' interest in physics learning and cultivate a spirit of scientific inquiry. Enhance students' hands-on abilities through virtual experiments.

5.3 Teaching Key and Difficult Points

Teaching focus: The concept of friction and its generation conditions. Factors that affect the magnitude of friction force (pressure, roughness of contact surface).
Teaching difficulties: The application of friction in practical life. The concept of frictional force generation.

5.4 Teaching Process

Lesson 1: Virtual Experiment Exploring Friction Force
(1) Import new lesson (5 minutes)
The teacher displays friction phenomena in daily life (such as car brakes) through an electronic whiteboard, and analyzes why the car stops by introducing Newton's first theorem (which students have already learned in Chapter 8, Section 1 of the eighth grade textbook), and guides students to think about the existence and

role of friction.

Question: Can you tell me what friction is? How is friction generated?

After introducing the reason for the car stopping and raising the question, we will proceed to the experimental stage with the question and analyze and solve the problem during the experiment.

(2) Virtual Experiment: Conditions for Generating Friction (20 minutes)

Experimental scenario: Students enter a virtual laboratory wearing VR devices and observe the changes in the readings of a small wooden block in different motion states using a Newton's tensile force meter.

Experimental operation:

Students use a virtual controller to slowly pull a small wooden block from rest and observe whether the reading of the Newton tension gauge changes.

Repeat the experiment multiple times to observe the variation pattern of the tensile force gauge.

Experimental conclusion: The generation of friction requires two objects in contact with each other, and there is a relative motion or tendency towards relative motion between them.

(3) Virtual experiment: Factors affecting the magnitude of friction force (15 minutes)

Experimental scenario: Teachers guide students to propose hypotheses (such as' Is friction related to contact area? ') and encourage autonomous verification through VR experiments. Students enter the virtual laboratory through VR devices to explore which factors are related to the magnitude of sliding friction.

Experimental operation:

Experiment 1: Keep the roughness of the contact surface unchanged, change the weight of the wooden block (by adding weights), and record the change in the magnitude of the Newton's tension meter reading (as shown in Figure 4).

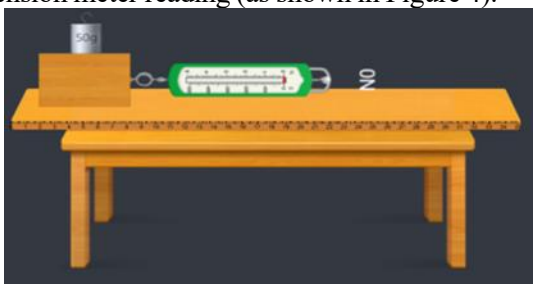

Figure 4. Investigate the Magnitude of Frictional Force by Changing the Weight of a Wooden Block

Experiment 2: Keep the weight of the wooden block constant, change the roughness of the contact surface (such as from a smooth plane to a rough plane), and record the change in the magnitude of the Newton tension meter reading.

Experimental data: The virtual laboratory automatically records experimental data and generates charts for students to analyze.

Students summarize the experimental conclusions themselves and write them on the experimental report form to submit to the teacher. At the same time, the teacher can also view the students' experimental data and details on the intelligent teaching system's teacher end, and intelligently summarize the basic errors that students make in the experiment (such as the Newton tension meter not maintaining its level, etc.). At the same time, the intelligent system can provide adaptive teaching evaluations and practical suggestions based on students' concentration and other factors.

(4) Classroom Summary (5 minutes)

The teacher summarized the experimental content of this lesson, evaluated the experimental operation of the teacher's classmates based on the data summarized by the intelligent system, and reviewed the theoretical knowledge. In this lesson, we learned the definition of friction force: when two objects in contact slide relative to each other (relative motion or the trend of relative motion), a force that hinders relative motion is generated on the contact surface, which is called sliding friction force. At the same time, we also learned that friction is related to the magnitude of pressure and the roughness of the contact surface.

Assign homework: Consider whether the magnitude of friction is related to the area of the contact surface, and propose the difference between dynamic friction and static friction. At this point, our class has come to an end.

6. Conclusion and Prospect

Integrating intelligent technology into middle school physics teaching is a multidimensional and complex problem that requires extensive teaching experiments and reasonable analysis to determine suitable teaching methods. This article provides possible paths for new teaching by proposing some intelligent assisted teaching strategies, but lacks experimental data support. The current strategy needs to be further validated through comparative experiments, such as comparing the performance improvement rates between the intelligent group and the traditional group. Nevertheless, this article has demonstrated the foresight and innovation of intelligent assisted teaching. In future research, I believe more

people will engage in related studies to provide data support for the theory. With the deepening of research, intelligent assisted teaching will continue to be improved, making it more in line with practical teaching needs. At the same time, new teaching methods will keep pace with the times, integrate more diverse and advanced intelligent technologies, and inject continuous vitality into the education industry.

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