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Research on the Innovation of Physics Teaching Model in Junior High School under the Smart Classroom Environment

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Abstract: Under the digital transformation of education, smart classrooms have provided crucial support for the renewal of physics teaching models in junior high schools. Based on relevant educational policies and the actual situation of junior high school physics teaching, this paper explores the innovative practice of physics teaching models in the smart classroom environment, analyzes the main problems existing in the practice, puts forward corresponding innovative paths, and supplements them with specific course cases. The research aims to break through the limitations of traditional teaching, deeply integrate smart technology with junior high school physics teaching, help teachers improve teaching methods, enhance teaching accuracy, implement the cultivation goal of core literacy, and provide practical references for the high-quality development of junior high school physics teaching.

Keywords: Junior high school physics; Smart classroom; Teaching model; Innovative research

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1. Introduction

Against the background of digital transformation in education, the "China Smart Education White Paper" has launched the "National Education Digital Strategy 2.0", and the "Compulsory Education Physics Curriculum Standards (2022 Edition)" requires strengthening practical teaching and promoting the reform of education methods. Meanwhile, the "Opinions on Strengthening Science Education in Primary and Secondary Schools in the New Era" proposes to use artificial intelligence and other technologies to improve experimental teaching and solve the problem of educational equity. At present, junior high school physics teaching still suffers from rigid traditional models and a lack of precise teaching, which cannot meet the requirements of core literacy cultivation. Under such policy guidance and practical teaching demands, innovating the junior high school physics teaching model by relying on smart classroom technology and realizing the deep integration of technology and subject teaching has become an inevitable choice for implementing educational policies and improving teaching quality, with important theoretical and practical significance [1].

2. Practical significance of innovating junior high school physics teaching model in the smart classroom environment

The innovative practice of junior high school physics teaching model in the smart classroom environment is mainly based on the characteristics of junior high school physics and students' cognitive laws, breaking the bottlenecks of traditional teaching practice [2]. Compared with traditional teaching models, the innovative model, supported by smart technology, transforms physics experiments from demonstration-based to inquiry-based. Students can operate virtual simulation experiments and analyze data in real time, effectively improving their practical operation ability and scientific inquiry ability. It also improves teaching interaction, realizing accurate interaction between teachers and students and among students, overcoming the lag of feedback in traditional classrooms, enabling teachers to timely identify students' learning deficiencies and make improvements. In addition, this practice can cultivate students' digital learning ability, meet the needs of core literacy development of students in the new era, and provide direct practical support for improving the quality and efficiency of junior high school physics teaching and realizing the transformation of education models.

3. Practical difficulties in innovating junior high school physics teaching model in the smart classroom environment

3.1. Incomplete data collection and difficult learning situation diagnosis

Teachers lack a systematic methodology for data collection in smart classrooms, with no clear dimensions and standards for collecting key learning situation data throughout the teaching process. They only focus on superficial data such as classroom answer accuracy, ignoring in-depth information including students' thinking processes, error causes, and knowledge weaknesses. Without scientific data screening, integration and analysis methods, scattered data cannot be converted into actionable teaching information, leading to incomplete and inaccurate judgments of students' learning status. This fails to provide a reliable basis for subsequent teaching adjustments and affects the pertinence of teaching model innovation [3].

3.2. Formalized interaction and insufficient deep thinking

Teachers lack a scientific interactive guidance methodology in designing and implementing smart classroom interactions. Most use preset questions and simple feedback without building an interactive platform that stimulates in-depth thinking. Interaction design is not centered on cultivating the core literacy of physics, lacking accurate control of interaction rhythm and depth, and failing to guide students in inquiry and critical interaction around key and difficult teaching points [4]. Teachers provide insufficient feedback and sublimation of interaction results, failing to identify students' thinking loopholes or guide the advancement of thinking. As a result, interaction fails to spark ideological collisions and cannot achieve the teaching goal of deep learning.

3.3. Insufficient resource adaptation and difficulty in considering individualization

Teachers lack scientific methodological guidance in selecting, integrating and using smart teaching resources. They cannot screen and reorganize massive online resources according to the characteristics of junior high school physics, key teaching points and students' cognitive differences. Resource application mostly stays at simple display, without personalized adaptation plans for students at different levels, nor in-depth integration of resources with teaching objectives and links. Teachers lack awareness and methods of dynamically updating resources, failing to ensure the timeliness and adaptability of resources, which cannot meet students' personalized learning needs and affects the effectiveness of teaching model innovation [5].

3.4. Complex technical operation and scattered energy

Teachers lack an efficient integration methodology for smart classroom technology, are unskilled in operating smart teaching equipment and software, and have not formed the awareness of technology serving teaching. They spend a lot of time solving technical operation problems in class. Teachers fail to reasonably arrange technical application scenarios or organically integrate technical operation with teaching links, resulting in the separation of technology from teaching objectives. This distracts teachers' teaching work and students' attention, affects normal teaching progress, and hinders the development of teaching model innovation [6].

4. Analysis on innovative paths of junior high school physics teaching model in the smart classroom environment

4.1. Intelligent diagnosis of learning situation and data-driven teaching

Teachers should establish a systematic learning situation diagnosis methodology, build a full-process learning situation collection system relying on smart classroom technology, clarify collection dimensions and standards, capture both superficial data and in-depth information, and abandon single-data evaluation methods [7]. Using scientific screening, integration and analysis methods, scattered data are converted into implementable teaching guidance information to accurately identify students' knowledge weaknesses and cognitive laws. Based on this, personalized teaching plans are formulated, teaching link design is improved, promoting the transformation of teaching decisions from experience-based to data-driven, and enhancing the pertinence and scientificity of teaching.

For example, in the lesson "Transformation and Conservation of Energy," teachers use the smart classroom learning situation collection function to comprehensively collect data on students' understanding of energy transformation forms and conservation conditions, focusing on students' thinking processes and error logic in judging energy transformation in different scenarios, rather than only counting answer accuracy. Scientific analysis of collected data accurately identifies students' weaknesses in understanding the connotation of energy conservation and analyzing transformation processes. Teaching links are improved according to students' cognitive laws, and targeted explanations are designed for cognitive deviations, making teaching decisions closer to students' actual learning and improving teaching accuracy and effectiveness [8]. Teachers can use the answer annotation function of smart classrooms to let students mark their thinking steps during answering. Combined with background data statistics, they can clearly know whether students can distinguish between energy transfer and transformation, and whether they ignore the application scope of conservation conditions, so as to adjust teaching progress in a targeted manner, supplement error-prone knowledge points, deepen students' understanding of the core content of the law of conservation of energy, and truly make learning situation data serve teaching improvement.

4.2. Virtual-real integrated experiments for exploring principles and seeking truth

Teachers should establish a scientific experimental teaching methodology, break through the constraints of traditional experimental teaching, integrate smart technology with physics experiments, and build a virtual-real complementary experimental teaching system. Emphasis is placed on guiding students to actively participate in experimental design and inquiry, using virtual simulation technology to overcome the limitations of experimental conditions, enhancing the value of real experiments, and organically combining virtual inquiry with real operation. By optimizing the experimental teaching process and focusing on the exploration of physical principles, students' scientific inquiry ability and rigorous scientific thinking are cultivated to achieve the goal of cultivating subject core literacy [9].

Taking "Electric Current and Circuit" as an example, teachers combine virtual simulation experiments with real experiments based on key knowledge points such as circuit composition and the principle of current generation, building a virtual-real integrated experimental inquiry system. Virtual simulation technology overcomes the risk of equipment damage caused by wrong circuit connections in physical experiments, allowing students to try different circuit connection methods and observe the process of current formation. Real experiments are then used to verify the results of virtual inquiry, deepening the understanding of circuit composition and current direction, and cultivating rigorous scientific inquiry thinking and experimental operation ability [10]. Teachers can use the virtual simulation platform to design hierarchical inquiry tasks, enabling students to gradually master the functions of power supplies, electrical appliances, wires and switches, and observe circuit states in open and short circuits. Then, through real experiments, students manually connect series and parallel circuits, compare differences between virtual and real experimental phenomena, analyze causes, use smart classrooms to record experimental data, sort out problems in students' experiments, and deepen the understanding of the principle of current formation and circuit working rules.

4.3. Dynamic resource push and teaching according to students' conditions

Teachers should form a methodology for teaching resource application and adaptation, accurately select and reorganize massive online resources based on the characteristics of junior high school physics and students' cognitive differences, abandoning the simple stacking of resources. A dynamic resource update mechanism is established to ensure the timeliness and adaptability of resources, and a hierarchical resource system is built according to teaching objectives and links. Resources are accurately pushed based on students' learning situation data to meet the learning needs of students at different levels, promoting the deep integration of resource application and personalized teaching, and giving full play to the educational value of resources [11].

For example, in the lesson "Laws of Voltage in Series and Parallel Circuits," teachers select and optimize appropriate teaching resources around the key knowledge point of voltage distribution characteristics in series and parallel circuits, building a hierarchical resource system. Based on students' learning situation data, basic explanations and simplified demonstration resources of voltage laws in series and parallel circuits are pushed to students with weak foundations, and exploratory resources are pushed to students with strong abilities, achieving precise push. Meanwhile, resources are adjusted according to changes in teaching links to ensure they adapt to teaching objectives and students' cognitive needs, helping students correctly grasp course knowledge. Teachers can integrate virtual demonstration videos, knowledge point dismantling courseware and error-prone point analysis resources. According to students' pre-class preview data, popular explanation resources of voltage laws are pushed to students with weak foundations, and exploratory resources of voltage laws in different circuit scenarios are pushed to students with strong abilities. Combined with classroom learning data, the content of resource push is adjusted in real time to keep resources consistent with students' progress and cognitive needs [12].

4.4. Data-driven evaluation and precise improvement

Teachers should establish a data-driven evaluation methodology, abandoning the traditional extensive evaluation mode. Relying on smart classroom learning situation data, they accurately identify the causes of students' answer errors and knowledge loopholes. The evaluation process is improved, focusing on key and difficult teaching points and common problems of students, emphasizing the pertinence and effectiveness of evaluation, and attaching importance to the explanation of personalized wrong questions, allowing students to think, discover and solve problems independently. By optimizing evaluation feedback, subsequent teaching strategies are improved, forming a closed loop from data collection, analysis and diagnosis, evaluation and improvement to teaching optimization, so as to improve teaching quality [13].

For example, when teaching "Application of Ohm's Law in Series and Parallel Circuits," teachers rely on smart classroom learning situation data to accurately identify common errors and individual problems in students' application of Ohm's law and calculation of series and parallel circuits, focusing on explaining key contents such as circuit resistance calculation and current and voltage derivation [14]. Common errors are intensively explained with problem-solving ideas and error-prone points, and targeted guidance is provided for individual loopholes, allowing students to reflect and fill gaps independently. Subsequent teaching methods are improved according to evaluation feedback to strengthen students' understanding of Ohm's law application knowledge points, achieving precise improvement of teaching quality. Teachers can use the error analysis function of smart classrooms to classify students' errors in solving total resistance in series circuits and current distribution in parallel circuits, analyze the causes of these errors, explain how to use problem-solving formulas and analyze circuit structures, then push personalized error exercises. Students sort out knowledge points from wrong questions, and teaching strategies are adjusted according to subsequent learning situation data feedback, forming a complete teaching improvement closed loop [15].

5. Conclusion

In summary, this paper mainly studies the innovative practice of junior high school physics teaching model in the smart classroom environment. Based on relevant educational policies and teaching status, it clarifies the practical significance of innovating junior high school physics teaching model in the smart classroom environment, systematically analyzes various problems encountered in the innovation process, puts forward targeted innovative paths, and supplements detailed cases combined with specific junior high school physics courses, realizing the organic integration of theoretical analysis and practical application. Based on the characteristics of junior high school physics and teachers' teaching practice, with the goal of core literacy cultivation, this paper starts from four aspects: learning situation diagnosis, experimental integration, resource adaptation and precise evaluation, providing a scientific basis for breaking through traditional teaching limitations and promoting teaching model transformation. It enriches the practical research on the deep integration of smart classrooms and junior high school physics teaching, helps improve the quality of junior high school physics teaching, and implements the fundamental task of fostering virtue through education.

Disclosure statement

The author declares no conflict of interest.

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