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Exploration of Effective Strategies for Empowering University Physics Teaching with Artificial Intelligence

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Abstract: Against the background of educational digital transformation, artificial intelligence technology has been extensively integrated into university physics teaching, reshaping its models and concepts and injecting new vitality into its reform. Nevertheless, relevant teaching and research work are still in the initial stage. In practical operation, there exist problems such as perfunctory AI empowerment, superficial technology application, insufficient prominence of students' subjective status, and weaknesses in experimental teaching, which require more useful attempts by frontline teachers. Based on the core values and practical dilemmas of AI-enabled university physics teaching, this paper puts forward effective strategies to promote the reform of university physics teaching for reference.

Keywords: Artificial intelligence empowerment; University physics; Teaching; Effective strategies

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1. Introduction

In the field of university physics teaching, AI empowerment is not a simple superposition of physics teaching and artificial intelligence technology. Instead, supported by artificial intelligence technology, it realizes systematic reforms of teaching concepts, teaching contents and teaching methods, so as to effectively solve traditional teaching problems and promote the precise, personalized and efficient development of university physics teaching. The proposal of the advanced concept of AI empowerment has brought new opportunities for the innovation of university physics teaching. It is the key to comprehensively improving teaching effects for teachers to reshape the models and concepts of university physics teaching through AI empowerment and give full play to the intelligent, personalized, situational and data-driven advantages of artificial intelligence technology.

2. Core values of AI-enabled university physics teaching

2.1. Solving teaching pain points and improving teaching efficiency

AI-enabled university physics teaching can effectively solve the pain points of traditional university physics teaching, such as "abstract theories, limited experiments and insufficient personalization", and improve the efficiency of university physics teaching. For example, teachers can transform abstract physical concepts and laws into visual content through virtual simulation teaching, helping students quickly understand knowledge; repetitive work can be handled through functions such as intelligent Q&A and automatic grading, allowing teachers to devote more energy to teaching innovation and personalized guidance [1].

2.2. Implementing personalized teaching and promoting students' all-round development

Artificial intelligence can build personalized learning models based on students' learning data, analyze students' actual learning needs and weak links, and then push personalized learning contents and practice tasks to students, providing targeted learning guidance to realize "one-to-one tailored" teaching. By empowering university physics teaching with artificial intelligence, teachers provide suitable learning support for students with different foundations and needs, stimulating students' learning initiative and enthusiasm, which is of great significance to students' all-around development [2].

2.3. Strengthening experimental teaching and cultivating innovative ability

Teachers can optimize experimental teaching methods through artificial intelligence technology and provide corresponding practical fields for the development of students' innovative ability. For instance, virtual simulation technology is used to build real and complex physical experiment scenarios, simulating various variable changes and emergencies in the experiment process, allowing students to conduct repeated trials and explorations in a virtual environment. This teaching model breaks through the limitations of traditional experimental teaching, further enriches students' experiment scenarios, and makes the cultivation of students' innovative ability smoother [3].

2.4. Promoting teaching reform and improving the education system

AI-enabled university physics teaching can promote the transformation of teaching concepts from "knowledge imparting" to "ability cultivation and literacy improvement", the transformation of teaching models from "teacher-led" to "student-centered and teacher-guided", and the transformation of teaching evaluation from "single summative evaluation" to "diversified formative evaluation". Empowering university physics teaching with artificial intelligence is an important measure to promote teaching reform and improve the education system.

3. Existing problems in university physics teaching in the AI era

3.1. Outdated teaching concepts and superficial integration

In the process of integrating artificial intelligence technology with university physics teaching, some teachers adhere to traditional teaching concepts, focus teaching innovation on knowledge imparting, and regard artificial intelligence only as "a tool for auxiliary teaching", failing to give full play to the personalized, interactive and data-driven advantages of artificial intelligence. Teachers take artificial intelligence as an auxiliary teaching tool, only using it to push learning materials, assign homework and play teaching videos, without deeply exploring the potential of artificial intelligence in teaching model reform, personalized learning support, experimental teaching innovation and other aspects [4,5]. This reflects that teachers' teaching concepts are outdated, and the integration of artificial intelligence and university physics teaching is superficial.

3.2. Superficial technology application and insufficient adaptability

Some teachers lack opportunities to systematically learn artificial intelligence technology, are unskilled in operating relevant equipment and software, and cannot give full play to the core functions of the tools. For example, they have only a superficial understanding of big data and cannot comprehensively analyze students' learning data with the data analysis function of artificial intelligence. In this case, teachers often cannot fully grasp the learning situation, and the formulated intelligent teaching strategies are deficient, making it difficult to fully adapt to students' learning needs [6].

3.3. Inadequate implementation of personalized teaching and insufficient prominence of students' subjective status

Although artificial intelligence has the advantage of personalized adaptation, some teachers fail to give full play to this advantage in actual teaching. Due to the lack of advanced concepts and methods, they cannot apply the "one-to-one" learning guidance and personalized learning path recommendation provided by artificial intelligence to teaching. In this case, personalized teaching is difficult to implement in place, relevant teaching measures are mismatched with students' actual needs, and students' subjective status cannot be highlighted [7].

3.4. Weaknesses in experimental teaching restricting students' all-round development

Experiment is the core link of university physics teaching, and also a key carrier for cultivating students' practical and innovative abilities. However, the integration of artificial intelligence and university physics experimental teaching faces problems such as uneven quality of virtual simulation experiment platform construction, poor connection between virtual experiment teaching and offline teaching, and lack of innovation in virtual experiment teaching contents, which restricts students' all-around development. Teachers need to eliminate the weaknesses in experimental teaching and improve the effect of experimental teaching in view of the practical problems in the integration of the two.

4. Effective strategies for AI-enabled university physics teaching

4.1. Renewing teaching concepts and strengthening integration awareness

To realize AI-enabled university physics teaching, teachers should take the initiative to renew their teaching concepts and strengthen the integration of artificial intelligence into the whole process of university teaching under the guidance of advanced teaching concepts. On the one hand, teachers should actively participate in relevant lectures, seminars and training courses, deeply understand the core value and application potential of artificial intelligence technology, and then establish the awareness of "technology empowers teaching and teaching serves students". On the other hand, teachers should explore in-depth integration methods of artificial intelligence and university physics teaching in daily teaching practice to realize diversified and personalized integration methods of the two. For example, drawing on the successful experience of online education, try to use an artificial intelligence Q&A system to build interactive teaching and dynamically adjust its implementation mode, combined with students' learning performance. It is the basis for improving cognition, changing concepts and enhancing abilities for teachers to understand the value and methods of AI-enabled university physics teaching through various channels, try to integrate artificial intelligence technology into classroom activities, and constantly optimize the teaching process. Teachers should establish the awareness of integrating artificial intelligence with university physics teaching, and then gradually deepen their understanding of artificial intelligence technology from the aspects of theoretical learning, research and teaching practice [8,9].

4.2. Introducing tools precisely and improving adaptability

Teachers should conduct an in-depth analysis of students' learning needs through big data, clarify students' learning interests and weak points, and introduce suitable intelligent teaching platforms and tools in a targeted manner to ensure their adaptability to the learning situation. For example, when selecting a virtual simulation experiment platform, teachers should check whether the experiment content of the platform fits students' experiment interests and ability levels, and whether the operation interface is friendly to students; when selecting an intelligent Q&A system, test whether the system can accurately understand students' questions and give high-quality answers. In addition, teachers can also customize and develop or optimize the functions of existing tools according to the learning characteristics of students in their own universities, making them more in line with the actual needs of students learning university physics [10,11]. For example, some students report that it is difficult to deeply understand complex physical formulas. Teachers can introduce intelligent tools supporting natural language processing to analyze complex physical formulas and help students form an intuitive cognition of the formula derivation process. Through these measures, teachers can accurately introduce intelligent tools and provide teaching services adapting to students' actual needs, which can effectively improve the teaching effect.

4.3. Improving the personalized teaching model and stimulating students' internal motivation

From the perspective of AI empowerment, teachers should promote teaching personalization from teaching design, classroom implementation, evaluation feedback, and other links, and provide teaching contents and methods adapted to students' learning styles and needs. For example, in the teaching design stage, teachers can use artificial intelligence technology to collect and analyze students' learning behavior data, so as to understand students' interests, knowledge blind spots and learning preferences, and design differentiated teaching plans accordingly [12]. In the classroom implementation process, teachers can push personalized learning resources such as micro-lecture videos, interactive exercises and extended reading materials for students through intelligent recommendation systems to meet the learning needs of students at different levels; through real-time data analysis, conduct real-time monitoring and analysis of students' learning behaviors and effects, and then dynamically adjust the teaching pace and content. In the evaluation feedback link, teachers should use artificial intelligence technology to build a diversified evaluation system, combine formative evaluation with summative evaluation, comprehensively understand students' learning situation, and feedback the evaluation results to students to guide them to adjust their learning plans. For example, record data such as students' participation, homework completion, and classroom interaction performance in the learning process through an intelligent system, generate personalized learning reports, and share them with students [13].

4.4. Enriching students' practical carriers and strengthening virtual-real integration

In view of various problems existing in experimental teaching, teachers should improve the construction quality of virtual simulation experiment platforms and further integrate virtual simulation experiments with real experiments. In this way, students' practical careers can be enriched, allowing students to deepen their understanding of knowledge, master operating skills proficiently, and strengthen innovative thinking in the experimental teaching of virtual-real integration. Firstly, teachers should attach importance to the construction of virtual simulation experiment platforms to ensure high restoration of experiment scenarios and standardized experimental operation procedures, which can meet students' experiment needs. For example, cooperate with professional virtual simulation experiment development companies to jointly develop virtual simulation experiment platforms suitable for university physics teaching. Secondly, teachers should constantly strengthen the connection between virtual simulation experiments and real experiments to promote their synergistic effect in students' all-around development. This requires teachers to correctly understand the relationship between virtual simulation experiments and real experiments, closely combine the two, and give full play to their advantages in experimental teaching. Taking optics experiment teaching as an example, teachers can first let students understand the phenomena such as light interference and diffraction and the operation methods of experimental instruments through virtual simulation experiments, and then guide students to conduct real experiment operations, observe experimental phenomena, measure experimental data, and deepen their understanding of optics knowledge [14,15].

5. Conclusion and prospect

Supported by artificial intelligence technology, teachers promote systematic reforms of university physics teaching concepts, contents and methods, inject new impetus into the development of university physics, help solve teaching pain points, implement personalized teaching, strengthen experimental teaching and deepen teaching reform. In the new era, teachers should attach importance to AI empowerment, give full play to the intelligent, personalized, situational and data-driven advantages of artificial intelligence in university physics teaching, and realize the comprehensive improvement of teaching effects. However, in practical operation, there are still problems such as perfunctory AI empowerment, superficial technology application, insufficient prominence of students' subjective status and weaknesses in experimental teaching, which require teachers to make more useful attempts guided by problems.

In the future, with the continuous iteration and improvement of artificial intelligence technology, the integration of artificial intelligence and university physics teaching will present a more diversified, intelligent and precise development trend. Teachers can strengthen AI empowerment and promote the innovation of university physics teaching from the following aspects:

(1) Keep an eye on the cutting-edge trends of artificial intelligence technology, actively learn and master emerging technical tools, and flexibly apply them to teaching practice;
(2) Deepen the integration level of artificial intelligence and teaching contents, and explore more innovative application scenarios;
(3) Establish a sound feedback mechanism, regularly collect students' opinions and suggestions on AI-enabled teaching, adjust teaching strategies in a timely manner, and ensure that teaching reform always takes students' needs as the core;
(4) Strengthen virtual-real integration to further expand students' learning space and experiment platforms.

Disclosure Statement

The author discloses no conflicts of interest.

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