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Strategies for the Application of Digital Means in Teaching University Physics

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Abstract: The National Education Work Conference proposes that in the new period, it is necessary to continuously deepen the digital reform of physics teaching in colleges and universities, strengthen the exchange of physics teaching innovation, and strive to improve the quality of teaching of basic physics courses and the quality of training of high-quality and innovative talents. This paper argues that this is an inevitable requirement to adapt to the changing needs of the high-tech industry and the new education model. This paper analyses the challenges faced by the application of digital means of university physics teaching from three perspectives: technological resources, teachers' roles and students' training, and points out that digital teaching not only requires the integration of innovative technologies and resources, but also needs to pay attention to the students' personalized needs, the cultivation of interdisciplinary abilities and the reform of the teaching assessment methods, hoping to provide a better solution to the challenges faced by the universities. It is hoped that it can provide reference and reference for the digital reform of university physics teaching.

Keywords: digital teaching and learning, university physics, digital resources, teaching and learning assessment

Introduction

The world is undergoing rapid changes, and the rapid development of new technologies, such as telemedicine, digital payments and industrial automation, poses challenges in many areas, including the economy, the environment, the population and the application of artificial intelligence. Universities, as the cradle of training future social elites and innovators in science and technology, must impart the right knowledge and skills to students to meet these challenges. As an important branch of the basic sciences, educators in physics need to not only impart scientific knowledge, but also cultivate students' interdisciplinary skills, such as effective communication, teamwork and creativity. However, traditional physics teaching often neglects this, and many graduates will enter non-academic fields and apply knowledge in a different way from what they have been taught at school, so curriculum and teaching reforms in recent years have begun to emphasize and encourage universities to design more flexible physics teaching, i.e., to emphasize knowledge and skills as well as to highlight the development of inter-professional competencies. Moreover, the rapid development of digital teaching tools has provided unprecedented opportunities for university physics teaching, and the traditional physics teaching model relying on classroom lectures and laboratory operations, although classical, is insufficient to meet the diverse learning needs of students in the rapidly changing educational environment[1]. In the face of the challenges of new technologies and changes in education, university physics teaching must embrace digitization and continuously innovate teaching concepts and methods to cultivate composite scientific and technological talents who possess not only profound physics knowledge but also interdisciplinary ability, innovative spirit and practical ability. This is not only a requirement for physics educators, but also an inevitable choice for university education to adapt to the development of the times.

1. Challenges in the application of digital tools in teaching university physics

1.1 Disconnect between professional education and civic education

The national ideological and political work of colleges and universities will have been on the clear: "to use the classroom teaching as the main channel, ideological and political theory courses should adhere to the improvement in the strengthening, enhance the affinity and relevance of ideological and political education, to meet the growth and development of students' needs and expectations, the other courses should be guarded a good section of the canal, planting a good field of responsibility, so that all types of courses and ideological and political theory courses in the same direction, forming a "synergistic effect". This passage clearly points out the necessity of promoting the effective integration of professional education and ideological and political education in colleges and universities in the new period. However, the reality is that since the teaching of physics in most colleges and universities has long been more concerned about the learning of students' professional knowledge or the improvement of their professional ability, so even though some schools have made attempts to integrate professional education and ideological and political education, on the whole, the objectives of university physics and ideological and political education are still on their own, and the teaching content tends to focus on the explanation of physical theory and experimental skills, while the content of ideological and political education is is marginalized and not effectively integrated into daily teaching. In addition, some professional teachers tend to position their role as the transmitter of professional knowledge and neglect their role as the guides of students' thoughts and shape of values, making it difficult for the role of Civic and Political Education to be effectively brought into play.

1.2 Inadequate technical support and resourcing

Observing the digital transformation process of university physics teaching, it is not difficult to find that the understanding and application of digitization by some teachers and students are still insufficient. Teachers often lack sufficient experience and skills in carrying out online teaching, and students also lack the ability to apply digital technology, which leads to the ineffectiveness of digitization teaching in key aspects such as physics laboratory teaching, data analysis and simulation. Coupled with the fact that digital teaching of university physics relies on high-performance computing resources and advanced experimental equipment, however, the current status of digital infrastructure in many universities is not optimistic to support these high standards of teaching and learning needs, limiting the development of scientific research and innovation and experimental teaching activities.

1.3 Inadequate adaptation to the changing roles of teachers

With the rapid development and application of information technology, university physics teachers urgently need to master the necessary information technology to adapt to the needs of digital teaching, but the reality is that many teachers are often faced with many adaptive challenges in the process of changing from the traditional role to the digital role of teaching, and even still use the traditional passive mode of teaching. Moreover, the training effect of some colleges and universities to improve the digital literacy of physics teachers is not satisfactory, and teachers can hardly play a leading role in digital teaching, which affects the overall quality of teaching.

1.4 Poor development of students' self-directed learning habits

Standardized physics education tends to specify the course content, syllabus and examination standards uniformly, but ignores the individual differences and personalized needs of students. This traditional university physics education paradigm is difficult to adapt to the trend of open schooling in the digital era, i.e., it is a student-centred approach that encourages students to choose the content of their studies according to their own interests and needs, and advocates a flexible approach to teaching methods and curricula in the hope that students can develop innovative abilities and practical skills through the educational model of practical operation and problem solving to develop innovative ability and practical skills[2]. This brings certain challenges to the transformation of students' learning habits, and students must have the ability to actively learn and explore the knowledge of unknown fields, and constantly update their knowledge system and skills in

order to adapt to the talent needs of the future society.

2. Strategies for the application of digital means in teaching university physics

2.1 Professional civics regularization

In order to promote the normalization of Civics teaching in university physics, professional teachers can cooperate with Civics teachers to establish and improve the library of Civics elements in university physics, and systematically collate the achievements of ancient Chinese physics, important events in the history of physics, the development of cutting-edge science and technology as well as typical cases of engineering applications, and digitize these contents. For example, restoration videos of ancient physics experiments, biographical animations of physicists, and application cases of cutting-edge science and technology can be made into digital resources and used to create interactive electronic teaching materials, which can make the contents of Civic and Political Education more vivid and intuitively presented to the students by means of illustrations and video animations. Teachers can make use of the teaching mode of "one guide, two classes and three platforms", combined with online courses, WeChat public number, B station live classroom and other platforms, so that students can enjoy the online discussion or live interaction of the teaching of Civics and Politics of Physics, and improve students' participation and discursive ability. In addition, colleges and universities can also establish an inter-college civic education resources sharing mechanism, open up the spatial transmission of civic education resources between different colleges and universities, and jointly develop university physics civic education courses through inter-college cooperation projects, as well as organize seminars and workshops, so as to improve the teaching level and research ability of teachers.

2.2 Digitization of teaching resources

Curriculum resource sharing is the key to promoting educational equity, knowledge popularization, systematization and resource structuring. In today's context of the deep integration of AI and education, colleges and universities can work together with MOOC and other online education platforms' teams to discuss and create a knowledge mapping AI course, disassemble and refine professional knowledge around the course objectives, knowledge frameworks and learning logic, and build a multi-dimensional knowledge network to help students to fully master the course knowledge system. Specifically for the course content, in addition to clearly sorting out the main knowledge points and knowledge relationships of university physics, it is also necessary to create a "Multi-modal" resource learning space and structured association between the textbook and the extended resources to provide students with comprehensive learning support in four dimensions: introduction to knowledge points, detailed content, learning resources and assessment[3]. Curriculum design also needs to disassemble and correlate global level problems, conceptual level problems and methodological level problems in the direction of cultivating students' observation, analysis and problem solving abilities, integrating the basic theories and technologies of AI to provide teachers and students with intelligent assessment and personalized learning paths with real-time feedback, including but not limited to the learning mode based on the visualization of the objectives, the AI intelligent learning path mode, and the search of knowledge point content, Intelligent search of teaching resources and intelligent Q&A, etc.

2.3 Personalization of the learning process

University physics teachers should uphold the new teaching concept of "student-centred, interest-driven, ability-focused and output-oriented", make full use of digital teaching resources and tools to broaden the time and space for teaching, and explore the blended teaching programme of "online and offline + inside and outside the classroom" to stimulate students' intrinsic motivation and maximize their abilities in the learning process. Explore the "online and offline + inside and outside the classroom" blended teaching programme to stimulate students' intrinsic driving force, so that students' abilities can be brought into full play to the greatest extent in the learning process. Teachers should not only integrate digital resources such as micro-teaching and catechism into students' pre-study and post-study, but also make full use of animation, video and other tools to visualize abstract physical concepts, and dynamically display them for students

through the big screen or online sharing platform, while students can instantly express their own ideas and questions through pop-ups, online Q&A, etc., so that they can gradually cultivate the good habits of independent thinking, independent learning and practice[4]. In addition, teachers can also use online physics experiment simulation tools such as PhET Interactive Simulations to carry out virtual simulation experiments. The operation of simulation experiments is highly similar to that of real experiments, providing students with intuitive and vivid experimental scenarios, and it is also equipped with instant guidance and prompts, which can help students experience physics knowledge first-hand during the process of completing the experiments corresponding to the core knowledge points. It also provides students with immediate guidance and hints, which can help them experience the process of exploring physical knowledge and deepen their understanding of the knowledge points in the process of completing the experiments corresponding to the core knowledge points.

2.4 Scientific evaluation of teaching and learning

In the current wave of digitization, university physics teaching urgently needs the integration of virtual laboratories, simulation software, online teaching platforms and other cutting-edge information technology to promote the innovation of teaching content and methods, which not only enriches the means of teaching, but also enhances the learning experience, making physics teaching more vivid and intuitive. On this basis, it is an inevitable trend to build a comprehensive evaluation system, which should make full use of digital tools such as classroom exercises and online tests to monitor students' learning progress in real time, and realize effective interaction between teachers and students and instant feedback through big data analysis technology, so as to dynamically grasp the learning status of students. In order to ensure that the evaluation system can penetrate the teaching activities in an all-round and whole-process way, teachers need to carefully design the evaluation programme to ensure a high degree of consistency between its objectives and the teaching objectives. Evaluation activities should not be an add-on to the teaching process, but should become an integral part of it, directly mapping the effectiveness of teaching and learning. For example, students' learning behaviors and growth trajectories should be continuously tracked and recorded through immediate questioning in the classroom, in-depth reflection reports after group discussions, and detailed observation records during experimental operations. These detailed records will constitute an important reference for evaluating students' learning process, helping teachers to more accurately assess students' knowledge mastery, thinking development and practical skills.

3. Conclusion

Digital technology provides new perspectives and methods for university physics teaching, and promoting the application of digital means in university physics teaching is not only to make use of the computer's rapid calculation and digital drawing ability to simulate the basic principles of physics, complex phenomena and their interaction processes, and to realize the visualization of abstract physical concepts and the digital conversion of physical laws, but also to enrich the content of university physics teaching, improve the efficiency and quality of classroom teaching and promote students' ability to deeply understand physical laws, so as to cultivate innovative and practical physics talents. It is also to enrich the content of university physics teaching, improve the efficiency and quality of classroom teaching and promote the students' ability to understand the physical laws in depth, so as to cultivate physical talents with innovative spirit and practical ability. In order to achieve the effective promotion of the digital reform of university physics teaching, teachers must continue to optimize and update the digital teaching resources, develop more detailed and interactive physics simulation software and strengthen the digital skills training for the teaching team, so as to effectively guide students to explore and discover in the digital learning environment. At the same time, it is also necessary to always integrate the content of the course ideology into the digital teaching resources, through diverse forms of teaching integration to achieve the organic combination of knowledge transfer and value leadership, through the transmission of correct values to the students, so that the students in the study of physics professional knowledge at the same time can also better improve their own scientific literacy, the spirit of innovation and a sense of social responsibility.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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