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Reform and Practice of Physics Experiment Teaching Based on Information Simulation

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Abstract

Physical experiments are the foundation of physics. They play a vital role in cultivating physical concepts, mastering physical laws, and cultivating scientific inquiry awareness. At present, there are many deficiencies in the teaching of physical experiments in China, including theoretical teaching of experimental links, insufficient equipment, and no demonstration experiments. With the continuous deepening of educational reform, the combination of information technology and education has become closer and closer, and teaching methods are constantly changing, gradually making up for the traditional experimental teaching model. As a new product of the information age, simulation experiments have been widely used in teaching. How to organically combine simulation experiments with traditional experimental teaching is a difficult problem that troubles front-line physics teachers. In order to solve this problem, this paper discusses how to combine simulation experiments with physical experiments to improve the quality of experimental teaching. This paper will point out the concept and characteristics of simulation experiments, and then explain the physical experiment teaching process based on information simulation. Finally, it points out the relevant suggestions for the reform and practice of physical experiment teaching based on information simulation, in order to promote the reform of simulation physics experiment teaching in the information age.

Keywords

Informatization; Simulation Physics Experiment; Teaching

With the rapid development of modern information technology, the big data, cloud computing, and simulation reality of "Internet +" have entered people's daily lives. "Knowing everything that happens in the world without leaving home" is no longer a fantasy. Teaching is no longer limited to the classroom, textbook knowledge, or the teacher's explanation; online teaching, micro-classes, flipped classrooms, MOOCs, etc. have not only had a profound impact on the teaching field, but also had a new impact on traditional teaching methods. In education, the direct manifestation of educational informatization is: the informatization of the basic teaching platform: multimedia classrooms, voice classrooms, etc.; multimedia courseware, electronic documents, video courseware, online courseware, etc.; informatization of teaching processes: mainly teachers have a certain level of attainment in information technology and provide students with informatization teaching; informatization of teaching media: including teaching materials, teaching means, teaching methods, etc. In physics classes, simulation experiments are the most intuitive reflection of classroom informatization, also known as "dynamic experiments", that is, teachers and students can access the simulation laboratory through the Internet to operate, and operate through the Internet, emphasizing the interaction and simulation of experimental operations, thereby promoting the quality of experimental teaching and students' learning enthusiasm, making it an important part of physics experimental teaching.

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Physics is a natural science based on experiments. It is a science of basic physical structure, interaction and motion. From the natural philosophy of ancient Greece to the classical physics of the 18th century, and then to the modern theory of relativity and quantum theory, a lot of experiments are needed to prove and study. At present, because both physics teachers and students are under learning pressure, in teaching, theoretical teaching is generally the main method. Because there is no timely updated experimental equipment, even if some experiments are done in class, it is only a small part of the experiments. Most of the experiments are carried out in textbooks, test papers and memory. For a long time, due to the "textbookization" of experimental teaching, the "monotonization" of experimental equipment, the "proceduralization" of experimental process, and the "rigidity" of laboratory management, the current experimental teaching has shown a "rigid" trend. This teaching method violates the basic principle of physics learning, believing that theory comes from practice, and students' learning is also "rootless", and they do not have a good grasp of the essence of physics; at the same time, it is also contrary to the inherent requirements of the new curriculum standard for physics teaching, and is not in line with the purpose of physics teaching. Therefore, the new curriculum reform is imperative, and promoting school informatization is an important way to promote the new curriculum reform.

1. Overview of simulation experiment

1.1 Concept of simulation experiment

Simulation experiments use multimedia, network, simulation, simulated reality and other technologies to organically combine a series of software and hardware to build different experimental environments and goals. The simulation experiment uses a simulation experiment system, which is divided into a simulation experiment platform and simulation experiment teaching management. The simulation experiment platform is similar to a real experimental bench and is equipped with corresponding experimental equipment and required experimental materials. Through the simulation experiment platform, students can connect, configure, and use a variety of experimental equipment to perform independent experimental operations; in experimental teaching, teachers can use simulation experiments to demonstrate experiments.

Simulation experiment is an experimental method based on computer software and hardware. It is a simulation of the real world. Although with the development of science and technology, simulation experiments are becoming more and more "real", "real" cannot replace "imperfect" experiments. Therefore, simulation experiments, as an auxiliary means of experimental teaching, must be selectively adjusted according to teaching objectives, teaching design principles, teaching content, etc.

1.2 Characteristics of simulation experiments

1.2.1 Interactivity

An important feature of simulation experiments is the good interactive effect. Through simulation experiments, students can conduct multiple interactions in real time, intuitively and vividly; during the experiment, the operator interacts with the computer to operate, understand concepts and information. In this interaction, students gain knowledge and practice operating skills without risk. Operators can interact with each other across fields and communicate about experimental operations on the same experimental interface, providing a platform for collaborative learning for operators from different countries, achieving learning tasks and achieving common progress.

1.2.2 Immersion

The so-called immersion means that when the operator conducts a simulation experiment, he will have an immersive sense of reality, as if he is in a simulation world set by the system, fully engaged, and giving the operator a lifelike feeling. Through the study of physical concepts, physical laws and other knowledge, learners can better understand physical knowledge and thus achieve the purpose of learning.

1.2.3 Openness

The system adopts a network platform to realize network sharing, breaking through the limitations of traditional experimental geographical space and making it possible to share learning environment and learning resources; the simulation test platform is open to any user and operators can use it anytime and anywhere.

2. Physics experiment teaching process based on information simulation

2.1 Teaching process of “student group experiment” assisted by simulation experiment

"Student group experiment" is an important part of physical experiment. It is organized by teachers to conduct experiments in groups, and group members conduct experimental operations, observations, collection and organization of experimental data to enhance experimental ability and teamwork spirit. "Student group experiment" is generally carried out in the laboratory. The traditional teaching method is that the teacher explains the experimental principles, precautions, and experimental plans, and then installs equipment, conducts experiments, observes phenomena, and collects and organizes experimental data. For example, in "Determination of the Electromotive Force and Internal Resistance of the Battery", the teacher will explain the experimental principles, experimental circuit diagrams and precautions, and then the students will conduct experiments, record the experimental data, and finally analyze the results. During the entire experimental process, all students follow their own steps without any thinking, just connect them together, test, record, and process. This teaching method is very unfavorable for cultivating students' spirit of exploration and scientific thinking ability.

In the traditional "group experiment" teaching, students do more hands-on work than brain-based work. In order to cultivate students' thinking ability, simulation experiments are introduced into experimental teaching. The implementation process of simulation experiments is divided into three steps: the first is to create a new classroom environment and guide new classroom questions; in the second section, students discuss in groups, design experimental plans, and verify the plans with simulation tests; the third part is that students conduct actual experiments in actual experiments.

In the "group experiment", the function of the simulation experiment is to allow students to think and practice independently, so that students have a platform to implement the design concept. Therefore, in the entire teaching process, "virtual" comes first and "real" comes later, and "virtual" brings confidence to "real". Since the experimental plan is designed and verified by the students themselves, in practice, the students' confidence and work efficiency will be improved. On this basis, the ability of independent learning, exploration, cooperation, etc. is cultivated and developed.

2.2 Teaching process of “demonstration experiment” assisted by simulation experiment

"Demonstration experiment" is an experiment closely related to classroom teaching content, which is completed with the assistance of teachers or students. Before understanding new concepts and new rules, students' perceptual cognitive ability is cultivated through demonstration experiments. In traditional experimental classes, demonstration experiments are often limited to teachers' oral lectures and picture displays due to problems such as instruments and equipment and experimental time, and students' introduction of new knowledge is limited to imagination; some experimental demonstration effects are not obvious, which cannot allow students to experience the intuition generated by the experiment, and is not conducive to the establishment of perceptual cognition. In response to the above two common situations, this article proposes a teaching process of using simulation experiments to assist "demonstration experiments" that cannot be truly operated, and a teaching process of using simulation experiments to assist "demonstration experiments" that can be truly operated.

2.2.1 The teaching process of "demonstration experiments" that cannot be carried out in real life is assisted by simulation experiments

In the teaching process, if teaching cannot be carried out due to various reasons, it can be achieved through simulation experiments, the contents of which include: first, providing teaching background according to textbook content, teaching objectives, students' existing knowledge structure system, connection with life, hot issues, etc., so as to arouse students' interest in learning and stimulate students' learning mood; secondly, taking simulation experiments as the main line, through the experimental process and phenomena of simulation experiments, cultivate students' perceptual cognition of new knowledge and construct physical models; secondly, show students real experimental phenomena to prevent suspicion and cognitive contradictions caused by watching demonstration experiments in simulation experiments; finally, summarize the relevant concepts and laws obtained through experiments.

In the teaching process of "demonstration experiment", simulation experiment cannot be carried out. The teacher obtains the corresponding experimental results by combining "virtual" and "real". Situational teaching promotes

students' active learning by asking questions; simulation experiment explores the problem, gets the answer, and builds a physical model in the mind; the correctness of the problem is confirmed by demonstrating the image of the actual experimental phenomenon; such a teaching process is suitable for experiments that cannot be demonstrated. Compared with teachers only imparting knowledge, it can help students understand knowledge and build knowledge structure.

2.2.2 Teaching process of "demonstration experiment" assisted by simulation experiment and can be actually operated

In the "demonstration experiment", it can also be achieved through simulation experiments. The specific steps are as follows: first, create a physical environment for students to understand new knowledge; then, through actual experimental demonstrations, let students better experience the feeling of the experiment; secondly, with the assistance of simulation experiments, enable students to analyze and review the knowledge they have learned, thus laying a solid foundation for future learning; finally, summarize the relevant concepts and laws obtained through the experiment.

With the assistance of "demonstration experiment", it has two main functions: one is to use simulation experiments to help students observe, analyze and think about the experimental process that is important, wants to be emphasized, and wants to be highlighted, but flashes quickly in reality; at the same time, through the operation of simulation experiments, students can also review the process and phenomena of the experiment, thereby deepening their understanding of the experiment and laying a foundation for future learning.

3. Reform and practical suggestions for physics experiment teaching based on information simulation

3.1 Selectively use simulation experiments to assist experimental teaching

Using simulation experiments to assist teaching in physical experiments can improve teaching efficiency, but not all experiments must rely on simulation experiments. Through research on students, it is found that students are more willing to conduct their own experiments. Therefore, under the premise of conditions, actual experiments should be used as much as possible, and simulation experiments should be flexibly applied to a certain extent to improve the effectiveness of classroom teaching.

3.2 Control the teaching arrangements of the key and difficult points in the teaching process

The teaching process is a step-by-step and progressive teaching activity. Through simulation experiments to assist experiments, it is not necessary to concentrate knowledge on a specific link like traditional teaching, so that students can learn more. In the teaching process, it is necessary to reasonably arrange the teaching content, the development of key points and difficulties, and the time of each link.

3.3 Simulation experiments cannot replace real experiments

Simulation experiments cannot be the standard for verifying the truth, nor can they be as convincing as real experiments, and they cannot replace real experiments. In real experiments, students' technical and practical abilities will be greatly affected, while real experiments will have various influences that simulation experiments do not have, and this interference can also affect the success or failure of the experiment. Simulation experiments are based on a simulated experimental environment, emphasizing the interaction and simulation of experimental operations, which can reduce the pressure on schools and experimental teaching and improve the quality of experimental teaching, but they cannot replace actual experiments. Therefore, simulation experiments can only play an auxiliary role.

4. Conclusion

With the integration of information technology and education, it will become an inevitable trend of the development of the times. At the same time, we also hope that more front-line physics teachers can understand the connotation of " informatization ", truly use "simulation experiments" as a tool to assist experiments, introduce "informatization" into teaching, realize the effective integration of tradition and modernity, and make unremitting efforts to cultivate innovative talents in the new century.

References

[1] Lin Haifeng, Xiong Feibing, Wang Yiping. Reform of university physics experiment teaching based on virtual simulation[J]. China Education Informatization·Basic Education, 2017(11):91-93.

[2] Jiang Can, Wu Fan. Research on reliability assessment method based on fault physics simulation[J]. Electronic Product Reliability and Environmental Testing, 2020, 38(4): 5-9.

[3] Wang Xiaohan, Guo Hongxia, Lei Zhifeng, et al. Single event upset calculation method based on Monte Carlo and device simulation[J]. Acta Physica Sinica, 2014(19):196102-1-196102-7.

[4] Zhuang Zhuo. Simulation-based engineering and science adapted to globalization[J]. China Manufacturing Informatization, 2009, 38(24): 58-60.

[5] On domain model representation method in physical simulation experiment [D]. Jilin: Northeast Normal University, 2008.