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Innovation of Experimental Teaching in Senior High School Physics

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Abstract: The innovation of experimental teaching in senior high school physics is to ensure that experimental activities in classrooms are more in line with the teaching concept of the discipline and to assist students to understand physics in the form of experiments so as to improve students' understanding and the learning efficiency of classrooms. In the teaching of high school physics, there are still several disadvantages and problems in experimental teaching. Teachers need to reflect and summarize previous experimental teaching practices in the teaching design stage as well as look for a more targeted breakthrough point for curriculum innovation from the problems encountered in order to formulate reasonable innovation strategies and ensure a smooth process for the improvement of the effectiveness of experimental teaching.

Keywords: High school physics; Classroom experiment teaching; Innovation strategy

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1. Introduction

Experimental teaching is an important aspect in the teaching of senior high school physics. By carrying out experimental teaching activities in classrooms, students can transform their theoretical knowledge into concrete practical representation through direct experience in the process of practice and observation of experiments. This deepens students' understanding of the theoretical knowledge of physics. Eventually, this would also improve the learning efficiency in classrooms and the students' learning literacy. In the teaching design stage of its curriculum, teachers should pay full attention to the educational significance of experimental teaching. In consideration of the problems existing in experimental teaching at this stage, teachers should also look for an effective way for curriculum innovation so as to ensure that experimental teachings are carried out in an energy-saving environment and would assist students' learning activities. This would in turn promote the practical improvement of students' learning efficiency of physics and their learning literacy.

2. Significance of experimental teaching in senior high school physics

2.1. Optimize the course structure and cultivate students' interest in learning physics

The exam-oriented education of physics in senior high schools mainly focuses on teachers imparting theoretical knowledge in classrooms. As a result of that, students lack interest in learning physics. In addition, the theoretical development of the curriculum also greatly reduces the interest of students in physics, thus leading to the difficulty in cultivating students' emotions during physics lessons. By innovating experimental teaching and introducing experimental activities in its curriculum, the curriculum structure can be optimized. With the practical enrichment of the original theoretical course and experimental links with diversified forms as well as interesting practical processes, the purpose of

cultivating students' interest in learning physics can be achieved.

2.2. Concrete teaching content and experience the process of knowledge generation

Senior high school physics is relatively difficult as its contents are abstract for students, especially during the learning stage. Therefore, students often encounter many problems in the process of understanding physics, resulting in poor learning efficiency. By designing classroom experimental activities, abstract theoretical knowledge can be transformed into concrete representations in experiments. By guiding students to participate in these experimental activities, the teaching content can be expressed concretely, and students would be assisted in their understanding of the subject. Moreover, with students' participation in experimental activities, teachers can further guide students to establish a direct experience of the specific production process of knowledge so as to deepen their understanding of physics and improve the efficiency of learning physics.

3. Current situation of experiment teaching in senior high school physics

3.1. Strong functionality and lacks reasonable design

At this stage, teachers are gradually paying attention to the significance of experimental teaching in classrooms and have preliminarily applied experimental teaching in classrooms. The purpose of all these is to promote the innovation of traditional teaching, create a more efficient curriculum learning platform, and help students improve their learning efficiency. However, in actual teaching, most physics teachers lack the process of specific research on experimental teaching, leading to the strong functionality of the experimental activities in the curriculum. This refers to teachers who only express the knowledge points in the curriculum, thus appearing as if they are just promoting the progress of the curriculum in classrooms. This problem which is caused by teachers' lack of reasonable design greatly weakens the educational value of experiments and leads to the difficulty in meeting the needs of assisting students in learning physics.

3.2. Lacking independent experience and imbalance in the subjectivity of the experimental process

The concept of quality education emphasizes that teachers should always assume students as the main body in the curriculum and promote the change of students' passive learning to active learning so as to ensure students are truly the masters of classroom learning activities as well as improve the quality of learning in independent classrooms. However, at this stage, physics experiments in senior high schools are often dominated by teachers with their demonstrations. Teachers blindly pursue curriculum progress and neglect students' subjective design of experimental activities, resulting in the lack of independent experience of experiments. This imbalance with excessive subjectivity bias toward teachers makes it difficult for the improvement of students' learning literacy through experiments and greatly reduces the teaching significance of the experimental link.

4. Innovative strategies of experimental teaching in senior high school physics

4.1. Strengthen the visibility of experiments and stimulate the interest to participate in experiments

Carrying out experimental teachings in classrooms can attract students' attention by intuitively displaying interesting physics phenomena through experiments. This stimulates students' interest in the experimental link, encourages their active involvement in the experimental process, as well as provides students opportunities to experience specific physics knowledge and the charm of learning physics. Eventually, there would be an improvement in students' emotional literacy through experimental teachings. In order to further strengthen the attraction of experimental activities for senior high school students, teachers should

first strengthen the visibility of classroom experiments. As the innovation direction, teachers should perform experiments that are directly linked to physics knowledge in front of their students as clearly as possible so as to stimulate students' interest in subsequent experimental activities.

For example, in the teaching of free fall, teachers can show two identical A4 papers to the students at the beginning of the lesson and ask the students who seated at the front row to compare the size of the paper. After that, one of the papers is crumpled into a shape of a ball, and the two pieces of paper are allowed to fall freely from the same height. When observing the falling trend, students would then note that the crumpled paper falls first. This high visibility experimental activity demonstration would stimulate students' curiosity. This encourages students to explore the reason of why the papers have great differences upon falling even at the same height. In turn, students would actively participate in independent experiments in the follow-up lessons. By actively exploring and learning the knowledge of physics existing in the experiment and finally understanding the knowledge related to resistance with high efficiency, the goal of improving students' learning efficiency can be improved. Experiments with high visibility make full use of the factor of interest in experimental activities and directly stimulate students' desire for exploration. Such experiments employ students' subjective psychological factors to improve the efficiency of curriculum teaching.

4.2. Emphasize students' subjectivity and prepare sufficient experimental materials

In order to improve the imbalance of subjectivity in experimental teaching, teachers should timely transform their educational ideas and realize that students are the main body in the experimental process. Only by respecting students' status, then they can improve their physics literacy through experiments. In order to really strengthen the subjectivity of students in the experimental link, teachers should prepare sufficient experimental materials with specific experimental methods and provide objective conditions for students' participation in classrooms so that students can understand the knowledge received through independent participation in classroom experiments.

For example, in the teaching of elasticity, teachers can prepare rubber bands equal to the number of students in the class as experimental materials. Then, in the following classroom teaching link, teachers can guide the students to feel the force generated by the rubber band in the stretching process by allowing each student to independently try to stretch the rubber band and observe the changes in the rubber band during the process. Through experimental observation and experience, students can intuitively feel the form of elasticity and the deformation phenomenon in the process. As the main experimental material of the experimental activity, the rubber band can be distributed to each student. In this way, students have the opportunity to participate in the process of independent experiment as well as experience and observe the elasticity of the rubber band from a close distance. Indeed, students can truly become the main body of the experimental link in this manner, deepen their understanding of physics through independent experiments, and finally achieve the teaching goal of improving their learning efficiency.

4.3. Promote the digitalization of demonstrations and provide concrete guidance

As senior high school students have relatively little experience in experiments, teachers need to demonstrate the experimental steps and specific experimental methods in the actual process. This is an important reference standard to guide students to conduct experiments more efficiently, thus reducing experimental errors and obtaining good experimental experiences. In regard to the innovation of experimental teaching, teachers can optimize traditional demonstration methods with the help of micro course resources, promote the digital innovation in experimental demonstrations, give full play to the advantages of micro course resources, provide concrete guidance in the experimental process, and promote the improvement of students'

experimental efficiency.

For example, in the lesson of measuring speed with a dot timer, in order to enable students to accurately use the dot timer to complete the task of measuring speed in the experiment, teachers should not only perform a full demonstration of the overall experiment, but also record videos of the experimental process as micro course resources, which can be played synchronously during the lesson to assist students in the experiment. In this way, the demonstration would first lay the foundation for the students so that the they would be able to substitute the experimental operation process performed by their teachers with their own theoretical cognition of the experiment, form a more concrete impression, and lay a foundation for follow-up experimental activities. In addition, the micro course resources that would be played synchronously during the experiment will always be in the form of circular videos with key experimental steps to help students correctly complete the experiment according to the standard steps. By integrating micro course resources and promoting the digitalization of experimental demonstrations, students can further improve their accuracy in the experimental process so as to form a deeper understanding of the knowledge points in the experiments along with good experimental experiences, and finally improve their experimental efficiency as well as the teaching efficiency.

4.4. Skillfully set up a small living theater to improve students' application literacy

The main purpose of physics in senior high schools is to guide students to look more dialectically at real phenomena in life through the understanding of basic physics while applying their knowledge of physics to solve life problems and optimizing the solution of problems so as to improve practical efficiency. In order to achieve this goal, teachers should create a small theater in experimental teachings and simulation activities requiring problem-solving skills so that students can carry out experimental activities to solve specific problems as well as improve their own knowledge and application literacy in the process of accumulating experimental experience.

For example, in the teaching of friction, teachers can request the students to place two desks on the stone corridor and the smooth marble floor of the class, respectively. Then, the students can push the desks to feel the different forces generated in the movement of the desks even with similar forces. They can then be encouraged to describe the differences felt and ponder about how to push the desks more effortlessly to move them to specified positions based on the friction elements analyzed in the process. This would continue to trigger the students' cognition. By using the desk as a way to create a situation that relates to the movement of objects in life, students would be able to clearly understand the hindering role of friction while moving objects and master the methods to reduce friction in subsequent experiments in order to lay a foundation for practical activities in the future. In another example, teachers can create a practical situation of tug of war in the teaching of decomposition of force. In this situation, two male students would pull the rope from each side in opposite directions to straighten the rope, and then a female student would be asked to pull the rope from the middle. The students would find that in the force state, the boys at both ends can be easily pulled. In this manner, the students can appreciate how the force is decomposed through the experiment. Therefore, in future encounters with heavy objects, students would be able to integrate the experimental experience to easily realize the effect of "four or two pulling a thousand pounds" from the middle by placing two herringbone boards on each side of the heavy object, complete the movement of the heavy object, and apply physics to the practical link.

5. Conclusion

The purpose of innovating classroom experimental teaching in senior high school physics is to better assume the experimental link as an important link in order to assist students in learning physics. In this way,

students can truly form experiential learnings through experiments and earn their status as masters of the classroom under experimental teaching to break the restrictions brought by traditional teaching methods, thus improving their comprehensive quality.

Disclosure statement

The author declares that there is no conflict of interest.

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