STRATEGIES FOR SUCCESSFUL PHYSICS LEARNING

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Abstract: *Physics occupies a very important place in science. Therefore, physics education should be carried out carefully and effectively. As studies have repeatedly shown, classical teaching models are so ineffective in physics education that the gain at the end of the learning process is almost insignificant. Therefore, physics education should be based on active learning models that have been proven to be effective and natural.*

Keywords*: Physics, Physics Education, Active Learning.*

INTRODUCTION

In the last century, three major revolutions in physics have occurred, and these revolutions have destroyed old paradigms. The most studied areas of physics today are quantum physics, relativity physics, and chaos physics. Yet these advances in physics are still not reflected in textbooks. Students are still taught classical physics; we teach mechanics, electricity, and thermodynamics. There are important differences between the physics that students learn from textbooks and the physics that is based on current technology. This situation, namely the outdatedness of the curriculum, is one of the main problems in physics education. But here we discuss what we consider to be a more important problem and its solutions: the classical teaching method in physics education is very ineffective.

So where do we come to this conclusion? The exams we take, the labs we do, and the students' coursework all lead us to this conclusion. When we look at all of this, we see that students are actually learning very little. Although the world we live in and the entire universe obey the laws of physics, the classical teaching methods we use do not provide an understanding of these laws. The only way to achieve this is to change our teaching techniques. Instead of classical teaching techniques, we need to use one of the active teaching methods that has been proven effective, is compatible with the human brain, and takes into account individuality.

"I understand the topics taught in the course. But I fail at solving the problem." These words are spoken by the vast majority of students who have taken basic physics courses in the past and who are taking basic physics courses today. When studying physics in class or from a book alone, everything seems normal and understandable. But for some reason, when students encounter questions on an exam or practice questions given by the teacher, they feel as if they are reading a text written in a foreign language that they do not know.

Method: In other words, they cannot understand the questions of different structures. So where does this problem come from? How can we determine whether a student understands the topics or not? If a student passes exams well, successfully completes experiments, and can solve the given exercises, we can say that the student has a certain understanding. Otherwise, memorizing the given information and formulas does not provide a certain understanding. Unfortunately, most students fail to understand the subtle difference between knowing and understanding. So, what can we do as teachers to help students gain a deeper understanding? The main question we need to ask ourselves is: “How can I teach the course if classical teaching methods are not enough in physics education and education in general?” Here we will answer this question and focus on many alternative methods.

Disadvantages of the classical teaching method

In the classical teaching method, the teacher is active and the student is semi-passive or completely passive. If we consider the teacher as the transmitter, the student as the receiver, and the lesson as the message, then a large part of the message in the learning environment is not absorbed by the receiver. In other words, the classical teaching method does not provide adequate understanding for most students. Alan Van Heuvelen (Van Heuvelen, 1991a) summarizes the current situation very well in his research: "Historically, we have been brought up with a classical education method. We have taught students the physics that underpins the universe." "We teach rules and how to use those rules to solve problems. This method is a very effective way to transfer knowledge because class time is limited. We teach concepts and techniques. But students don't have this advantage. Studies show that the classical method of teaching is very inadequate. "The transfer of knowledge is effective, but the student's assimilation of knowledge is almost imperceptible."

Most of today's teachers were trained in schools that used the classical teaching method, and they have the drawbacks of this method. Now, let's list the disadvantages of this method below.

• Physically, a person's attention span is 10-15 minutes.

• A lesson taught in the classical way can be compared to a fast-flowing river. There is no time to think while standing in the river. However, if the act of thinking does not occur, most of the incoming information is recorded in short-term memory and does not leave a deep impression on the student. If you want, let's test ourselves now. Write down what you remember from the seminar or conference you attended last week and see how little you remember.

• Most students don't even know how to follow the lesson. Taking notes during the lesson helps them remember important points. But here we come to another problem. Most students take notes unevenly; randomly crossed equations, incorrectly written equations, incorrectly drawn numbers, etc. As a result, students cannot even take notes correctly.

• Most courses cover topics that are already in the textbook. There is never time for advanced topics and techniques.

• Most courses focus on very technical topics, such as deriving an equation, calculating an integral, or making rough predictions about a physical quantity. However, what is needed is to focus on the physical phenomena themselves and try to understand these phenomena on a conceptual basis.

Active learning model

We will now briefly describe the active learning model and then examine active learning methods used in physics education. The core of the constructivist educational philosophy is that students construct their own knowledge. In this model, instead of passively receiving information, the goal is for the student to construct knowledge by thinking, acting, and interacting with the environment. This is simply called self-regulation. Zimmerman suggests that the process of self-regulation consists of sub-processes such as self-monitoring, self-evaluation, and self-improvement. According to research, the process of self-regulation has a significant impact on learning activities.

A successful active learning application should have the following key features. Students spend a large part of their class time actively; They spend their time thinking, doing, and interacting with other students. The student is in constant contact with other students and the teacher. However, in the classical teaching model, there is almost no interaction between students. The teacher plays the role of a guide rather than a transmitter of information. In other words, the teacher is more of a guide. Students take responsibility for the knowledge they have acquired. This can be manifested in participation in classes, independent study of the textbook, and timely completion of homework assignments. For example, after an exam, "This topic was not explained in class. That's why I couldn't answer four questions." Such an objection is unacceptable.

Before listing the various applications of the active learning model in physics education, let us make a caveat. In the classical teaching model, there is also some interaction: students are encouraged to ask questions and are allowed to discuss things with each other. But this interaction is never at the desired level. In a classical environment, only a small number of students, those who are interested in the course, ask questions and participate in discussions. The rest of the class is mostly passive spectators and listeners. In contrast, due to the discussion groups in an active learning environment, interaction is enhanced both within and between groups, and each student is inevitably involved in the course.

Result:

Active learning apps for physics education

As we have already mentioned, there is no single way to implement an active learning model. What a teacher needs to do is to use the method that is most appropriate for their situation and their school. Some approaches can be applied to classes with a large number of students, while other approaches can be applied to classes with a small number of students. Some approaches require the assistance of a teaching assistant, while others allow the teacher to do the work alone. But regardless, the conclusion from Hake's research is that all active learning approaches produce good results. Any approach that actively engages the student in the lesson is more effective than the classical method.

OCS approach (overview, physics examples)

This approach was developed by Alan Van Heuvelen. Although this approach was developed for large classes, it works equally well in classes with smaller students. The topics covered in the semester are divided into three major sections. Each track, such as Newtonian Physics, begins with a period of qualitative reflection that exposes students to alternative understandings and allows concepts to be reinforced. After this period, the topics are examined quantitatively and students learn problem-solving techniques. The final stage is a case study that requires the integration of many techniques and concepts. The case study shows students how different quantities are interconnected and allows them to build a coherent structure of knowledge.

Discussion: Here the teacher may spend some of the class time demonstrating how to use different methods. However, the lessons are never formally taught. Most of the class time is spent by the students solving various exercises and problems that are given to them. These problems and exercises are selected from the ALPS (Active Learning Problem Sheets) set. In the first stage, the problems are conceptual and qualitative, not requiring mathematical processing power. Over time, in the second stage and in case studies, the problems become quantitative in nature. Students first work on their own, and then discuss their results with the students next to them. The teacher periodically addresses the class to see how many people got the correct answer or if anyone solved the problem differently. If there are differences in the answers, students are invited to defend their views. Finally, after a certain time, the correct answer is given and the students are enlightened. As we have said above, the lesson in OKS is divided into three stages. Quantitative data is studied in the development stage. The ALPS exercises used in this stage require problem-solving strategies that an expert may have. Students first start with a clear definition of the problem. Then, the problem is solved by following a series of processes; The problem is analyzed by determining the coordinate system in which it is to be solved, drawing free body diagrams, etc. In the final stage, the problem is expressed in equations.

CONCLUSION

Physics is perhaps the most difficult and universal science to understand. Natural phenomena occurring in our immediate vicinity and in the most remote corners of the universe can only be understood thanks to the science of physics. On the one hand, physics allows us to understand the universe in which we live, and on the other hand, it allows us to produce technology by imitating nature. From this point of view, physics education plays a very important role. Unfortunately, physics lessons taught using classical teaching methods cannot give students a deep idea of the workings of nature. We can explain this with a simple analogy: take an apple. In the classical teaching method, apples are always depicted. Apples are red, yellow, green; They grow on trees, are round in shape, contain many vitamins, etc. However, if a student has not held an apple in his hand, examined it, smelled it, bitten it, tasted it, there is no point in describing an apple to him. Therefore, it is necessary to abandon the descriptive approach of classical teaching in physics education and adopt a relevant active learning approach. It is clear that it is the need of the century for teachers to switch to active teaching as soon as possible, since there are active teaching techniques that are suitable for any situation.

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