The Design and Implementation of Classroom Teaching Reform in College Physics

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Abstract. Big part of educating students is classroom instruction. Here, we proposed the significance and implementation of classroom teaching reform taking college physics as an example. By reform, we can deepen our understanding of knowledge, strengthen the interaction between teachers and students, and broaden students' knowledge of physics. Four aspects are carried out in classroom teaching reform, including making full use of online teaching resources with computer technology, optimizing the course teaching content, reforming classroom teaching methods, and updating the assessment and evaluation methods. The improvement in student engagement in the classroom and the good rate of process assessment over 80% are both results of the classroom teaching reform. It might pave the path for the development of students who are integrated with the arts and sciences and have strong moral and intellectual character.

Keywords: classroom teaching reform · college physics · assessment and evaluation

1 Introduction

The primary mode of delivery for higher education is the classroom, which is crucial for boosting learning outcomes, boosting the caliber of instruction, and highlighting students' talents. The college that takes on the responsibility of student cultivation should adhere to the fundamental rules of higher education and talent development, place "cultivating virtues" as the task's foundation and "talent training" as its focal point, and prioritize teaching [1]. We must actively build excellent, effective classes and develop "golden lessons" that are representative of the university [2]. As a result, a multifaceted and diverse teaching content and curriculum system could be created, greatly enhancing the quality of talent development.

For students majoring in science, engineering, or technology, college physics is a crucial foundational course. The topics covered include optics, contemporary physics, vibration and wave, heat, electromagnetism, and mechanics [3, 4]. College physics covers the following topics: investigations of typical physical phenomena and application of physical rules to daily life. For scientific and engineering students, the study of college physics provides a solid basis for learning additional specialized courses.

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With the development of computer and information technology, numerous teaching resources have been updated in science and technology. Some teachers are attempting to improve classroom instruction by utilizing information technology. The mixed learning model [5], the allosteric learning model [6, 7], the ETA teaching technique [8], the computer-aided system [9], and other reform strategies [10–12] were offered in the meantime by a large number of academics. And other reform strategies were offered in the meantime by a large number of academics. They attempted to enhance the effectiveness of the teaching process.

2 The Significance of Classroom Teaching Reform

The implementation of the "classroom revolution" might spark the interest of classroom participants including teachers, students, and instructional materials. Consequently, a teaching method that is focused on students, teachers, instruction, and quality can be developed. We ensure that the curriculum is outstanding, that the teachers are capable, that the students are engaged, that the administration is strict, and that the effects are real. The primary educational channel's role is devoted to the classroom.

2.1 Deepen Students Understanding of Knowledge by Computer Technology

The content displayed in the classroom through modern computer technology is a step-by-step process, which solves the problem that students do not know how to standardize the laws and equations in physics. The classroom teaching reform makes teaching activities more dynamic through multimedia and information technology. Many complex problems are vivid and simple by showing example questions, pictures, animations and science fiction videos in the teaching process. For example, when explaining the movement of Yang's double-slit interference fringe, we can create a flash of the fringe movement to show how they move dynamically as a result of changes in the double-slit slit's width, the light source, and the light's wavelength. To match the learning objectives and preferences of the students, teachers can design a variety of individualized, top-notch multimedia classes.

2.2 Strengthen the Interaction Between Teachers and Students

One important goal of teaching reform is strengthening the interaction between teachers and students, thus the classroom teaching process will be more efficient. The classroom is not a single process of knowledge transfer, but an interactive process of teacher and students. In a 50-min lecture, more interactions prove more participating chances for teachers and learners. The novel multi-teaching process allows students to understand the teaching content clearly, so that they can think, ask questions and communicate with the teacher on the typical knowledge point. Furthermore, they can communicate in real-time through line-interactive activity. The classroom reform can give sufficient time for students' thinking and imagination firstly, and then the teacher explains the knowledge specifically, which improves students' participation in class and facilitates the interaction between teachers and students.

2.3 Broaden Students' Knowledge of Physics

Due to the limitation of course hours, teachers mainly impart textbook-related knowledge in college physics lectures. Through the reform of classroom teaching, the introduction of the latest physics research progress, physics science knowledge, and important scientific and technological breakthroughs. Pictures, flashes and videos are employed in the teaching process via computer technology instead of expressionless language, making the teaching content more active. By explaining physics knowledge in an illustrated and friendly format and using abundant online examples, students can better understand the application of physics knowledge and tap into the physical laws around them, which is a powerful supplement to the teaching of textbook knowledge.

No matter what teaching methods are adopted, the ultimate purpose of classroom teaching reform is to serve the teaching effect. By innovating the teaching concept, teaching content, teaching methods and assessment forms, we can mobilize students' enthusiasm for learning, stimulate teachers' flexibility in teaching, improve the teaching effect and accomplish teaching objectives in the process of interaction.

3 Implementation of Classroom Teaching Reform

We will fully utilize the role of instructing students in the classroom, enhance the three-dimensional college physics teaching method with computer technology, and solidify the foundation of students' fundamental subject understanding. We try to make the shift from a "teaching-centered" emphasis on knowledge transfer to a "learning-centered" emphasis on knowledge, thinking habits, and creative thinking. The college physics course becomes a public foundation course that strengthens the foundation of science and technology as a result of the students' motivation to learn and love learning.

3.1 Make Full Use of Online Teaching Resources with Computer Technology

The rapid development of computer and information technology has facilitated the teaching reform of college physics. At present, college students have much free time to study a subject themselves, which leads some students to feel more pressure in the course learning without real-time guidance. Thus, teachers provide online learning resources to students to preview their knowledge and identify problems before class. Such as MOOCs, school online, smart education platforms, etc. Teachers inform students in advance of the content to be explained and the videos they need to learn. The students complete pre-study assignments after self-study. By making use of online resources, students can freely carry out pre-study learning of the course and deepen their understanding and mastery of the learning content. It will make the classroom teaching process more targeted and efficient through the use of modern computer technology online. During the reform process, the selection of online resources should be proper for students in different majors. Teaching resources are not the more the better but should be adapted to the characteristics and knowledge base of students. With the implementation of teaching reform, information technology will be more and more important in college physics teaching. Figure 1 shows the online learning model of college physics classroom reform. There are three parts: cognitive learning, thinking training and dynamic feedback.

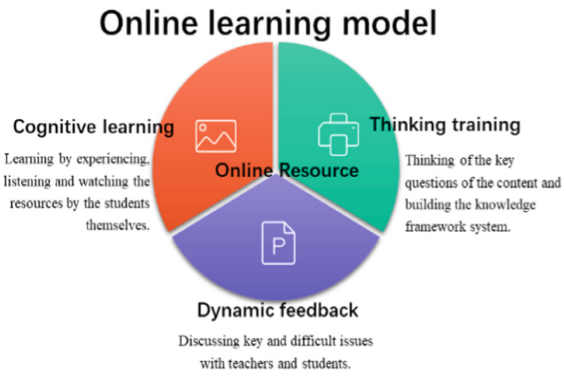

Fig. 1. The online learning model of college physics classroom reform (owner-drawing)

3.2 Optimize the Course Teaching Content

The college classroom should include multiple aspects, such as knowledge transfer, ability building, and spirit of inquiry cultivation. The significance of teaching reform is the optimization of the course teaching content. During the reform process, we try to introduce much academic content knowledge, and incorporate the latest academic advances in specific chapters, such as optics, fluctuations, relativity, etc. We combine the previous work with the integration of thought-provoking elements such as physicists' stories and the life of physics and science and technology. Also, we employ computer technology to show many interesting physical phenomena and stories. College physics is not only a course with knowledge, but also a comprehensive education system, which provides additional abilities to students, such as elaborative faculty, physical thinking, logical thinking, and dialectical thinking. Therefore, we build the physics classroom into a novel space for education (Fig. 2).

3.3 Reform Classroom Teaching Methods

The teaching design of ability-oriented education should be adopted for teaching reform. We conduct inspiring lectures, interactive communication, and inquiry-based discussions to motivate students and guide them to think and explore. Diverse teaching methods are employed for educating college physics. I. Theoretical analysis and experimental confirmation are two methods we encourage students to use while exploring problems. This allows them to gradually arrive at the physical laws. II. The simulation approach involves setting up a situation for students to take part in and letting them interact with it. Students gain information and learning comprehension when participating in "immersion" thinking. III. The "show and exchange" method: we assist the student in explaining a few unique course portions in the classroom. Students can completely express their thoughts and thought processes using the teaching platform to gain a thorough understanding. Additionally, we focus on developing physical thinking in the classroom, which includes model thinking, limit thinking, inductive reasoning, and more.

It is particularly important that we employ computer technology more frequently in the classroom so that it can enhance the standard of instruction. To further support

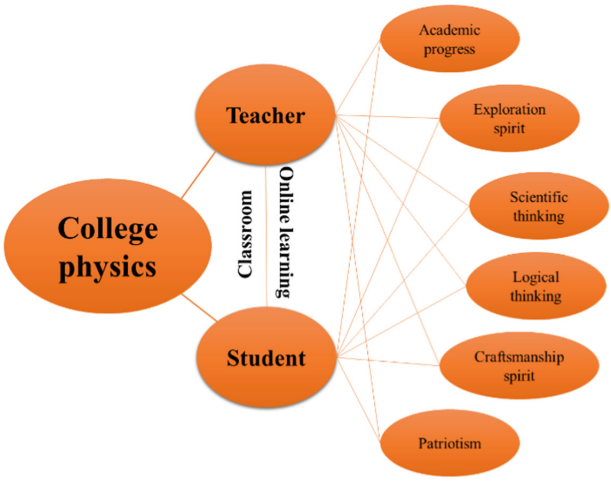

Fig. 2. Content correlation of college physics classroom reform (owner-drawing)

students' understanding and assimilation of knowledge, we employ Rain Classroom to engage students in real-time classroom discussion and in-class practice. The Chaoxing Platform is used for chapter tests, post-class summaries, and pre-class previews to better understand how students learn. College physics instruction is now more dynamic and thorough thanks to the use of new technologies, which also help students learn more and develop their skills.

3.4 Update the Assessment and Evaluation Methods

We carry out diversified process tracking such as pre-course study, tracking during learning, thesis research papers, and final exams. According to the characteristics of the course, we implement diversified assessment, increase the proportion of the learning process assessment, and break the assessment method of 'one exam determines the grade'. In combination with tests, homework, papers, final exams, and class discussion, we strive to make the process assessment not less than 50%. We can continuously track the academic progress of students through information technology. Figure 3 shows the process assessment score of the latest term. The homework accounts for 30%, classroom test accounts for 24%, chapter summary accounts for 14%, course paper accounts for 16%, and online learning accounts for 16%, respectively. All the above parts are recorded as the process assessment score of 50% and the final exam accounts for another 50%. Through the classroom teaching reform, students' participation in the classroom has been improved, and the good rate of process assessment has exceeded 80%, which has effectively promoted the improvement of the quality of talent cultivation in science and technology.

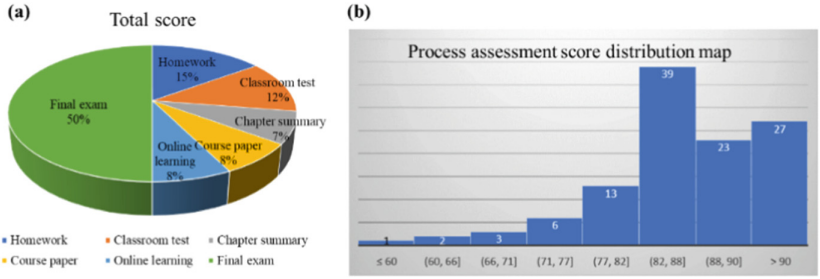

Fig. 3. The composition chart of the total score and process assessment score distribution map (owner-drawing)

4 Conclusion

College physics is a crucial course, and its outstanding teaching impact will have a direct impact on how well students learn in professional courses. The combination of outstanding presentation and a wealth of instructional material can produce even better learning outcomes. The motivation of teachers and students to participate in the teaching process is increased through classroom teaching reform. To further support the enhancement of the students' learning effect, the various teaching techniques are student-centered and backed by several assessments. It might pave the path for the development of students who are integrated with the arts and sciences.

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References

1. Yan X L. Teaching reform of food related majors' human physiology course based on case analysis combined with flip classroom teaching mode[J]. Creative Education Studies, 2021, 9(3):626-630.
2. Wan Z, Tao Y, Wu Z. Teaching reform of basic mechanics experiments under the background of engineering education certification[J]. Education Study, 2021, 3(1):14-19.
3. Lv H, Wang X, Guo G H, et al. Design and implementation of ideological and political education in basic courses of science and engineering—with example of college physics[J]. Education Modernization, 2021,8(22):148-152. (in Chinese)
4. Zhang X, Qu F, Chen J, et al. Research on college physics online teaching system based on course group construction[C]. In Journal of Physics: Conference Series, 1744: 042039.
5. Zhang W Y, Xu D H, Duan L, et al. Research on the effect and influencing factors of blended learning of college physics[J]. Physics and Engineering,2021,31(6):163-168. (in Chinese)
6. Chen Y J, Huang Z X, Zhan X, et al. Research on deeper learning of college physics based on allosteric learning model—Taking freshmen to solve a mechanical problem as an example[J]. Physics and Engineering,2022,32(3):41–45,49. (in Chinese)
7. Hou T, Bian Y, McGuire T, et al. Integrated multi-class classification and prediction of GPCR allosteric modulators by machine learning intelligence[J]. Biomolecules, 2021,11(6), 870

8. Mu L Z. The ETA physics learning method: The analysis and solution of physics learning problems for undergraduate students based on the physical cognition theory[J]. Physics and Engineering, 2022, 32(2). (in Chinese)
9. Li R, Zheng L, Ren X. Teaching reform of applied technology university physics based on computer aided system[C]. Journal of Physics: Conference Series, 2020,1578:012149.
10. Orland-Barak L. Wang J. Teacher mentoring in service of preservice teachers' learning to teach: Conceptual bases, characteristics, and challenges for teacher education reform[J]. Journal of teacher education, 2021, 72(1), 86-99.
11. Yang W, Zhang M, Long H, et al. Thoughts on teaching reform of resources majors in colleges and universities under the background of carbon peak and carbon neutralization—taking mineral resources exploration course as an example. Sustainability[J], 2022, 14(24), 16523.
12. Campbel S . Education and curriculum reform: the impact they have on learning[J]. Budapest International Research and Critics in Linguistics and Education (BirLE) Journal, 2020, 3(2):1074–1082.