

# Consideration on College Physics Teaching Reformation under the New Situation

Lihua Teng\*

School of Mathematics and Physics  
Qingdao University of Science and Technology  
Qingdao, China

Guanghai Guo\*

School of Mathematics and Physics  
Qingdao University of Science and Technology  
Qingdao, China

**Abstract**—Along with the rapid development of science and technology and continuous changing of social demands, it is imperative for the college physics teaching to reform. The course shall be concise aiming to the compressed teaching hours in each professional training program; the innovative college physics teaching system shall be constructed in order to cultivate the creative and practical talents in universities; the “ideological and political physics” will be explored and implemented in order to guide students to form correct value orientation and realize “ideological and political education”; along with the promotion of student-oriented teaching mode, the scientific design on teaching process is required in the implementation process of information teaching. The above several aspects in the paper will be analyzed and discussed so as to provide reference for the follow-up college physics teaching.

**Keywords**—College Physics; Creative and Practical Ability; Ideological and Political; BOPPPS Teaching Mode

## I. INTRODUCTION

Regarded as a public compulsory course for the students of science and technology, college physics can not only lay the indispensable foundation for students to learn the follow-up professional courses and manage basic skills of engineering technology, but also cultivate students’ capabilities of scientific thoughts. However, along with the changing at the aspects of students learning conditions and social demands, a series of problems occur in the teaching of college physics. Firstly, the modern society gradually proposes higher demands on the students’ professional knowledge level, the teaching hours of professional courses in each university are continuously increased in order to guarantee that students have sufficient time to learn professional knowledge; meanwhile, the situation of compressed learning hours occurs in the college physics [1,2]. Besides, the content of college physics is with strong theory, logic and abstraction, the good physics teaching and learning within the limited hours has become the mutual challenge for both teachers and students. Secondly, students generally pay attention to the follow-up work and study, they hold the view that their study must satisfy the career or postgraduate demands; however, it’s very hard for many students in non-physics majors to see the follow-up direct application value of college physics due to the insufficient knowledge scope and recognition depth, so they don’t have high learning positivity [2,3]. Thirdly, the cultivation of ideological morality is an important task for the college

teaching; as a public course, the target audience of college physics is large, which brings about much significance of “ideological and moral education” in the college physics teaching [3,4]; however, the current teachers have insufficient recognition in the combination of ideological and moral education during the teaching and there’s no sufficient scientific entry point of ideological and moral education. Fourthly, the traditional teaching mode of spoon-feeding class is very single, students can hardly accept due to the low learning interest, which doesn’t meet the current student-oriented teaching concept, and it’s also not favorable for the cultivation of innovative talents [5, 6]. Therefore, the course content shall be concise or adjustable aiming to the compressed teaching hours of different levels in each university; the theory combined with reality is required for the cultivation target of innovative and practical talents in universities so as to construct the college physics teaching system with innovative significance. The ideological and political factors shall be taken into consideration during the college physics teaching so as to cultivate the high-quality talents with both integrity and ability and realize “ideological and moral education”. Along with the coming of information teaching era as well as the promotion of student-oriented teaching mode, the traditional spoon-feeding teaching measures will be imperatively replaced by the new teaching mode, and how to design teaching is also very crucial during the implementation of information teaching. Suggestions and considerations on teaching reformation aiming to the above problems are separately presented in the paper combined with the teaching experience in college physics.

## II. TEACHING CONTENT SETTINGS

Urgent adjustment shall be performed on the corresponding scope and depth of teaching content for the sake of compressed teaching hours of college physics, and the specific corresponding measures include three aspects. Firstly, the connection between the physics in senior high school and college physics is optimized. In order to make the students who has graduated from senior high schools acclimatize themselves to the learning of college physics, some of the college physics knowledge is usually prepared in the teaching process so as to produce a link between the preceding and the following. On the other hand, excessive overlaps of knowledge may reduce students’ learning interest and enthusiasm on college physics. In consequence, the content of physics in senior high school shall be compared with the college physics, the repeated part

Found project: the paper is supported by the project of college physics teaching team of Qingdao University of Science and Technology.

shall be deleted or simplified in accordance with actual conditions, professional characteristics and career direction of students, the limited teaching hours shall be used to teach the new content as much as possible. Secondly, the teaching content setting as per majors. The teaching of college physics faces to all of the majors of science and technology, diversified college physics teaching program shall be made according to the characteristics of each major because there's obvious difference. For example, the mechanics shall be taken as the main teaching content for the machinery majors, electromagnetism shall be taken as the main teaching content for the major of electric automatization, the oil and gas storage major and transportation engineering shall be more inclined to the teaching of thermodynamics, the key teaching content shall be based on the characteristics of each major combined with the teaching of the rest part in mechanics, thermology, electricity, photology and modern physics. Thirdly, teachers shall have thorough understanding of the teaching content, sharpen key and difficult points and apply the limited teaching time to the key and difficult points. Teachers shall make efforts to clarify the teaching system, then present the key content in teaching target briefly and succinctly, summarize the introduction for the content needs to be understood, make students study the expansive content as homework, exert students' initiative and train the self-study ability.

### III. CULTIVATE INNOVATIVE AND PRACTICAL ABILITY OF STUDENTS

The cultivation of students' innovative and practical ability is a sacred mission which is endowed to each teaching staff by era, and it's also an important task in college physics teaching. Not only the basic knowledge points shall be taught to the students during the teaching process, but also the students' innovative and practical capability shall be cultivated. The physics knowledge can be applied in the follow-up work and study. Meanwhile, the students' learning interest can be inspired. The specific training program includes three aspects. Firstly, the traditional teaching mode where teachers are subjects shall be eradicated during the teaching process, and the dominant role of students shall be exerted by adopting the methods of students' "study, discussion and exploration" and teachers' "briefing, teaching, and guidance", for the purpose of guiding and encouraging students to perform initiative study and exploratory thought, and cultivate students' ability of scientific thought. Secondly, teachers shall keep up with the times, grasp the forefront of science and integrate the physics content into the modern fields of engineering and technology, especially the fields closely related to the students' majors as well as actual life, broaden students' vision and improve comprehensive quality and the practical knowledge application capability of students. Always pay attention to the combination with the forefront science during the course introduction, teaching process and other conditions in the whole teaching link. Change the pure exercise teaching into the application study of the knowledge in the actual solutions after the basic knowledge teaching, and guide students to perform thorough consideration and analysis. For example, students can be guided to discuss the working principle of 3D glasses during the study on polarization of light, students can be guided to perform discussion during the study of time dilation effect or

compute if time dilation effect shall be considered for the Global Positioning System (GPS) and so on. The students with residual energy can be guided to participate in the project development and subject research based on the understanding of basic knowledge points. Thirdly, the laboratory teaching shall be strengthened in order to cultivate students' innovative and practical capability. The setting of compulsory and elective experiments shall be considered. The compulsory experiments, such as Newton rings experiment, sound velocity measurement experiment and so on, mainly realize the application of the knowledge points, practice students' operation ability and consolidate the knowledge. Students shall be encouraged to choose the elective experiments which they are interested in. The elective experiments belong to innovative experimental items which can cultivate students' innovative ability and spirit. Students shall be encouraged to make numerical simulation experiments aiming to the quantum physics that's hard to realize by experiments as well as experiments at the aspect of relativity theory physics. Meanwhile, the advanced teaching instrument and equipment shall be introduced to carry out forefront experiments and provide the experience opportunities of advanced science and technology for the sake of making the experimental teaching advance with the times.

### IV. IDEOLOGICAL AND POLITICAL THEORIES TEACHING

The cultivation of high-quality talents with both ability and integrity is the core task of university education. In the National Ideological and Political Conference of 2016, President Xi Jinping strengthened that the main channel of course teaching shall be applied well, and each kind of courses should move towards the ideological and political theories teaching so as to form synergistic effect. From the perspective of course characteristics, as a compulsory course for all the students of science and technology, college physics shall integrate the ideological and political education. It has the advantage of broad students scope. Meanwhile, the ideological and political factors are integrated into the relatively dull theory teaching, edutainment can improve students' learning interest and enthusiasm. However, how to find scientific entry point of ideological and political education through the teaching of college physics becomes the difficulties for the ideological and political implementation of physics, it includes three aspects. Firstly, make use of examples of scientists. The life stories of domestic and overseas physicists in both ancient and modern times can be introduced during the teaching process. For example, the scientific research process of Newton can be introduced during the teaching of Newton's laws of motion; Thomas Young's story can be introduced during the teaching of Young's double-slit interference experiment. As a doctor, Yang loves physical research and dares to propose doubts to the authority in physics. Students can be inspired by means of physicists' achievements, and accordingly we can cultivate students' scientific spirit-love science, like observation, don't fear difficulties and keep persistence. Secondly, China's scientific innovative achievements in the world's leading edge need to be sufficiently introduced. Physics is a kind of continuously developed subject, and the development of physics promotes the continuous progress of science and technology. Nowadays, China has been in the world's leading role in laser technology, magnetic suspension,

quantum communications satellites, cargo ship launching and so on. The introduction on China's scientific achievements can strengthen students' national pride, inspire their patriotism and make them study hard to make contributions to the country. Last, the philosophical principle included in the physics knowledge shall be explored. As a natural science, the physics mainly researches the motional law of all matters, and its research content is originated from the material view of Marxism, the philosophical principle included in the knowledge points are favorable for the cultivation on the students' material view and world outlook. For example, the theorem of kinetic energy of particle presents, the force's work on particle equals to the increment of the particle kinetic energy. Thereinto, the work is the accumulation of the force in space, that's the quantitative change of force in space, the results of quantitative change is the change of kinetic energy, thus the qualitative change is also produced. The philosophy included in the process is very abundant, and we can tell students the qualitative change can be inevitably caused by the continuous accumulation of the quantitative change. Therefore, the significances from three aspects can be obtained. Firstly, the perseverance is most valuable for everything. Secondly, the little goodness can achieve great kindness, and the small evilness can be changed into big badness. So we can't neglect the small goodness and should never do bad things, even if it's small. Thirdly, teamwork spirit is very important, only the cooperation can make achievements.

#### V. TEACHING DESIGN

The scripted teaching method and spoon-feeding teaching model, which can't meet the student-oriented teaching principle, severely damage students' learning initiative, positivity and creativity. Therefore, flip class, blending teaching and the reformation of other teaching modes gradually occur [7] based on various resources of micro class and MOOCs; until recent years, and the occurrence of Rain Classroom, Learning Through and other teaching platforms promotes the information teaching reformation to the climax. How to design teaching is also very crucial during the implementation of information teaching, the writer obtains great effects from the program design in the teaching process of college physics. Firstly, the preview courseware can be pushed to students by means of teaching platform so that students can perform preview, complete preview test and enter into the classroom. The design of teaching process can refer to the BOPPPS [8] originated from Canada. BOPPPS is a kind of teaching design method, which includes 6 teaching links. Bridge-in, questions can be presented by active videos or pictures and the new course can be introduced by the advantage of "internet+" at the beginning of each chapter so as to inspire students' learning interest. Outcome, the concepts, theorem, methods and other key contents needed to be understood through the learning shall be clearly notified to students, students' learning and teachers' teaching will be guided by clear targets. Pre-test, the mastery of the previous basic knowledge that's closely connected to this chapter shall be clearly understood by means of questions or discussion, and review shall be performed according to the level of mastery. Participation, the dominant role of students shall be focused during the teaching process, let students participate in teaching

through group discussion and real-time feedback of teaching platform in order to cultivate students' initiative, independence and creativity; teachers answer the questions aiming to the students' feedback conditions at the platform and perform explanation on the generally existing problems. Post-test, in accordance with the teaching targets, the corresponding test shall be made and pushed to students by means of teaching platform so as to check the learning effect and inspect whether the learning target can be reached or not. Summary, students together with teachers summarize the main knowledge points of the chapter, then teachers assign the homework and preview tasks to students through the platform. Six teaching links are dispensable for a complete teaching course segment. The whole teaching process can be organized by the Rain Classroom, Learning Through and other teaching platforms. Teachers can timely know the students' learning conditions, timely answer questions, continuously modulate the teaching mode and content so as to further optimize the teaching by pushing tests, homework and receiving students' feedback at each stage of preview, class teaching and homework. The theory shall be combined with the reality during the teaching process, and the integration of scientific forefront and ideological/ moral factors shall be concentrated.

#### VI. CONCLUSION

College physics, which is of great significance for the teaching of basic professional knowledge and scientific thought training among the students of science and technology, can broaden students' thought, inspire their exploratory and innovative spirit and improve their scientific quality. However, the teaching of college physics must advance with the times. At present, how to confront the teaching hours compression of college physics, how to cultivate students' innovative and practical ability so as to meet social demands, how to integrate ideological and political factors into teaching process, cultivate high-quality talents with ability and integrity, and how to organize the student-oriented teaching and inspire their learning positivity and creativity have become problems that are urgently needed to be solved. The discussion is performed from four aspects in the paper, and some solutions and suggestions have been presented combined with the summarized teaching experience in college physics so as to produce certain reference for the teaching staff of college physics during the follow-up teaching.

#### REFERENCES

- [1] Q. F. Xu, Z. Z. Lin, and M. W. Zheng, "Exploration on the teaching reform of college physics based on the innovation ability," *Education Teaching Forum*, no. 15, pp. 139-140, April 2019. ( In Chinese)
- [2] J. K. Yang and Z. Pan, "Pattern analysis of standardization and measures for current college physics teaching," *Journal of Hotan Normal College*, vol. 38, pp. 86-88, April 2019. ( In Chinese)
- [3] L. X. Wang, W. X. Zhu, C. Wang, X. Y. Guan, "The research on college physics curriculum system based on general education," *Science Journal of Education*, vol. 4, pp. 53-56, April 2016.
- [4] X. P. Xia, X. L. Cao, and Y. Q. Zhuo, "Research on the moral education infiltration in College Physics course teaching," *Education Modernization*, vol. 5, pp. 284-286, May 2018.

- [5] G. R. Jia and Y. Y. Liu, "The realization of "College Physics" teaching for non-Physics major students," *American Journal of Physics and Applications*, vol. 7, pp. 43-47, May 2019.
- [6] H. Zhao, H. L. Zhao, G. B. Zhao, X. C. Xu, and W. F. Lin, "Practice and exploration on teaching reformation of university physics for non-physics majors," *Physics Bulletin*, no. 2, pp. 16-18, February 2019. ( In Chinese)
- [7] A. S. Wellington-Igonibo1, B. I. Dambo, and D. J. Oyadongha, "Assessing the constraints in the application of E-learning by secondary school teachers in Bayelsa State, Nigeria," *Higher Education Research*, vol. 2, pp. 27-30, February 2017.
- [8] L. P. Xu, P. L. An, R. Xue, Y. Q. Gao, and H. S. Li, "Exploration and practice of BOPPPS education and teaching mode in college physics based on OBE concept," *The Science Education Article Collects*, no. 444, pp.52-55, December 2018. ( In Chinese)