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Research and Practice on Promoting the Comprehensive Quality and Multidimensional Ability Development of College Students through Physics Academic Competition

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Abstract: With the development of society, the cultivation of comprehensive qualities and multi-dimensional ability among college students has received increasing attention. The Physics Academic Competition as the most participated and largest debate-style Physics Academic Competition among undergraduate students nationwide plays a key role. This paper explores its competition questions and competition models and their roles and significance. Through the drive of interest and curiosity, it not only helps to cultivate the comprehensive practical ability of college students in analyzing and solving real-world situations based on physics knowledge but also contributes to the deep understanding, systematic and structuring of physics subject knowledge. At the same time, it also promotes college students' independent thinking, independent inquiry, literature review, commonly used scientific research and office software skills mastering, collaborative innovation ability, interpersonal communication ability, and stimulates leadership among college students. In addition, it helps to improve the ability to express academic views, argue and comment smoothly. After the competition, the scientific research expansion training has further improved the coordinated development of students' scientific research literacy and multi-dimensional ability. This research may boost the innovation and reform of physics teaching resources and modes in higher education under the background of digital intelligence.

Keywords: Physics academic competition; College students; Comprehensive quality; Multidimensional abilities; Cultivate

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1. Introduction

In the rapidly developing society and the advancing background of science and technology, modern societal needs have evolved with the changing demands of modern society, equipped with demanding individuals with disciplinary knowledge, extensive skills, and capabilities. Therefore, enhancing the comprehensive abilities of college students is more important. This includes cultivating students' ability to comprehensively practice and solve practical problems in real scenarios, enhancing their fluency in expressing academic viewpoints

and argumentation, and comprehensively enhancing their collaborative innovation ability driven by interest and curiosity under information technology conditions, as well as teamwork and open mindset. However, in traditional higher education in our country, the transmission of systematic knowledge accounts for a large proportion. Personally written exams based on memory, understanding and application are usually the main assessment and evaluation methods, emphasizing problem-solving over real-world solution-finding. With the increasing attention paid to the cultivation of comprehensive qualities among college students, in addition to the first classroom of teaching through textbooks, universities have actively opened up second classrooms. In the second classroom, students can comprehensively develop their qualities and abilities by participating in various club activities, volunteer services, scientific research practices, cultural and artistic activities, innovation and entrepreneurship and academic competitions [1–2].

The cultivation of comprehensive abilities is one of the main tasks of physics majors in Chinese universities [3–4]. The Physics Academic Competition is the highest level and largest debating physics academic competition aimed at undergraduate students from all universities in the country. It provides students with a platform to apply knowledge and skills, express communication skills, participate in debates, solve challenging problems and collaborate with peers. By participating in academic competitions in physics, college students have the opportunity to deepen their subject knowledge and skills, enhance critical thinking and practical problem-solving abilities, and cultivate effective communication and teamwork skills while stimulating creativity and leadership potential. Understanding the research background and significance in this field can help us explore how Physics Academic Competition can promote the comprehensive development of college students [5–10]. Therefore, this article proposes research and practice on promoting comprehensive quality and multidimensional ability cultivation of college students through Physics Academic Competition.

2. Physics academic competition's influence on college students' Comprehensive Quality and Multidimensional Ability

2.1. Improving the comprehensive practical ability of college students to analyze and solve real-world problems with physics knowledge

The China Undergraduate Physics Tournament (CUPT) adopts the rules and titles of the International Young Physicists' Tournament (IYPT, also known as the Physics World Cup). Its 17 questions are derived from natural phenomena or actual physical problems encountered in daily life and production practice and are announced in mid-August each year. Each question can be seen as a small scientific research topic aimed at enabling students to use their knowledge of university physics to construct theoretical models. At the same time, experiments are emphasized, and students are encouraged to use simple equipment to make experimental phenomena through delicate design. Validate theory through experiments and explain experiments through theory. The competition takes physical knowledge as the main body, covering mathematics, computer, electronics, materials, machinery and other fields. These questions do not have fixed answers, emphasize inquiry, are close to reality, have a high degree of openness, and have high research and interdisciplinary comprehensive practicality. They guide students to experience, try, practice, and discover in real life and the natural world. Life is education, nature and society are schools, and understanding world affairs is knowledge.

2.2. Improving college students' interest and curiosity-driven independent thinking, independent inquiry, literature review and collaborative innovation ability and interpersonal skills and inspiring leadership, but also contributing to the deep understanding, systematic and structuring of physics knowledge, as well as the mastery of commonly used scientific research and office software skills

The preparation process for Physics Academic Competition involves topic interpretation, experimental setup, phenomenon observation, problem guidance, content explanation, inspiring discussion, theoretical speculation, theoretical simulation, and experimental verification. In this process, some scientific research software tools are often used, such as Mathematics software for theoretical derivation and symbolic drawing, experimental tracking software Tracker, phyphox and Matlab, simulation software Matlab and Comsol, as well as drawing software Origin and Matlab. In addition, PPT and academic posters for all the competition reports involve common office software skills. In this way, it can break through the limitations of traditional teaching hours and venues in the first classroom, enrich the second classroom, provide more flexibility and freedom for talent cultivation, stimulate students' interest and curiosity, promote their independent thinking, independent exploration, and collaborative innovation, and also help improve their interpersonal communication skills and stimulate leadership. In addition, this competition can also help students deepen their understanding of various subject knowledge, construct knowledge, construct knowledge, and master commonly used scientific research and office software skills.

2.3. Training students' ability to express academic opinions, argue and comment smoothly, and promoting collaborative innovation among the Reporter, Opponent, Reviewer, and Referees

The rules of the physics academic competition are as follows: each team consists of 5 contestants, and the competition is conducted through drawing lots and team debates. Before the competition, the teams are divided into groups by drawing lots, each consisting of three teams. Each team participates in 3–5 rounds of physics fight (PF), which are divided into 3 stages. Each team plays 3 different roles at different stages: Reporter, Opponent, and Reviewer. The order of role transitions is as follows (**Table 1**).

Table 1. Order of role transitions

The rules	Team One	Team Two	Team Three
Phase 1	Rep (Reporter A)	Opp (Opponent B)	Rev (Reviewer C)
Phase 2	Rev (Reviewer C)	Rep (Reporter A)	Opp (Opponent B)
Stage 3	Opp (Opponent B)	Rev (Reviewer C)	Rep (Reporter A)

At the beginning of the competition, the Opponent team first challenges the competition topic to the Reporter team and receives a response from the Opponent team within 1 minute of accepting or rejecting the challenge. If the Reporter team accepts the challenge, they will have 1 minute of preparation time and then deliver a statement around the established open-ended practical physics problem for 12 minutes. Next, the Opponent team questions the fallacies or deficiencies in the statement made by the Reporter team, and the Reporter team answers for 2 minutes; The Opponent team will prepare for 2 minutes, summarizing and stating the strengths and weaknesses of the Reporter's report for 3 minutes, followed by a 9-minute discussion between the Reporter and Opponent teams. The Reviewer asks questions, and the Reporter and Opponent teams answer, for a total of 3 minutes. The Reviewer team will have 2 minutes of preparation time, followed by 4 minutes of brief commentary on the overall performance of both the Reporter and Opponent teams. Finally, the

Reporter team will have 2 minutes to summarize their speech. Each team can only have one person responsible for the main control report, and other team members can communicate and collaborate with the main control team member. Finally, Referees will score, comment and discuss for 4 minutes. The ultimate goal of Physics Academic Competition is to explain phenomena and solve problems through collaborative innovation of several parties, and to cultivate college students to express academic views, argue and comment fluently (**Figure 1**).

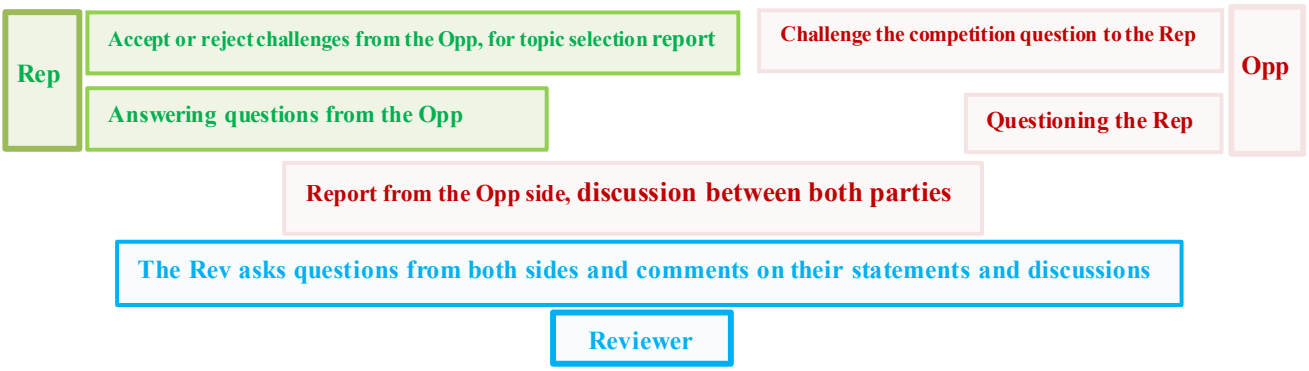

Figure 1. CUPT rules

2.4. Post-competition scientific research literacy expansion training

This stage reflects and summarizes after the competition, provides further guidance on paper writing and publishes research results in the form of research papers. Through a series of processes in previous competitions, students have conducted in-depth research on many topics and further guidance on paper writing can consolidate their research results by writing high-quality scientific research papers. In addition, further research will continue to delve deeper into the issue of insufficient research during the competition stage, to gradually transition to the form of scientific research papers. Finally, through submission, review, and round- trip communication and discussion with editors and reviewers, we aim to enhance the scientific research literacy of college students.

3.Conclusion

In summary, Physics Academic Competition's questions and competition mode aim to enhance students' ability to comprehensively apply their learned knowledge to analyze and solve practical physics problems and cultivate their open thinking. The participating students will engage in a debate competition on the basic knowledge, theoretical analysis, experimental research and result discussion of practical physics problems. This competition mode can not only exercise students' ability to analyze and solve problems, and improve scientific research literacy, but also help to cultivate their innovative thinking, teamwork spirit and effective communication skills, achieving comprehensive and coordinated development of knowledge, skills and literacy. At the same time, this also provides better competitive advantages for future employment and further education. In addition, it will also promote the reform and innovation of physics teaching resources and models in higher education under the background of digital intelligence, such as integrating CUIT questions and model into physics teaching [11–15], forming a series of innovative physics teaching, combining engineering for physics teaching, etc.

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References

[1] Zhu JM, Yang DY, Wu W, et al., 2023, Promoting Innovation through Competition: Research and Practice on Cultivating the Innovation and Entrepreneurship Ability of College Students. New Curriculum Teaching, 4(8)19: 178–180.

[2] Jia L, 2015, Several Thoughts on the Preparation for Participating in the Shanghai University Physics Competition. Education and Teaching Forum, 2015(9): 17–19.

[3] Yang Y, Li W, Zhang L, et al., 2020, Exploration and Practice of English Teaching Methods for "College Physics" for International Students Majoring in Software Engineering. Education and Teaching Forum, (38): 24–26.

[4] Wang J, Li C, Li W, et al., 2019, Exploration of Campus Public Elective Course Construction Based on Physics Debate. University Physics, 38(9): 34–37 + 42.

[5] Duan X, Hou J, 2021, The Promoting Effect of Academic Competitions in College Physics on the Comprehensive Ability Cultivation of Master's Students. Western Quality Education, 7(22): 67–69.

[6] Jia H, Niu R, Liu H, et al., 2020, Enhancing the Comprehensive Quality of College Students Based on Academic Competitions. Asia Pacific Education, 2020(23): 39–40.

[7] Du Y, Hong Y, Wang J, et al., 2019, Research and Practice of Innovative Quality Education Based on Academic Competitions in College Physics. College Physics Experiment, 32(1): 42–45.

[8] Guo D, He J, 2017, Cultivating Innovative Practice Abilities of College Students Based on Physics Academic Competition Platforms. Science and Technology Innovation Journal, 14(27): 33–35.

[9] Liu S, Liu W, Zhao Y, 2017, Exploration of the Organization and Training Model of Physics Professional Competitions: A Case Study of Chinese University Physics Academic Competition. Qiu xue, 2017(11X): 74–76.

[10] Zhang W, Zeng J, Lu Y, et al., 2011, Cultivating High-Quality Innovative Talents through Academic Competitions in College Physics. College Physics, 30(6): 35–37.

[11] Zheng XJ, Luo YM, Zhou YP, et al., 2009, Conducting Physics Competitions to Promote College Physics Teaching: Inspiration from the First College Physics Competition in Hunan Province. Physics and Engineering, 2009(4): 21–23.

[12] Chen T, Xiong X, Zhang Y, et al., 2023, On the Practice of Academic Competitions in Physics for College Students. Education of China Science and Technology Economic News Database, 2023(12): 1–4.

[13] Chen J, Li C, Chen Z, et al., 2022, A Physics Academic Competition Education Model Based on OBE Concept. Physics and Engineering, 32(6): 80–86.

[14] Pu X, Wu X, Han Z, Wang S, 2022, Exploration and Practice of the CUPT Teaching Model for Cultivating Top Undergraduate Students. Physics Experiment, 42(10): 14–19 + 24.

[15] Zhang L, 2017, Exploration and Practice of Physics Academic Competitions Assisting Research-Oriented Teaching in University Physics. Seeking Knowledge Guide, 2017(27): 65–68.