

Exploring the integration of physics education and sustainable development education: resource utilization and environmental awareness cultivation

Lele WANG

Chongqing Three Gorges University, Chongqing 405451, China

Abstract: This article explores the role of physics education in resource utilization and environmental awareness cultivation, as well as the integration strategy with sustainable development education. Physics education enables students to gain a deeper understanding of the processes of energy generation, transformation, and utilization through experiments, observation, and exploration, thereby enhancing their understanding of resources. At the same time, physics education can also cultivate students' environmental awareness through case analysis and practical activities, emphasizing interdisciplinary cooperation and action practice. The integration of physics education and sustainable development education contributes to sustainable development education, cultivating students' environmental awareness, sustainable development values, and scientific literacy, making them citizens with sustainable development thinking and action abilities. Therefore, the integration of physics education and sustainable development education can help shape a more sustainable future.

Key words: physics education; resource utilization; environmental awareness

1 Background and significance of the study

Nowadays, the rational utilization of resources and environmental protection have become important challenges facing the world. In order to achieve the sustainable development goals, education plays a crucial role in shaping the sustainable societies of the future. Physics education, however, as an important part of science education, not only imparts knowledge, but also develops students' awareness and consciousness of resource utilization and environmental issues.

Physics education can help students gain insight into the process of generating, transforming and utilizing different energy sources through experimentation, observation and exploration [1]. In this way, students are able to understand the characteristics, advantages and disadvantages of various energy sources as well as their impact on the environment, so that they can utilize resources more scientifically in their daily lives and reduce waste and pollution. Physics education can also stimulate environmental awareness among students through case studies, making them aware of the finite nature of resources and the impact of human activities on the environment.

Therefore, physics education, as an important way to cultivate students' awareness of resource utilization and the environment, as well as its integration with education for sustainable development, has injected new vitality into the

promotion of a sustainable society [2]. Through the efforts of physics education, we can foster a new generation of citizens who are more concerned about resources, the environment and sustainable development, and work together towards a better future.

2 Domestic and international research status

At present, there have been many domestic and international studies on education for sustainable development and physics education, most of which have been explored from the perspectives of educational content, teaching methods and teaching evaluation. Studies at home and abroad have shown that physics education has a positive impact on and contribution to the integration with the education for sustainable development (ESD). Educational content and curriculum design: A number of studies have focused on how to integrate the concepts and principles of sustainable development into the pedagogical content and curriculum design of physics education [3]. These studies emphasize the development of students' understanding of environmental issues, energy use and the sustainable development goals by covering sustainable development topics and practical examples.

Internationally, a number of educational research institutions and scholars have begun to realize the link between physics education and ESD and have conducted relevant research. For example, organizations such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Association for Physics Education (IAPS) have carried out a series of research projects aimed at promoting the integration of physics education and ESD [4]. The results of the studies show that physics education can develop students' environmental awareness and sustainable development values, and improve their competence and literacy in the field of sustainable development.

In China, the integration of physics education and education for sustainable development has also attracted the attention of the academic community. Some scholars have carried out research in the areas of curriculum, teaching methods and textbook preparation to explore how to integrate the concept of ESD with the practice of physics education. They believe that physics education can guide students to think about energy use and environmental issues and develop their problem-solving ability and sense of innovation through case studies and experimental investigations.

However, there are still some shortcomings in the current research. First, there are relatively few studies on the integration of physics education and ESD, and more in-depth discussions and practices are needed. Second, the existing studies are limited to exploring from the theoretical level and lack the support of empirical studies and practical cases. Therefore, future research can further expand the scope of the study to explore in depth the specific strategies and effects of physics education and ESD in conjunction with actual teaching practices [5].

3 Purpose and content of the study

3.1 Analyzing the theoretical basis for the integration of ESD and physics education

First, the theoretical basis of education for sustainable development can be analyzed from the perspective of sustainable development education [6]. ESD refers to an educational approach that, through education, fosters students' concern for, understanding of and support for the goals of sustainable development, as well as applying relevant knowledge and skills to promote the coordinated development of the economy, society and the environment, and the realization of sustainable development. It is an important component of the United Nations 2030 Agenda for Sustainable Development.

Physics education, on the other hand, is an educational approach to develop students' scientific literacy and scientific methodology. It emphasizes the development of observation, reasoning and experimental skills in the process of investigating physical phenomena, and the enhancement of students' understanding and application of natural sciences [7].

3.2 Exploring the role of physics education in resource utilization

Resources are indispensable elements for the development of human society, but the consumption and pollution of resources have a serious impact on the environment. Physics education, on the other hand, can enable students to understand, master and apply relevant knowledge and techniques of resource utilization through teaching content and experimental teaching, promoting the curriculum objectives of rational resource utilization and energy conservation.

At the same time, experimental teaching can also be used to let students experience and understand the process of resource utilization and energy conversion [8]. For example, some experiments on energy conversion or physical principles, such as solar energy, dynamics, optics and other related experiments, can be designed and carried out to stimulate students' interest in learning and enhance their environmental awareness and ability to utilize resources.

3.3 Examining the role of physics education in the development of environmental awareness

Environmental issues are one of the major challenges facing the world, and physics education can also contribute to the development of environmental awareness and provide scientific and technological support for solving environmental problems through its content and teaching methods.

Specifically, students' knowledge of environmental issues can be enhanced by introducing physical knowledge, principles and cases related to environmental issues. For example, students can be made aware of the impact of the atmospheric environment on living things, the utilization and management of water resources and other aspects [9]. At the same time, students' knowledge and feelings about environmental problems can be deepened by discussing environmental problems and conducting social practices.

In addition, physics education can be taught in such a way as to promote students' understanding and mastery of environmentally friendly technologies and green and clean production. For example, students can be asked to introduce and make environmentally friendly products, or to analyze and assess the environmental friendliness of different models of automobiles.

4 Strategies for integrating physics education and sustainable development education

4.1 Resource utilization and environmental protection strategies in physics laboratory teaching

First of all, we can advocate the principle of green laboratories by choosing small quantities of non-hazardous and non-polluting materials for experiments, thereby reducing the impact on the environment. For example, use environmentally friendly reagents instead of toxic or dangerous reagents, and save the amount of energy and water used in the experimental process. Secondly, experimental programs involving environmental protection are carried out to allow students to experience personally the application effects of environmental protection technology. These experiments can cover eco-box experiments, solar cell experiments, wind energy conversion experiments, etc. Through hands-on practice, students will intuitively feel the positive effects of science and technology on environmental protection, thus deepening their awareness of environmental protection.

In addition, we can also encourage students to adopt green experimental methods, that is, to utilize recycled materials and conserve energy [10]. By promoting this environmentally friendly approach to experimentation, students can develop the habit of conserving resources and realize that they themselves can do their part to protect the environment in their daily lives.

4.2 Sustainability and environmental strategies in physics curriculum design

The number of knowledge points and cases related to resource utilization and environmental protection can be increased, such as energy conversion, battery recycling, waste treatment, etc. Through theoretical learning, students will learn about the finiteness of resources and the impact of environmental pollution on human society, thus triggering their thinking about sustainable development.

4.3 The use of sustainable science activities in physics education

The application of sustainable development science activities in physics education can provide students with a deeper understanding and experience of the concept of sustainable development. By designing relevant science activities, the principles of physics can be combined with practical issues of sustainable development to stimulate students' interest and active participation.

One way of applying sustainable development science activities is to organize practical experiments on energy use and conversion. For example, a solar cell experiment is designed to allow students to personally assemble solar cells, observe the process of converting solar energy into electricity, and explore the renewability and environmental friendliness of solar energy. Through such practical activities, students will experience first-hand the application and effects of sustainable energy and gain a deeper understanding of the importance of sustainable development.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Liu Y, Liu E, Liu D. 2019. Incorporating sustainability education into physics teaching: a case study on energy conservation. *Journal of Cleaner Production*, 213: 880-888.
- [2] Macdonald A, Kristensen S. 2019. Sustainability education in physics teacher training: a case study from Norway. *Sustainability Science*, 14(4): 917-930.
- [3] Kamenidou I, Tsigilis N. 2019. Integrating sustainability in physics education: a systematic review of empirical studies. *Science Education International*, 30(2): 173-191.
- [4] Oon PC, Chia LS, Tan HB. 2018. Designing context-based and activity-oriented physics curriculum to promote sustainability education. *Journal of Science Education and Technology*, 27(5): 446-461.
- [5] Thomsen MR, Thomsen PV. 2021. Teaching sustainable development and the sustainable development goals (SDGs) through physics education. *International Journal of Environmental and Science Education*, 16(7): 547-560.
- [6] Tsaparlis G, Scherz Z, Mutabazi I. 2015. Sustainable development in chemical education--a global perspective. *Chemistry Education Research and Practice*, 16(2): 383-394.
- [7] Chen Y, Chen D. 2018. The practice of integrating education for sustainable development in university physics teaching. *Physics*, 2: 140-144.
- [8] Wang Q. 2019. Exploration of experiential classroom teaching--taking the course of "sustainable development" as an example. *Science and Technology Literacy for Elementary and Middle School Students*, 2: 76-77.
- [9] Luo D, Liu QQ. 2018. Research on the cultivation of knowledge and awareness of sustainable development in physics education. *Experimental Technology and Management*, 2: 132-135.
- [10] Sun XN, Zhao LN. 2021. Exploration of "sustainable development" concept into university physics education. *Economic Management Education*, 4: 91-92.

About the author

Wang Lele (1999.4.24-), female, Han, Chongqing, student, master's degree, research direction: education.