Universe Scientific Publishing

Analysis of Middle School Science Education Strategies Based on Scientific Literacy

Hanjie Si, Junchi Mao, Qingqing Shao

School of Physics Hangzhou Normal University, Hangzhou 311121, China.

Abstract: Middle school science education is an important way to cultivate scientific literacy. After clarifying the meaning and essence of middle school science education, this paper discusses three major deficiencies in the current middle school science education for cultivating scientific literacy, and illustrates five specific methods for cultivating students' scientific literacy in science education with examples.

Keywords: Scientific Literacy; Middle School Science Education; Project-based Learning; Student Development

Introduction

Middle school science education is a special existence in China. Of the 34 provincial-level administrative regions in China, only Zhejiang Province still carries out middle school science education, while other places are starting to implement discipline-based teaching. So what is middle school science education? Why is it necessary to implement a combined science education?

1. The Meaning and Essence of Science Education in Middle School

To really understand middle school science education in Zhejiang Province, we must first know what science is. Science is an orderly system of knowledge based on testable explanations and predictions of the form and organization of objective things, and is knowledge that has been systematized and formulated. According to the field of the object to be reflected in the knowledge of the scientific system, it can be mainly divided into natural science, social science, thinking science, formal science and cross-discipline.

From the definition of science, it is not difficult to find that science is a multidisciplinary subject, that is to say, students need not only need to have knowledge of a single subject but also need to build connections between disciplines when learning science. The middle school science curriculum in Zhejiang Province carries this forward well.

Middle school science education is an education that teaches basic scientific knowledge and takes quality education as the basis, reflects the scientific thinking method and scientific investigation method. It cultivates the scientific spirit and scientific attitude, establishes a complete view of scientific knowledge and values, and carries out training of basic scientific research ability and application of science and technology.

From the above-mentioned meaning of science, under the surface of understanding scientific knowledge, there are also deeper abilities such as understanding the objective laws behind the material world, developing students' comprehensive thinking and analytical skills, understanding and practicing the general process of scientific research, and developing students' critical thinking skills and practical skills, which we will collectively call scientific literacy. And scientific literacy is the essence of what we are pursuing when we conduct middle school science education.

2. Deficiencies in the development of scientific literacy in middle school

The most important occasion for cultivating students' scientific literacy is the school's science class. However, many school science classes have not played the role of cultivating students' scientific literacy. The author believes that the specific deficiencies reflects in the following three points:

2.1 The class is dominated by the teacher and lacks experimental investigation

At present, Chinese education is still based on examination-based education, and the "scores only theory" is deeply rooted in the hearts of teachers, students and parents, but this greatly deviates from the original purpose of education, which is to cultivate talents who can serve society and develop thinking. In the face of high test-taking pressure, many schools have ignored the development of scientific literacy.

All scientific knowledge is inseparable from experimental investigation, the same cultivation of scientific literacy is also inseparable from scientific investigation, but in our current classes, there are few experiments. Many teachers even think that doing experiments is a waste of time. The classroom has been in a state of no experiment for a long time, which makes it impossible for students to exercise and improve their scientific inquiry ability and scientific thinking. Over time, the scientific spirit has also been wiped out, not to mention scientific literacy.

2.2 Ignore students' learning situation, teaching content ahead or lagging behind

Teachers do not properly grasp the students' learning situation and cannot set a proper task for students. Students have a process of accepting knowledge. Many teachers are eager for success when students have not fully understood knowledge, and give students a task that is far beyond their ability to complete which undermines students' self-confidence. Or students have fully understood the knowledge, but teachers give too simple tasks, which will make students feel bored and affect their enthusiasm for class and are also not conducive to the development of students' scientific literacy.

2.3 Inability to provide timely feedback and lack of a sound evaluation standard system

Students often encounter many problems in the process of learning. Under the background of large-class teaching in China, it is difficult for teachers to fully consider every student, so the feedback on students' problems is not very timely. At the same time, in addition to the test scores of scientific knowledge, there is a lack of a perfect evaluation system, and teachers' evaluations are often too subjective which often creates problems of fairness and sometimes may discourage students' learning and is not conducive to the development of students' scientific literacy.

3. Methods in cultivating students' scientific literacy in middle school science teaching

In the face of the many shortcomings of middle school science education, we must realize that the essence of education should be to inspire thinking, the pursuit of the "highest" wisdom, the essence of the middle school science teaching -- "scientific literacy"-- is a kind of wisdom and a spirit, then how to develop students' scientific literacy in middle school Science class in the development of students' scientific literacy? The author believes that the specific methods are as follows.

3.1 Be a new teacher in the 21st century

As a new teacher in the 21st century, we must be good at using high-tech equipment such as mobile phones and computers to assist teaching. Teachers should continue to learn new technologies and try to keep up with the times. With the help of these tools, they can combine some scientific knowledge outside textbooks, the latest scientific research progress,

scientific situations based on assumptions and other information as curriculum introduction or extracurricular extension, so as to better integrate technology Integrate with disciplines. For example, in the lesson “The Shape and Internal Structure of the Earth”, Chapter 3, Section 1, Volume 7, Grade 7, Zhejiang Education Edition, teachers can use multimedia to play images of the Earth seen in space, or use high-tech equipment such as VR to let students immersive, so as to have a more intuitive feeling of the shape of the earth.

3.2 Adhere to the main position of students

It is important to establish the dominant position of students. This requires teachers to pay attention to the interaction with students. Students can participate in the classroom in the form of question and answer. The teacher acts as the leader of the classroom rather than the leader. For example, when learning the human body system, the time for teaching is reduced, and a task list is designed, so that students can read and complete the task independently, and then the teacher will conduct timely summarization and guidance. In this process, students complete the task independently and find the answer, which requires students to think. At this time, the real learning happens.

3.3 Organize project-based learning

Organize project-based learning. The flexible use of knowledge is what is lacking in middle school science at present. Therefore, teachers can adopt project-based learning to build a bridge between scientific subject knowledge and real life, which can stimulates students’ interest in learning, and also develops students’ teamwork and communication skills.

Project-based learning requires students to integrate and apply knowledge. As a course that integrates many disciplines, science class needs to reflect the connection between various disciplines in the classroom. For example, in the section of making an ecological bottle, students must be able to think of multidisciplinary knowledge. Plants will carry out photosynthesis and respiration and animals will carry out respiration, so how to keep the balance between the two,while the solubility of carbon dioxide and oxygen in water are also different, how to ensure sufficient oxygen and so on.

In the process of project-based learning, it is necessary to encourage and protect students’ curiosity and imagination, stimulate students’ creativity and innovation, and cultivate students’ critical thinking. In the class, teachers should take the initiative to guide students to think, which can be carried out in the form of group discussions, assign group tasks to students, or give students only one big theme, so that students can play and create independently. When working in groups, teachers should pay attention to the ideas put forward by students, think about the advantages and disadvantages of these ideas, and give students feedback in a timely manner, which invisibly encourages students and enhances their confidence in in-depth exploration.

3.4 Focus on scientific investigation

Paying attention to scientific inquiry practice and the cultivation of hands-on operation ability. Learning science should be an active and self-directed process. This requires us to improve the status of practice and inquiry in science classes.The experiments that appear in the textbook should be experienced by students, such as the investigation of the balance of forces and the investigation of electrolysis of water. At the same time, extracurricular experiments can be assigned, and a reward system can be set up to give awards to students who independently conduct extracurricular scientific investigations. Finally, after the experiments are done, the group will make a group report and share the results of the investigations to the whole class. And we will discuss together, which can be included in the results of students’ assessment.

3.5 Establish a sound evaluation system

Optimizing the teaching evaluation of middle school science education. Teachers should also pay attention to avoid the single, stereotypical evaluation method of “score-only” in the process of teaching evaluation. They should pay attention to the content and practice of the science curriculum, and conduct a comprehensive and multidimensional evaluation, which can combine process evaluation and summative evaluation. This can help guide students to change the single goal of “improving

a grade" and motivate them to think outside the box about learning tasks and objects of study.

4. Summary

The highest level of science education in middle school is to cultivate students' scientific literacy. We must make students become the discoverers of knowledge, to establish students' dominant position, to cultivate students' critical thinking and scientific spirit, and to encourage students to apply and innovate their knowledge. Cultivating scientific literacy is not an easy task, but we believe that with our unremitting efforts, this will eventually succeed.

References

[1] Rodriguez AJ, Mark S, Nazar CR. Gazing Inward in Support of Critical Scientific Literacy[J]. Journal of Science Teacher Education,2022,33(2).

[2] Liang WJ, Fung D. Designing STEM Education in Small Class Teaching Environments: The Hong Kong Experience[J]. The Asia-Pacific Education Researcher, 2022 (prepublish).

[3] Holmes K, Berger N, Mackenzie E, et al. Editorial: The Impact of Place-Based Contextualised Curriculum on Student Engagement and Motivation in STEM Education[J]. Frontiers in Education,2022.

[4] Ergasheva GS, Rajabov KHM, Atakulova MN, Altynsarin I. International programs for assessing the quality of education-a factor in increasing the scientific literacy of students[J]. Academicia: An International Multidisciplinary Research Journal, 2021, 11(5).

[5] Zaragoza MC, Díaz GJ, Caparrós AF, et al. The teacher of the 21st century: professional competencies in Catalonia today[J]. Educational Studies,2021,47(2).