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Study on STEM Education Management Mode in Secondary Schools from the Perspective of Creativity Cultivation

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Abstract

In the current era of economic globalization and knowledge economy, science and technology are important driving forces for economic and social development. Moreover, the outstanding performance of talents in innovation and skills has received worldwide extensive attention, which has promoted educational innovation to be an essential task. In this context, it is necessary to applying STEM to the education curriculum system from a strategic perspective is one of the critical paths to cultivate comprehensive, innovative talents. Thus, this paper will introduce the basic concepts, and significant characteristics of STEM education then explore the STEM teaching management model in a secondary school based on students' traits.

Keywords

STEM; Teaching management; Creativity; STEM mode.

1. Introduction

STEM education has aroused a broad concern of educators for integrating multidisciplinary knowledge and cultivating innovative spirit and practical ability in recent years. For the reasons to implement the STEM education concept in the teaching management of secondary schools, discipline teaching is one of the critical modes, which can also promote STEM teaching mode. This paper believes that the introduction of STEM into discipline teaching management should start from the perspective of teaching objectives to enhance students' integration ability, problem-solving ability and practice ability under the STEM mode.

2. The Basic Concept of STEM Education

In 'Science, Mathematics and Engineering Education of Undergraduate Course' released by the National Science Board (NSB)1986 first explicitly put forward the programmatic proposal of the 'integration of science, mathematics, engineering and technology education'. This proposal is considered to be the beginning of STEM education, while STEM is the acronym of the four disciplines that are science, technology, engineering and mathematics.

With the development of the concept of STEM, different scholars have different understandings. There are two main views within the mainstream school currently. The first one that STEM is to integrate various disciplines and solve practical problems organically. However, the other considers STEM to be a way to cultivate the students' ability to analyze and solve problems. Despite the different interpretations of STEM in the education field, it is commonly recognized that STEM has the characteristics of interdisciplinary integration and cultivates students by integrating multiple disciplines to become comprehensive interdisciplinary compound talents.

In promoting STEM education, it is essential to understanding the "STEM literacy" formed through STEM education. STEM literacy is an organic unity of STEM-related knowledge, ability and emotional attitude, and this can be more intensively presented as STEM ability with emotional attitude. He Shanliang (2020) proposed a 'concentric circle structure of STEM literacy', which further elaborated the ability of students STEM literacy under the background

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of quality education [1] (Figure 1). For students, STEM literacy is derived from each specific discipline's ability and higher than the ability of each particular domain. It can be shown in detail, including integrating the knowledge of various fields, innovation and creativity, and solving problems. These abilities are embodied in the specific qualities of question raising, idea generation, image creation, iterative optimization, and creativity materialization. In addition, STEM literacy also includes independent thinking, critical thinking, the concept of cooperation, etc.

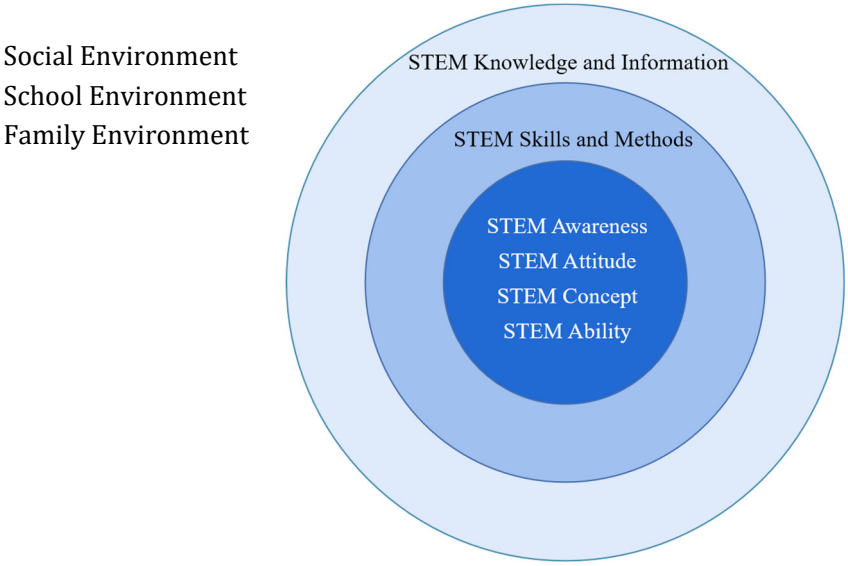

Figure 1. The concentric circle structure of STEM literacy

3. The Characteristic Analysis of STEM Education

3.1. Interdisciplinarity

The most apparent characteristic and strength of STEM is interdisciplinarity. It can accurately take the problem as the orientation and emphasize integrating science, physics, chemistry, and other fields to solve practical problems to promote the interaction and integration of multiple disciplines to cultivate students' interdisciplinary analysis ability and solve practical problems. This innovative teaching mode advocates that students learn in multidisciplinary exchange and shift their attention from the past method of focusing on a single discipline to the development and association of interdisciplinary learning. Therefore, it can enhance their comprehensive quality and creative ability and avoid the dullness and repetition of single discipline education [2].

Table 1. A comparison between single-disciplinary learning and interdisciplinary learning

Type	Single-disciplinary learning	Interdisciplinary learning
Subject	homogeneous students	heterogeneous students
Object	Single-type course	Integration of Diversified courses
Rule	Single-disciplinary learning and application	Integration of interdisciplinary learning
Tool	Tools that are suitable for the characteristics of single-discipline	Innovative combination and groups
Division of work	Jigsaw division of work	Project-based division of work
Environment	Theme scenarios	Blended learning environment

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3.2. Real Situation

It is worth mentioning that STEM focuses on the interaction between students' real-life environment and learning rather than cramming. From the perspective of real situations, STEM mainly uses technical methods to reproduce the actual scene. Thus the problems and cases can motivate the students to learn, stimulating them to review and match what they have learned and formed a new framework. In this circumstance, STEM can highly exercise the student's ability of situational learning. Beyond that, STEM can also enhance their ability to analyze, exploring and solving problems. Therefore, the actual situation emphasized in STEM can enable students to acquire knowledge and improve their practical operation ability.

3.3. Project-based Learning

Project-based learning, abbreviated as PBL, is a representative teaching mode in STEM education and has a wide application. PBL generally includes multiple sections, such as question raising, project research, planning, achievement presentation, result feedback and evaluation, covering important parts, including content, project activities, the reappearance of situation and results, etc. The student's ability to explore and decide can be cultivated through real problems and enhance their innovation and practice ability. Generally, PBL is problem-oriented, determine the corresponding group goals and division of work tasks through the establishment of cooperative groups, and complete the learning objectives based on cooperation, which has the advantages of feasibility, unity and openness [3].

3.4. Emphasizing Cooperation and Communication

Cooperation and communication cover two aspects, which are ‘cooperation and ‘communication’. Firstly, ‘cooperation’ means assisting each other in completing tasks together, while ‘communication’ means communicating with each other. STEM requires learners to help and communicate with each other to complete the tasks through co-work. These tasks usually exist in reality and need assistance for successful completion. Therefore, in study solving, students should establish groups to analyze problems, research materials, display results. Then they need to focusing on cooperation and communication. In addition, in the evaluation system, collaboration and communication are also essential factors to be considered rather than individual performance.

4. Exploration of STEM Teaching Management Mode in Secondary Schools

4.1. To Design Interdisciplinary Development Mode Based on the Development Trend of Disciplines

Firstly, schools should attach importance to the development trend of the interaction and integration of disciplines, including the fields into the corresponding systems, and design the discipline integration combining with the problems of single-discipline management in the past and the goal of training innovative talents.

Secondly, schools should expand their cooperation with third-party educational institutions and enterprises to maximize the sharing of social resources.

Thirdly, schools also need to innovate the current student evaluation system and apply the STEM evaluation system that includes formative, summative and other evaluation methods through the new concept of interdisciplinary education. Experts in multidisciplinary development should be invited to work together to check the students' homework and provide scientific guidance and feedback on their multidisciplinary learning. Schools should not only focus on students' interdisciplinary learning but also emphasize the learning and development of the groups.

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Furthermore, the interdisciplinary learning groups' environmental atmosphere and external achievements should also be evaluated [4].

4.2. To Emphasize the Students' Principal Position and Improve Their Thinking Ability

One of the significant challenges STEM comes from teachers, who do not have a fixed standard model and method for reference to integrate multiple disciplines with STEM. At present, some teachers adopt the technique of combining teaching with practice, by which students master the knowledge and practical skills by completing learning tasks in different stages. This method can help students review the real events to a certain extent. However, it fails to achieve the purpose of facilitating, and the teacher-center situation has not been changed. STEM values students' principal position and students can play a leading role in the learning process. Currently, most schools adopt the task-based approach with the guidance of teachers to promote cooperative learning. However, from the overall point of view, this teaching method is relatively limited. STEM is an organic integration of the 5E Teaching Method and engineering projects, providing a learning method with high feasibility. With the guidance of integrating the above two modes, teachers can use multiple ways to stimulate students' learning desire, such as model method, role play and exchange, field investigation, outdoor practice and story method, etc. In addition, STEM guides and cultivates students with argumentation thinking to obtain learning methods based on evidence. Thus the students' critical thinking ability can be cultivated and improved. Therefore, in developing STEM in China, students should be taken as the subject and should emphasize the construction of student thinking ability.

4.3. To Drive Practice Teaching Based on Situations

In the process of the situational design of the STEM curriculum, teachers should attach great importance to the problem situations, guiding students to understand the current social problems and challenges from the perspective of personal and social relations and improve their sense of responsibility and obligation. At present, some well-known international organizations represented by the National Academy of Engineering of the United States have put forward several research projects, such as resource regeneration, prevention of terrorist crisis, emerging energy and virtual reality technology, etc. In the process of setting the situations, teachers should be open-minded, focus on globalization, and cultivate students' sense of social responsibility with a series of global problems and opportunities [5].

4.4. To Construct the Interdisciplinary Teaching Teams

First and foremost, teachers of different disciplines should take the initiative to strengthen communication and cooperation and form specific teams of disciplines. The selected excellent groups can lead the building of the innovative community of interdisciplinary development and learning and teaching, explore and discuss the multidisciplinary development strategy from the horizontal and vertical perspectives. Moreover, with the premise of retaining the characteristics of the discipline itself and giving full play to the parts of teachers in different fields, a more effective integrated curriculum can be provided for students.

What is more, teachers should enhance their awareness of personal development, maintain the spirit of exploration in their disciplines, and have the concept and understanding of interdisciplinary development. In the STEM application and development process, teachers should have professional knowledge in different fields, associate the learning with real life, and make efficient and comprehensive use of multiple teaching methods and modes to achieve interdisciplinary teaching. The effect of multidisciplinary development should be comprehensively evaluated considering various factors, including the diversity, clarity, tasks, and the degree of investment, management, and interaction of teaching.

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5. Conclusion

From the perspective of creativity cultivation, STEM teaching management mode in secondary schools comprehensively adopts the knowledge and methods of mathematics, physics, chemistry, biology, engineering, and other specific disciplines in the secondary education stage to understand problems derived from and higher than the particular disciplines. This paper believes that compared with the traditional teaching elements, STEM teaching in secondary schools from the perspective of creativity cultivation emphasized teachers' awareness of STEM education concept and their ability to control STEM interdisciplinary teaching in courses in the era of quality education. STEM teaching requires teachers to continue to pursue the knowledge updating and iteration and needs the guidance of policies and collaborative support and training from teaching and research departments, thus promoting the continuous enhancement of STEM education quality.

References

[1] Chittum Jessica R, Jones Brett D, Akalin Sehmuz, Schram ásta B.The effects of an afterschool STEM program on students'motivation and engagement[J]. International journal of STEM education.2017 (1).

[2] TIAN Chuanjun, RAO Xing. Exploration on Construction of Experimental Teaching Center Based on STEM Education[J]. Research and Exploration in Laboratory.2021, 40(3):260-263.

[3] ZHAO Zhen. STEM Education: A Project Teaching Based on the Idea of Subject Integration[J]. The Guide of Science & Education. 2021 (5): 63-65.

[4] Wu Jiaxia, Xue Dong. The Realistic Needs,Core Contents and Basic Features of American Graduate STEM Education Reform:Based on the Analysis of the U.S. Report Entitled"Graduate STEM Education for the 21 st Century"[J]. Journal of Teachers College Qingdao University.2021, 9(2):87-92.

[5] XUE Dong, WU Jiaxia. The Latest Core Competencies of American Graduate STEM Education: Policy Context,Standard Framework and Training Path[J]. Journal of Graduate Education.2021 (2):90-97.