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Exploration of STEM Education Curriculum Construction in Normal Universities

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Abstract: To fully meet the societal demands for future teachers, this paper comprehensively designs the STEM education curriculum for science education students from multiple dimensions including teaching content, teaching models, and instructional design. Through the designed instructional process, student teachers are effectively trained to develop their capabilities in delivering STEM education. The integrative curriculum design enables student teachers not only to impart knowledge but also to stimulate students' innovative thinking and problem-solving skills, laying the foundation for nurturing future innovative talents.

Keywords: STEM Education; Curriculum; Teacher Education Colleges; Science Education.

1. Introduction

The construction of STEM curricula is not only an innovation in educational models but also a cross-disciplinary educational philosophy aimed at breaking the boundaries between traditional disciplines and organically integrating knowledge from science, technology, engineering, and mathematics. Through this integration, students experience a richer and more diversified teaching methodology, and educators adopt a multi-dimensional evaluation system to encourage students' autonomous learning, in-depth inquiry, and spontaneous practice, thereby fostering higher levels of learning abilities and practical skills. STEM education emphasizes enhancing students' transfer abilities-the capability to apply knowledge and skills learned in one discipline to other fields; cross-disciplinary integration abilities-the capability to blend different disciplinary knowledge and skills to solve complex problems; and innovative and creative abilities-the capability for original thinking and innovative practice. These skills are crucial for students' future professional development in technology fields and are key qualities for becoming future science and technology talents.

The importance of STEM education is not only reflected in nurturing science and technology talents but also in boosting a nation's innovation capacity and competitiveness. STEM education holds a strategic, foundational, and pioneering position, profoundly impacting the long-term development of a country. With the rapid development of global science and technology and the deepening of economic globalization, countries worldwide are increasingly focusing on mastering advanced technologies and cultivating innovative talents. Thus, many nations have elevated STEM education to a strategic national level, viewing it as a key avenue to enhance national competitiveness and achieve sustainable development.

As a comprehensive educational model, STEM education not only fosters students' overall literacy and innovative abilities but also provides strong talent support for national technological advancement and economic growth. In the future, as technology continues to progress and educational philosophies are updated, STEM education will continue to play a crucial role in nurturing more talents with innovative spirits and practical abilities.

2. Curriculum Objectives

Understanding scientific knowledge, scientific and engineering principles is an indispensable part of students' learning processes. This includes not only an understanding of basic scientific concepts but also an in-depth exploration of scientific theories and technological applications. Through this process, students can comprehend the close connections and interactions between science, technology, and engineering, thus fostering a spirit of scientific inquiry and the ability to apply theory to engineering practice.

On this basis, the educational goal is to cultivate students with scientific ways of thinking and working methods, helping them to establish lofty ideals and firm beliefs in striving for the development of the country and the revitalization of the nation. This type of education focuses not only on imparting knowledge but also on shaping students' values and guiding their life goals.

By exploring problems, conducting experiments, and engaging in collaborative learning, students have the opportunity to conceive, design, and implement innovative solutions, thereby cultivating their creativity and innovative thinking. Faced with real-world problems and challenges, students will solve these issues through analysis and practice, not only enhancing their thinking capabilities but also strengthening their abilities to tackle real-life problems. This learning process helps students enhance their interdisciplinary integration skills and improve their overall quality.

Integrating theory with practice and incorporating disciplinary knowledge into all aspects of learning is an important aspect of education. Through collaborative learning, students can share experiences and discuss problem-solving methods, which not only cultivates their scientific teamwork spirit but also helps them develop a lifelong learning mentality. This educational model encourages students to continuously explore and progress during their learning process, laying a solid foundation for their future studies and life.

3. Key Issues in Curriculum and Instructional Reform

In the current educational system, curriculum and instructional reform is a key link in enhancing educational quality, and addressing key issues is at the core of reform. First, students lack sufficient awareness of the educational philosophy of this course, and their understanding of the course's educational value is not high, which directly affects their learning enthusiasm and teaching effectiveness. Therefore, we need to enhance students' understanding of the educational philosophy and their appreciation of the course's value through various means, such as course introductions and special lectures.

Second, with the advent of the knowledge economy era, the ability to integrate interdisciplinary knowledge has become particularly important. Students need to learn how to integrate knowledge from different disciplines into a comprehensive knowledge structure to better adapt to future societal needs. Therefore, curriculum reform should focus on cultivating students' interdisciplinary knowledge integration skills by designing interdisciplinary course content and practical activities, enabling students to actively explore and practice during their learning process, thereby enhancing their overall literacy.

Teaching design ability is an important part of professional development for teachers. An excellent teacher must not only have profound professional knowledge but also the ability to effectively impart this knowledge to students. Therefore, curriculum reform should focus on cultivating students' teaching design abilities through simulated teaching, case analysis, and other teaching activities, allowing students to learn how to design teaching plans that align with students' cognitive patterns in practice, improving the effectiveness of teaching.

Curriculum development ability is the capability of teachers to develop suitable teaching content and resources based on student needs and teaching goals. In a rapidly changing society, teachers need to continuously update and innovate curriculum content to meet new teaching requirements. Therefore, curriculum reform should focus on cultivating students' curriculum development abilities through project-based learning, research-based learning, and other methods, allowing students to learn how to develop and optimize curriculum content in practice to meet different students' learning needs.

Teaching implementation ability is the capability of teachers to transform teaching designs into actual teaching activities. A teacher's ability to implement teaching directly affects teaching effectiveness and students' learning experiences. Therefore, curriculum reform should focus on cultivating students' teaching implementation abilities through simulated teaching, teaching internships, and other practical activities, allowing students to learn how to effectively implement teaching plans in practice, enhancing the practicality and appeal of teaching.

In summary, the key issues to be addressed in curriculum and instructional reform include enhancing students' awareness of the curriculum's educational philosophy, cultivating interdisciplinary knowledge integration skills, teaching design abilities, curriculum development abilities, and teaching implementation abilities. Through these reform measures, we can effectively enhance educational quality and cultivate more outstanding talents to meet the developmental needs of future society.

4. Course Content and Organization

Firstly, based on the specific conditions of our region and school, we have designed a training program for educational capabilities that meets actual needs. In this program, we particularly emphasize the teaching practice of STEM education concepts, introducing a variety of teaching cases to help students deeply understand how STEM education enhances individuals' overall literacy and innovative abilities through the integration of different disciplinary knowledge. This teaching method not only deepens students' understanding of the connotations of STEM education but also stimulates their interest and desire to explore interdisciplinary knowledge.

Interdisciplinary integration is one of the core characteristics of STEM education. We encourage students to learn across multiple disciplines, understanding the inherent connections between different disciplinary theories and methods, thereby acquiring a broader range of knowledge, skills, and abilities. This mode of interdisciplinary learning enables students to better solve complex comprehensive problems, cultivating their innovative thinking and problem-solving skills.

We use a systemic approach to analyze teaching problems and determine teaching goals. This approach requires us to develop a complete set of solutions and strategies, test these solutions, evaluate the test results, and make necessary modifications. Additionally, we provide students with opportunities to operate various learning instruments and devices, allowing them to understand the performance and operating methods of these devices and integrate these devices into course design, thereby enhancing the practicality and interactivity of the course.

We provide students with more comprehensive and practical technical training. We have strengthened training in information technology skills, enabling students to master modern educational tools, such as teaching software, online teaching platforms, and digital multimedia technologies. Through this training, students can not only flexibly use information technology to develop courses but also better adapt to the development trends of future education.

We offer rich practical teaching opportunities, including recorded classrooms, micro-classrooms, smart classrooms, and other advanced teaching facilities. These facilities help students record and analyze their teaching processes, timely reflect and correct, thereby continuously improving their teaching skills and quality. Through these practical opportunities, students can better integrate theoretical knowledge with practical teaching, laying a solid foundation for becoming excellent educational workers in the future.

5. Course Assessment Methods

The assessment methods for the course are mainly divided into two parts: formative assessment (ongoing assessment) and summative assessment (final assessment). Formative assessment focuses on students' performance and participation during the course, including classroom attendance, classroom performance, performance in group activities, and product testing, all recorded on a 100-point scale. Summative assessment focuses on students' mastery and application of course knowledge, mainly through the submission of course design works and experiment reports.

Course design assignments not only include on-site design, assembly, and post-welding circuit debugging work but also showcase abilities in teaching design.

Assessment Requirements: Adopting a project-based approach, students are required to reasonably select and apply STEM teaching resources, solving problems in the project through the integrated application of science, technology, engineering, and mathematics. Students need to apply scientific and engineering thinking patterns to reasonably design, implement, and evaluate projects. This assessment method not only examines students' knowledge mastery but also evaluates their innovative thinking, problem-solving skills, and teamwork abilities. Through this method, students' learning outcomes are recognized by peers, various sectors of society, and also promote students' activeness and participation in the course, enhancing classroom interaction between teachers and students and making communication more efficient.

6. Course Evaluation and Reform Effectiveness

Students are highly satisfied with the course, and the evaluation of teachers is also generally high. Teachers have repeatedly helped students achieve excellent results in various competitions.

The distinctive features and highlights of the course and teaching reform are mainly reflected in the following aspects: interdisciplinary integration, practical teaching, the use of modern technology in teaching, and enhanced communication and interaction. The course construction actively integrates ideological and political elements, reflecting the co-advancement of intellectual development and moral cultivation.

Course construction is not a simple accumulation of disciplines, but an integration of science, technology, engineering, and mathematics, emphasizing the integrative and comprehensive nature of interdisciplinary. Integrating excellent teaching platforms, the course provides students with abundant learning resources, enabling them to timely acquire relevant knowledge, supplement knowledge gaps discovered in projects, and effectively build connections between knowledge. Additionally, a teaching team is established to actively guide students' practical projects.

Emphasizing the cultivation of students' practical abilities through practical projects, experimental activities, and participation in competitions, students master knowledge and skills during actual operations. Encouraging students to engage in inquiry-based learning through project-based learning and actual operations, we cultivate students' innovative abilities during practical processes, thereby stimulating their creativity and scientific exploration spirit.

Utilizing modern technology to promote learning, we focus on adopting diversified teaching methods, such as project-based learning, to cultivate students' team cooperation awareness and communication skills. Through these methods, students can not only better master knowledge but also enhance their overall quality.

Organizing students to participate in competitions at the college, school, district, city, province, and national levels related to the course, we help students broaden their horizons, expand their thinking, clarify gaps and goals, and promote their continuous growth in practice. Supporting local primary and secondary schools, training institutions, administrative departments, etc., we actively expand employment channels through exchanges and interactions.

7. Conclusion

In the ongoing course construction plan, the direction and specific implementation plans for course construction will be clearly defined, gradually establishing a sustainable course management system. Through these efforts, we believe the course will be further improved, better serving students and providing more support for their growth and development.

References

[1] Yin Shidong, Li Min. Concepts, Strategies, and Insights from the Development and Implementation of STEM Education Curricula in Canada[J]. Global Education Outlook, 2024 (08):147-180.

[2] Song Jiawei. Construction and Practice of the STEAM Education Evaluation Index System[D]. Chongqing: Southwest University, 2024.1-98.

[3] Xie Ying. Construction and Application of a Project-Based Learning Process Evaluation Model for STEM Courses[D]. Shenyang: Shenyang University, 2024.1-116.