

Research Article



Developing a STEAM-PBL Teaching Model for Vocational High Schools in the Context of Quality Education

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ABSTRACT

Currently, quality-oriented education has entered a new stage of development, with the goal of cultivating students' comprehensive qualities. This study aims to construct a new teaching model based on the theories of quality-oriented education, humanistic education, and multiple intelligences, to explore the feasibility of integrating STEAM educational concepts with PBL teaching, the correspondence between the requirements of quality education and the STEAM-PBL model, and to integrate the STEAM educational philosophy with the PBL teaching model to develop a STEAM-PBL teaching model tailored to vocational secondary school curricula. The goal is to cultivate comprehensive competencies in vocational secondary school students, such as divergent thinking, teamwork skills, problem-solving abilities, digital innovation capabilities, and professional competence. This new approach seeks to provide fresh perspectives and methods for vocational secondary education, thereby achieving the goal of cultivating high-quality, application-oriented talent.

1. Introduction

Against the backdrop of educational modernization, China's education system is undergoing a profound transformation from traditional knowledge transmission to competency development. In the 14th Five-Year Plan, the state places great emphasis on enhancing the quality of education for vocational high school students. By deepening vocational education reform and emphasizing an educational model that integrates moral education with technical skills and combines theory with practice, the plan aims to cultivate more master craftsmen on the front lines of industry while simultaneously improving students' overall quality. Additionally,

industry development requires high-quality, skilled talent. During the "15th Five-Year Plan" period, China will fully enter the era of mass tourism, with public tourism demands gradually shifting toward personalization and high-end experiences. This means that many tasks cannot be addressed by relying on knowledge from a single discipline alone; rather, comprehensive qualities and competencies are required to provide excellent customer service. Therefore, the current demand extends beyond tourism professionals with strong specialized knowledge to include those equipped with interdisciplinary knowledge and skills who can adapt to society's diverse development. The core mechanism of the STEAM educational philosophy—which fosters students' comprehensive qualities and innovative abilities through interdisciplinary integration, real-world problem-solving,

and hands-on learning—aligns with the principles of holistic education. Currently, as vocational schools advance quality-oriented education, they face challenges such as disciplinary silos, teachers' lack of interdisciplinary experience, students' passive learning attitudes, and a lack of confidence in innovation. The core feature of Problem-Based Learning (PBL) is that students begin with real-world problems, while teachers act as facilitators, guiding students toward independent learning, stimulating their intrinsic motivation, and fostering the ability to transfer knowledge. Based on national quality education objectives and integrating STEAM concepts with the PBL teaching method, this paper proposes a combined STEAM-PBL approach aimed at aligning with current policy trends and addressing the existing challenges in secondary vocational education.

2. Current State of Research

2.1 The Concept of Quality Education

The concept of quality education in China can be traced back to 1993, when the Central Committee of the Communist Party of China and the State Council issued the "Outline for the Reform and Development of Education in China," proposing that primary and secondary schools shift from "exam-oriented education" to a path of comprehensively enhancing the quality of the nation's citizens. This approach aims to serve all students, comprehensively improve their ideological and moral, cultural and scientific, labor skills, and physical and psychological qualities, and promote their vibrant and dynamic development. Factors influencing quality-oriented education include curriculum reform, teacher development, and evaluation systems. Regarding curriculum reform, Peng Jixiang et al. (2023) proposed that the new national curriculum standards for the arts in compulsory education should break away from traditional knowledge frameworks and strengthen the integration of aesthetic education through a core focus on music and fine arts, supplemented by elective options. This indicates that interdisciplinary integration is gradually becoming a trend, and vocational schools should implement curriculum reforms to cultivate students' comprehensive qualities. Teachers' professional competence is also a key driving factor influencing the improvement of quality in students' quality-oriented education. Luo Haiou (2024) argues that Yang Shuzi's educational practice demonstrates that the growth path of a "great teacher"—who embodies the roles of scientist, thinker, and educator—sets a model for teaching innovation. Currently, vocational teachers still face issues such as dominating the classroom and relying on traditional teaching methods. Therefore, teachers should keep pace with the times—for example, by balancing the application of AI technology with traditional classroom instruction and clarifying that teachers are facilitators rather than dominators of the classroom. As educational philosophies continue to evolve, the educational evaluation system is also gradually being reformed. Tan Ying et al. (2024) innovatively designed a "progressive competency-based objectives + value-added assessment" model to stimulate self-directed learning, while Liu Yunsheng (2024) proposed a "Three-Dimensional Evaluation System" that achieves comprehensive coverage of

formative data collection, providing strong support for the holistic assessment of students' comprehensive qualities. Although the evaluation system is gradually improving, existing competency assessments largely rely on subjective observations and lack quantitative validation tools; the scientific rigor of evaluation tools still needs to be enhanced.

In summary, in light of the current state of research on quality-oriented education in secondary vocational schools, this paper focuses on the talent development programs for these institutions, with an emphasis on enhancing interdisciplinary integration in secondary vocational curricula, improving teachers' comprehensive competencies, and refining the educational evaluation system.

2.2 The STEAM Educational Philosophy

In recent years, countries have promoted interdisciplinary integration by establishing curriculum standards and assessment mechanisms. In the field of vocational education, Xu Hui (2024), in line with the "integration of industry and education" requirements outlined in the "National Implementation Plan for Vocational Education Reform", developed a STEAM practical training model for Java programming courses in secondary vocational schools, utilizing project-based instructional design to enhance learners' innovative thinking skills. Vocational and technical education features a large number of courses that integrate theory with practice. Currently, secondary vocational schools do not employ sufficiently diverse methods to cultivate students' higher-order thinking skills, such as innovation. Therefore, it is necessary to explore diverse teaching methods—such as the STEAM practical training model—to foster students' comprehensive thinking abilities. Vocational and technical colleges primarily cultivate talent for the industry. Zhang Huiqing et al. (2024), drawing on the theory of complex adaptive systems, proposed the construction of a four-party collaborative STEAM ecosystem involving "government, enterprises, schools, and research institutions," in which enterprises assume responsibility for talent development through technological empowerment and resource sharing. In secondary vocational education, teaching models should be reasonably designed with an industry-oriented focus to ensure they not only meet industry needs but also enhance students' comprehensive competencies. Furthermore, digital technology has enabled STEAM education to transcend temporal and spatial constraints; Zhengkun Li (2024) found that integrating VR technology into teaching promotes the development of students' higher-order thinking skills. The research team led by Yingchun Ke and Shien Zhang (2024) proposed a four-dimensional evaluation system to provide a new paradigm for assessing secondary vocational education.

In summary, based on the current state of research on STEAM education concepts, this paper applies the STEAM educational philosophy with a focus on enhancing the comprehensive competencies of vocational students, providing new pedagogical concepts for vocational and technical education, and refining the educational evaluation system.

2.3 The Essence and Development of PBL Instruction

Since its emergence in the 1960s, the Problem-Based Learning (PBL) teaching method has gradually become an important pedagogical approach in the fields of higher education and vocational education. Its core lies in using problems to drive students to actively explore knowledge, thereby fostering critical thinking and practical skills. In the field of secondary vocational education, Wang Lei et al. (2025), using “Belt and Road” geography instruction as an example, pointed out that the PBL model cultivates students’ international perspectives and cross-cultural communication skills by simulating transnational cooperation projects, thereby meeting the demand for multidisciplinary talent from enterprises in the context of globalization. Technological innovation serves as the core driving force behind the evolution of the PBL teaching model, and the introduction of digital tools and intelligent platforms has greatly expanded teaching scenarios and resource integration capabilities. Virtual reality (VR) and augmented reality (AR) technologies have significantly enhanced the immersiveness and interactivity of PBL. Chen Xuanxuan et al. (2024) designed a geography teaching model titled “Industrial Relocation in Vietnam” based on ChatGPT, utilizing AI to generate learning tasks and strengthen students’ data analysis and decision-making skills. While the application of the PBL teaching method to vocational education curricula is now an inevitable trend, several challenges remain, such as insufficient adaptability and difficulties in interdisciplinary integration; students’ weak independent learning abilities, which hinder their ability to solve complex problems; and an imperfect evaluation system lacking quantitative assessment methods.

3. Theoretical Foundation

3.1 A Theory of Quality Education

“Quality” was originally a concept in psychology; however, when applied to the field of education, its definition expanded. The concept of “quality education” is the result of interpreting “quality” from an educational perspective. Quality education emphasizes the cultivation of well-rounded individuals, encompassing knowledge, character, physical health, abilities, and cultural literacy. It advocates that learners achieve both comprehensive development and the preservation of their unique individual traits, realize their potential through work and practice, and ultimately develop a well-rounded personality.

3.2 The Humanistic View of Education

The humanistic view of education is a student-centered educational philosophy that emphasizes attention to students’ individual differences, emotional needs, and self-actualization, and focuses on fostering students’ autonomy, creativity, and personal development. Humanistic psychologists advocate for the study of human cognition, emotion, will, and behavior, and believe that the ultimate goal of education is to promote students’ self-actualization and well-rounded development. Renowned psychologist Carl Rogers proposed that humanistic education should be student-centered, with teachers’ lesson preparation, teaching process, and post-class reflection all centered on students’ learning needs. In terms of classroom models, the humanistic educational philosophy advocates for

“open classrooms” that encourage students’ active participation and independent exploration. In today’s digital age, scholar Zhu Zhihong has proposed placing students in an online environment to engage in collaborative, research-based learning in small groups, with the aim of fostering their innovative thinking and proactive learning. This educational philosophy not only focuses on the development of students’ knowledge and skills but also prioritizes their emotional and mental well-being, striving to help them become well-rounded individuals capable of adapting to environmental changes.

4. The Correspondence Between the Requirements of Quality Education and the STEAM-PBL Model

In the field of vocational education, the requirements of quality education align closely with the STEAM-PBL model. *China’s Education Modernization 2035* lists “developing quality education” as a strategic task, emphasizing the all-round development of students’ moral, intellectual, physical, aesthetic, and labor education, and promoting the implementation of quality education. The integration of vocational education’s quality education requirements with the STEAM-PBL model not only helps enhance students’ comprehensive qualities but also cultivates high-caliber, skilled professionals who can meet societal needs. First, quality-oriented education in secondary vocational education emphasizes the integration of disciplinary knowledge, avoids the fragmentation of subject-based education, and focuses on the all-round development of students in moral, intellectual, physical, aesthetic, and labor education. The STEAM-PBL teaching model emphasizes solving problems by integrating multidisciplinary knowledge to meet the needs of real-world projects; students enhance their comprehensive competencies through interdisciplinary practice. For example, the combination of logical thinking and artistic aesthetics in engineering design within secondary vocational education aligns with the goal of all-round development in quality-oriented education. Second, quality-oriented education in secondary vocational schools requires fostering a spirit of innovation, hands-on skills, and the ability to solve real-world problems. The STEAM-PBL teaching model requires the creation of contextual scenarios to stimulate student interest and guide them toward independent exploration and the implementation of solutions. Third, quality-oriented education in secondary vocational schools emphasizes teamwork and communication skills. STEAM-PBL emphasizes that secondary vocational students complete project tasks through group collaboration, with teachers serving as mentors throughout the process. Fourth, quality-oriented education in secondary vocational schools calls for the cultivation of active learning, critical thinking, and lifelong learning skills. STEAM-PBL requires students to independently summarize and reflect on their learning; for example, the “student-led summarization strategies” within the STEAM framework assign tasks tailored to the diverse needs of secondary vocational students, thereby promoting the development of independent learning skills. Finally, quality education in vocational schools calls for strengthening aesthetic education to enhance aesthetic appreciation and cultural understanding. STEAM-PBL requires the integration of art into teaching and emphasizes the important role of artistic thinking in vocational education.

Additionally, STEAM-PBL instruction is often combined with social and cultural issues to cultivate humanistic sensitivity.

Through strategies such as interdisciplinary integration, real-world problem-based learning, collaborative inquiry, and the integration of the arts, the STEAM-PBL model comprehensively addresses the requirements of vocational quality education for innovation, practical skills, a spirit of cooperation, and humanistic literacy. Its core lies in a student-centered approach, achieving knowledge transfer and the internalization of comprehensive qualities through “learning by doing,” which aligns closely with the essence of quality education.

5. Developing the STEAM-PBL Teaching Model

Against the backdrop of quality education, the training objectives for vocational education—based on the STEAM educational philosophy—are to cultivate students’ ability to comprehensively apply multidisciplinary knowledge in science, technology, engineering, art, and mathematics through interdisciplinary integration and hands-on practice, thereby enhancing their vocational skills and professional competence. At the same time, emphasis is placed on strengthening students’ critical thinking, communication and collaboration skills, cultural literacy, and innovative mindset. Furthermore, students should be encouraged to develop a sense of social responsibility and the capacity for lifelong learning, while promoting their individualized development. The goal is to cultivate high-quality technical and skilled professionals with comprehensive abilities, a professional ethos, and innovative capabilities—individuals who can adapt to rapidly changing social and occupational demands and achieve well-rounded development. Based on an analysis of the current state of tourism-related course instruction in secondary vocational schools and addressing existing issues in such education, this study—guided by the principles of quality education and a humanistic educational perspective—has preliminarily established a framework for a STEAM-PBL teaching model grounded in the philosophy of quality education. This model ultimately aims to cultivate students’ comprehensive qualities. The core objective of quality education lies in achieving the all-round development of the individual. Gao Baoli (2025) points out that quality education must be grounded in the fundamental task of “cultivating virtue and fostering talent,” with the goal of nurturing innovative talents who are well-rounded in moral, intellectual, physical, aesthetic, and labor education, thereby echoing the Marxist concept of “the all-round development of the individual.” Zhou Hongyu (2024) further emphasizes that quality education aims to “comprehensively enhance basic human qualities,” fostering sound personalities through character development and the stimulation of potential, thereby serving the strategy of national rejuvenation. At the practical level, Hao Wenwu et al. (2024) propose that the focus should be on “competency development,” promoting a shift in subject teaching from knowledge transmission to competency cultivation, and strengthening critical thinking and innovative literacy. This paper argues that comprehensive literacy—which encompasses fostering students’ divergent thinking, teamwork skills, problem-solving abilities, digital

innovation capabilities, and professional competence—is theoretically well-suited to the actual teaching and learning context of secondary vocational education. The STEAM-PBL teaching model permeates the pre-class, in-class, and post-class phases of instruction; the following sections provide a detailed elaboration of each component.

5.1 Lesson Preparation

Teaching preparation primarily takes place before class, and thorough preparation is a crucial prerequisite for the teaching process during class. This section of teaching preparation is designed based on the theories of quality education and humanism, emphasizing that teaching must align with students’ all-round development. Students’ knowledge acquisition and learning should not only consider the subject matter itself but also take into account the teaching environment and atmosphere. By analyzing the current state of teaching among vocational school teachers, students’ learning conditions, and talent development plans, the main pre-class preparations focus on assessing the teaching situation, identifying potential issues, and preparing the teaching environment.

Teaching context refers to the teacher’s need to fully understand student learning profiles, textbook content, and instructional objectives before designing the lesson. First is the student learning profile: vocational high school students are generally between the ages of 15 and 18, a critical period of physical and psychological development. They have distinct personalities and can be challenging to manage; while they may not show high interest in learning, they possess a strong curiosity about new things. They excel at hands-on activities but lack good study habits and have poor self-control. Second is the textbook content. Vocational tourism courses are highly practical and skill-oriented, making them well-suited for the STEAM-PBL teaching model. Finally, regarding instructional objectives, based on a comprehensive consideration of vocational curriculum goals, the school’s educational objectives, and the talent needs of the tourism industry, it is determined that the STEAM-PBL teaching model should prioritize the development of vocational students’ comprehensive qualities—namely, divergent thinking, teamwork skills, problem-solving abilities, scientific and innovative thinking, and professional ethics.

Problem preparation refers to the teacher’s responsibility before class to create problem scenarios, assign tasks, and delegate roles. When designing problems, teachers should ensure they are set in contexts relevant to work and daily life, take students’ zone of proximal development into account, and anticipate student behaviors during problem-solving activities.

Environmental preparation refers to teaching equipment, online platforms, and learning resources; teachers must ensure that all necessary equipment, tools, and resources are ready. The STEAM-PBL teaching model requires the integration of information technology tools, such as simulated training labs, as well as digital learning platforms like “Learning Pass” and various educational websites.

5.2 Teaching Process

The design of the STEAM-PBL teaching process is based on a

humanistic educational perspective and the theory of quality education, emphasizing the central role of students and the guiding role of teachers. The entire teaching process consists of six stages: context creation, problem formulation, group formation, collaborative exploration, presentation of results, and summary and reflection. Throughout all stages, teachers must aim to cultivate students' comprehensive competencies. Unlike traditional PBL teaching models, this approach requires the integration of STEAM educational principles and the theory of comprehensive quality into every stage of the process. This enables students to receive education in science, technology, engineering, the arts, and mathematics, thereby fostering the development of divergent thinking, teamwork skills, problem-solving abilities, digital innovation thinking, and professional competence. The key elements to consider in each stage are as follows: First is the scenario creation stage. The scenario serves as a crucial element for students to gain an initial understanding of the learning task and for teachers to introduce new content. In STEAM-PBL instruction, the scenario serves as the vehicle for real-world problems and is indispensable; real problems require the creation of authentic scenarios that are grounded in reality. Second, scenarios must be designed around comprehensive literacy to facilitate interdisciplinary teaching and learning for both teachers and students. Second is the problem-formulation stage. When formulating problems, attention must be paid to the roles and behaviors of teachers and students: the teacher acts as the facilitator who poses the problem, while students serve as the agents responsible for solving it. When designing problems, teachers must consider whether they facilitate the integration of interdisciplinary knowledge and the application of digital technology. Problems should build upon the context established in the previous phase and facilitate division of labor and collaboration within groups. Third is the group formation phase. Students form learning groups on a voluntary basis, though teachers may intervene based on students' strengths and weaknesses to ensure a balanced level of ability within each group. Once groups are established, members must promptly divide tasks according to the teacher's questions and assignments to ensure effective problem-solving. Fourth is the collaborative exploration phase. As one of the core components of the teaching process, teachers must actively guide students to broaden their thinking, apply multidisciplinary knowledge and digital technologies to solve problems, and cultivate divergent thinking and digital innovation. During group collaboration, students should speak up boldly in discussions while learning to acknowledge and incorporate their peers' perspectives. By staying closely aligned with the course objectives, they ultimately finalize and present a solution—a process that fosters students' teamwork skills. Fifth is the Outcome Sharing Session. Groups present their work and share their insights. This session fully demonstrates students' problem-solving and communication skills. During this process, the teacher is responsible for summarizing, providing feedback, and managing the session—summarizing students' solutions, offering timely positive feedback, and ensuring the smooth progression of group presentations. Sixth is the Summary and Reflection Session. The teacher summarizes the lesson by focusing on

the instructional objectives and then hands the session over to the students. By having students conduct their own summary and reflection, the teacher can assess whether their professional competence has improved.

5.3 Teaching Evaluation

A combination of formative and summative assessments aligns with current educational reform and addresses the issue of overly simplistic evaluation methods in classroom instruction. This approach ensures a diverse range of evaluators, with grades determined jointly by the instructor, the students in the class, and observing teachers. It marks a shift from the traditional model of evaluation by a single teacher to one involving multiple evaluators; teachers must not only grade fairly but also guide students to evaluate their peers with fairness and impartiality. Student self-assessment is equally important; students should be guided to view themselves from a developmental and appreciative perspective, thereby forming accurate self-assessments and self-perceptions. The inclusion of peer evaluation between teachers and students provides teachers with greater motivation to teach, as students' personal insights and suggestions often inspire new teaching approaches. At the same time, teachers will evaluate students' problem-solving abilities, including but not limited to group presentation proposals, teamwork outcomes, and test scores. Whether formative or summative, neither is more important than the other; what matters is their effective and appropriate application at every stage of the teaching process to provide students with timely and useful feedback that promotes their development.

6. Conclusion

As educational reform continues to advance in China, quality-oriented education has become the core objective in the field of education. This paper argues that quality-oriented education emphasizes cultivating students' divergent thinking, teamwork skills, problem-solving abilities, digital innovation capabilities, and professional competence. Against this backdrop, vocational education—as a vital component of the educational system—is actively exploring teaching models that meet the demands of quality-oriented education, with the aim of cultivating more high-quality technical and skilled professionals capable of adapting to societal development. STEAM education emphasizes the integration of interdisciplinary knowledge and the cultivation of comprehensive competencies, placing a strong focus on students' innovative thinking and practical abilities. The PBL (Problem-Based Learning) model, on the other hand, begins with real-world problem scenarios and enables students to acquire new knowledge through independent and collaborative problem-solving, thereby cultivating their self-directed learning and problem-solving abilities. This paper proposes the STEAM-PBL teaching model and applies it to secondary vocational education, striving to refine instructional design to put new pedagogical approaches into practice. It is hoped that through this model, not only will students' vocational skills be enhanced, but they will also better align with the requirements of well-rounded education, thereby cultivating more high-caliber technical and skilled professionals for society. Guided by the theory of quality

education, the STEAM-PBL teaching model employs a three-tiered progressive structure—comprising pre-class problem-driven activities and scenario preparation, in-class process-based practice, and post-class effectiveness evaluation—to transform previously fragmented knowledge and skills into a chain of problem-solving tools. This approach enhances interdisciplinary integration in vocational courses, improves teachers' comprehensive competencies, and refines the educational evaluation system.

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