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Exploring the Project-based learning in Vocational College—The practice of "4A-5Steps" Teaching Model

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Abstract: Project-based learning (PBL) is an innovative educational approach that has been widely integrated into vocational college education in China. However, some educators in vocational colleges in China fail to give full play to the characteristics and advantages of PBL. In response to this challenge, this paper introduces the "4A-5Steps" teaching model, aiming to better implement PBL in courses and thereby more effectively improve students' vocational skills.

1. Introduction

Project-Based Learning (PBL) represents a cutting-edge educational methodology that has been increasingly adopted within China's vocational education system. However, there remains a necessity for further exploration to enhance its practical application.

1.1 Introduction to Project-Based Learning

Project-based learning is a pedagogical approach where students engage in an extended process of inquiry and problem-solving in a real-world context. It encourages active learning and emphasizes student-driven exploration rather than teacher-directed instruction. This method can help students acquire deeper knowledge by actively applying what they learn to a project.[1]

The history of PBL can be traced back to the late 19th and early 20th centuries, heavily influenced by educational theorists like John Dewey. His ideas about "learning by doing" and the centrality of experience in education laid the groundwork for PBL's principles.[2]

From mid-20th century till now, PBL has experienced dissemination and development in the United States and international teaching practices in different countries. [3]Today, PBL is an integral part of educational reform worldwide, with its principles being incorporated into STEM (Science, Technology, Engineering, and Mathematics) education, interdisciplinary teaching, and digital learning environments.

1.2 PBL in China’s Vocational Colleges

In China, due to the drawbacks of the exam-oriented education system, many educators have begun to explore new educational paths in the late 20th century. Although PBL started relatively late in China, it is considered a new direction for classroom teaching reform, as it emphasizes the

developmental of individuals, in line with the "student-oriented" educational philosophy within educational reform. At the same time, PBL also faces some challenges, such as differences across disciplines, course types, teaching models, and implementation processes. Therefore, vocational colleges need to continuously explore and improve the implementation strategies of PBL to enhance teaching quality and effectiveness.

1.3 Course Projectization and Project-Based Course

In the educational teaching reform of vocational colleges by PBL, the concepts of "course projectization" and "project-based course" are often mentioned. Although they sound similar, they actually have different meanings and focuses.

Course Projectization: This typically refers to the integration of course content with actual work projects, making course teaching more closely aligned with real work situations. It emphasizes the introduction of project elements in the course teaching process, allowing students to participate in specific project practices while completing their course studies. Its purpose is to enhance students' practical abilities, innovative capabilities, and problem-solving skills through project practice.

Project-Based Course: These are courses that are led by projects, with the entire course design and implementation centered around the completion of specific projects. Such courses usually have clear project objectives, content, implementation steps, and evaluation criteria, forming a complete teaching unit. Project-based course often spans the entire semester, with student learning activities in the course revolving around the project, including project planning, execution, and outcome presentation. They focus on allowing students to systematically master relevant knowledge and skills through project implementation, experiencing the entire process from the start to the finish of a project. [4]

Differences between Course Projectization and Project-Based Course:

1) Scope and Depth: Course projectization may only be a part of a course or a segment of it, whereas project-based course centers around projects and runs through the entire course.

2) Teaching Organization: Course projectization can be more flexible and adjusted according to the characteristics of different courses; project-based course requires a more systematic teaching design and organization.

3) Learning Experience: Project-based course provides students with a more complete project experience, which helps students develop a systematic workflow and methodology.

2. "4A-5Steps" Teaching Model proposed

In vocational colleges, considering most courses require students to have a solid foundation of theoretical knowledge, then applying theoretical knowledge to practical operations to enhance their vocational skills. Therefore, for vocational college students in year 1 and year 2, we prefer to use the way of ‘Course Projectization’ to delivery the course.

Specific implementation of course projectization can be carried out as following: We arrange the whole course into two modules, one for basic module (theory + basic practice) and another for project module (comprehensive practice). By doing this, students can complete the learning of theoretical knowledge and master simple applications in the basic module; then strengthen practice in the project module, master the comprehensive application of knowledge points in projects, and improve comprehensive skill levels. The "4A-5Steps" teaching model proposed later in this paper is a teaching model proposed for the implementation of the project part in course projectization.

By integrating above traditional process and the teaching experience of our team, we proposed the "4A-5Steps" teaching model for the implementation of projects in course projectization (see Figure 1 for details):

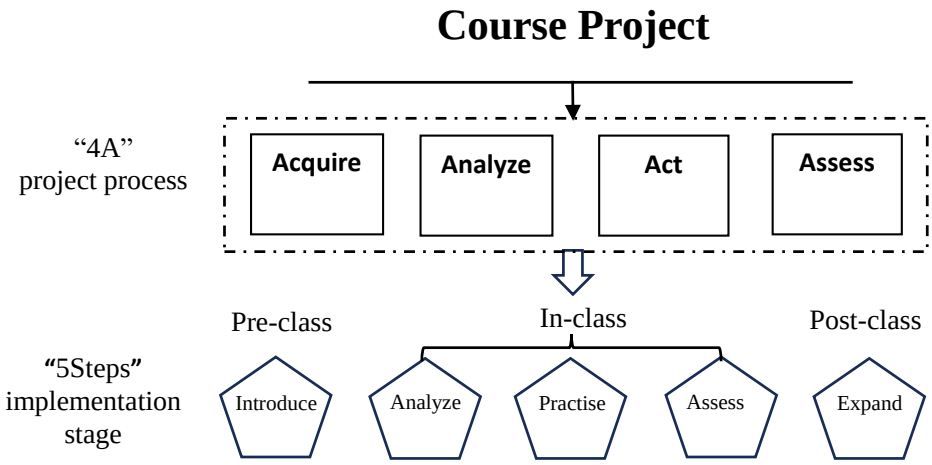

Figure 1:"4A-5Steps" teaching model

Project adopts the "4A" project development process: Acquire, Analyze, Act and Assess.

Project can be implemented using the "5Steps" approach: "Introduce (Project Introduction)," "Analyze (Problem Analysis)," "Practise (Learning by Doing)," "Assess (Multidimensional Assessment)," and "Expand (Expanded Task)," which run through pre-class, in-class, and post-class activities.

3. Practice of PBL by using "4A-5Steps" teaching model

To practise in real course, our teaching team applied the "4A-5Steps" teaching model in the course of "Software Testing and Quality Assurance", which will be specifically introduced below.

3.1 Overview of Course information

Our college - Suzhou Centennial College (SCC) was established through partnerships of Suzhou University of Science and Technology (SUST), Centennial College Canada (CC) and Global Education Management Group (GEM). "Software Testing and Quality Assurance" is a core course in Software Engineering Technician (SET) program, which is run by both SCC and CC. Based on the requirements from "Teaching Standards for Software Technology Majors in Higher Vocational Colleges" and Centennial College(CC) in Canada, aligning with the professional standards of computer software testers and the software testing requirements in the Computer Programming Level Certificate, we developed the course standard and teaching plan, making it a diversified and comprehensive course, which could be delivered by course projectization.

This course combines both theory knowledge and practical skills and has 56 course hours totally. In the evaluation scheme given by CC, there is one section called “Assignments, Workshops, Class Works”, which weighted 37%. By adopting course projectization, we arranged one project module, where eight small projects are designed according to different software testing methods, as shown in Figure 2. Each project integrates different professional skill points, thus to improve students' skill level and job competitiveness.

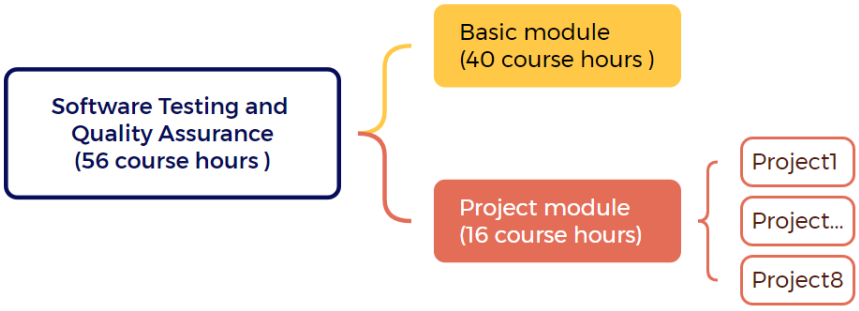

Figure 2: Course framework

3.2 Details of Practice

Course projects adopt small-group collaboration approach, which can enhance students' awareness of cooperation and team spirit. At the same time, through online platform and classroom learning, course instructor can well track the learning and growth of group members throughout the process. Additionally, project integrates morality cultivation and professional English knowledge, leveraging the advantages of information technology and digital resources to break through key and difficult points, aiming to cultivate high-quality international software testing talents who are knowledgeable in theory, good at thinking, skilled in practice, and capable of applying knowledge flexibly.

3.2.1 Specific Implementation of the "4A-5Steps" teaching model

Course project follow the "4A" project development process: Acquire, Analyze, Act and Assess.

In the implementation stage, classroom teaching is generally arranged into three phases: pre-class preparation, in-class guidance, and post-class extension, forming a complete teaching circle that has online resources, class activities, and assessment throughout the process (see Figure 3 for details). Inquiry-based learning is adopted, allowing students to complete tasks through independent exploration, so as to further enhance their problem-solving and innovative abilities.

Below is a list of expanded details while we processing the "5Steps".

(1) "Introduce" (Pre-class preparation phase): Online learning in four stages

The pre-class preparation phase can be carried out in four stages: "Pre-study Task release → Online Self-study → Online Pre-test → Pre-study Data Analysis." Specifically, based on the project content, instructor provides teaching resources on the online platform and issue Pre-study Task. After students completing independent learning and Pre-tests online, instructor analyze the performance of students' Pre-study based on visual data from the online platform.

(2)"Analyze, Practise, Assess" (In-class Guidance phase): Implementation of Integrated Teaching Model to achieve teaching objectives

1) Analyze the problem

Based on the overall and personalized data from students' online learning, identify teaching difficulties, adjust teaching strategies, and address the key and difficult points of teaching. Analyze the problems encountered by students in the Pre-test and reinforce their understanding of key knowledge points during the class.

2) Learning by doing

The implementation of this phase follows the process of "Scenario introduction" → "Demonstration and explanation" → "Learning and practicing simultaneously" → "Demonstration and evaluation." Instructor conducts targeted operational demonstrations, utilizing information technology such as real-time screen sharing to achieve one-to-many communication and solve the

problem of unclear viewing during demonstrations. Group activities are conducted through role-playing. Based on the teaching philosophy of "skills are not learned, but rather mastered through repeated training," step-by-step progressive teaching activities (beginner -> intermediate -> advanced) are designed to steadily enhance students' skill levels.

3) Multi-dimensional Assessment

After completing the project in groups, students will present their works, conduct self-assessment within the group, and peer assessment between groups. Finally, the course instructor will provide comments, grade the works and make a summary.

(3)"Expand" (Post-class Extension phase):

Students utilize the platform for post-class evaluation, expanded tasks and discussion, students can also further interact course instructors online.

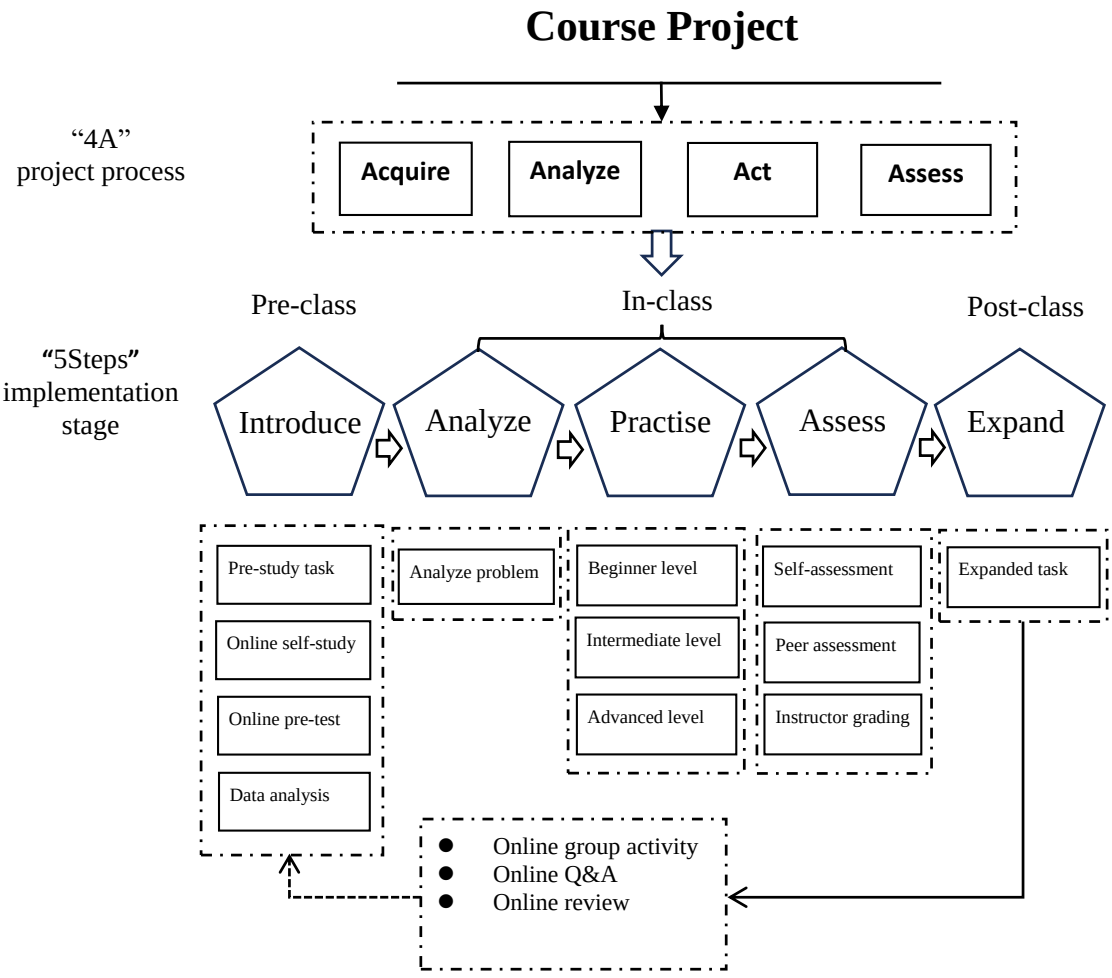

Figure 3: Practice of "4A-5Steps"

3.2.2 Multi-dimensional evaluation mechanism for comprehensive assessment of teaching

For the evaluation of teaching, a multi-dimensional evaluation mechanism has been introduced to reflect students' learning and overall qualities. The main components are as follows:

1) Process evaluation

The course content has been reformed into project-based and task-driven formats, where tasks and group collaboration are used to complete the teaching objectives. Classroom activities are scored, and students' learning progress is tracked in real time. Through formative assessments, students' knowledge, abilities, and professional qualities are improved, reflecting the teaching effect

of "integrating teaching with practice."

2) Outcome Evaluation

Outcome evaluation is based on the results generated by the project implementation. The final project works of each group are evaluated, which includes self-assessment within the group, peer assessment between groups and grading by course instructor.

3) Dynamic Evaluation

Dynamic evaluation is adopted during pre-class and post-class, allowing students to learn relevant knowledge before class and take online self-assessments in advance, enabling instructor to be informed on students' learning progress in time.

After class, online platform is used to further improve students' problem-solving skills, creativity, and exploration abilities.

4) Value-added Evaluation

In project activities, both students and course instructor participate together. Through the analysis of qualitative and quantitative data from process and outcome evaluations, as well as online and in-class evaluations, students' performances are tracked. This allows instructor to gain real-time insights into students' development progress.

3.3 The Success of Practice

3.3.1 Achievement of two-dimensional Goals

- True Knowledge: Through the basic module and the review phase during the project module, students have truly mastered the fundamental knowledge of software testing.
- True Skills: Through the project module of course projectization, which integrates "job, course, and certification," students can truly acquire professional skills related to real jobs.

3.3.2 The Success of Practice

The "4A-5Steps" teaching model takes full advantage of course projectization by integrating course content with actual work projects. Through course projectization, students can be better trained to become professionals who are both knowledgeable in theory and skilled in practical thinking, with strong technical abilities that can be applied flexibly. This approach fully leverages the advantages of PBL, laying a solid foundation for students' future career development.

4. Conclusion

In this paper, we have deeply explored the theory and practice of the "4A-5Steps" teaching model in vocational college. Through empirical research on the course "Software Testing and Quality Assurance", we have found that the "4A-5Steps" teaching model can effectively enhance students' professional skills, innovative thinking, and teamwork abilities, while also strengthening their professional ethics and sense of responsibility.

We will continue to optimize the "4A-5Steps" teaching model, remain committed to the innovation and improvement of teaching models, adapt to new trends in education development, and meet the industry's demand for high-quality technical and skilled talents.

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