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Exploration and Practice of the Five-Step Four-Cycle Teaching Model

By

Gong Xiugang, Wang Pengfei, Dong Zhihui, Zhang Dongmei, Zhang Yanhua

Shandong University of Technology,

China

Abstract

To improve the instructional outcomes of practical courses, the Hohenstein educational goal taxonomy has been integrated into the curriculum of "Internet of Things Technology and Project Design" and similar hands-on subjects. The course's final evaluation is structured around the realization of a project or system. The content is restructured to encompass a variety of analytical mini-projects, simulation training mini-projects, testing projects, design-oriented experiments, and comprehensive systems. Each phase of implementation is designed to provide feedback to the preceding phase, thereby creating a five-step, four-cycle teaching model. Empirical evidence suggests that this model substantially enhances students' practical skills.

Keywords*: Hohenstein Educational Goal Taxonomy, Five-Step Four-Cycle, Skill Progression*

Introduction

Shandong University of Technology's Computer Science and Technology major is one of the first pilot majors of the national "Outstanding Engineer Training Program" and a national-level construction site for first-class undergraduate majors. To enhance students' practical abilities, a variety of measures have been implemented, including the application of the Hohenstein Educational Objective Classification to IT practice courses.

The Hohenstein Educational Objective System is an innovation and development of Bloom's Taxonomy of Educational Objectives. It categorizes educational goals into four main areas: cognition, affect, psychomotor skills, and behaviors, with each area further subdivided into five levels (Nianjin D, 2004).

As shown in Figure 1.

Field / Arrangement	Cognitive domain		Emotional field		Field of motor skills		Behavioral domain	
1.0	Conceptual ization	Recognition Definition Summary	Acceptance	Perceived Willing Attentive	Perception	Cognition Recognition Observation Intention	Acquisition	Acceptance Perception Conceptualization
2.0	Understand	Translation Explanation Judgment	Response	Default Compliance Valuation	Imitation	Activation Imitation Coordination	Assimilation	Acceptance Perception Conceptualization
3.0	Application	Clarify Answer	Value evaluation	Recognition Preference Confirmation	Integration	Integration Standardization	Adaptation	Value evaluation Application Integration
4.0	Evaluate	Analyze Describe	Belief	Believe Believe in	Creation	Maintain Debug	Implementation	Belief Evaluation Creation
5.0	Comprehen sive	Assumption Solution	Behavior	Display Change	Proficiency	Establishment Refinement	Achievement	Behavior Comprehensiveness Proficiency

Figure 1 Schematic Diagram of the Hohenstein Educational Objective Classification Framework.

From Figure 1, it is evident that the significance of the Hohenstein Educational Objective Classification lies in its provision of a more refined and comprehensive method for classifying educational goals (Lim Y, 2017). By selecting teaching methods that match the different domains/natures of courses at various levels/stages, it helps teachers to better understand and achieve teaching objectives (Hauenstein A D, 1998). That is; by subdividing educational goals into different domains and levels, teachers can more clearly know which aspects to focus on in classroom teaching, and how to achieve these goals through different teaching activities (Borazon E, 2023). Moreover, this classification system also emphasizes the transformation of intrinsic emotional qualities into external behaviours, promoting the development of qualities, which is of great importance for cultivating students' value qualities (Yaqin H, 2021); therefore, this classification system is more suitable for guiding classroom teaching.

From this perspective, Hohenstein's Educational Objective Classification not only transcends Bloom's system but also provides teachers with a more concrete and practical tool to help them plan and execute teaching plans more effectively, thereby promoting the comprehensive growth of students.

The Implementation Framework of the Five-Step, Four-Cycle Teaching Model

Firstly, select courses with strong practicality and set the assessment methods for these courses as the design of systems or projects. For example, choose "Internet of Things Technology and Project Design" as a pilot course, with the final assessment projects including smart fruit and vegetable traceability, smart irrigation, remote monitoring of guest room environments, and intelligent gatekeeping systems.

Next, select teachers with project experience or engineering backgrounds to reconstruct the course content, breaking it down into several sub-projects that encapsulate the course material in terms of both connotation and

extension. Projects are generally divided into five categories:

a. Analytical mini projects
b. Simulation training mini projects
c. Testing projects
d. Design-oriented experiments
e. Comprehensive systems

Finally, implement the teaching model as shown in Figure 2.

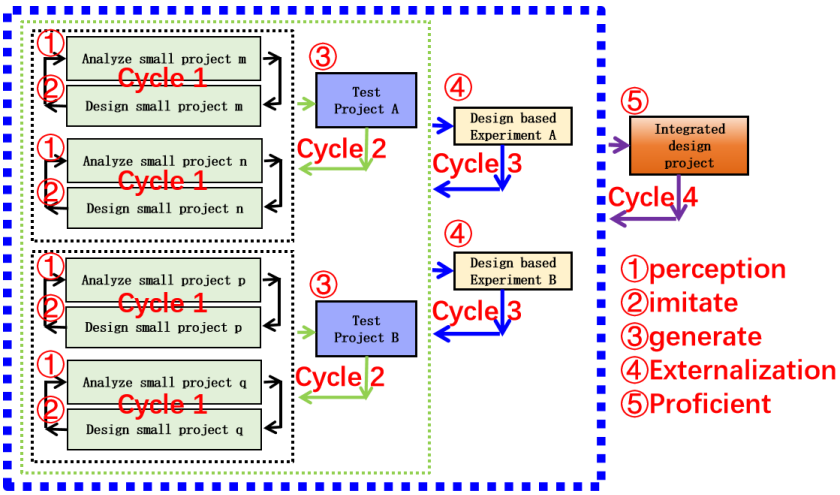


Figure 2 Implementation Process of the Five-Step, Four-Cycle Teaching Model

In the classroom, the process begins with an explanation of analytical projects, enabling students to understand the relevant technologies, referred to as perception. Following this, students engage in the design of similar mini projects, known as imitation. After gaining an understanding of several technologies, they proceed to design testing projects, allowing students to master the application of multiple technologies, termed as generation. After implementing several testing projects, students undertake design-oriented experiments to develop a certain level of comprehensive ability, referred to as externalization. Finally, the realization of a comprehensive system is carried out, which is called mastery.

The implementation process is divided into five steps, with each step forming a feedback loop with the previous one, creating four cycles.

Five-Step and Four-Cycle Teaching Model

Shandong University of Technology's "Internet of Things Technology and Project Design" is a pilot course for

assessment reform, which implemented process assessment in 2014 with the final assessment being the project design. Therefore, this course was chosen as a pilot course.

The course instructor, who has development experience in projects such as "Remote Monitoring and Automatic Statistical System for Medical Equipment Utilization," has designed the course projects based on their experience. The projects include 18 demonstration/analysis mini-projects, 18 simulation training mini-projects, 5 testing projects, 3 design-oriented experiments, and 1 comprehensive system. The specific project names are shown in Figure 3.

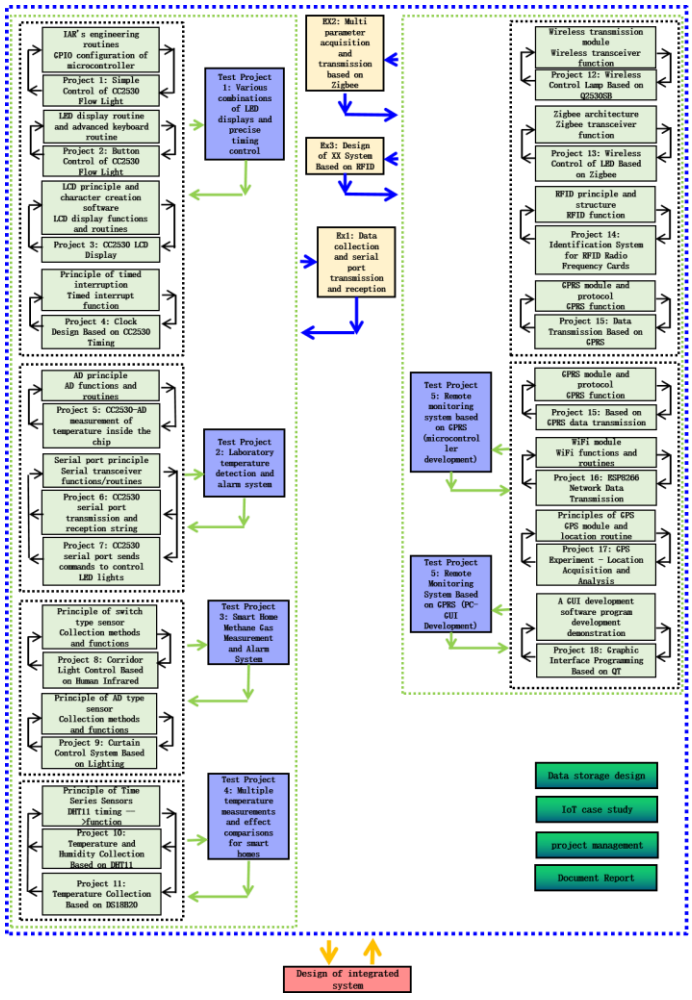


Figure 3 Schematic Diagram of the Implementation of the Five-Step and Four-Cycle Teaching Model in "Internet of Things Technology and Project Design".

In Figure 3, after the demonstration/analysis mini-project "IAR Engineering Example" is explained, students proceed with the training of "Project 1: Simple Control of CC2530 Running Lights"; following four mini-projects, they engage in "Testing Project 1: Laboratory Temperature Detection and Alarm System"; after

four testing projects, they advance to "Design Experiment 1: Data Acquisition and Serial Communication"; upon completion of three design experiments, students are able to master data collection, transmission, and processing, thereby being capable of designing an integrated system, achieving a progressive cultivation of abilities.

Results

After years of exploration, the main achievements are as follows:

1. The Computer Science major was honored with the "Professional Alignment with Industry Projects for the Transformation of Old and New Kinetic Energy in Education Services" in Shandong Province (2018) and the national "First-Class Undergraduate Major" construction project (2020); the Software Engineering major was also rated as the "First-Class Undergraduate Major" construction project in Shandong Province (2019).
2. The core members of the team participated in 21 provincial and ministerial-level teaching research projects, won the second prize of Shandong Province Teaching Achievement, and received 5 school-level teaching achievement awards.
3. In the past three years, students majoring in the Internet of Things direction have achieved excellent results in various academic competitions, winning more than 100 national-level awards each year. In the team programming competition of the China College Students' Computer Competition, they competed with 985 universities and ranked in the top ten for three consecutive years. The proportion of students participating in A-level events accounts for 60% of the total number of the school. In addition, students published 7 academic papers as the first author, obtained 2 utility model patents, and more than 30 provincial-level college student innovation and entrepreneurship training project initiations.

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