

# A Study on the Pathway of Empowering Computational Thinking Cultivation through Performance Assessment from the Perspective of Micro-Project Learning

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**Abstract:** The Compulsory Education Information Technology Curriculum Standards (2022 Edition) incorporates computational thinking into the four core competencies of the information technology discipline. How teachers can rely on a scientific evaluation system to promote the progressive development of junior high school students' computational thinking has become a core issue that must be addressed in the current reform of junior high school information technology teaching. In response to the practical challenges prevalent in current computational thinking evaluation—such as emphasizing results over processes, the difficulty of quantifying implicit thinking qualities, and the disconnect between teaching and evaluation—this paper attempts to propose an implementation pathway for performance assessment using micro-project learning as a carrier. By clarifying the inherent alignment logic between micro-project performance assessment and the development of computational thinking, it puts forward implementation strategies for micro-project performance assessment aimed at fostering junior high school students' computational thinking. The goal is to offer a practical pathway for implementing core competency educational goals in the junior high school information technology discipline.

**Keywords:** Micro-project Learning; Performance Assessment; Junior High School Information Technology; Computational Thinking

## 1. Problem Statement: Realistic Dilemmas and Breakthrough Pathways in Computational Thinking Evaluation

Computational thinking is a core component of the core competencies in the information technology discipline during compulsory education. The "Compulsory Education Information Technology Curriculum Standards (2022 Edition)" (hereinafter referred to as the "Curriculum Standards") describes computational thinking as the individual's application of ideological methods from the field of computer science, involving thinking activities such as abstraction, decomposition, modeling, and algorithmic design in the process of problem-solving <sup>[1]</sup>. This thinking activity not only enhances students' interest in learning information technology and promotes curriculum reform but also drives the transformation of student information literacy connotations in an intelligent society <sup>[2]</sup>. Therefore, scientifically evaluating its development level is a key link to promoting the advancement of students' computational thinking literacy and implementing the goals of promoting teaching and learning through evaluation. The "teaching-learning-evaluation" consistency advocated by the "Curriculum Standards" <sup>[3]</sup> inherently requires that the evaluation of computational thinking resonate with teaching in terms of content and run through the entire learning process in terms of timing.

However, examining the current practical landscape of computational thinking evaluation reveals a significant gap from the ideal state described above: In terms of content dimension, existing evaluations mostly focus on algorithms and programming, paying insufficient attention to computational thinking performance in areas such as information processing, networking, and artificial intelligence, which are explicitly mentioned in the curriculum standards <sup>[4]</sup>. From the perspective of the evaluation system structure, existing computational thinking evaluations often remain at a macro level <sup>[5]</sup>, far from forming a progressive system architecture of "classroom evaluation—assignment evaluation—unit evaluation—end-of-term evaluation—stage evaluation" <sup>[3]</sup>. These dual dilemmas make it difficult to implement whole-process monitoring of students' computational thinking development during teaching, thereby

hindering the pursuit of value in "promoting teaching through evaluation" and "promoting learning through evaluation."

Based on the above, performance assessment, characterized by authenticity, process-orientation, and developmental nature, can serve as a new approach and direction to address these dilemmas. Performance assessment relies on authentic or highly simulated task contexts, enabling teachers to intuitively observe students' implicit thinking processes through explicit behavioral manifestations. Simultaneously, it helps document the process of students' competency development. Compared with standard examinations, performance assessment features tasks with greater authenticity, more diverse pathways for problem-solving, a more intuitive student learning process, and greater student autonomy in task completion [6]. This paper further proposes that teachers can deeply integrate micro-project learning with performance assessment. By utilizing more specific and refined micro-project tasks, performance assessment can be further concretized within each micro-project task, achieving documentation and guidance of students' computational thinking development.

## **2. Micro-Project Performance Assessment: Internal Logic and Practical Pathways for Promoting Computational Thinking Development**

Micro-project teaching is a teaching model evolved from project-based teaching [7]. Therefore, it aligns with the basic requirements of project-based learning, referring to the design of curriculum content into small, refined micro-projects for learning. It simplifies the project-based learning process, offering advantages such as being concise, having refined activities, and being efficient for learning [6], thereby injecting new vitality into information technology classrooms. Micro-project teaching not only lowers the implementation threshold of project-based learning in classrooms but also possesses a natural high degree of coupling with performance assessment. Theoretically, both target problem-solving in authentic contexts and emphasize the demonstration and development of students' intrinsic core competencies through practical application processes. Therefore, embedding performance assessment throughout the core logic of micro-project learning involves adopting a "backward design" philosophy of "beginning with the end in mind" to construct a closed-loop implementation pathway that progresses from setting computational thinking competency goals and gathering learning evidence to deepening learning activities.

The primary condition for implementing this practical pathway is that teachers need to reconstruct the curriculum content. First, teachers must follow the Curriculum Standards as the fundamental guideline, use the internal logic of textbook content and students' cognitive development as starting points, summarize unit learning goals centered on the core elements of computational thinking, and decompose the unit's teaching content into multiple interconnected, progressively advancing "micro-project clusters." This ensures each micro-project corresponds to a clear computational thinking cultivation objective, forming a complete learning unit and thereby building a stepped scaffold for students' cognitive advancement. Second, through backward design, teachers clarify observable evidence of learning—that is, to determine which specific student behaviors need to be observed to demonstrate achievement of the preset learning goals, and how to standardize the description and evaluation of these performances.

Consequently, this requires teachers to pre-design performance tasks that can externalize students' implicit thinking processes, along with matching evaluation rubrics, before teaching activities commence. Finally, teachers must integrate the evaluation process throughout the entire micro-project learning journey, ensuring that evaluation is not merely a summative step at the end of learning but a core component driving the learning process and optimizing learning outcomes. Through this process, as students complete micro-project tasks, their core computational thinking activities—such as problem decomposition, algorithm design, and model construction—are manifested, thereby transforming into observable, documentable, and assessable explicit "performances."

## **3. Three-Dimensional Synergy: Strategies for Cultivating Computational Thinking within Micro-Project Performance Assessment**

Computational thinking is rooted in the core competencies of information technology, manifesting as higher-order behavioral abilities and thinking qualities in information technology learning activities [8]. To effectively integrate performance assessment in micro-project learning and promote the deep development of students' computational thinking, teachers can implement an operational strategy termed "one core, dual threads, three-dimensional synergy." By analyzing the elements of computational

thinking, teachers identify a learning theme that aligns with students' digital life experiences. On one hand, starting from solving real-life problems, students experience the complete project development process. On the other hand, starting from designing relevant activities, students experience the process of using computers to solve problems. Through student self-assessment, peer assessment, and teacher-assisted assessment, the focus is on performance assessment for cultivating computational thinking<sup>[9]</sup>. The following uses the "Smart Voice-Activated Lamp" micro-project cluster from Unit 2, Introduction to Control and Feedback in the Internet of Things, in the Sichuan Education Edition for eighth grade as an example.

### ***3.1. Anchoring in Life Situations, Establishing the "Core" Theme***

Teachers need to keenly identify authentic problems in life. These problems should stimulate students' curiosity, drive their thinking development, and be closely connected to their digital life experiences, ultimately transforming them into challenging micro-project themes. In the information age, the Internet of Things (IoT) has gradually permeated daily life and education, opening new pathways for interdisciplinary teaching and deep learning<sup>[10]</sup>. This is fully demonstrated in specific textbooks. Taking the "Smart Voice-Activated Lamp" micro-project cluster as an example, with the core task of "designing a voice-controlled smart lamp for a dormitory," teachers can guide students to think like software engineers, experiencing the complete computational thinking process of "analyzing problems — abstracting modeling — designing algorithms — verifying and optimizing."

### ***3.2. Advancing in Parallel on Two Fronts, Constructing the "Pathways" for Thinking***

Building upon the core theme identified above, two mutually supportive and deeply integrated threads are advanced simultaneously in authentic teaching practice.

#### ***3.2.1. The "Problem-Solving Thread": Centered on solving authentic life problems, experiencing the complete micro-project learning process***

Teachers should start from students' authentic life needs, deconstructing a large project task into multiple interlocking micro-projects. Throughout the process of completing specific micro-project tasks, students can experience the complete learning and inquiry process. Taking the "Smart Voice-Activated Lamp" micro-project as an example, students first complete Micro-project 1: "Functional Requirements Analysis of the Smart Voice-Activated Lamp." Through group collaboration, they discuss and outline a list of functions—identifying the specific needs the smart voice-activated lamp should fulfill—and draw corresponding functional module diagrams. Subsequently, in Micro-project 2: "Control Flow Design of the Smart Voice-Activated Lamp," they concretize the full logic of voice control using standardized flowcharts. Finally, in Micro-project 3: "Demonstration and Optimization of the Design Proposal," students identify core issues in their proposals through group peer review mechanisms, with teachers providing targeted improvement suggestions.

Throughout this process, the three micro-projects progressively enhance students' problem-solving abilities. Students, taking on the role of product developers, undergo the complete practical process of "requirements analysis — algorithm design — solution evaluation."

#### ***3.2.2. The "Thinking Development Thread": Using stepped micro-project design as a carrier, experiencing computational thinking in problem-solving***

In this process, teachers need to meticulously design stepped learning activities that align with the problem-solving thread, guiding students to gradually internalize their explicit practical behaviors into stable computational thinking patterns. First, in Micro-project 1, students engage in activities such as "identifying core needs — abstracting core problems — decomposing system functions," focusing on cultivating core computational thinking abilities like abstraction and decomposition. Next, in Micro-project 2, through practical steps like "constructing system models — designing execution algorithms — describing operational procedures," students transform vague design ideas into standardized, executable process plans. Finally, in Micro-project 3, through output activities such as "reflecting on plan deficiencies — optimizing system design — articulating design logic," students gradually refine their design proposals. Using teacher-provided evaluation rubrics and reflection sheets, they contemplate which aspects of their thinking abilities are weak. Throughout this journey, students achieve deep thinking through practical application, realizing competency advancement through reflection. The core cultivation of computational thinking is progressively nurtured and deepened through repeated micro-project practices.

### ***3.3. Three-Dimensional Synergistic Evaluation, Empowering the "Wings" of Growth***

Evaluation is the key lever for promoting thinking development. Through the synergy of the three dimensions of "self-assessment — peer assessment — teacher assessment," a powerful combined force is formed to drive the development of students' computational thinking.

#### ***3.3.1. Self-Assessment as the Main Axis, Driving Introspection and Construction of Thinking***

Teachers can provide clear performance rubrics, such as a computational thinking ability performance scale, at the outset of the project. Teachers extract the computational thinking elements embedded in performance tasks and guide students to attempt self-evaluation against the ability performance scale based on their specific performance during the task process. This allows students to engage in learning with goals in mind, implementing effective self-evaluation. As the project progresses, students can continuously self-diagnose against the rubric elements, reflecting on their performance in areas such as problem-solving orientation, collaborative learning attitude, and abilities like abstraction, decomposition, and algorithms, making improvements accordingly.

#### ***3.3.2. Peer Assessment as a Platform, Promoting Collision and Expansion of Thinking***

Peer assessment is an important vehicle for broadening students' perspectives and inspiring design ideas through mutual evaluation among peers. During the implementation of the "Smart Voice-Activated Lamp" micro-project, teachers can utilize interactive models like "one student presents, one student tours." This requires students not only to articulate their own design proposals and logic clearly and completely but also to engage in multi-faceted comparisons, analyses, and critical reflection on their own work while examining peers' work. Through diverse interactive forms such as sticker voting, proposal presentations, and on-site Q&A, students' implicit thinking processes are externalized through communication.

#### ***3.3.3. Teacher Assessment as Guidance: Facilitating the Deep Sublimation of Computational Thinking***

In the process of micro-project performance assessment, the teacher's core role is as a guide for student learning, rather than a mere judge of student work. Teachers need to observe students' micro-project learning processes closely and provide appropriate guidance based on multiple core dimensions of computational thinking-oriented performance assessment, including students' thinking perspectives, problem-solving, and group collaboration. When students encounter thinking difficulties or deviate from the right track, the teacher's timely intervention and directional guidance can greatly assist students in progressively breaking through thinking limitations and obstacles, gradually constructing a clearer knowledge framework and thinking pathway for the entire unit. More importantly, teachers need to guide students to transfer and apply core methods, such as problem analysis and algorithm design, learned in micro-projects to solve similar problems in daily life, ultimately achieving a core leap in students' computational thinking from "knowledge acquisition" to "practical application."

## **4. Conclusions**

Guided by the "one core, dual threads, three-dimensional synergy" teaching strategy, teachers lead students through computational thinking activities encompassing "requirements analysis — algorithm design — solution evaluation." This helps students progressively enhance core computational thinking abilities, including abstraction, decomposition, modeling, algorithm design, and solution evaluation. Simultaneously, during collaborative learning with group members, students exhibit positive changes in learning confidence and willingness to express themselves verbally. This demonstrates the positive guiding effect of the micro-project performance assessment method on students' learning attitudes and thinking development. Teachers also undergo a role transformation during the teaching practice, shifting from being mere judges of outcomes in traditional teaching to becoming holistic observers, thinking guides, and competency facilitators throughout the student learning process. Their instructional design capabilities and evaluation skills are concurrently enhanced, effectively promoting the implementation of the integrated "teaching-learning-evaluation" concept in the classroom.

In summary, combining micro-project learning with performance assessment not only constitutes an effective implementation pathway for promoting the development of junior high school students' computational thinking but also serves as a crucial lever for achieving core competency educational goals. Further research in this area could explore the application of this model across diverse learning themes and student groups at different educational stages, as well as investigate the integration of more

universally applicable and operable evaluation tools, providing more specific practical references for cultivating computational thinking among students in the basic education stage.

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### References

- [1] Ren Youqun, Huang Ronghuai, Xiong Zhang. *From Information Technology to Information Science and Technology: A Dialogue on the "Compulsory Education Information Technology Curriculum Standards (2022 Edition)"* [J]. *Curriculum, Teaching Material and Method*, 2022, 42(12): 21-31.
- [2] Yu Yanfang, Li Yi. *Research on the Construction and Application of Project-Based Teaching Curriculum Based on Computational Thinking: Taking the High School Information Technology Course "Introduction to Artificial Intelligence" as an Example* [J]. *Journal of Distance Education*, 2020, 38(01): 95-103.
- [3] Ministry of Education of the People's Republic of China. *Information Technology Curriculum Standards for Compulsory Education (2022 Edition)* [S]. Beijing: Beijing Normal University Press, 2022.
- [4] Li Feng, Cheng Liang, Gu Xiaoqing. *Content Construction and Method Design for Academic Evaluation of Computational Thinking: From the Perspective of Comparative Literature Review* [J]. *Distance Education in China*, 2022, (02): 65-75+77.
- [5] Feng Youmei, Wang Shan, Wang Xinyi, et al. *Designing a Computational Thinking Description Framework to Support the Construction of China's Information Technology Curriculum Evaluation System* [J]. *e-Education Research*, 2022, 43(06): 115-121.
- [6] Jin Leihong. *Performance Assessment in Lower Grade Science Based on Micro-Project Learning* [J]. *Primary School Teaching Monthly (Comprehensive Edition)*, 2024, (Z2): 50-53.
- [7] Meng Fankun. *Practical Exploration of Micro-Project Learning in Junior High School Physics: Taking the Micro-Project "Making a Sundial" as an Example* [J]. *Basic Education Forum*, 2023, (23): 78-80.
- [8] Zhou Chun. *Promoting the Development of Junior High School Students' Computational Thinking through Unit Performance Assessment* [J]. *China Information Technology Education*, 2023, (01): 34-38.
- [9] Wu Chengzhu. *Practical Research on Performance Assessment in Information Technology Based on Computational Thinking* [J]. *Teaching Reference for Primary Education*, 2025, (03): 86-88.
- [10] Xiang Li. *Practice of Problem-Inquiry Teaching in Smart Classroom Environments: Taking the Comprehensive Practical Activity Course "The Internet of Things and Our Life" as an Example* [J]. *Educational Information Technology*, 2020, (Z2): 48-50.