

Retraction

Retracted: A Study on the Optimization Mechanism of the Civic OBE Concept for a Computational Thinking-Oriented Basic Programming Course

Mathematical Problems in Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their

agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] H. Xiong and M. Talha, "A Study on the Optimization Mechanism of the Civic OBE Concept for a Computational Thinking-Oriented Basic Programming Course," *Mathematical Problems in Engineering*, vol. 2022, Article ID 6983942, 12 pages, 2022.

Research Article

A Study on the Optimization Mechanism of the Civic OBE Concept for a Computational Thinking-Oriented Basic Programming Course

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This paper conducts an in-depth study and analysis of the optimization mechanism of the Civic OBE concept through the basic programming course of computational thinking. The connotation, implementation principles, and key points of the OBE concept are thoroughly studied and analyzed, and the new requirements of knowledge, ability, and quality of applied talents are specifically analyzed with the characteristics of applied talents in local undergraduate institutions and demand-oriented; the “top-down” idea is fully considered, and the top-down design is based on the middle school IT learning objectives. The reverse design focuses on the cultivation of skills and emotional goals, satisfies students’ individual needs, and enhances students’ ability to analyze and solve problems, and, second, to adapt to the rapid information society, the development of online open platforms, the use of information technology, the integration of modern learning resources, changing the traditional classroom teaching, and stimulating students’ learning enthusiasm and autonomy, to truly achieve efficient classroom. Based on this, this study tries to provide some new ideas and contribute some strengths to the design and practice research of information technology education in junior high school. In the process of effect analysis, data analysis was conducted on the achievement of the competency index points and related achievements of the research subjects. Oral interviews were also conducted with the teachers and students who participated in the experiment to explore the effectiveness of the project-based learning teaching model based on the OBE concept and to summarize the shortcomings of the model in teaching.

1. Introduction

Information technology is rapidly leading humankind from an industrial society to an information society, and the “digital natives” of the new era are growing up in an information technology environment. The cultivation of information technology disciplines is shifting the focus to computational thinking and data awareness. As digital citizens, they grow up in the information technology environment. They are exposed to all kinds of mobile devices and digital tools, but most of them only stay at the basic operation level of the tools. They do not perceive the methods and processes of data collection and processing inherent in computers [1]. The 21st century, as a digital era, has new

requirements for digital citizens’ computational thinking ability, which does not mean being able to use various digital tools flexibly, but the ability to solve problems and transfer knowledge, thinking education, from problem identification to problem-solving, and then transferring to other similar problems in everyday life [2]. The origins of computational thinking are algorithmic and procedural thinking, but to this day, computational thinking is still identified with the use of computer technology, and there is a misconception about computational thinking that using computer technology is developing computational thinking.

The field of information technology is ever-changing and full of novelty and challenge. For IT subjects, the subject content and structure are not static. Teachers are always

ready to teach students' knowledge and skills that they are unfamiliar with or even have never been exposed to before, which is both an opportunity and a challenge for IT teachers. With the emphasis and importance of a series of policy documents, the status of IT curriculum implementation has been greatly improved [3]. At present, most provinces, cities, or regions offer IT as a stand-alone course in the third grade of primary school, along with many other creative classrooms, etc. However, teachers are afraid of teaching new content initially, believing that they do not know the knowledge points, do not know how to teach them, lack teaching experience, are afraid of not teaching well, etc. For teachers of other subjects, the structure of subject knowledge is already clearer, and teachers think more about having questions about teaching methods and teaching tools during lesson preparation [4]. Currently, teachers understand the significance and role of interdisciplinary as well as knowledge integration, but integrating knowledge and ways of thinking into the existing classroom, teachers need to have enough preparation and full confidence in themselves to get the teaching done. The study is conducive to advancing the discipline of ideological and political education [5]. The teaching mode plays a pivotal role in education and teaching, and the proper use of the method is directly related to the achievement of the teaching effect. The reasonable use of the teaching mode will produce twice the effect with half the effort on teaching. The opposite will be very ineffective and difficult to achieve the desired effect. To make students internalize the textual knowledge they learn and correctly deal with the relationship between internalization and externalization. The teacher must use the teaching mode skillfully, reasonably, and effectively. The party and the state also attach great importance to and repeatedly issued documents, requiring the Civics class to develop the times to explore new teaching models and constantly improve the level of teaching. The teaching of the Civics class "content is king" is the eternal theme; the teaching mode is always to serve the teaching content. We cannot leave the teaching content to talk about teaching mode; otherwise, it is like a rootless wood, no source of water, losing the original meaning and value.

The influence of ideological and political theory courses in colleges and universities on the ideological and behavioral of college students is far-reaching and lasting, and the proper use of ideological and political theory course teaching mode is directly related to the teaching effect of ideological and political science courses. It is of great theoretical significance and value to introduce new ideas and to improve and innovate the existing teaching mode [6]. On the one hand, OBE as an educational concept is introduced and applied in the context of adapting to the new development of the times and educational needs, and the combination of the new concept and the college Civics class is bound to collide with new theoretical sparks, which is of great significance for improving the teaching mode system of ideological and political theory class, promoting the theoretical innovation of the teaching mode of Civics class, developing the research field of Civics class teaching mode, and enriching the theoretical research results. The new era, new background, and

new vision have put forward a series of new requirements for the ideological and political theory course in colleges and universities, prompting the teaching mode of Civics and Political Science course to make reforms and innovations. We pay close attention to and closely combine the current research frontiers of teaching mode of Civics and Political Science class, take the dilemma, opportunities, and challenges faced by the current teaching model of Civics and Political Science class in colleges and universities as the starting point, deeply analyze the fit between OBE concept and teaching mode of Civics and Political Science class in colleges and universities, put theoretical thinking and path exploration into the current background of the reform of teaching mode of Civics and Political Science class in colleges and universities, and further expand the research of teaching mode of Civics and Political Science class in colleges and universities. Theoretical thinking and path exploration will be put into the background of the current reform of the teaching mode of college Civics class and, further, expand the research on the teaching mode of college Civics class. The integration of the OBE concept with the teaching mode of college ideological and political theory class is conducive to reforming and innovating the existing teaching mode of Civics and Political Science class, bringing into play the synergistic effect of various teaching factors and improving the effectiveness of Civics and Political Science class; it is also conducive to helping college students grow and become successful and laying a solid foundation of moral quality for them to realize their personal and social values.

2. Current Status of Research

Some scholars have pointed out that as an educational concept, OBE has made great development since its establishment, and the research on OBE concept has gone through a logical process from shallow to deep, from theoretical elaboration to practical application, from macroscopic grasp to microscopic expansion, and from foreign emergence to domestic exploration, the research perspective has been gradually broadened, and the research tends to be more extensive and profound [7]. The concept can be combined with the practical to play its role in guiding the actual teaching [8]. In China, scholars are more likely to combine the OBE concept with related courses and discuss it. The teaching model based on the OBE concept is firstly applied to higher engineering education accreditation in universities, and scholars point out that in higher engineering education accreditation, three changes should be made, namely, from subject-oriented to goal-oriented, from teacher-centered to student-centered, and from quality monitoring to continuous improvement [9]. The roots of the concept of "computational thinking" are thought to be in the form of "algorithmic thinking", which refers specifically to the use of an orderly and precise sequence of steps to solve a problem and, where appropriate, the use of a computer to automate this process [10]. As computational thinking continues to evolve and gain importance, it has led to a wave of research on computational thinking and is currently one

of the most influential scholars on the definition of computational thinking [11]. The term “computational thinking” is used to express that it is not just for computer science professionals and computer scientists who can benefit from thinking, but that it is a way of thinking for everyone in the world. The definition of computational thinking was added: computational thinking is a process of thinking from problem formulation to problem-solving that can be expressed in a way that can be effectively executed by information processing agents [12].

The conceptual framework of computational thinking is the decomposition of the structure of computational thinking, a hierarchical overview, and reorganization of computational thinking from different dimensions, which can help people further understand and apply computational thinking from the side; it contains the dimensions and components of computational thinking and the interrelationship between each dimension or element [13]. The definition of computational thinking can be considered a matter of opinion, and the understanding of the connotation of computational thinking varies. This has led to vibrant research on computational thinking but at the same time has added many difficulties to the pedagogical application of computational thinking [14]. Therefore, the definition of computational thinking needs to be unified, and the study of the nature of computational thinking needs to be further explored, which is the objective need for its theoretical development and the practical need for teaching practice [15]. At present, the research on the evaluation and measurement of computational thinking is still in the exploration stage, and there are relatively few relevant studies. Many scholars have explored computational thinking assessment based on computational thinking framework and elements and other basic theories and have obtained certain results and progress. However, due to the late development of computational thinking, the implicit nature and complexity of computational thinking, and the lack of unified and effective assessment standards and systems at home and abroad, the evaluation and measurement of computational thinking still need further research and development [16]. The study extrapolates the implicit cognitive level and computational thinking during programming based on the behavioral representation perspective of programming, broadening the evidence base for curriculum-based programming education and providing an experience for programming educators to better conduct educational practices; students can use visual programming as an effective vehicle to make full use of time in and out of class to exercise and internalize higher-order thinking and computational thinking skills; in addition, strategic recommendations are made for the development [17]. In addition, the strategic recommendations provide actionable guidance for curriculum design that fosters higher-order and computational thinking, and teachers can use the results to redesign practical programming tasks that fit students’ thinking development, emphasize obscure or confusing concepts, design more targeted feedback and improvement measures, focus on a broader range of computational thinking skills, and focus on the formation of students’

higher-order thinking qualities rather than just the acquisition of specific programming language skills.

By combining the literature related to this topic, we can find that many scholars have studied the concept of “computational thinking” from different angles and put forward their own opinions and definitions, but these definitions are relatively abstract and not yet unified, which affects the research on computational thinking evaluation indicators and scales. In addition, the application of computational thinking is being researched at home and abroad, and understanding the current level of students’ computational thinking is a prerequisite and foundation for the implementation of computational thinking. Therefore, investigating the current level of students’ computational thinking is the current research trend. The study of the nature of “computational thinking” and the refinement of the computational thinking scale are the necessary actions of this research trend. In this paper, we focus on the operation and interaction of students’ programming activities with the Scratch visual programming tool, analyze students’ problem-solving, error correction, and reuse processes, externalize students’ implicit cognitive level and computational thinking, and observe students. We also observe students’ application of each programming block, analyze students’ problem-solving style, assess students’ cognitive level and computational thinking performance, explore the relationship between cognitive level and computational thinking, and help optimize programming course teaching, teaching decision, and computational thinking cultivation.

3. Analysis of the Mechanism for Optimizing the Civic OBE Concept for a Computational Thinking Basic Programming Course

3.1. Programming Fundamentals for Computational Thinking Course Platform Design. The cultivation goals of creative computational thinking include the dimensions of computational goals oriented to code and algorithms, design goals oriented to system processes, and creative goals oriented to thinking and imagination. Based on this, this study argues that creative computational thinking is an organic unity of computational thinking, design thinking, and creative thinking, and the three interpenetrate together to achieve the sublimation of creative computational thinking. Among them, computational thinking is learners’ awareness and behavior of logical planning of the whole picture, which is the foundation of creative computational thinking; design thinking focuses on learners’ analysis of the needs of the real environment, which is the concept of creative computational thinking; creative thinking refers to students’ imagination space and innovation consciousness, which is the core of creative computational thinking.

The development of creative thinking is the target element, and computational thinking and design thinking are the paths and methods to achieve it [18]. Creative thinking is a way of thinking that comes from entities but is above them, “creativity” is often above reality, but its goal is to recreate the characteristics of concrete things. Computational

thinking is an important foundation to support creative thinking. As a form of thinking that promotes universal participation, the wisdom and inspiration contained in computational thinking is itself a crystallization of creative thinking, which emphasizes the planning of tasks, promotes logical and planned learning and thinking, and is a very important reference for people to solve problems regularly. Design thinking is an effective way to achieve creative thinking development and a way to promote deeper thinking in learners. Design thinking focuses on needs analysis at the front end of a task and aims to achieve optimal learning through purposeful iteration, as shown in Figure 1.

Computational practice refers to the development process where learners combine theory and practice, such as debugging projects and remixing the work of others. The computational practice focuses on the process of thinking and learning by the learner, a thought-building process where the learner is internally clear about what they are learning and how they are learning it. Certain regularities exist when learners create programming projects, forming their strategies for computational practices, which are an expression of the externalization of computational thinking. Computational conceptions refer to the views that learners form about the world around them or themselves [19]. Learners' computational conceptions can be presented in the form of self-descriptions of their understanding of project work, relationships with other learners, etc., but are only part of the picture; more personal conceptions are difficult to measure and capture, and ways of adding the dimension of the bystander's perspective can be tried to describe changes in learners' awareness and behavior.

Clarifying the learning objectives is the first stage, which is extremely crucial and is the characteristic of the OBE teaching model. The objectives should be designed to reflect the orientation of the OBE model and follow the "principle of flexibility" so that students will not be obsessed with formality but only provide the right direction, not the shackles of confinement, and not make learning a mechanical production line. The overall goal should be set as a basic standard that students can achieve, not an absolute super-high standard, so that students can actively explore and have more room to play and not be too detailed when setting specific goals, focusing on independent operation, leaving room for students to develop freely and generate their own creative goals. Only with clear learning objectives and a good grasp of the relationship between predetermination and generation can we better carry out the next teaching. The specific objectives are guided by the overall objectives, and the IT curriculum is divided into modules to make them concrete and operational. Because the content of the junior high school information technology course has theoretical basic knowledge and online operation knowledge, the specific learning objectives are divided into theoretical knowledge objectives and operational knowledge objectives, where the theoretical module includes information and network fundamentals, operation, and multimedia fundamentals. The operation module includes Word, PPT, Excel, Flash, basic multimedia, and robotics operation. Each section is designed based on the core competencies and

literacies that students should acquire and is presented in the form of a mind map to facilitate students' understanding. After clarifying students' learning outcome expectations, the second stage of learning activities is to achieve these learning outcome expectations, it is necessary to adopt some learning methods and measures, to highlight the collaborative and challenging features of the OBE teaching model, to emphasize students' cooperative learning, to make progress together, to set challenging tasks, and to cultivate students' higher-order competency development.

Independent inquiry strategy refers to the strategy applied when students watch the video before class; students should learn self-regulation and independent inquiry; first of all, they watch the video to have self-control and learn to write down the problems they cannot see or will not and watch back and forth to study the problem and independent inquiry; no longer all rely on the teacher to explain the demonstration; the teacher has become an auxiliary guide; students become more and more active and become the master of learning. Cooperative inquiry strategy is applied in class when students cooperate to investigate and solve problems, requiring students to focus on interpersonal communication skills; communication is an important part of the cooperation; mastering communication skills is very important; in addition, to pay attention to the relationship between the division of labor and cooperation, division of labor is for better cooperation, students in the completion of their part, to cooperate with group members to solve problems together and develop cooperation skills, as shown in Figure 2.

Factor analysis was conducted to determine the validity of teachers' computational thinking teaching efficacy scales through the four predefined dimensions of teaching efficacy. Feedback is an important tool to improve the teaching design and effectiveness of teaching. Simply teaching online makes teachers lack immediate feedback on students' learning, and it is difficult to make teaching fully reflect students' realistic needs. In addition, how to test the teaching effect of the flipped classroom, how to guarantee the interaction between teachers and students, how to grasp the actual degree of the flipped classroom, and how to ensure students' independent learning outside of class are all problems that need to be studied and solved in this teaching model. Whether these problems can be appropriately grasped and solved is directly related to the actual teaching effect of the Civics class.

3.2. *Thinking OBE Concept Optimizes Mechanism Design.*

This study is based on the analysis of the current situation of project-based learning and OBE concept, the implementation principles of focusing on results, expanding opportunities, raising expectations and reverse design, and the model construction based on Acharya's OBE education model and project-based implementation process, with the idea of "results-oriented, achieving the desired goal as the goal", and finally designing a project-based learning teaching model based on OBE concept [20]. The model includes four parts: clarifying the outcome goals, carrying out teaching

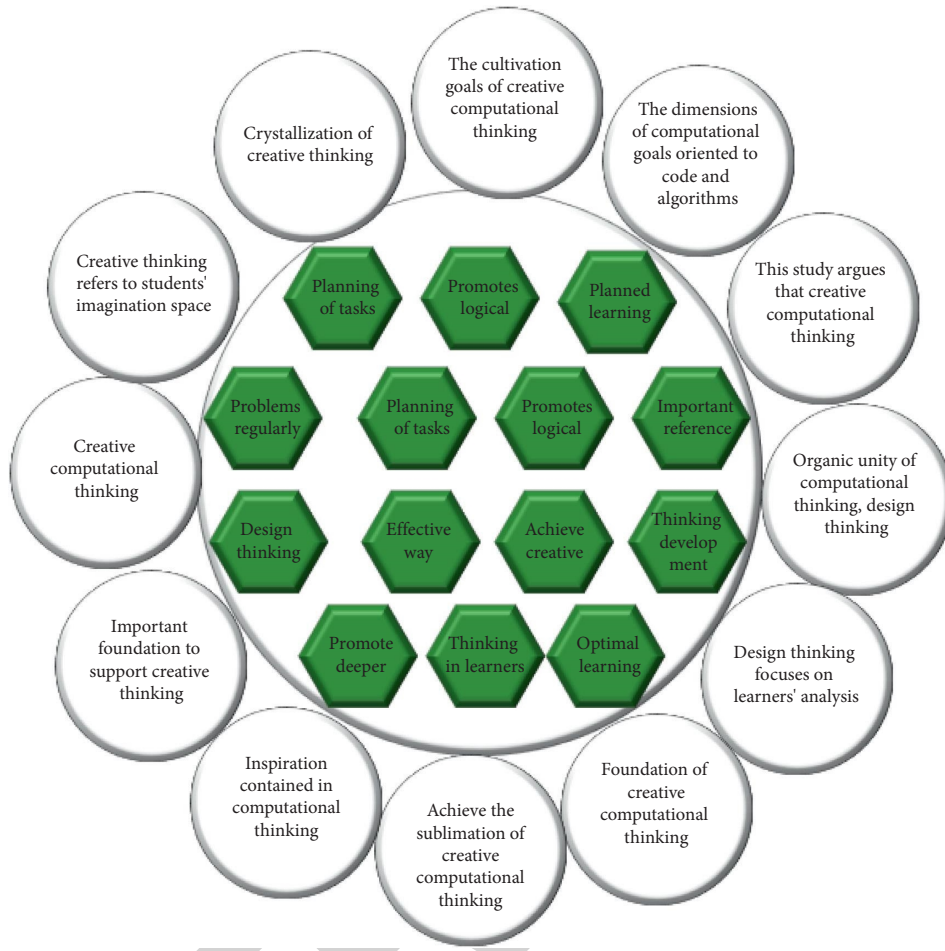


FIGURE 1: The architecture of creative computational thinking.

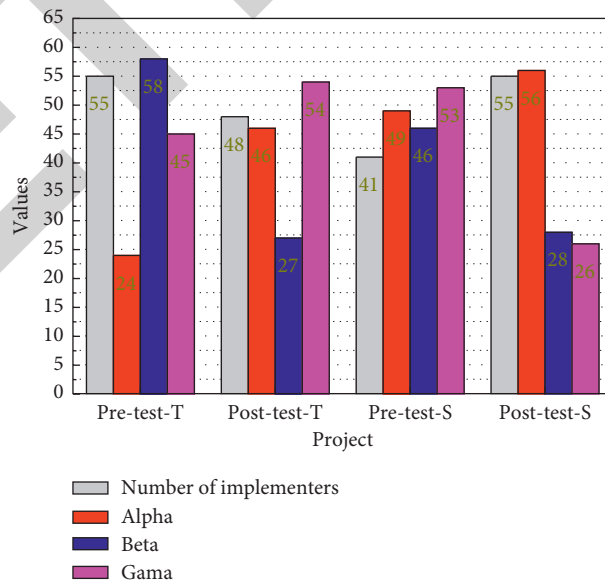


FIGURE 2: Reliability of the scales.

activities, evaluating the learning outcomes, applying the learning outcomes, and elaborating the content of each part. The design of the student-centered, learning results-oriented, project completion-oriented, and comprehensive ability-cultivating-based teaching model is expected to provide new ideas for the current teaching reform, as shown in Figure 3.

Defining learning outputs is the formation support for realizing graduation requirements, and it is also the key link to reflect the core idea of the OBE teaching concept, which is implemented in specific courses to clarify the outcome objectives. From the perspective of coordinating current demand with social demand, matching industry demand with talent training, and combining school orientation with professional characteristics, the training objectives and graduation requirements of contemporary college graduates are clarified. The cultivation objectives and graduation requirements determine what kind of people to cultivate, and their main role is the link between society and the classroom. Graduation requirements are then directed to the outcome goals of each course, which are then subdivided into indicator points of the competency's students should possess, forming a matrix with the projects in the course, and reverse-designing the teaching content to ensure that students can obtain the expected learning outcomes upon completion of their studies. The reframing of content requires the selection of instructional resources as well as the design of the instructional environment around the intended learning outcomes.

Social demand refers to the expectation of social development for the development of certain professional skills, literacy abilities, and moral quality trends. Cultivating high-quality talents needs to start from the society, investigate the requirements of the society for talents in relevant industries, and understand the current employment situation and popular occupations [21]. This can be done by searching the Internet, consulting with graduates or relevant enterprise departments, etc. to understand the relevant situation and provide a reference for setting the outcome objectives of subsequent courses. Learning outcome objectives refer to the specific and valuable results that students need to achieve through learning in the teaching process. Firstly, the development situation of each industry is clear from the development of society, and colleges and universities need to adjust their personnel training plans and training objectives following the current needs of the industry, then set the graduation requirements for students, and finally determine the outcome goals of specific courses according to the graduation requirements again. In this study, the outcome objectives are divided into three dimensions: knowledge objectives, ability objectives, and literacy objectives. According to the current requirements of talent training quality, in addition to grasping the learning of students' knowledge and skills, the teaching should also expect students' comprehensive ability to be cultivated.

The ability to develop is a generic ability acquired through learning and practice based on professional ability, an ability that can fulfill the needs of any occupational position and is capable of adaptation and migration,

covering the ability to learn independently lifelong learning, and international exchange. The ability of independent learning is the ability of students to learn based on their consciousness and initiative and their existing knowledge, ability, and quality. Lifelong learning ability is an ability to learn and develop continuously and the ability to grow in knowledge, ability, and quality together with the accumulation of time. With the rapid development of society, the knowledge and technology of various industries are constantly being researched and updated, and the cultivation of lifelong learning ability is particularly important to realize that applied talents can adapt to the changes in job requirements in the future.

Theory course assessment and evaluation, as an important method and means to measure the achievement of course objectives, should not only focus on the results of the examination paper and the teacher-oriented evaluation method but should adopt a diversified evaluation method from the students themselves, adhere to the quantitative evaluation method combining formative and summative evaluation, and assess the achievement of students' technical level knowledge and quality at the end of the course. Different assessment methods are used according to different learning outcomes, such as measurable knowledge, offline formative evaluation is used, which attaches importance to the evaluation of learning outcomes, through quizzes and assignments, with one or several indicators in the learning process as evaluation points, to timely identify students' problems and correct them; summative evaluation is used, which is conducted at the end of the students' whole course learning, with the final examination paper as the basis of evaluation. The purpose is to test whether the students' learning outcomes meet the requirements of the course objectives. The online platform provides a time-limited test for students after each lecture, with randomly selected questions and quick answers to ensure students' listening effect. The final exam drastically reduces theoretical knowledge and other memory-based knowledge assessment sets more subjective questions such as case studies and reduces the weight of the final grade in the overall grade. The overall assessment content is a combination of online and offline learning effects, integrated with students' usual test scores, to assess the degree of students' proficiency in theoretical knowledge, and finally achieve a comprehensive assessment of students' learning performance, as shown in Figure 4.

To ensure effective and timely communication between the two parties, the government, and students and to facilitate the management and evaluation of students and teachers by local undergraduate institutions and enterprises, schools and enterprises need to build information-based teaching and learning management platforms. By adopting the Internet and big data, the information-based teaching management platform is built. On the one hand, the management platform can integrate resources from bases inside and outside the university for comprehensive sharing, unified management and scheduling as well as virtualized software embedding and remote access, covering subsystems such as virtual simulation experimental learning, laboratory booking, intelligent guidance of experimental process,

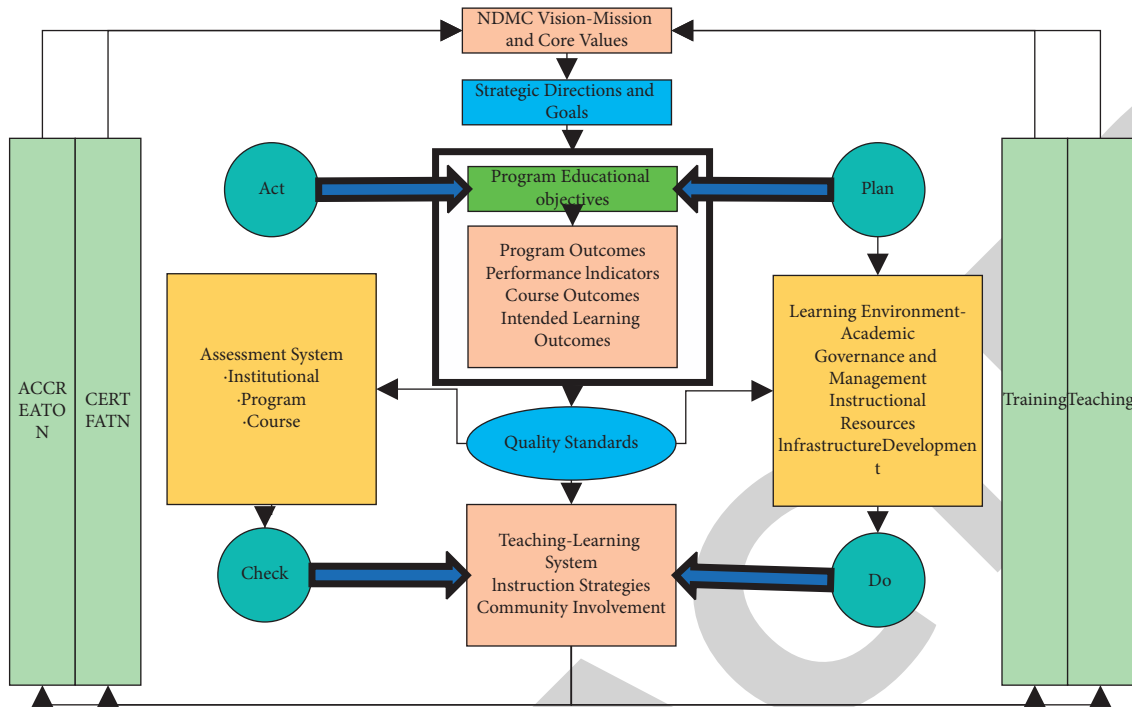


FIGURE 3: Diagram of the project-based learning teaching model based on the OBE concept.

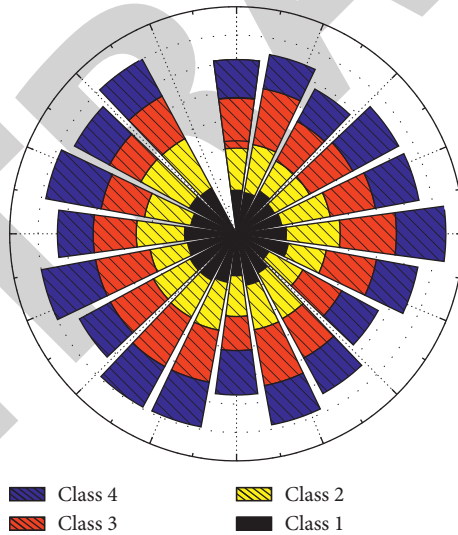


FIGURE 4: Project scores.

automatic correction of experimental results, the statistical query of experimental results, and digital resource management, and teachers and students can log into the management platform by themselves according to their respective needs and choose to access the experiment or others. On the other hand, the informatization teaching management platform can manage information storage, query, update, and access to the tutor library to classify and display teacher information, student information, and enterprise information [22, 23].

It can not only strengthen the communication between professional teachers, enterprise instructors, and students

but also realize information sharing, achieve fine management, avoid the problem of communication and information asymmetry, and improve the efficiency and effectiveness of school-enterprise work to a certain extent [24].

The use of the project-based learning teaching model based on the OBE concept requires a high level of teaching competence from the teacher. Education today is no longer about the simple transfer of inherent knowledge but about producing socially competent individuals who meet the requirements of the times. I need to keep up with the times, update my knowledge base, and design projects that both meet the graduation requirements and achieve the desired outcomes.

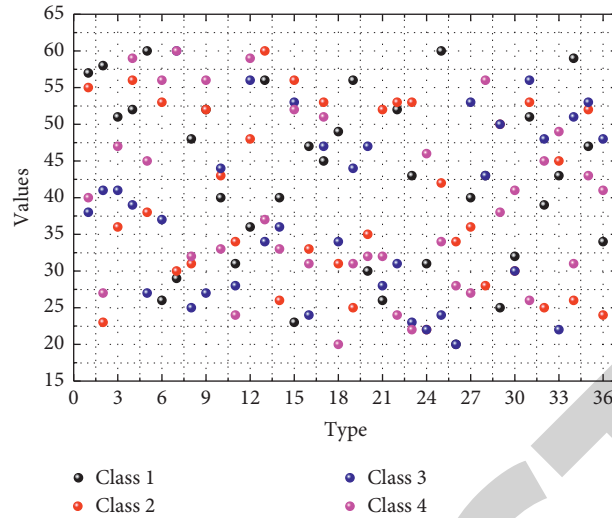


FIGURE 5: Behavioral characterization results.

Secondly, I need to balance the needs of students of different ability levels, especially taking care of those with weaker foundations, so that students do not feel frustrated and give up learning, and strive to teach according to their abilities.

4. Analysis of Results

4.1. Performance Results for the Programming Foundations for Computational Thinking Course Platform. In the design phase, students are guided to create their artworks in a variety of forms by selecting task topics that capture their attention and stimulate their imagination, fully grasping the features of the Scratch visual programming tool. Production is the process of transforming design blueprints into physical objects, and the selection and addition of backgrounds, characters, and scripts are essential to the production of each work, using this idea as a reference for students to analyze and produce complex works. Evaluation is the rereflection and recognition of one's work, making full use of the advantages of multisubject evaluation to help students iteratively modify and improve their works to achieve the most optimal effect of their works. Among them, the algorithmic flow script of the work case (taking the small fish character in the game scene as an example) is shown in Figure 5. The collected sample data was processed using the qualitative analysis software NVivo 11, and the available videos were imported into NVivo's internal material, which was open coded for each video.

After the video data was transformed into textual data, the time nodes were divided according to the timeline tool, allowing the programming behavior to form a continuous sequence of operations in the temporal dimension. The open-ended coded data were revisited i.e., spindle coded according to the basic framework of cognitive goal classification and programming activity to explore the relationship between programming behavior and cognitive level. To ensure the reliability of the sample data coding, the data coding was done jointly by two researchers who passed the expert training, and a total of 3431 events were identified,

182 events that remained in disagreement after discussion were discarded, and the number of adopted coded events was 3249.

Under the guidance of the teacher, understanding computational concepts, working together to deconstruct complex tasks, and specifying the stages required to complete the task are the basis for completing the computational practices. The conceptualization task and tools, and deconstructing the modularization task stages, often occurred before the students' programming activities and were mostly coconstructed with the teacher, while the act of manipulation only partially reflected the cognitive process, with an average of 12.14% of the total manipulation time per person (the sum of 4.75% for knowing and 7.39% for understanding) and roughly equivalent to the average conceptualization task time per person and teacher, overall on students taking more than one-fifth of the time to complete the preprogramming work, as shown in Figure 6.

The programming teaching process should be student-oriented, gradually transition from a graphical programming platform to a text-based programming platform according to students' stage developmental characteristics, seize every occasion or opportunity to exercise students' thinking, guide students to understand task requirements and standards, let students think independently and explore ways and means to reach their goals, and form an awareness of independent conceptualization of programming task requirements and success criteria. The process of teaching multilevel task programming that can be set from shallow to deep should be student-oriented, gradually transitioning from a graphical programming platform to a text-based programming platform according to students' stage developmental characteristics, seizing every occasion or opportunity to exercise students' thinking, guiding them to understand task requirements and standards, allowing them to think independently and explore ways and means to reach their goals, and forming an awareness of the autonomous conceptualization of programming task requirements and awareness of success criteria.

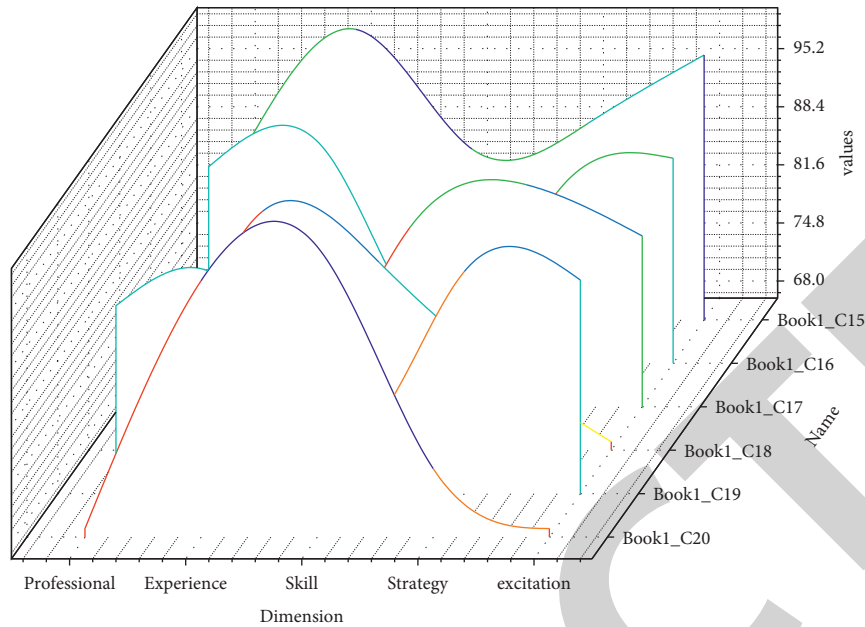


FIGURE 6: T-test results.

Analyzing cognitive levels is another core cognitive need triggered by programming practice, a higher-order level of thinking that has a greater impact on developing computational thinking skills. Analysis during programming includes predictive analysis and posttest analysis, in which students reflect on a part of their experimentally developed program or the complete program, conceptualize possible errors and parts of the program that need further improvement, and actively make adjustments to the program until it conforms to their logic or desired outcome; high analytical skills play an important role in both the efficient completion of programming tasks and the development of computational thinking. The computational practice skills included in the analysis hierarchy include analyzing and modifying scripts before testing (iteration) and analyzing and modifying script errors after testing (testing and debugging). Iteration is an activity where the feedback process is repeated many times to approach the desired goal, and iterative skills optimize programs and products and refine personal development. To further enhance students' practical skills in experimental and iterative computing, teaching should give students enough independent time and space to iteratively modify the program after experimenting with developing part of the program, with the feedback obtained from each iteration providing reference value for reaching the final goal.

4.2. Results of the Analysis of the Optimization Mechanism of the Civic OBE Concept. After a semester of study, there has been a noticeable shift in the mindset of the students in the lab class. First, in terms of attitude toward participation, the experimental class was able to register for the competition actively and enthusiastically, wanting to get a chance to prove themselves. In the control class, the number of

applicants was very small, and most of them felt that they would not be able to get a ranking even if they participated in the competition, so they gave up participating. Secondly, during the preparation process, the students in the experimental class were able to practice actively in their free time and could work together, help each other, and find solutions to difficulties or ask their teachers for advice. In contrast, the students in the control class did not have a strong sense of teamwork and did not have a positive mindset to prepare for the competition. Finally, in the results of the competitions, ten students in the experimental class won the ranking, but only two students in the control class were on the list. The OBE concept not only helps students to master their knowledge and skills but also helps them to develop their overall quality.

This study was conducted to analyze the performance of the experimental and control classes. Throughout the teaching process, the experimental class counted the data of multiple evaluation criteria such as intra- and intergroup self-assessment, mutual assessment, teacher assessment scale, project completion quality, competition results, and online test results as the students' final comprehensive grades; the control class counted the students' class performance, attendance rate, and final exam results as the students' final comprehensive grades. The specific data are shown in Figure 7, which shows that the grades of the experimental class ranged from 98 to 72, and the average grade of the whole class was 88.384. The control class scored between 93 and 64 points, and the class average was 83.345 points, which shows that the experimental class students' performance was generally higher than that of the control class.

The number of failures in both the experimental and control classes was 0, indicating that students in both classes had a basic grasp of ideological and political knowledge.

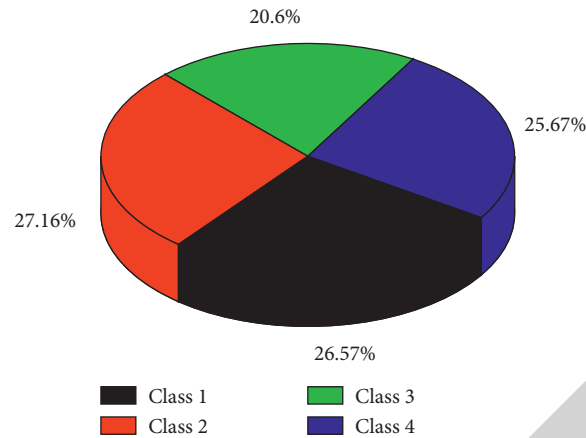


FIGURE 7: Student achievement.

However, the number of students in the excellent section of the experimental class was 11 more than that of the control class, the number of students in the good section was 15 more than that of the control class, and the number of students in the passing section was 20 less than that of the control class, which shows that the model has a positive effect on the performance of learners at all stages. Certain actions can only be taken under certain perceptions and awareness. In education and teaching, the continuous updating and keeping up with the times of educational concepts and ideas has a crucial role to play, which to a certain extent determines the teaching reform and even affects whether the reform can be carried out after it has started. Most workers engaged in the education and teaching of Civics and Political Science classes need to establish the concept and awareness of continuous renewal and improvement of the teaching mode and realize sincerely the significance of the renewal of the teaching model to the teaching of Civics and Political Science classes. If most educators accept and recognize the principle of continuous improvement of teaching mode, it may play a far greater role than we expect.

The current teaching mode of ideological and political theory class is categorized into nine teaching modes from three perspectives, and SWOT analysis is applied to analyze the advantages and shortcomings of the current teaching model of ideological and political theory class and the opportunities and challenges it faces. In the process of practical operation, we will study the possibility of integrating and developing the teaching mode of ideological and political theory class in the new era based on OBE concept, firstly, we should establish a student-centered “trinity” mixed teaching implementation path, secondly, we should establish a comprehensive evaluation system oriented to the results, and finally, we should establish a long-term mechanism for improving the teaching mode based on the principle of continuous improvement. The practical operation of the teaching mode of ideological and political theory courses in colleges

and universities is implemented from three aspects, to provide some feasible suggestions for enhancing the effectiveness of ideological and political theory courses in colleges and universities in the new era, so that the teaching mode of ideological and political theory courses can keep pace with the development of the times and educational needs and make new progress continuously, as shown in Figure 8.

The study also examined the differences in computational thinking skills between male and female students by conducting independent sample tests on pre- and posttest data of computational thinking skills of male and female students to test whether there were differences in the level of computational thinking between students of different genders before and after the activity. Finally, to verify whether the frequency of students’ application of computational thinking in their daily life and study is related to their computational thinking ability, the students’ self-test data on the frequency of their application of computational thinking was correlated with their scores on the computational thinking ability test, and the results showed that the students’ daily application of computational thinking ability and their scores on the computational thinking ability test were significantly correlated at the 0.001 level. This indicates that students’ computational thinking skills are reflected in their course work and enable them to use computational thinking to understand and solve problems in their daily lives and studies.

As teachers mostly learn to teach better in this age group, other extrinsic motivational factors have little effect on their teaching efficacy. On the other hand, the job title is most likely to influence teachers’ sense of teaching efficacy through teaching motivational factors. Moreover, since the training activities enable teachers to quickly improve in terms of teaching competence and familiarity with the content and acquire skills and strategies related to teaching computational thinking, the activities designed can enhance teachers’ sense of efficacy in teaching computational thinking.

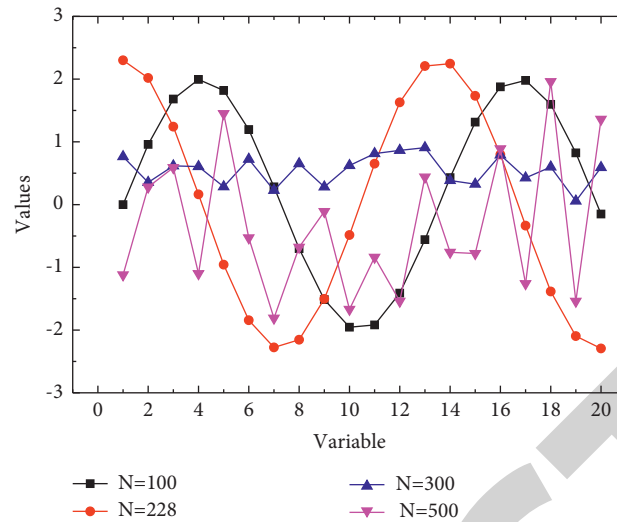


FIGURE 8: Analysis of differences in the choice of teaching evaluation methods.

5. Conclusion

By implementing the designed activities for the development of teachers' computational thinking pedagogical efficacy, teachers' level of computational thinking skills was improved and they were able to positively influence their level of computational thinking skills through students' behavioral performance in the actual teaching sessions. After implementing the designed activities for the development of teachers' computational thinking pedagogical efficacy, teachers returned to teaching and students' levels of computational thinking skills were improved and computational thinking skills positively influenced their approaches to problem-solving in everyday life. Computational thinking education is not about making students learn advanced knowledge but about bridging the gap between source code and natural language or about training students to become computer experts but more importantly about shaping a way of thinking for children to survive in a new environment, to think about how to solve problems in their daily digital lives, to learn, to innovate, and to communicate. Teachers are an important part of the teaching process; their guidance and help for students in the learning process are very critical to achieve the goal of training the next generation of qualified digital citizens, teachers' teaching of computational thinking is very important, and teaching efficacy as an important factor affecting the quality of teachers' teaching will affect teachers' own ability to improve the level of motivation and the learning of students; after developing students' computational thinking ability, this then motivates teachers' computational thinking ability enhancement and so positive cycle to form a good teaching and learning environment.

Data Availability

Data are available on request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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