Educational Administration: Theory and Practice
2024,30(3), 318-326
ISSN:2148-2403
https://kuey.net/
Research Article

A Study on the Application Effect of Blended Teaching Method in Vocational College Students' Computational Thinking Courses

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Citation: Lili Huang et al.(2024), A Study on the Application Effect of Blended Teaching Method in Vocational College Students' Computational Thinking Courses, *Educational Administration: Theory and Practice*, *30*(3), 318-326, Doi: 10.53555/kuey.v30i3.1262

ARTICLE INFO

ABSTRACT

In the context of continuous development in information technology, traditional classroom teaching models no longer suffice to meet the demands of modern education. The blended teaching approach, combining online and offline components, introduces a new perspective to contemporary education. This study investigates the application effect of the blended teaching method in computational thinking courses. The 2024 cohort of 102 students serves as the control group, receiving predominantly traditional lecture-based instruction, while the 2025 cohort of 106 students serves as the experimental group, utilizing the Cloud Classroom learning platform and employing the blended teaching method. A comparison is made between the two groups in terms of theoretical and skill assessment scores, computational thinking abilities, and a satisfaction evaluation for the experimental group. The research findings indicate that the 2025 cohort demonstrates significantly higher theoretical and skill assessment scores as well as computational thinking abilities ($P < 0.05$) compared to the 2024 cohort. Moreover, students in the experimental group express a higher level of satisfaction with the blended teaching method. The application of blended teaching in computational thinking courses proves to enhance student learning outcomes and computational thinking abilities.

Keywords: Blended Teaching; Vocational College Students; Computational Thinking Courses

1.Introduction

Computational thinking is defined as a problem-solving approach rooted in computer science principles (Lodi, M., &Martini, S., 2021) and has become a cornerstone of essential skills for individuals in modern society. With the widespread integration of technology into our daily lives, the demand for individuals with computational thinking skills has surged across various professional domains, leading to a paradigm shift in higher vocational education institutions. This shift aims to assist students in better addressing the challenges brought about by the digital age. Integrating computational thinking into higher vocational education is crucial to ensuring graduates possess the necessary skills to thrive in an increasingly technology-driven world. However, traditional teaching methods in higher vocational colleges fall short in adequately meeting the dynamic demands of students to develop these skills. To bridge this gap, this study focuses on exploring the application effect of the blended teaching method in computational thinking courses for higher vocational students. Previous research has shown promising prospects for blended teaching methods, characterized by a combination of traditional face-to-face instruction and online learning resources, in enhancing learning experiences across various educational settings. This approach offers potential benefits, including increased flexibility, personalized learning opportunities, and improved resource access (Namyssova, G. et al, 2019). The effectiveness of blended teaching in the specific context of computational thinking courses for higher vocational students is a domain worthy of further exploration. The primary objective of this study is to assess the impact of blended teaching methods on student learning outcomes in computational thinking courses, comprehensively analyzing quantitative indicators such as academic performance assessments to determine their effectiveness. This research focuses on key indicators such as student performance, engagement, and satisfaction, aiming to gain detailed insights into how blended teaching methods foster the development of computational thinking skills in higher vocational students. By exploring the experiences and perspectives of educators and students, this study aims to provide insights that can inform future teaching design and implementation strategies. In the ever-evolving landscape of education, understanding the role and impact of blended teaching methods in computational thinking courses for higher vocational students becomes crucial. This research contributes to the ongoing discussion on effective teaching methods, striving to enable educators and institutions to better assist students in meeting the demands of a technology-driven workforce.

2. Relevant Concepts and Research Progress

2.1 Concepts

Computational thinking, as noted by Cansu, F. K., & Cansu, S. K. (2019), is defined as a cognitive skill involving the use of computer science principles to solve problems. It encompasses algorithmic thinking, abstraction, decomposition, and pattern recognition, playing a crucial role in assisting individuals in addressing challenges in the digital age. By cultivating structured problem-solving approaches, computational thinking not only fosters students' technical skills but also enhances their ability to analyze complex problems and design creative solutions(Angeli, C., & Giannakos, M., 2020). Rooted in computer science principles, this problem-solving and analytical approach involves breaking down complex problems into smaller, more manageable parts, identifying patterns and trends, and creating algorithmic solutions. Computational thinking emphasizes logical thinking, algorithmic thinking, and abstract thinking, which are essential skills not only in computer science but also in various disciplines(Grover, S., & Pea, R., 2018). Integrating computational thinking into educational curricula has become imperative for cultivating a workforce capable of navigating the complexities of an increasingly digitized society.

Blended teaching methods, also known as blended learning, involve a deep integration of traditional face-to-face classroom instruction and online learning resources(Skelton, D. J. 2007). This teaching method integrates technology and digital platforms, combining face-to-face interactions with virtual components (such as online lectures, multimedia resources, and collaborative activities) to enhance the overall learning experience (Anthony, B. et al, 2022). The advantages of blended teaching are multifaceted, including increased flexibility for students, personalized learning experiences, and improved access to diverse learning materials. However, challenges such as integrating technology, maintaining student engagement, and ensuring a coherent learning experience across modes require careful consideration. Educators seeking to optimize the strengths of face-to-face and online teaching must understand the subtle differences in blended teaching methods.

2.2 Research Progress on Computational Thinking

With the increasing momentum of integrating computational thinking into the educational framework, there is a noticeable lack of dedicated research investigating the application of blended teaching methods in the context of computational thinking courses in higher vocational education. Although existing research is primarily focused on broader educational levels or specific subjects, there is a certain gap in the literature regarding challenges and opportunities in the context of higher vocational environments. Despite the notable contribution by Aydeniz, M. (2018), emphasizing the importance of interdisciplinary integration of computational thinking, their main focus remains on K-12 education. This raises questions about the effectiveness of integration in higher vocational education settings. Furthermore, the study by Demaidi, M. N., Qamhieh, M., & Afeefi, A (2019) extensively explores the impact of blended learning in computer programming courses, revealing the effects on student performance and their satisfaction with blended learning methods. However, these findings still warrant further exploration concerning their general applicability to computational thinking courses in higher vocational education environments.

This literature review emphasizes the critical role of computational thinking in the digital era, explores the potential and challenges associated with blended teaching methods, and identifies gaps in existing research. As educators increasingly seek innovative teaching methods, understanding the synergies between computational thinking and blended teaching methods becomes crucial for cultivating the ability of higher vocational students to adeptly navigate the complexities of the modern workforce.

3. Methodology

3.1 Research Participants

This study selected 102 students from the 2024 cohort and 106 students from the 2025 cohort, enrolled in the computational thinking course at our university, as the control group and experimental group, respectively, totaling 208 students as research participants.The textbooks and teaching instructors for both groups were the same. Population demographic characteristics captured for research participants included age, gender, and academic background.The control group consisted of 102 students, with 60 males and 42 females. The experimental group comprised 106 students, with 70 males and 36 females. There were no statistically significant differences in gender, age, and self-learning ability between the two groups ($P>0.05$), ensuring comparability.

3.2 Research Methods

This study employed a quasi-experimental design, with the experimental group utilizing a blended teaching approach, combining synchronous and asynchronous online activities, while the control group received traditional face-to-face instructional guidance without online components. The computational thinking course is a compulsory elective for lower-level students in computer-related majors and non-computer majors at our university, with a total of 64 class hours, of which theoretical hours account for 60%. Both groups of students followed a unified curriculum and teaching plan, with the final assessment comprising both theoretical and practical performance. The intervention measures will continue for one semester to comprehensively assess the longitudinal impact of blended teaching on student performance.

3.3 Research Operational Design

3.3.1 Experimental Group Intervention Design

The experimental group utilized the Cloud Classroom platform to build a four-stage blended M teaching model, including instructional resource preparation, educational goal setting, instructional process design, in-class blended teaching, and post-class evaluation expansion.

1. Instructional Resource Preparation: Prepare the Cloud Classroom platform website effectively. Teachers will import computational thinking course learning resources into the platform, including case videos, PPT slides, operational videos, theoretical knowledge micro-lessons, and quizzes. Tasks will be assigned for students to watch videos and PPT slides within a specified time, and engage in problem discussions within their groups as per the teacher's instructions. Before class, teachers will review students' pre-learning status and questions raised, conducting a comprehensive analysis of student progress. This analysis helps identify key areas of difficulty, allowing for further optimization of teaching design. Each student can communicate with teachers and classmates through the learning platform. Teachers can gain a relatively accurate understanding of each student's situation, using it as a basis for personalized guidance and formative assessment.
2. Educational Goal Setting: The talent training program and curriculum standards focus on systematic learning around computational thinking and practice. Setting educational objectives around the history and fundamental knowledge of computers; concepts, relevant theories, and application scenarios of new-generation information technology; basic knowledge of databases; fundamental concepts of computer networks; understanding of digital multimedia technology and information security. Preparing pre-class introductory micro-lessons to awaken students' foundational awareness of computational thinking. Releasing pre-class tasks 2-3 days before class to allow students to engage in self-directed learning. Based on case studies or micro-lessons, students complete tasks or answer questions. The platform system accumulates regular learning scores, stimulating students' enthusiasm for learning and enhancing their self-directed learning abilities.
3. Instructional Process Design: Pre-class guided learning, task-oriented. Pre-arranging pre-learning and practical activities to stimulate students' exploration of knowledge(Xia, J. 2020). Taking the class on "Fundamentals of Information Technology" as an example, students watch micro-lesson videos to gain intuitive experiences. Guiding students to construct knowledge frameworks through video watching, encouraging self-practice for knowledge expansion, and answering key points. Teachers categorize, organize, and summarize students' responses, systematically conducting teaching activities in line with the class's educational objectives to enhance learning effectiveness.
4. In-class Blended Teaching: Teachers evaluate students' pre-class independent learning, conducting discussions based on questions, such as the features of digital multimedia technology and common software operations. After group discussions, students, guided by the teacher, articulate key points and establish preliminary concepts. The teacher breaks down the technical aspects, demonstrates with precision, records operations, and projects them onto a large screen, guiding students in real-time operations. The entire process is recorded in real-time and uploaded to the Cloud Classroom Learning Platform. Using the platform, students transmit self-operational videos, and activities include watching videos, discussing, correcting errors, self-evaluation, group evaluation, and teacher evaluation. In addressing highlighted issues, the teacher provides further explanations and demonstrations. In this

session, students not only master the common software operations of digital multimedia technology but also enhance computational thinking, experience human care, and improve critical thinking abilities such as curiosity and self-confidence. The Cloud Classroom Learning Platform is used for real-time assessment of student learning. Teachers and students express their evaluations and summarize, assessing teaching effectiveness and student comprehension. Students are guided to value computational thinking and encouraged to express their individual viewpoints.

5. Post-class Evaluation and Extension: Teachers utilize the Cloud Classroom Learning Platform to comprehensively analyze and provide feedback on students' attendance and quiz performance, incorporating it into semester assessments. Teachers forward videos from each group in the class to colleagues teaching the same course for evaluation, and this information is then shared with students. Assignments, further exploration, and reviewing mistakes in homework or tests are assigned. Students are encouraged to continue collecting and reading relevant literature, developing the ability to learn similar knowledge and skills. The Cloud Classroom Learning Platform is extensively used to maintain communication between teachers and students, strengthen interactions, and facilitate blended teaching both online and offline.

3.3.2 Intervention Design for the Control Group

The control group's theoretical classes primarily use lecture-based teaching methods, evaluating student review and preparation through questioning. Experimental classes combine lectures with demonstrations, watching instructional videos, and in-class exercises.

3.3.3 Evaluation Indicators

1. Student Final Grades

The final exam papers for both groups are set by the same teacher, and the question types, difficulty, and quantity are reviewed by the course coordinator. Skill assessments adhere to grading standards, utilizing practical assessments and simulated evaluations, conducted by the subject teacher. The assessment items are determined by drawing lots and assessed on-site.

2.Student Computational Thinking Abilities

Student computational thinking abilities are assessed using a measurement scale with four dimensions (creativity, algorithmic thinking, critical thinking, problem-solving) and a total of 20 items. Students self-evaluate using a scoring method from 1 to 5, where higher scores indicate stronger computational thinking abilities.

3.Teacher Satisfaction with Blended Teaching Application Effectiveness

After the course instruction concluded, a self-designed questionnaire was employed for investigation. Experimental group students evaluated the teaching effectiveness of the instructor, encompassing five items.

Each items included options ranging from: Very effective、 Effective、Effective but Not obvious、No effect.

3. Results and discussion

4.1 Results

(1) Comparison of Theoretical and Practical Assessment Scores Between the Two Student Groups (Refer to Table 1)

At the end of the semester, a comparative analysis of the theoretical and practical assessment scores of the two student groups reveals that the experimental group's scores are significantly higher than those of the control group, with statistical significance (P<0.05).

Table 1 Comparison of Theoretical and Practical Assessment Scores Between the Two Student Groups ($\bar{x}$ ±s)

	Experimental Group (n=106)	Control group (n=102)	t-value	p-value
Theoretical scores of the experimental group	76.45±9.08	65.93±7.38	2.328	0.023
Skill scores of the experimental group	72.89±5.34	62.87±8.74	2.491	0.013

(2)Comparison of Computational Thinking Abilities Before and After Teaching for Two Groups of Students (See Table 2)

Evaluating the computational thinking abilities of both groups before and after the teaching, there was no statistically significant difference in computational thinking abilities between the two groups before teaching (P>0.05). However, after teaching, the computational thinking abilities of the experimental group were significantly superior to the control group,and the difference was statistically significant (P<0.05).

Table 2: Comparison of Computational Thinking Abilities Before and After Teaching for Two Groups ($\bar{x}$ ±s)

	Before teaching				**After teaching**			
	Experimental Group (n=106)	Control group (n=102)	t-value	p-value	Experimental Group (n=106)	Control group (n=102)	t-value	p-value
Creativity	21.56±4.37	22.01±2.67	0.458	0.576	24.25±3,65	22.18±3.12	1.982	0.041
Algorithmic thinking	18.86±3.72	19.63±3.75	0.536	0.593	22.16±3.19	20.82±3.76	2.350	0.020
Critical thinking	9.68±2.67	9.01±3.02	0.394	0.767	15.53±2.64	13.95±3.02	1.979	0.049
Problem solving	15,63±2.54	15.78±2.97	0.651	0.414	16.39±3.54	15.89±3.94	2.368	0.017
Total score	65,73±13.31	66.43±12,41	0.932	0.346	78.33±13.02	72,84±13.84	2.832	0.004

(3)Evaluation of Teacher's Teaching Effectiveness (See Table 3)

After the semester, a self-made questionnaire was used to investigate students in the experimental group's evaluation of the effectiveness of the hybrid teaching of the computational thinking course. The results showed that students were overall satisfied with the hybrid teaching method used in the course.

Table 3 Satisfaction evaluation of 106 experimental group students on hybrid teaching [person, (%)]

Variable	Very effective	Effective	Effective but Not obvious	No effect
Level of Interest	50(47.2%)	31(29.2%)	16(15.1%)	9(8.5%)
Promotes practical application of knowledge	53(50.0%)	33(31.1%)	14(13.2%)	6(5.7%)

Improved ability to think independently	47(44.3%)	32(30.2%)	14(13.2%)	13(12.3%)
Improved team collaboration skills	65(61.3%)	30(28.3%)	6(5.7%)	5(4.7%)
Overall evaluation of blended teaching	58(54.7%)	31(29.3%)	12(11.3%)	5(4.7%)

4.2 Discussion

According to the data obtained from the teaching design and experiments, it can be seen that the hybrid teaching method has better teaching effects in computational thinking courses than traditional teaching, which is reflected in the following aspects.

1. Increase student engagement:

The blended teaching approach utilizes online activities and a cloud classroom platform (Cloud Classroom) that allows students to take advantage of a variety of resources, including videos, slides, and quizzes. This promotes active participation and interaction. Pre-learning tasks and group discussions before class lay the foundation for classroom activities, cultivating a sense of community and collaborative learning (Zhao, S. R., & Li, H. 2021). The use of real-time assessments and multimedia elements helps create a dynamic and engaging learning environment.

2. Personalized learning and flexibility:

Cloud classroom platforms facilitate personalized instruction and formative assessment based on students' individual progress (Nedungadi, P., & Raman, R. 2012), enabling teachers to identify and address key areas of difficulty. Pre-class assignments and independent learning enhance students' ability to explore topics at their own pace, catering for different learning styles and preferences. Blended learning provides the flexibility to allow students to access materials and engage in activities outside of the traditional classroom setting.

3. Actively apply knowledge:

Classroom blended instruction includes real-time manipulatives, demonstrations, and collaborative activities. This practical approach ensures that theoretical knowledge is actively applied and reinforced. Utilize the cloud classroom learning platform for real-time assessment, encourage students to produce self-operated videos, and cultivate a culture of continuous improvement and reflection.

4. Comprehensive evaluation and feedback:

Post-class evaluation and extension, combined with the cloud classroom platform, can provide comprehensive analysis and feedback on students' performance. Teachers assess not only final exam papers but also computational thinking skills, providing a holistic view of student learning outcomes. Sharing videos among colleagues for assessment and subsequently with students can promote transparency and peer learning. And the analysis of the theoretical and skill assessment scores at the end of the semester showed that the experimental group was significantly better than the control group ($P<0.05$).

5. Development of computational thinking skills:

The quasi-experimental design showed that although there was no significant difference in computational thinking ability between the two groups before teaching, the experimental group showed significantly superior abilities after the intervention ($P<0.05$). Measurement scales for educational goal setting, pre-course tasks, and computational thinking skills demonstrate efforts to develop specific cognitive skills, including creativity, algorithmic thinking, critical thinking, and problem solving.

6. Positive teaching satisfaction and student feedback:

A self-designed questionnaire assessing teachers' satisfaction with blended teaching methods showed positive feedback from the experimental group. The overall evaluation of blended teaching as being very effective and effective is as high as 84%, and students expressed overall satisfaction, indicating that the blended approach helps to achieve a positive learning experience.

7. Vertical Impact and Sustainability:

The intervention was implemented for one semester to comprehensively evaluate the longitudinal impact of blended instruction on student achievement. Consideration of long-term effects adds depth to the study. Cloud classroom platforms are widely used for continuous communication between teachers and students, which shows that hybrid teaching methods have the potential to be sustainable.

5.Conclusion

This study demonstrates that the blended teaching method has a significant application effect in the teaching of computational thinking courses for higher vocational students. Through the organic combination of online and offline methods, students can better grasp knowledge and skills while fostering autonomy, collaboration, and problem-solving abilities. It enhances students' creativity, algorithmic thinking, critical thinking, and problem-solving abilities guided by computational thinking. This is of great significance for their future learning and career development. The study provides valuable insights for this field; therefore, we encourage educators to consider integrating the blended teaching method into the teaching of computational thinking courses as a strategic approach to cultivate computational thinking skills. Furthermore, we suggest further optimizing the application of blended teaching in higher vocational education to cultivate more high-quality talents with comprehensive skills.

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