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Innovative Teaching Research of "Java Programming" Course in the Context of New Engineering Education

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Abstract: According to the requirements of new engineering construction, colleges and universities carry out the upgrading and improvement of professional construction according to the needs of industry, and put forward higher requirements for talent training. For engineering courses of program design and project development, the improvement of students' engineering practice ability and innovation ability is one of the problems that need to be solved urgently. In order to change the problems existi ng in the previous teaching of Java programming, this paper makes innovations in the teaching mode, adopts the Oto online and offline mixed teaching mode, applies the characteristics of combining information technology and network technology, and makes full use of the modern information-based teaching platform. To "liberate" students' learning habits from passive learning in class and change students' learning habits. Make students become the main body of learning, and teachers guide students to learn independently.

Keywords: New engineering, Java programming, Engineering education concept, Online and offline mixed teaching mode.

1. Introduction

Since the Ministry of Education launched the New Engineering Initiative in 2017, universities have been upgrading their academic programs to align with industry demands while raising talent cultivation standards. For engineering courses like programming and project development, enhancing students' practical skills and innovative capabilities has become a critical challenge that urgently needs addressing.

Today, Java has become a widely adopted language for network applications and mobile devices, standing as one of the mainstream object-oriented programming languages. As a core computer science course with strong specialization [1], "Java Programming" is typically offered after foundational courses like "University Computer Fundamentals" and "C Language Programming". This curriculum aims to develop students' skills in Java SE design and application debugging. It also lays essential programming groundwork for advanced courses such as "JSP Dynamic Web Design" and "Android Development".

Through foundational courses like "University Computer Fundamentals" and "C Programming", students have acquired essential computer literacy and basic programming skills. While they generally show strong interest in WYSIWYG (What You See Is What You Get) technologies that allow hands-on learning, the curriculum often lacks sufficient integration of theory with practice, resulting in limited application of theoretical knowledge in real-world scenarios [2].

Traditional Java Programming courses predominantly focused on theoretical knowledge dissemination, prioritizing textbook explanations over practical application. The lack of contextual connections between concepts left students struggling to grasp programming fundamentals. The curriculum predominantly relied on textbook materials and multimedia presentations, resulting in weak hands-on skills and problem-solving capabilities. Consequently, students showed limited interest in learning Java programming courses. Their superficial understanding created significant barriers to advanced project development studies [3].

2. Innovation and construction of teaching mode

Guided by the engineering education philosophy of "outcome-oriented, student-centered, and continuous improvement", we have developed a blended OTO (Online-to-offline) teaching model that integrates modern information technology with network capabilities. By implementing a three-phase approach—pre-class preparation, in-class engagement, and post-class review—we liberate students from passive learning habits, cultivating a structured routine of "pre-class self-study, in-class knowledge reinforcement, and post-class gap-filling". This student-centered model shifts from spoon-feeding to active learning, requiring self-motivated exploration and innovative thinking for meaningful progress [4-6].

In the first session of this course, we employ a "task-driven" teaching approach to introduce students to setting up Java development environments and running Java programs correctly, thereby enhancing their learning engagement. For subsequent courses, we implement a "flipped classroom" model where students preview relevant technologies before class. We share preparatory materials (including courseware, micro-lecture videos, images, texts, and web links) on the Yunbanke platform, while also publishing pre-class assignments and tracking student inquiries. Teachers analyze the platform's learning analytics and available resources to design optimal instructional methods, focusing on key concepts during live sessions and addressing challenges from pre-class preparation and ongoing study.

The practical training course adopts a "project-based" approach in classroom instruction. Before hands-on sessions, instructors first demonstrate and address common questions from theoretical classes or preparatory studies. Students then participate in group competitions where each team completes specific tasks, with scores and rankings determined by performance outcomes. This format aims to foster a competitive atmosphere and ignite students 'learning

enthusiasm. The training process primarily employs inquiry-based learning and group discussion methods to stimulate engagement, spark innovative thinking, and develop students' ability to resolve challenges through internet solutions. These approaches ultimately enhance both learning efficiency and programming skills development.

After class, according to the students' performance in class, personalized guidance is implemented, learning resources are pushed, homework is corrected in time, and summary and reflection are made to continuously improve teaching ability.

3. Implementation Process

3.1. Self-study Before Class

Before class, teachers upload learning materials including videos, documents, courseware, and web links to the Yunbanke platform, assign preparatory tasks, and set up light live-streaming sessions or Q&A discussion boards. Students are required to watch video materials and courseware attentively. Through remote interactions between teachers and students as well as peer-to-peer exchanges, instructors adjust teaching strategies based on online assessments and Q&A sessions, implement differentiated instruction, and design offline assignments tailored to varying difficulty levels.

3.2. In-class Knowledge Consolidation

During formal classes, teachers first introduce the lesson topic, evaluate students 'pre-class online self-study outcomes, and address any questions. They then assign new learning tasks for collaborative learning and interactive discussions. Finally, they provide detailed explanations on key and challenging content commonly encountered by students, effectively leveraging students' active participation while demonstrating teachers' exemplary leadership.

3.3. Check and Fill in The Gaps After Class

According to the class situation, teachers provide personalized guidance after class, push learning resources, urge students to complete homework, and realize online discussion, collaboration and communication between students and teachers to consolidate and improve the knowledge learned.

3.4. Teaching Evaluation

In the implementation of course instruction, we have moved beyond relying solely on final exam scores to determine academic performance. Instead, we have adopted a formative assessment system that evaluates the entire teaching process, integrating both online and offline learning. The evaluation framework consists of 20% online performance, 10% practical training results, and 70% offline academic achievements. Online learning outcomes primarily include attendance records, pre-and post-class quizzes, classroom participation, and group assignments, with specific scores calculated as percentage points derived from students' accumulated experience points on the teaching platform.

4. Achievements

The innovation of this course teaching mode is to take students 'self-study as the main part and teachers' guidance as the auxiliary part. The OTO blended teaching mode and task-driven teaching method are used to realize the integration of knowledge, theory and practice, so as to build an innovative classroom.

4.1. Implementation of Ideological and Political Education in Curriculum

By integrating ideological and political education into curriculum design, we can help students develop sound worldviews and values while mastering professional knowledge. This approach effectively cultivates students' sense of responsibility and patriotic spirit, ensuring the educational objectives are fully achieved through systematic integration of ideological content throughout the teaching process.

For instance, when teaching inheritance – a fundamental object-oriented concept – educators can skillfully weave in patriotic themes. By using relatable examples, teachers can ignite students' patriotism and foster a sense of responsibility toward their nation and family. Consider this approach: When defining the three-tiered structure of nation, family, and individual, the nation serves as the parent category, with the family being its subclass, and the individual its subclass. This hierarchy demonstrates inheritance principles. Just as nations inherit moral and legal frameworks, families and individuals must not only preserve these foundations but also cultivate their own social accountability and cultural literacy.

4.2. Reshaping the Learning Process

The first innovation involves adopting a blended online-offline teaching model that revolutionizes the learning process by completing knowledge delivery outside the classroom. Students engage in self-directed learning before class, conduct in-depth study during lectures to address academic challenges, and receive personalized tutoring post-class through resource recommendations and assignment supervision to consolidate knowledge. The second innovation adopts a student-centered approach that transforms teaching roles: students take the lead in autonomous learning while teachers act as facilitators guiding the educational process. These dual "disruptive" strategies boost student motivation, with the resulting active participation and engagement effectively enhancing teaching effectiveness.

By analyzing big data and statistical data on students' completion of viewing materials, online quizzes, and Q&A sessions, we gain insights into their pre-class knowledge mastery, ensuring clear understanding of learning outcomes. Based on accurate academic analysis and talent development needs, we design offline classroom discussions with targeted content to scientifically define teaching objectives, effectively highlighting key points and addressing challenging areas. Through comprehensive optimization of teaching methods guided by instructional analysis reports, we enhance teaching efficiency. The specific learning engagement statistics are illustrated in Figure 1.

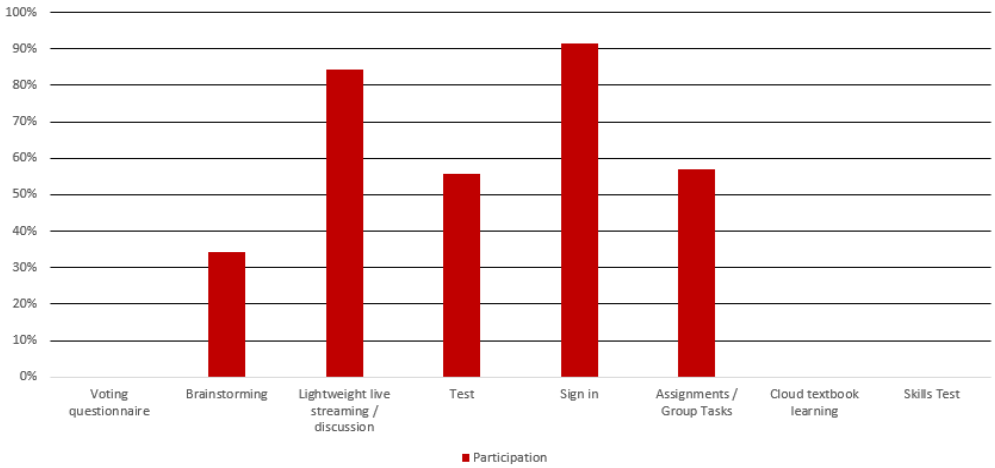

Figure 1. Learning engagement

4.3. Management of Learning Time and Space

The strategic application of information technology has significantly expanded learning opportunities, allowing students to utilize fragmented time—whether commuting, studying in self-study rooms, or dining halls—through digital platforms for self-directed learning. This approach enables real-time access to educational videos and practice materials, breaking away from the traditional classroom-centered model. It effectively explores pathways to build smart classrooms while establishing a solid foundation for their development. The distribution of teaching resources and activity statistics is illustrated in Figure 2.

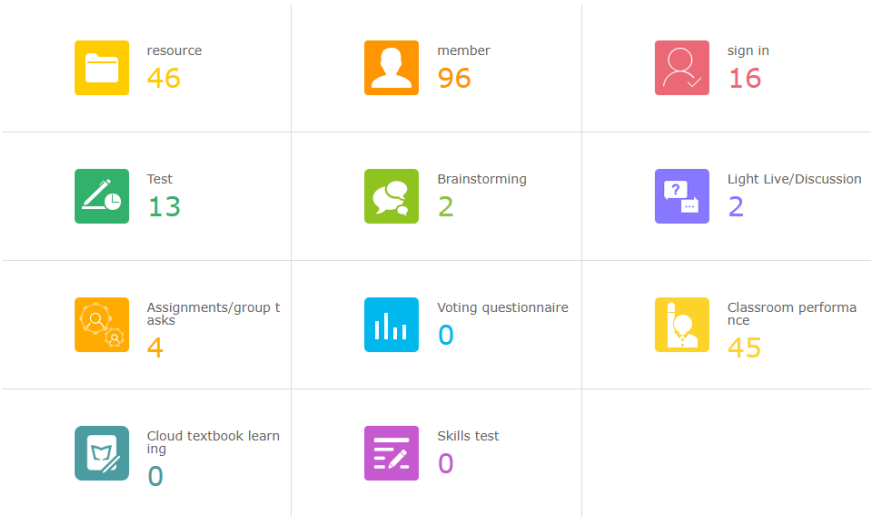

Figure 2. Statistics of teaching resources and activities

4.4. Teach Students According to Their Aptitude

The curriculum integrates information technology and network technologies deeply. The Yunbanke platform delivers meticulously crafted learning resources (micro-videos, courseware, images, texts, etc.) to assist students in completing self-directed pre-study. Through online live-streaming sessions for Q&A discussions, remote interactions between teachers/students and peer-to-peer learning are facilitated, enhancing teaching efficiency while expanding instructional time and space dimensions. This approach promotes personalized learning by dynamically delivering diverse learning materials tailored to individual student characteristics and class-level standards. The system enables tiered instruction through differentiated teaching methods, truly implementing education tailored to individual needs. Figure 3 illustrates students' personalized development characteristics.

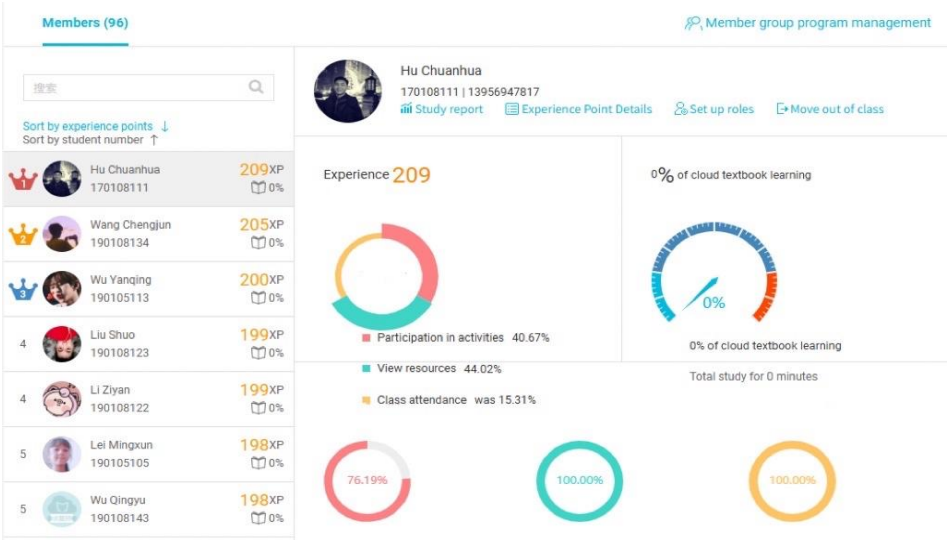

Figure 3. Personalization characteristics of students

4.5. Formative evaluation

To document the reinforcement learning process, big data-based applications are utilized to enable teachers and students to conduct more authentic and comprehensive evaluations. These tools support online teaching assessments, real-time progress tracking, blended learning evaluations, and satisfaction surveys. Through analyzing students' performance, academic achievements, and daily learning attitudes, a holistic evaluation system is established. Students can monitor their detailed scores and ranking positions in real time, which facilitates self-analysis, proactive problem-solving, and motivation to learn. This approach fosters confidence, encourages exploration of effective study methods, and promotes self-directed learning. Teachers can adjust instructional strategies, pacing, and lesson designs based on these evaluations to implement differentiated instruction tailored to individual needs. The formative assessment criteria are detailed in Table 1.

Table 1. Formative assessment criteria

Attendance evaluation	Student attendance information is obtained through one-click check-in, gesture check-in and time-limited check-in.
Homework evaluation	Test assignments of students are graded manually or automatically through the cloud class platform, and the completion status and learning effect are automatically evaluated. Teaching plans are adjusted according to the evaluation.
Group peer evaluation	Groups can evaluate each other and have the power to evaluate students.
Participate in evaluation	Students' participation in class will be evaluated, such as answering questions, shaking hands and other activities.
Test evaluation	Automatic marking and evaluation of pre-class, in-class, after-class and test.

5. Summary

As a core curriculum for computer-related majors, Java is designed to cultivate students 'problem-solving and innovative practical skills. Within the framework of the New Engineering Education Initiative, this paper explores the teaching model of the "Java Programming" course, detailing its pedagogical reform process and demonstrated outcomes. In practical implementation, the approach successfully transforms teacher-student roles—empowering learners as active participants while positioning educators as facilitators. This transformation effectively boosts student engagement and enhances instructors' instructional capabilities.

References

[1] Chen Chuanming, Yu Qingying, Xia Yun, Guo Liangmin. Research on the Blended Online-Offline Teaching Model for the New Engineering Practice Course "Java Object-Oriented Programming" [J]. Computer Knowledge and Technology, 2022, 18(15):140-142+157.

[2] Zhang Miao, Yu Renshi, Chen Longmeng. Teaching Reform of Java Programming in Innovation and Entrepreneurship Education [J]. Office Automation, 2022, 27(13):43-45.

[3] Min Shan. Teaching Model Reform and Innovation of Design Software and Application in Logistics Engineering [J]. China Storage & Transportation, 2022(08):207-208.

[4] Yang Zhuyuan. Innovation Research on Teaching Model of Convergent Journalism Course [J]. Journal of Journalism Studies, 2022, 13(13):18-20.

[5] Zeng Hao. Innovation of Online Teaching Model for Computer Courses [J]. Integrated Circuit Applications, 2022, 39(07):216-217.

[6] Gong Bin. Research on Teaching Quality Evaluation and Feedback Control Mechanism of Experimental Instruction [J]. Journal of Changchun University, 2021, 31(08):104-108.

[7] Li Qin, Wu Libin, Zhu Jiaming. Application of Flipped Classroom Based on Micro-Lectures in Linear Algebra Teaching [J]. Journal of Xinjiang Normal University (Natural Science Edition), 2019, 38(01):76-79.