

Theoretical Construction and Operational Logic of an SPOC–Rain Classroom Integrated Smart Classroom for Vocational Qualification Training

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Abstract: Vocational qualification examination training is a key link in vocational education, while the disconnection between online and offline teaching, unitary evaluation mode and lack of personalized learning support have long restricted the teaching quality of nursing licensing training. This paper takes the integrated application of SPOC and Rain Classroom as the research object, sorts out the theoretical basis of blended smart classroom construction, including constructivism, personalized learning theory and process evaluation theory, constructs a three-stage closed-loop theoretical framework of pre-class independent construction, in-class interactive internalization and after-class iterative consolidation, and clarifies the complementary embedding operation logic of SPOC resource platform and Rain Classroom interactive terminal. Combined with the practical application experience of nursing qualification examination training in higher medical vocational colleges, this paper analyzes the adaptability of the embedded model to qualification-oriented courses, expounds the theoretical advantages of breaking the time-space limitation of teaching, realizing full-process learning data tracking and constructing a multi-dimensional evaluation system, and puts forward the standardized operation path of the smart classroom model. The research can provide theoretical reference for the digital reform of vocational qualification training courses in similar colleges and universities worldwide.

Keywords: SPOC; Rain classroom; Smart classroom; Blended teaching; Vocational qualification training

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1. Introduction

With the continuous deepening of the “Internet + Vocational Education” reform, digital teaching tools have been gradually integrated into professional teaching scenarios in vocational institutions. Vocational qualification examination training, as a core teaching link connecting campus learning with industrial practice, directly determines the quality of talent cultivation. The Nurse Licensure Examination (hereinafter referred to as “NLE”), as a mandatory entry qualification assessment for nursing students, features wide coverage of test points, highly fragmented knowledge, and equal emphasis on theory and practice.

The traditional offline centralized lecture model has long had prominent shortcomings: a uniform teaching pace fails to accommodate differences in knowledge proficiency among undergraduate and junior college students; classroom teacher-student interaction forms are monotonous; students lack long-term resource support for autonomous post-class learning; teachers cannot fully grasp the phased learning weaknesses of all students; and summative score-based evaluation cannot reflect the complete learning process.

Small Private Online Courses (SPOC), supported by modular and tiered online teaching resources, provide students with flexible channels for autonomous learning. As a localized smart teaching interaction platform, Rain Classroom enables digital transformation of offline classrooms through functions such as QR code check-in, real-time quizzes, bullet-screen interaction, and post-class learning analytics. Most existing domestic studies focus on empirical analysis of the teaching effectiveness of combining the two tools, using quantitative data such as exam pass rates and questionnaire scores as core evidence^[1]. However, few systematically deconstruct the internal mechanism of their integrated operation from the perspective of educational theory, and no standardized theoretical teaching framework adapted to qualification-oriented courses has been established. Meanwhile, most overseas blended teaching research takes MOOCs as the core carrier^[2], with relatively limited theoretical construction on localized teaching platforms, making it difficult to form a localized smart classroom theoretical model for international vocational education reference.

In response to these research gaps, this paper takes NLE training courses as the practical carrier. Grounded in three core educational theories—constructivist learning theory, personalized learning theory, and process evaluation theory—it systematically sorts out the functional boundaries and complementary relationship between SPOC and Rain Classroom. It establishes a three-stage integrated smart classroom theoretical framework of “pre-class—in-class—post-class” and clarifies the complete logic of dual-platform coordinated operation. This paper de-emphasizes quantitative score comparison and only uses the two-year course implementation practice of our institution from 2025 to 2026 as feasibility evidence for the model. It focuses on constructing the theoretical system of the teaching model, providing theoretical support and standardized implementation ideas for the digital reform of vocational qualification training both in China and abroad.

2. Core theoretical foundations for the integrated smart classroom

2.1. Constructivist learning theory

Constructivist learning theory holds that learning is not a passive process of receiving knowledge through one-way teacher instruction but an active process in which learners build their knowledge system based on existing cognitive structures and with the support of external learning resources^[3]. Traditional NLE training mainly relies on teachers lecturing on test points and conducting unified practice drills, where students passively receive knowledge, lack space for active knowledge organization and gap filling, and thus have low knowledge internalization efficiency.

The SPOC platform can divide teaching videos and chapter exercises according to NLE subject modules, allowing students to adjust their learning pace based on their own weak areas and mark difficult knowledge points independently, which aligns with the core constructivist proposition of “learner-centeredness.” Rain Classroom establishes real-time interaction channels during classroom sessions, guiding students to actively express their learning thoughts through in-class quizzes, group presentation screen sharing, and bullet-screen Q&A. This forms a two-way closed loop of online independent construction and offline interactive

consolidation, theoretically addressing the inherent limitations of one-way lecturing in traditional classrooms.

2.2. Personalized learning theory

Nursing students in vocational colleges come from diverse academic backgrounds: undergraduate students have relatively solid theoretical foundations and strong demands for advanced exam preparation, while junior college students have weaker foundations and focus on consolidating basic test points. Unified teaching resources cannot meet the differentiated learning objectives of the two groups.

Tiered learning theory proposes that teaching resources and learning tasks should be graded according to learners' original cognitive levels to implement individualized instruction ^[4]. The SPOC platform can build a tiered resource library: basic-level resources for junior college students, covering textbook basics and introductory exercises; advanced-level resources for undergraduate students, including difficult past exam questions, comprehensive cases, and expanded test point analysis. Rain Classroom can quickly identify the proficiency stratification of the class through pre-class quiz data. Teachers can dynamically adjust the focus of classroom instruction based on real-time answer accuracy, forming a theoretical closed loop of tiered resource provision and tiered classroom teaching, and effectively addressing the challenge of delivering unified instruction to students at varied proficiency levels.

2.3. Whole-process developmental evaluation theory

Traditional NLE teaching evaluation only takes the final exam score as the sole criterion, which is a typical summative evaluation that cannot reflect students' complete learning status, including pre-class preparation, classroom participation, and post-class consolidation. Developmental evaluation theory advocates that evaluation should run through the entire learning cycle, take into account both process performance and outcomes, and comprehensively assess learning effectiveness through multi-dimensional data ^[5].

SPOC can record students' video viewing duration, exercise completion rates, and personal error logs; Rain Classroom retains comprehensive classroom data such as check-in records, in-class quiz accuracy, classroom interaction submissions, and group assignments. The linkage and integration of data from both platforms form a process-oriented evaluation system covering the full cycle of pre-class, in-class, and post-class learning. This breaks through the theoretical limitations of single-score evaluation and realizes the goal of improving both learning and teaching through evaluation.

2.4. Blended learning theory

The core tenet of blended learning theory is to integrate the dual advantages of online digital autonomous learning and offline face-to-face classroom teaching, while avoiding the shortcomings of purely online learning (lack of supervision) and purely offline learning (limited resources) ^[6]. SPOC serves as the carrier for long-term online autonomous learning, while Rain Classroom acts as the digital interactive medium for offline classrooms. The two are not simply superimposed, but form a functionally complementary embedded relationship: basic knowledge points are learned independently online, while offline sessions focus on in-depth discussion of difficult problems; online data provide the basis for offline teaching adjustments, and questions arising from offline classrooms in turn drive updates to online resources, forming a bi-directionally linked blended learning operational system.

3. Construction of the SPOC–Rain Classroom integrated smart classroom theoretical model

3.1. Definition of dual-platform functional boundaries and integration logic

SPOC is primarily positioned as a resource carrier for long-term autonomous learning. Its core functions include pre-class preview resource provision, post-class tiered question bank delivery, and long-term learning data storage. Its key strengths include reusable resources, flexible task completion, and tiered content design; its main limitation is the lack of real-time teacher-student interaction channels, which prevents instant in-class learning feedback.

Rain Classroom is positioned as a digital interactive medium for offline classrooms. Its main functions include class check-in, real-time in-class quizzes, bullet-screen interaction, group achievement display, and real-time classroom learning analytics. Its advantage lies in instant in-class feedback and simultaneous participation of all students; its limitation is limited resource storage capacity, which cannot host long-term, tiered autonomous learning resources.

The core logic of their integration is “resources deployed online in advance, interaction delivered offline, and bidirectional data interoperability.” It aims to address the functional limitations of a single platform and form a complete closed-loop teaching system, rather than being a simple combination of two tools ^[7].

3.2. Three-stage closed-loop theoretical framework

3.2.1. Pre-class: SPOC-led autonomous knowledge construction stage

The theoretical objective of this stage is to complete an independent preview of basic test points, identify knowledge gaps in advance, and reduce the pressure of basic knowledge instruction in offline classrooms. The implementation pathway is as follows: teachers structure chapter resources on SPOC in accordance with the NLE syllabus, divide them into basic and advanced learning packages, and push preview notifications through Rain Classroom three to five days in advance; students independently watch corresponding teaching videos and complete supporting preview exercises, and the system automatically collects wrong answers and marked difficulties; SPOC aggregates the overall knowledge weaknesses of the class and synchronizes them to the Rain Classroom backend, providing data support for teachers’ instructional design. From a constructivist perspective, students independently complete the primary construction of knowledge at this stage and enter the classroom with questions, which significantly improves the pertinence of offline teaching ^[8].

3.2.2. In-class: Rain Classroom-led interactive internalization stage

The theoretical objective of this stage is to resolve difficulties left from preview, complete knowledge integration, and comprehensive application, and implement tiered teaching strategies. The implementation pathway is as follows: at the beginning of class, attendance is confirmed via Rain Classroom QR code check-in; teachers retrieve SPOC preview error data to deliver targeted explanations of high-frequency difficulties; four interactive sessions are interspersed: real-time pop-up quizzes, random roll-call, group mind-map screen sharing, and bullet-screen Q&A; real-time quiz data generate accuracy reports instantly, based on which teachers dynamically adjust the pace of instruction, supplement explanations for weak knowledge points, and expand analysis of advanced question types for undergraduate students. Relying on Rain Classroom’s interactive functions achieves full-class participation, effectively addressing the common problems of silence in traditional classrooms and the dominance of class discussion by a small number of students, and completing the second stage of knowledge internalization.

3.2.3. Post-class: Dual-platform collaborative consolidation and iteration stage

The theoretical objective of this stage is to address knowledge gaps, support sustained practice, and fully document process evaluation data. The implementation pathway is as follows: after class, Rain Classroom automatically archives all classroom responses and interaction records and synchronizes them to SPOC; teachers assign tiered post-class assignments based on integrated learning data from both platforms, with junior college students focusing on basic practice and undergraduate students adding comprehensive case analysis; students complete chapter tests on SPOC, and wrong answers are automatically recorded in personal error logs; teachers regularly export full-process learning data to form individual student learning archives as the basis for process evaluation, and simultaneously update SPOC online resources based on common class errors, closing the iterative loop of teaching improvement.

3.3. Theoretical advantages of the model for qualification training courses

First, it adapts to the fragmented nature of qualification examination test points. SPOC modular resources can be split into fragmented learning sessions, meeting students' needs for fragmented exam preparation in their spare time. Second, it meets the tiered teaching needs of multi-level student groups. Dual-platform linkage enables the full implementation of tiered resources, tiered instruction, and tiered assignments. Third, it supports the long-term exam preparation demand of qualification examinations, as full-process data tracking can accurately locate students' long-term knowledge gaps. Fourth, it aligns with the reform requirements of developmental evaluation in vocational education, breaking free from the constraints of single-score evaluation and establishing a multi-dimensional comprehensive evaluation system^[9].

4. Practical implementation pathways and theoretical value of the model

4.1. Standardized implementation pathways

Based on two consecutive years of NLE training course practice at our institution in 2025 and 2026, standardized theoretical implementation pathways adapted to qualification examination training can be summarized. This paper does not compare pass rates across years or set up a control group for quantitative analysis, and only demonstrates the operability of the model.

- (1) Step 1: Construction of the SPOC school-based resource system. All teaching units are structured in strict accordance with the NLE syllabus, and a two-tier resource library (basic and advanced) is built simultaneously, supplemented by three types of supporting resources: chapter exercises, mock test papers, and test point mind maps. A quarterly resource update mechanism is established to adjust resource content according to changes in NLE exam trends^[10].
- (2) Step 2: Construction of the dual-platform integrated linkage mechanism. Data synchronization channels between SPOC and Rain Classroom are opened to realize bidirectional transmission of preview notifications, learning status reports, and post-class archives. Standardized operating procedures for pre-class, in-class, and post-class stages are formulated, and the roles and responsibilities of teachers and students at each stage are clearly defined.
- (3) Step 3: Standardized design of tiered teaching processes. Differentiated learning task lists are developed for undergraduate and junior college student groups; tiered questions are set in classroom interaction sessions; and post-class assignments are divided into two modules: basic consolidation and comprehensive expansion.

- (4) Step 4: Supporting the construction of the whole-process evaluation system. Data such as SPOC learning duration and exercise completion rates are integrated with Rain Classroom class participation and quiz performance. Detailed scoring rules for process evaluation are formulated, and process performance is included in the comprehensive course assessment.

The model has operated smoothly over two years of teaching practice, and all components of the theoretical framework are implementable. Students' participation in online autonomous learning and enthusiasm for classroom interaction have both shown positive feedback, confirming that this integrated smart classroom model has practical feasibility and can be replicated and applied to other medical qualification training courses.

4.2. Theoretical value for domestic health vocational education

Most current domestic research on nursing teaching reform focuses on empirical testing of teaching effectiveness, lacking systematic theoretical model construction. This paper clarifies the underlying logic of the integrated operation of SPOC and Rain Classroom, constructs a standardized three-stage closed-loop theoretical framework, fills the theoretical gap in localized dual-platform blended teaching, and provides a complete theoretical reference for the reform of NLE training, medical licensing, and similar exam preparation courses in domestic health vocational institutions.

Meanwhile, the model designs a tiered teaching system for multi-level nursing students, which aligns with China's parallel undergraduate and junior college nursing talent cultivation system and effectively addresses the lack of layered education theory in local vocational education.

4.3. Theoretical reference value for international vocational education

Most overseas blended teaching research relies on the MOOC system, lacking theoretical models adapted to lightweight smart interaction platforms. Taking Rain Classroom as the core interactive carrier, this paper constructs an implementable blended teaching theoretical framework. It can provide localized reference ideas for digital teaching reform in vocational colleges in Southeast Asia, Africa, and other similar developing regions, enrich the global theoretical system of blended teaching for vocational qualification training, and fill the theoretical gap in international research on China-developed smart classroom models.

5. Research limitations and future directions

This paper only completes the model construction of the SPOC–Rain Classroom integrated smart classroom from the perspective of educational theory and demonstrates the operability of the model based on two years of practical operation. It has not yet conducted large-sample quantitative verification, nor has it collected questionnaire or qualitative interview data to refine the theoretical framework, which constitutes the main limitation of this research. In addition, the model is currently built only for the NLE training scenario, and its adaptability to other types of vocational qualification training, such as accounting and preschool education, remains to be explored in future research.

Future theoretical research can be advanced in three directions: first, introducing qualitative interviews and student learning motivation questionnaires to supplement empirical support for the theoretical model and refine details related to tiered education and process evaluation; second, expanding the applicable scenarios of the model by adjusting SPOC resource stratification logic and classroom interaction design for different

categories of qualification courses, to form a generalizable theoretical system of smart classrooms for vocational qualification training; third, combining artificial intelligence teaching tools to explore an expanded theoretical framework of AI question banks integrated with the existing dual-platform model, further to improve the theoretical system of digital vocational education.

6. Conclusion

The digital transformation of vocational qualification training is the core direction of modern vocational education reform. SPOC and Rain Classroom respectively fulfill the core functions of online autonomous learning and offline interactive teaching. The three-stage closed-loop smart classroom model formed by their integration, built on mature educational theories such as constructivist learning theory, tiered learning theory, and developmental evaluation theory, fundamentally solves multiple practical dilemmas of traditional NLE training, including a lack of tiered instruction, unitary evaluation, and online-offline fragmentation.

The standardized theoretical operational framework constructed in this study is not only adapted to the current situation of multi-level nursing vocational education in China but also provides localized theoretical reference for digital teaching reform in similar vocational colleges worldwide. Follow-up teaching practice and theoretical research will continue to refine the model details, expand adaptation pathways for multiple types of qualification training scenarios, and continuously enrich the theoretical system of “Internet + Health Vocational Education.”

Disclosure statement

The author declares no conflict of interest.

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