World Journal of Educational Studies
Print ISSN: 2959-9989
Online ISSN: 2959-9997
DOI: https://doi.org/10.61784/wjes3124

APPLICATION RESEARCH OF BOPPPS TEACHING MODEL BASED ON OBE CONCEPT SPOC PLATFORM IN HIGHER VOCATIONAL EDUCATION: A CASE STUDY OF INTERNAL MEDICINE NURSING COURSE

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Abstract: Objective: To investigate the implementation of a hybrid teaching model—integrating the BOPPPS framework within a SPOC platform under the guidance of the OBE concept—in internal medicine nursing courses at higher vocational colleges. Methods: The 2022 and 2023 higher vocational nursing students (here in after referred to as nursing students) from a university in Baise City, Guangxi were selected by cluster sampling method as the research subjects. The intervention group (n=236 implemented hybrid teaching based on the BOPPPS teaching model with the help of the SPOC platform, and the control group (n=216) adopted conventional teaching methods. The autonomous learning ability, critical thinking and test scores of the two groups of nursing students were compared. Results: The autonomous learning ability, critical thinking and test scores of the nursing students in the experimental group were higher than those in the control group (P<0. 05). Conclusion: The hybrid teaching based on the BOPPPS teaching model under the SPOC platform based on the OBE concept has a positive effect on improving the autonomous learning ability, critical thinking ability and test scores of nursing students.
Keywords: OBE; BOPPPS; SPOC; Internal medicine nursing; Higher vocational colleges

1 INTRODUCTION

Integral to China's workforce development strategy, higher vocational education cultivates practice-oriented professionals for frontline sectors [1]. Central authorities mandate pedagogical innovation, including technology-integrated active learning—to develop socioeconomically aligned technical talent [2]. The China Education Modernization 2035 blueprint further prioritizes heuristic and collaborative pedagogies to enhance clinical problem-solving capabilities, coupled with faculty digital upskilling [3]. This policy framework establishes student-centered, employment-driven training of operationally competent practitioners.

As a core nursing course in higher vocational education, Internal Medicine Nursing constitutes 30%-40% of the professional curriculum by instructional hours and nursing licensure examination content. Its extensive scope and high cognitive complexity contrast sharply with prevailing didactic approaches reliant on passive multimedia delivery and large-class lectures. Current pedagogical limitations include: (1) Inadequate learning monitoring: Delayed feedback impedes personalized instruction; (2) Deficient learner engagement: Weak professional identity and self-directed motivation; (3) Critical skill gaps: Underdeveloped clinical reasoning, communication, and praxis translation—evidenced by theory-practice disconnects in case management. In the digital education era, this outdated model failed to meet national competency benchmarks. An urgent paradigm shift toward pedagogically structured, technology-enhanced teaching is imperative.

Proposed by Spady (1981), outcome-based education (OBE) centers on measurable competencies as the endpoint of curriculum design and delivery [4]. This learner-centered paradigm—alternatively termed competency-, goal-, or demand-driven education—has demonstrated efficacy in engineering pedagogy, online instruction, and general education reform [5]. Its core principles shift focus from content coverage to attainment validation, enhancing learner engagement, knowledge internalization, and clinical decision-making confidence. This empirical foundation positions OBE as a viable framework for optimizing medical education design. Small Private Online Courses (SPOC) leverage massive open online courses (MOOC) infrastructure to deliver targeted instruction for specialized cohorts, characterized by a three-phase pedagogical architecture: (1) Asynchronous video engagement where learners identify clinical reasoning challenges; (2) Instructor-facilitated discussions scaffolding preview-derived queries; and (3) Dynamic deployment of digital resources aligned with curricular objectives and learner needs [6-7]. This blended model demonstrates enhanced knowledge retention and diagnostic skill refinement, establishing SPOC as an evidence-based modality for medical education innovation.

The Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary (BOPPPS) teaching model originates from the Instructional Skills Workshop International Training Program (ISW-ITP), a faculty development system accredited by Originating from Canada's British Columbia Campus (BC campus), the BOPPPS model operationalizes student-centered pedagogy through six sequenced phases: Bridge-in (engagement stimulus), Objective (competency targets), Pre-assessment (baseline diagnostics), Participatory learning (active construction), post-assessment (outcome validation), and Summary (metacognitive consolidation) [8-9]. Empirical studies

demonstrate that strategic Bridge-in design elevates classroom engagement, while full-cycle implementation optimizes instructional scaffolding and knowledge retention [8-9]. Crucially, integrated Pre-/Post-assessment enables real-time learning analytics, permitting precision knowledge delivery and adaptive intervention, particularly vital for clinical reasoning development in nursing education. These evidence-based advantages establish BOPPPS as a methodologically robust framework for this investigation.

The OBE-anchored BOPPPS-SPOC integrated framework constitutes an evidence-based blended learning model, characterized by competency-driven design, multimodal resource curation, and real-time outcome analytics. This approach operates through three scaffolded phases: (1) Pre-class deployment of clinical simulations aligned with core competencies; (2) In-class facilitation of case-based peer critiques with deliberate practice scaffolding; and (3) post-class remediation using predictive analytics to close individual competency gaps. In this study, we implement this outcome-engineered model in Internal Medicine Nursing education, measuring clinical judgment maturation (Clinical Judgment Rubric) to advance precision nursing education.

2 METHOD

2.1 Study Population

A prospective, non-randomized cluster-controlled trial with parallel cohorts was conducted, adhering to the TREND statement for non-randomized interventions [10]. Cluster sampling was performed at a tertiary vocational medical college in Central China between September 2024 and January 2025 after obtaining informed consent. This resulted in two cohorts: 2022-level nursing students forming the Control group (n = 216) and 2023-level nursing students forming the Intervention group (n = 236). Participants were included if they met all the following criteria: (1) enrollment in a 3-year vocational nursing program, (2) completion of prerequisite courses (Human Anatomy, Pathophysiology, Biochemistry, Nursing Psychology, Health Assessment), and (3) first-time enrollment in the Internal Medicine Nursing course during their second academic year. Participants were excluded based on: (1) discontinuation due to medical leave exceeding 4 consecutive weeks, or (2) absenteeism exceeding 20% of scheduled sessions. There was no statistically significant difference in age and gender between the two groups of patients (P=0.984 and P=0.097, respectively).

2.2 Textbooks and Teaching Content

Both the control and experimental groups undertook the Internal Medicine Nursing course during the first semester of their second year. The textbook used was the 1st edition of Internal Medicine Nursing, edited by Wang Xinying and Wang Suorong and published by People's Medical Publishing House (PMPH). Identical teaching faculty and course syllabi were employed for both groups, with all theoretical and practical instruction delivered by the same full-time faculty members. The unit on "Nursing Care for Cerebrovascular Diseases" (totaling 3 credit hours) within this course was selected as the specific teaching content exemplar for this study.

2.3 Teaching Methods

2.3.1 Control group

The control group adopted the traditional classroom teaching method; the course is taught according to the conventional teaching method. The specific process is: first, teachers and students review the key points of the previous lesson together, introduce the new lesson through cases, and the teacher teaches according to the requirements of the syllabus. Finally, the key points of this lesson are summarized, and homework is assigned.

2.4.1 Intervention group

The intervention group adopted the BOPPPS hybrid teaching model based on the OBE concept under the SPOC platform. The detailed step is as follows:

(1) Pre-class: According to the curriculum standards, teaching objectives are set up, and online learning and communication platforms (QQ groups, WeChat groups, etc.) are established. One week before class, teachers publish learning task sheets, micro-classes, PPTs, animations, teaching cases, and post-preview test questions for course knowledge modules on the online MOOC platform and arrange pre-class tasks through the online learning and communication platform. Students complete pre-class learning as required (reading tasks, self-learning of pre-class knowledge, completing pre-class exercises, and marking learning confusions). Questions, confusions, and difficult-to-understand knowledge points in the pre-class are sent to the lecturer through the QQ group and WeChat group. The teacher prepares the teaching content based on the students' pre-class feedback and common problems.

(2) In-class: Phase 1: Course introduction. After students have completed pre-study, they will be introduced to the course in the online MOOC discussion area. The instructor will post cases, knowledge expansion links, social focus, thinking questions, and animations related to the teaching knowledge module in the discussion area to stimulate students' curiosity through discussion. → Phase 2: Goals. According to the teaching standards of the "Internal Medicine Nursing" professional course and the typical job task requirements of the position, the teaching objectives are determined, and they are uploaded to the MOOC one week before the class, so that students can complete the pre-study tasks with the teaching objectives. → Phase 3: Pre-test. The teacher will post the pre-class test questions on Rain classroom 2 days before the class. One day before the class, the teacher will analyze the test results to understand and judge the students' knowledge and ability weaknesses and adjust the content and objectives of the classroom teaching

accordingly. → Phase 4: Participatory learning. Based on the teaching objectives and job requirements, the teacher will determine the key points and difficulties of classroom teaching in combination with the pre-test results. In the classroom teaching, different teaching methods (student group discussion, scenario simulation, role-playing, etc.) are used according to different knowledge points, and the content of internal medicine nursing skills is organically integrated in a timely manner. →Phase 5: Post-test. Teachers set post-test questions based on the course teaching objectives, job competency requirements (including clinical practice ability training), teaching difficulties, and students· problems before and during class, and use a high-simulation electronic manikin system for assessment. →Phase 6: Summary. Summarize the teaching effect of the knowledge module of this course, analyze the problems and deficiencies of students in basic knowledge learning and application, professional skills mastery, and professional ability development, and propose solutions and suggestions for the problems. Finally, test questions are issued for common problems to check for omissions and further consolidate knowledge.

(3) Post-class: The person in charge of the "Internal Medicine Nursing" course organized all the teaching staff to conduct a discussion and summary, completing the process discussion and summary (students' online learning participation, pre-class preparation results, students' classroom teaching participation, group discussion and exchange activities participation, etc.), and the result discussion and summary (students' regular and final theoretical and practical examination scores, student questionnaires and interview results, test papers, etc.) → Based on the characteristics of this course, put forward improvement suggestions and guide the next step of teaching.

The design of the specific teaching process is introduced using the nursing care of patients with cerebrovascular diseases as an example. The teaching design is shown in Table 1.

Table 1 Nursing Care for Patients with Cerebrovascular Diseases: BOPPPS Hybrid Teaching Design Based on OBE Concept SPOC Platform

Time	Contents
Pre-class	Rain classroom pushes "pre-class learning task list" to help students complete pre-class independent learning. 1) Students go to the MOOC "Internal Medicine Nursing" knowledge map to learn cerebrovascular disease knowledge online according to the task list, and teachers supervise and feedback online. 2) Assigned individual pre-class subjective homework. After completing the homework, students take photos and upload them. Pre-class homework only counts completion points, not right or wrong points. 3) Assigned group pre-class tasks (report and present the discussion results in the form of PPT). To encourage group students to actively discuss and cooperate, every group member must participate, and each member must be assigned a task. The task topics include the following aspects: ① What are the three major diseases that currently cause human death? ② What are patients most worried about? ③ What is our main task as medical workers? ④ What are the upper limb spasticity patterns of hemiplegic patients? ⑤ Why is the side-lying position beneficial to patient recovery? ⑥ My opinion on the case of "White Strongman"? Episode 4: A taxi driver usually has a mild personality, but recently his temperament has changed drastically, and he is very irritable and irritable, causing a major traffic accident. After being admitted to the hospital for examination, it was found that it was caused by a brain tumor. Where is the brain tumor located? Why did it cause personality changes? Episode 10: A female patient was admitted to the hospital due to cerebral arteriovenous malformation. After arguing with others, she suddenly had a severe headache and vomited. What might be the reason? Episode 18: A worker was crushed by a heavy machine, resulting in severe cerebral hemorrhage. The doctor directly opened the skull without any medical equipment on site. Why did he take the risk to do so? 4) The task list emphasizes that the understanding and mastery of cerebrovascular diseases is the prerequisite for further exploration of the course.
In-class	The course is carried out in the order of "pre-class introduction - knowledge point sorting - raising questions - group competition (discussion + mutual evaluation) - learning feedback". 1) Pre-class test. The questions are 9 basic multiple-choice questions, multiple-choice questions and judgment questions to test students' pre-class learning effect. 2) Introduction of cerebrovascular diseases. The course content is introduced through the introduction of photos of celebrities such as Stalin, Roosevelt, and Churchill, and three pre-class debate questions (① What are the three major diseases that currently cause human death? ② What are patients most worried about? ③ What is our most important task as medical workers?). When answering the three questions, each group went to the podium to report and display in the form of PPT. There were 4 groups in each class, and each group had a time limit of 3 minutes to report. Other groups scored. 3) Knowledge point sorting. Focus on explaining the problems that occurred in the pre-class online test, personal homework, and pre-class test. 4) Constantly throwing questions. To cultivate students' high-level thinking abilities such as problem solving and in-depth thinking, questions are thrown in class: ① If someone around you suddenly speaks unclearly and has a crooked mouth, how would you judge whether he has a stroke? Use observation questions in life to introduce the knowledge of cerebrovascular diseases in this class. ② Is cerebrovascular disease a stroke? Is stroke equivalent to cerebrovascular disease? Why do some people recover almost completely after a stroke, while others are left with serious functional impairments? What are the reasons behind this? What is the difference between ischemic and hemorrhagic strokes? Which is more dangerous? Introduce the definition and classification of cerebrovascular diseases so that students can better understand the definition and

	classification of cerebrovascular diseases. The method of asking questions and on-site interaction is fascinating, so that students know the truth and the reason. ③ Why do high blood pressure and diabetes greatly increase the risk of stroke? Why does arteriosclerosis cause ischemic stroke? How do blood clots form and block cerebral blood vessels? Why does intracranial pressure increase after a hemorrhagic stroke? What are the hazards of increased intracranial pressure to brain function? Which organ is most likely to be damaged when hypoxia occurs? Introduce knowledge points such as cerebrovascular anatomy and risk factors. ④ When preparing to talk about the FAST principle, please demonstrate how the "FAST" principle can be used to determine stroke? And give several different patient symptoms, so that students can quickly determine whether it is an ischemic stroke or a hemorrhagic stroke? ⑤Suppose you are an emergency nurse and receive a patient suspected of stroke. How should you assist the doctor in making a preliminary diagnosis and treatment? Do you know what the "golden 4.5 hours" is? Why does the treatment of stroke emphasize time so much? Introduce knowledge points such as first aid measures. ⑥Why is the earlier the better for rehabilitation training after stroke? Is late rehabilitation still useful? Provoke students to think. 5) Group discussion, competition performance, and mutual evaluation. In order to encourage students to think and discuss, the "White Strongman" case and questions are pushed through Yu Classroom in the group competition performance. After independent thinking and peer discussion, the group students go on stage to make PPT reports. The group students discuss and summarize and share ideas, and the teacher makes supplementary summaries. The group evaluates and scores each other, and the teacher confirms the fairness of the scoring after class. 6) Feedback on learning this week. To encourage students to actively summarize, reflect and make suggestions, feedback in the form of subjective questions is set at the end of the class. Students respond to their self-study situation, satisfaction, learning confusion or suggestions in real time.
Post-class	1) Provide additional answers (text) based on students' classroom learning feedback. 2) Assign personal after-class homework within a limited time and score according to the correctness rate. 3) Assign personal optional after-class extension homework, including but not limited to drawing a mind map of cerebrovascular disease knowledge map, using simulated electronic people to conduct stroke treatment simulation drills, etc. 4) The cumulative public announcement of the group experience value of this class (before class + during class). Before class, the group performance accumulates experience value according to cooperative discussion and PPT completion, and the class accumulates experience value according to the group competition ranking. 5) Knowledge point hyperlink expansion, introduction to stroke treatment guidelines.

The flow chart of the BOPPPS teaching model under the SPOC platform is shown in Figure 1:

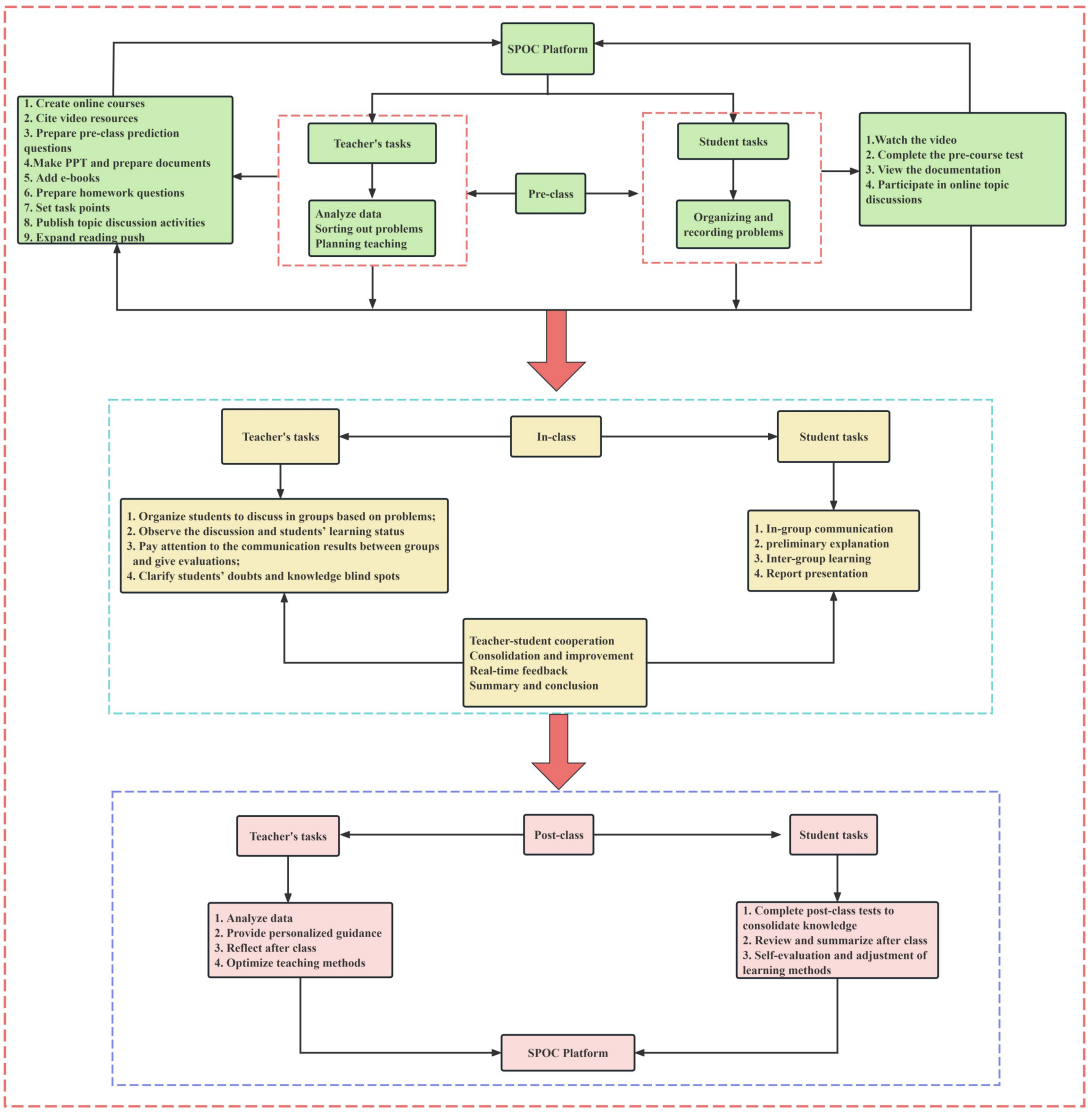

Figure 1 The Flow Chart of the BOPPPS Teaching Model under the SPOC platform

2.5 Evaluation Indicators

2.5.1 Autonomous learning ability

The scale was compiled by Zhang Xiyan et al [11]. It includes 4 dimensions: learning motivation, self-management ability, cooperation ability, and information literacy. There are 30 items in total. The Likert 5-level scoring method is used. Full compliance is 5 points, and full non-compliance is 1 point. The reverse statement items include 10, 16, 20, 24, and 28 for reverse scoring. The total score is 30-150 points, including 8-40 points for learning motivation, 11-55 points for self-management ability, 5-25 points for cooperation ability, and 6-30 points for information literacy. The higher the score, the stronger the autonomous learning ability. The Cronbach's a of the scale is 0.82, and the Cronbach's α of each dimension is 0.77, 0.79, 0.86, and 0.74, respectively.

2.5.2 Clinical thinking ability scale

The clinical thinking ability scale compiled by Song Junyan [12] was used, which includes three dimensions: critical thinking (6 items), systematic thinking (11 items), and evidence-based thinking (7 items), with a total of 24 items. Each item uses the Likert 5-point scoring method, ranging from 1 to 5 points from "very poor ability" to "very good ability". The higher the score, the stronger the clinical thinking ability. Cronbach's α coefficient of the scale is 0.909, and the test-retest reliability is 0.839, with good reliability and validity.

2.5.3 Academic performance

The final examination scores of the two groups of nursing students were compared. The examination papers were set by the same lecturer to ensure that the examination knowledge points, and difficulty was consistent. Included objective structured clinical examination (OSCE) skill score (30%) and theoretical score (70%).

2.6 Statistical methods

All data analysis will be conducted using the STATA statistical software package, Release 17.0 (Stata Corp LLC, College Station, Texas, USA, 2019). The count data of the two groups were expressed as [n (%)], and the chi-square test was used for comparison between the two groups. The measurement data of the two groups were described by mean ±

standard deviation (x ± s), and the values between the two groups were compared using independent sample t-test, with P < 0.05 indicating statistically significant differences.

3 RESULT

3.1 Comparison of Autonomous Learning Ability Scores between Intervention and Control Groups

The intervention group (n = 236) had significantly higher scores than the control group (n = 216) in all dimensions of autonomous learning ability ($P < 0.001$): learning motivation (34.5±2.79 vs 26.1±4.95, t = 22.3), self-management ability (44.5±4.45 vs 31.7±5.82, t = 26.5), learning cooperation ability (20.9±2.38 vs 12.1±2.54, t = 37.8) and information literacy (23.0±2.76 vs 13.4±1.97, t =42.5), and the total score difference was the most significant (122.9±6.29 vs 83.3±8.00, t = 58.8) (See Table 1 for details) (Table 2).

Table 2 Comparison of Autonomous Learning Ability Scores of Two Groups of Higher Vocational Nursing Students (Mean±SD, Points)

Group	N	Learning motivation dimension	Self-management ability dimension	Learning cooperation ability dimension	Information literacy dimension	Autonomous learning ability total score
Intervention group	236	34.5 ± 2.79	44.5 ± 4.45	20.9 ± 2.38	23.0 ± 2.76	122.9 ± 6.29
Control group	216	26.1 ± 4.95	31.7 ± 5.82	12.1 ± 2.54	13.4 ± 1.97	83.3 ± 8.00
T value		22.3	26.5	37.8	42.5	58.8
P		<0.001*	<0.001*	<0.001*	<0.001*	<0.001*

** P<0.001*

3.2 Comparison of Critical Thinking Ability Scores between Intervention and Control Groups of Higher Vocational Nursing Students

The intervention group (n = 236) demonstrated significantly higher scores than controls (n = 216) in total critical thinking ability (22.3±1.65 vs 13.1±1.69, t = 58.3), system thinking ability (34.2±2.25 vs 22.7±2.28, t = 53.8), and evidence-based thinking ability (19.7±1.55 vs 13.2±1.78, t = 42.0), with all comparisons P < .001. The largest effect was observed for total critical thinking ability (t = 58.3) (Table 3).

Table 3 Comparison of Critical Thinking Ability Scores between the Two Groups of Higher Vocational Nursing Students (Mean±SD, Points)

Group	N	Total critical thinking ability score	Total score of system thinking ability	Total score of evidence-based thinking ability
Intervention group	236	22.3 ± 1.65	34.2 ± 2.25	19.7 ± 1.55
Control group	216	13.1 ± 1.69	22.7 ± 2.28	13.2 ± 1.78
T value		58.3	53.8	42.0
P		<0.001*	<0.001*	<0.001*

** P<0.001*

3.3 Comparison of Written Test, OSCE Skills, and Total Scores between Intervention and Control Groups

The intervention group (n = 236) achieved significantly higher written test scores (86.9±9.52 vs 71.3±11.38, t = 15.82), OSCE skills scores (90.9±6.68 vs 87.1±6.66, t = 6.12), and total scores (88.1±7.12 vs 76.0±8.57, t=16.31) than controls (n = 216) ($P < .001$). The most substantial difference was observed in total scores (*t*=16.31), while OSCE skills showed the smallest effect size (t = 6.12) (Table 4).

Table 4 Examination Scores of Two Groups of Higher Vocational Nursing Students (Mean±SD, Points)

Group	N	Written Test Scores	OSCE Skills Scores	Total score
Intervention group	236	86.9 ± 9.52	90.9 ±6.68	88.1 ± 7.12
Control group	216	71.3 ± 11.38	87.1±6.66	76.0 ± 8.57
T value		15.82	6.12	16.31
P		<0.001*	<0.001*	<0.001*

** P<0.001*

4 DISCUSSION

Against the backdrop of nursing discipline advancement and the escalating complexity of healthcare environments, cultivating nursing professionals equipped with lifelong learning capabilities, critical thinking, and a high degree of autonomous practice has emerged as a paramount objective in global nursing education [13-16]. In response to this imperative, the present study developed and implemented a structured blended teaching model by deeply integrating the OBE philosophy with a SPOC platform, structured around the BOPPPS framework. Application of this model in nursing education demonstrated that it not only effectively enhanced students' theoretical performance and practical skills but also significantly stimulated their capacity for self-directed learning.

4.1 The Hybrid Teaching of BOPPPS Teaching Mode Based on OBE Concept and SPOC Platform can Stimulate the Autonomous Learning Ability of Nursing Students

In contrast to the traditional teacher- and textbook-centered approach in nursing education, which often results in relatively passive student engagement, the blended teaching model developed in this study represents a core innovation through the organic integration of three key dimensions: the guiding philosophy of Outcome-Based Education (OBE), the systematic structure of the BOPPPS instructional framework, and the technological enablement of the SPOC platform. Together, these elements form an interlinked, continuously improving pedagogical system designed to empower learners. Specifically, the OBE approach adheres to a "backward design" principle, whereby clear, measurable, and professionally relevant competency outcomes—such as "independently developing an evidence-based health education plan for patients with cerebrovascular disease"—are communicated to students from the very beginning of the course [17-18]. This establishes a definitive "navigational beacon" for self-directed learning, shifting students' perspective from passively completing coursework to actively pursuing competency attainment [19-20]. This internalized sense of purpose becomes a intrinsic driver for planning their learning, seeking resources, and evaluating progress. The BOPPPS structure, through its six-phase cycle (Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary), creates a coherent instructional loop aligned with cognitive principles, serving as a scaffold for autonomous learning [21]. It begins by sparking interest through clinically authentic scenarios, moves to self-diagnosis via pre-assessment, engages students in active thinking and collaboration through participatory methods such as case discussions and simulations, and concludes with post-assessment and summary to foster reflection and feedback. This structured process guides students through a continuous cycle of "anticipation, exploration, verification, and reflection," equipping them with sustainable learning strategies. Meanwhile, the SPOC platform transcends the role of a mere content repository to become a critical enabler that extends the "main arena" for self-directed learning [22]. It offers structured yet personalized learning pathways, allowing students to progress at their own pace [23]. Its interactive and data-driven features—such as asynchronous in-depth discussions, learning analytics, and embedded formative assessment tools—not only make the learning process visible and enable targeted instructor intervention but, more importantly, enhance students' self-monitoring and self-regulation capabilities, granting them genuine autonomy over the time, place, and pace of their learning [24-26]. This systematically designed external instructional framework effectively promotes positive shifts in learners' internal psychological processes: under the joint influence of OBE's clear goal orientation and the SPOC platform's empowering affordances, students transform from "task recipients" into "responsible agents." Within the participatory and reflective cycle of BOPPPS, their cognitive approach evolves from "superficial memorization" to "deep construction" of knowledge. Ultimately, through meaningful, challenging, real-world tasks and interactive experiences, their motivation shifts from being extrinsically driven by grades or attendance to being intrinsically fueled by genuine interest and value recognition in the nursing profession.

4.2 The Hybrid Teaching of BOPPPS Teaching Model Based on OBE Concept and SPOC Platform has a Positive Impact on the Critical Thinking Ability of Nursing Students

Critical thinking, as a core competency essential for ensuring safety, effectiveness, and ethically sound clinical decision-making, holds paramount importance in nursing education [13]. The blended BOPPPS teaching model developed in this study—grounded in the OBE concept and delivered via a SPOC platform—demonstrates a profound and positive impact on cultivating critical thinking abilities among nursing students through its systematic design of "goal orientation, structural scaffolding, and environmental enablement." The model first employs the OBE approach to explicitly define higher-order cognitive outcomes—such as analysis, evaluation, and creation—as essential competencies to be achieved. For instance, a learning outcome like "develop and justify an individualized care plan for a complex clinical case" transforms critical thinking from an abstract ideal into a concrete learning "target," guiding students from the outset to engage in information discrimination, logical reasoning, and comparative evaluation of options. Furthermore, the BOPPPS framework provides a repeatable and traceable "training ground for thinking [27]." Its "Bridge-in" and "Participatory Learning" phases create an authentic "problem space" by presenting real-world clinical scenarios characterized by uncertainty or ethical dilemmas, necessitating active questioning, contextual linking, and clinical reasoning [28]. The "Pre-assessment" and "post-assessment" components help uncover reasoning gaps and foster metacognitive reflection, while the "Summary" phase assists students in distilling generalizable thinking frameworks from specific cases, thereby advancing from experiential learning to methodological mastery. Simultaneously, the SPOC platform significantly expands the dimensions for cultivating critical thinking. Its asynchronous discussion function allows students to engage in deep, literature-based, logically structured, and revisable deliberative exchanges [29]. This textual and structured interaction encourages more prudent argumentation, more

precise use of evidence, and makes the thinking process visible, thereby enabling targeted instructional guidance. More importantly, the model embeds the development of critical thinking within a dual-motivation framework of "self-directed learning" and "professional identity formation [30]." As students experience professional responsibility and competence by achieving high-order outcomes, their drive to cultivate critical thinking shifts from external examination pressure to an internalized value commitment toward becoming a competent and accountable nurse. In summary, this model does not merely impart thinking skills in isolation. Rather, by integrating targeted competency outcomes, a structured training process, and an interactive technological environment, it reconstructs the entire learning ecosystem. This makes the development of critical thinking a natural emergent property and an inevitable requirement in students' pursuit of professional competency, offering a highly operational and theoretically coherent practical pathway for the systematic cultivation of this core literacy in nursing education.

4.3 The BOPPPS Teaching Model Based on the OBE Concept and SPOC Platform is Helpful to Improve the Learning Performance of Nursing Students

Learning performance, encompassing not only academic achievement but also the integration of knowledge, the proficiency of skills, and the sustainability of competencies, serves as a critical indicator of educational effectiveness [31]. The blended BOPPPS model, underpinned by the OBE framework and implemented via a SPOC platform, demonstrates a structured and synergistic approach to significantly improving the learning performance of nursing students [32]. This enhancement is achieved not through isolated interventions, but through a coherent pedagogical architecture that aligns objectives, process, and assessment. Fundamentally, the OBE concept redefines the endpoint of learning, shifting the focus from content coverage to demonstrable competency [33]. By establishing clear, measurable, and clinically-relevant outcomes at the outset—such as "conduct a comprehensive and culturally sensitive patient assessment" or "safely administer a complex medication regimen"—the model provides students with a transparent roadmap for success. This clarity reduces cognitive load related to uncertainty about expectations and directs student effort strategically toward mastering essential competencies rather than memorizing disjointed facts [34]. The alignment of all teaching activities and assessments with these predefined outcomes ensures a consistent and targeted learning experience, where every instructional element contributes directly to performance goals. The BOPPPS instructional framework operationalizes this outcome-oriented approach into a dynamic and engaging learning cycle. Its phased structure scaffolds the learning progression systematically. The Bridge-in phase activates prior knowledge and creates relevance, priming students for deeper engagement. The Objective phase reinforces the OBE goals, maintaining focus. Pre-assessment acts as a diagnostic tool, allowing both instructors and students to identify knowledge gaps early, enabling timely remediation and personalized focus [32]. The core Participatory Learning phase, through case-based discussions, simulations, and collaborative projects, transforms passive recipients into active constructors of knowledge. This active processing is crucial for deep understanding and long-term retention, directly translating into superior performance on applied assessments. Finally, the Post-assessment and Summary phases create essential feedback loops. They offer students opportunities to demonstrate their learning, receive formative feedback, and consolidate their understanding, thereby closing the gap between current and desired performance. The SPOC platform serves as the technological engine that amplifies and extends the effectiveness of this pedagogical design. It enables the consistent delivery of the BOPPPS structure outside the physical classroom, ensuring all students have access to core resources, structured activities, and asynchronous guidance. Its capacity for delivering multimedia content (e.g., procedural videos, interactive diagrams) caters to diverse learning preferences, enhancing comprehension. More importantly, the platform facilitates continuous formative assessment through quizzes, discussion analytics, and peer-review exercises. This provides real-time data on student progress, allowing for early intervention and support. The platform also fosters a learning community where students can learn from each other's questions and insights, thereby enriching the collective understanding and performance. The synergy of these three components creates a powerful ecosystem for improving learning performance. The OBE goals provide direction, the BOPPPS cycle provides the scaffolded journey, and the SPOC platform provides the flexible and data-rich environment. This integration leads to more motivated learners (due to clear relevance and active involvement), more efficient knowledge acquisition and skill development (due to structured practice and immediate feedback), and ultimately, more robust and transferable competencies as evidenced by improved performance in both theoretical evaluations and practical/clinical assessments. Therefore, this model moves beyond merely transmitting information; it systematically engineers the conditions for optimized and sustained learning achievement in nursing education.

5 ETHICAL STATEMENT

All participants were voluntarily recruited through a announcement and provided informed consent prior to their engagement in this study, which guaranteed anonymity and strictly limited the use of responses to research purposes in compliance with standard ethical guidelines.

6 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

While this study demonstrates the potential benefits of the OBE-SPOC-BOPPPS model, several limitations must be acknowledged to contextualize the findings and guide future research. First, the study was conducted within a single institution and involved a specific cohort of nursing students. The sample size, while adequate for the preliminary

analyses, may limit the generalizability of the results to other nursing schools with different curricula, faculty expertise, student demographics, or technological infrastructures. Multicenter studies with larger and more diverse populations are needed to validate the robustness and transferability of this model across varied educational settings. Second, the assessment of outcomes such as self-directed learning ability and critical thinking, though employing validated instruments, still relies partially on self-reported data and instructor evaluations, which may be subject to biases. While quantitative scores showed positive trends, incorporating more objective, longitudinal performance metrics—such as long-term knowledge retention rates, objective structured clinical examination (OSCE) scores over time, or tracking clinical decision-making performance during internships—would strengthen the evidence for the model's sustained impact. Third, the implementation of this integrated model places significant demands on both faculty and students. The requirement for instructors to design OBE-aligned content, create interactive SPOC materials, and facilitate the BOPPPS cycle represents a substantial time investment and necessitates advanced pedagogical and digital competencies. Similarly, students accustomed to passive learning required an adaptation period to fully engage with the self-directed and collaborative elements. The study's timeframe may not have fully captured this adaptation curve or the potential for instructor fatigue, which could influence long-term sustainability. Finally, the study primarily focused on the educational process and immediate learning outcomes within an academic setting. The ultimate test of any nursing education innovation is its impact on clinical practice and patient outcomes. This research did not trace whether the enhanced competencies observed in the classroom reliably translated into improved performance, confidence, or error reduction in real-world clinical placements or subsequent professional practice. Establishing this critical link remains an essential area for future investigation. Despite these limitations, this study provides a foundational framework and promising evidence for the model's value. The identified constraints clearly delineate pathways for further research and refinement.

7 CONCLUSION

This study developed and validated a blended teaching model that integrates the OBE philosophy, the BOPPPS framework, and the SPOC platform. The findings demonstrate that through its systematic "objective-process-environment" design, the model effectively stimulates nursing students' self-directed learning ability, promotes the development of critical thinking, and enhances their overall learning performance. It shifts the focus of education from teacher-led instruction to student-centered competency development, facilitating a transition from passive reception to active exploration. Whilst limitations remain in terms of generalizability, assessment methods, and implementation requirements, this model offers a clearly structured and practical pathway for transforming nursing education from knowledge transmission to competency cultivation. Future research should focus on conducting long-term, multi-center validations and exploring how such educational outcomes can be consistently translated into enhanced clinical performance, thereby cultivating nursing professionals with lifelong learning competencies who are better equipped to address future challenges in healthcare.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

FUNDING

This research was supported by the Department of Education of Guangxi Zhuang Autonomous Region (Guangxi Vocational Education Teaching Reform Research Project [Grant No: GXGZJG2024B267] and [Project Name: Application of the BOPPPS Teaching Model Based on the OBE Concept on the SPOC Platform in Higher Vocational Education: A Case Study of the "Medical Nursing" Course]; [Grant No: GXGZJG2022A057] and [Project Name:Blended Teaching Reform and Practice of 'Internal Medicine Nursing' Oriented by Cultivating Practical Application Ability under the OBE Concept).

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