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Evaluation of a Self-Directed Blended PAD Class in Undergraduate Reproductive System Disease Education

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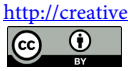

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Abstract

Objective: To evaluate a self-directed mixed PAD (Presentation–Assimilation–Discussion) class for teaching reproductive system diseases and to examine its effects on students' learning engagement, academic performance, and perceived clinical thinking. **Methods:** During the 2024-2025 fall semester, 294 fourth-year clinical medicine students at Chongqing Medical University were assigned by class, using computer-generated random numbers, to an experimental group (n = 141) or a control group (n = 153). The experimental group followed a three-stage sequence: an online micro-lecture preview, focused classroom teaching with inter-class case discussion, and online feedback and extension after class. The control group received conventional blended teaching. Class hours, syllabus, and assessment weights were identical in the two groups. The final grade combined process assessment (weighted to a maximum of 50 points) and the written final examination (weighted to a maximum of 50 points). Student and teacher satisfaction were assessed by questionnaire. **Results:** The experimental group scored higher than the control group on the weighted process-assessment component (44.02 ± 2.67 vs. 42.39 ± 3.54, $P < 0.001$) and on the total course score (82.74 ± 4.80 vs. 80.30 ± 7.12, $P < 0.001$); the weighted final-examination component did not differ significantly (38.72 ± 3.63 vs. 37.92 ± 3.99, $P = 0.071$). All eight student-satisfaction dimensions and all eight teacher-satisfaction dimensions favored the experimental group ($P < 0.05$). **Conclusions:** In this single-institution, class-level comparison, the mixed PAD class was associated with better process and total course scores and higher satisfaction among students and teachers. Whether it improves long-term clinical reasoning or transfer to clinical practice will require larger, multi-institutional longitudinal studies.

Keywords

Mixed PAD Class, Self-Directed Learning, Clinical Reasoning, Reproductive System Diseases, Medical Education

1. Introduction

Undergraduate medical education in China has shifted from a focus on quantity to a focus on quality, and an increasing number of courses are expected to link foundational knowledge with clinical reasoning. Diseases of the reproductive system are among the most challenging topics in clinical medicine curricula: the subject matter is abstract, the mechanisms are complex, and clinical instruction sometimes involves private patient information. Under traditional, teacher-centered instruction, students may have few opportunities for active participation and case-based reasoning (Zhang et al., 2024; Aulakh et al., 2025).

Blended teaching offers greater flexibility in scheduling and pace, but its effectiveness depends largely on how the online and face-to-face components are combined (Lockey et al., 2022; Li et al., 2024). For the flipped classroom, a related approach, meta-analyses have reported higher knowledge scores than traditional lecturing; however, the heterogeneity across studies is substantial, and pooled effects become smaller after adjustment for publication bias, so these benefits cannot be generalized to every course setting (Spaic et al., 2025; Peng et al., 2022). Against this background, we adopted the presentation-assimilation-discussion (PAD) class, in which knowledge delivery, individual internalization, and group discussion are arranged at different time points rather than compressed into a single session (Zhang, 2014). Within the existing class-hour allocation, we developed a self-directed blended PAD class for the reproductive system diseases course, comprising an online preview before class, focused teaching and interclass case discussion in class, and feedback and extension after class.

2. Materials and Methods

2.1. Participants and Allocation

Participants were fourth-year clinical medicine undergraduates taking the compulsory course Reproductive System Diseases in the fall semester of the 2024-2025 academic year. Students were eligible if they had completed the prerequisite basic medical courses, were taking the course for the first time, and agreed to the full evaluation. Students were excluded if they had interrupted or resumed their studies and no longer followed the original class schedule, had missed 20% or more of the classes or the final examination, declined to participate, or had incomplete data. Two parallel classes were allocated at the class level by computer-generated random numbers, with class 1 serving as the experimental group (n = 141) and class 2 as the control group (n = 153). The experimental group included 79 male and 62 female students, with a mean age of 20.86 ± 0.41 years; the control group

included 84 male and 69 female students, with a mean age of 20.79 ± 0.45 years. The two groups did not differ significantly in sex distribution or age ($P = 0.846$ and $P = 0.164$, respectively). The same teaching team taught both groups.

2.2. Teaching Intervention

The course comprised 93 class hours: 57 hours of theoretical instruction, 21 hours of clinical observation, and 15 hours of experimental sessions. The control group received conventional blended teaching, in which face-to-face lecturing was the main component and online resources were used for preview, review, and extension.

The experimental group received the self-directed blended PAD class, organized into three phases. Pre-class: within 24 hours before each session, students completed a 10 - 15-minute online micro-lecture and a basic preview task. In-class presentation: the teacher gave a condensed 15 - 20-minute presentation on the session's objectives, using flowcharts or mind maps where appropriate, and introduced a clinical case covering pathophysiology, clinical manifestations, diagnosis, and treatment. Consistent with the PAD principle of separating presentation from discussion, the case discussion was deferred rather than held immediately: during the first half of the following session, small groups discussed the case and raised questions, which the teacher answered before rating each group on the accuracy of its responses and the quality of participation. A "Show-Ask-Help" activity concluded this phase, in which each student presented one learning gain, tested a peer, and requested help on a remaining difficulty. Post-class: within 24 hours after each session, students wrote a brief reflection note; teachers answered questions online and used this feedback to adjust the next Session 2.3 Outcomes and assessment

2.3. Assessment of Learning Outcomes and Satisfaction

The final course grade (maximum 100 points) consisted of two equally weighted components: process assessment and the final written examination, each scored on a 100-point scale and then multiplied by 0.50. Process assessment comprised learning participation (10%), assignments (20%), online tests (40%), and discussion contributions (30%); the discussion score took into account the frequency and quality of participation as well as each student's contribution to the group. The final written examination covered male and female reproductive anatomy, pregnancy physiology, common gynecological diseases, pregnancy complications, normal and abnormal labor, breast diseases, and female pelvic-floor dysfunction. At the end of the semester, student and teacher satisfaction with the teaching model were assessed by questionnaire. The student questionnaire covered eight dimensions: interest in learning, clinical and analytical thinking, overall satisfaction with the teaching model, teamwork and discussion, learning efficiency and self-directed learning, theory–practice integration, knowledge consolidation and literature retrieval, and extracurricular burden and willingness to continue learn-

ing. All items were rated on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). The teacher questionnaire comprised eight dimensions: overall course experience and satisfaction, lesson preparation and innovation, classroom communication and facilitation, instructional design and technology integration, participation and motivation, resource use and instructional consistency, interactive feedback and learning support, and case-based teaching and practice guidance, rated on the same 5-point scale. The questionnaires were completed by 141 students in the experimental group, 153 students in the control group, and the 10 teachers involved in course delivery, each of whom rated the teaching model used in both classes.

2.4. Statistical Analysis

Analyses were conducted using Python 3.12 (Python Software Foundation). Continuous variables are presented as mean ± standard deviation. Student outcomes and student satisfaction scores were compared between groups using independent-samples t tests, with Welch's correction applied when variances were unequal on Levene's test. Because the same 10 teachers rated the teaching model used in both classes, teacher satisfaction scores were compared using paired-samples t tests, with Wilcoxon signed-rank tests performed as sensitivity analyses given the small sample size. Categorical variables are presented as n (%) and compared using chi-square tests. $P < 0.05$ was considered statistically significant.

3. Results

A total of 294 students were enrolled and included in the analysis: 141 in the experimental group and 153 in the control group. Both groups were taught by the same teaching team during the same semester, with identical syllabi, class hours, and assessment weights. At the end of the semester, satisfaction questionnaires were completed by all 294 students and by the 10 teachers involved in course delivery.

3.1. Academic Performance

As shown in Table 1, the experimental group scored significantly higher than the control group on the weighted process-assessment component (44.02 ± 2.67 vs. 42.39 ± 3.54; t = 4.488, $P < 0.001$). The weighted final-examination component was slightly higher in the experimental group, but the difference was not statistically significant (38.72 ± 3.63 vs. 37.92 ± 3.99; t = 1.812, $P = 0.071$). The total course score was significantly higher in the experimental group than in the control group (82.74 ± 4.80 vs. 80.30 ± 7.12; t = 3.470, $P < 0.001$).

3.2. Student Satisfaction

Student satisfaction ratings were significantly higher in the experimental group than in the control group across all eight dimensions (all $P < 0.01$; Table 2). The largest between-group difference was observed for learning efficiency and self-

directed learning (4.89 ± 0.36 vs. 4.50 ± 0.57; t = 6.904, $P < 0.001$), followed by overall satisfaction with the teaching model (4.85 ± 0.36 vs. 4.52 ± 0.59; t = 5.849, $P < 0.001$) and interest in learning (4.87 ± 0.36 vs. 4.56 ± 0.58; t = 5.509, $P < 0.001$). Interestingly, we also find significant differences in extracurricular burden and willingness to continue learning between the two groups. It may be explained by several factors. Firstly, the experimental group experienced learning across pre-, in-, and post-class phases. The preview and extension tasks were short, focused, and task-specific, which may have made the workload more manageable, and thus reduced the perceived burden of unstructured self-study compared with conventional blended teaching. Secondly, inter-class case discussion and timely online feedback likely enhanced students' perceived value and competence, which, consistent with self-determination perspectives, may have strengthened their willingness to continue learning. Thirdly, the control group's conventional blended format may have imposed a heavier and less scaffolded extracurricular load with less timely feedback, increasing perceived burden and weakening continuance intention.

Table 1. Comparison of weighted score contributions and total course score between groups (points, mean ± SD).

Group	n	Weighted process-assessment contribution (maximum 50 points)	Weighted final-Examination contribution (maximum 50 points)	Total course score (maximum 100 points)
Control	153	42.39 ± 3.54	37.92 ± 3.99	80.30 ± 7.12
Experimental	141	44.02 ± 2.67	38.72 ± 3.63	82.74 ± 4.80
t	-	4.488	1.812	3.470
P	-	<0.001	0.071	<0.001

Table 2. Comparison of student satisfaction between groups (mean ± SD).

Dimension	Experimental	Control	t	*P*
Interest in learning	4.87 ± 0.36	4.56 ± 0.58	5.509	<0.001
Clinical and analytical thinking	4.89 ± 0.31	4.63 ± 0.57	5.013	<0.001
Overall satisfaction with teaching model	4.85 ± 0.36	4.52 ± 0.59	5.849	<0.001
Teamwork and discussion	4.85 ± 0.40	4.58 ± 0.58	4.681	<0.001
Learning efficiency and self-directed learning	4.89 ± 0.36	4.50 ± 0.57	6.904	<0.001
Theory-practice integration	4.87 ± 0.36	4.61 ± 0.56	4.574	<0.001
Knowledge consolidation and literature retrieval	4.85 ± 0.38	4.68 ± 0.55	3.152	0.002
Extracurricular burden and willingness to continue learning	4.81 ± 0.45	4.51 ± 0.59	4.940	<0.001

3.3. Teacher Satisfaction

Teacher satisfaction ratings likewise favored the experimental teaching model on all eight dimensions (all $P < 0.05$; Table 3), with the largest between-group difference for instructional design and technology integration (4.80 ± 0.42 vs. 4.00 ± 0.67; t = 6.000, $P < 0.001$). Because the same 10 teachers rated both classes, paired-samples t tests were used; Wilcoxon signed-rank tests performed as sensitivity analyses yielded consistent conclusions. These teacher-based findings should be interpreted as exploratory.

Table 3. Comparison of teacher satisfaction between groups (mean ± SD).

Dimension	Experimental	Control	t	*P*
Overall course experience and satisfaction	4.80 ± 0.42	4.00 ± 0.82	4.000	0.003
Lesson preparation and innovation	4.70 ± 0.48	4.10 ± 0.74	3.674	0.005
Classroom communication and facilitation	4.80 ± 0.42	4.10 ± 0.88	3.280	0.010
Instructional design and technology integration	4.80 ± 0.42	4.00 ± 0.67	6.000	<0.001
Participation and motivation	4.60 ± 0.52	3.90 ± 0.74	4.583	0.001
Resource use and instructional consistency	4.60 ± 0.52	4.00 ± 0.67	3.674	0.005
Interactive feedback and learning support	4.70 ± 0.48	4.00 ± 0.67	4.583	0.001
Case-based teaching and practice guidance	4.70 ± 0.48	4.00 ± 0.82	4.583	0.001

4. Discussion

The defining feature of the PAD class is the separation of presentation from discussion: after the teacher introduces new material, students work through it individually before they are required to apply it in discussion (Zhang, 2014). This structure was preserved in our implementation. The online preview established an initial knowledge framework, the condensed classroom presentation focused on the core concepts, and the deferred case discussion then required students to retrieve and apply what they had learned on their own. All three steps were accommodated within the existing class hours rather than added to them.

The experimental group outperformed the control group in process assessment and the total course score, but not in the final written examination. This pattern suggests that the intervention influenced students' week-to-week learning behavior more than their performance on a single end-of-semester test. It should also be noted that the examination consisted mainly of recall- and reproduction-type items, which are not sensitive to the clinical reasoning that case discussion is intended to foster. Assessments incorporating more case-analysis and clinical decision-making items will therefore be needed before any claims about improved clinical reasoning can be made.

Students in the experimental group gave higher ratings on all eight satisfaction

dimensions. The weekly cycle of preview, group discussion, and reflection is consistent with self-determination theory, which holds that motivation is supported by autonomy, competence, and relatedness (Howard et al., 2021). In this course, students decided for themselves when to complete the preview tasks (autonomy), received continuous evidence of their progress through the discussions and online tests (competence), and worked in stable groups with the same peers throughout the semester (relatedness). These mechanisms were not measured directly, however, and should be regarded as possible explanations rather than demonstrated mediators. Our findings are in line with recent applications of the PAD class in health professions education. In a randomized trial on occupational bloodborne-exposure education for nursing students, the PAD class produced better test scores and stronger self-directed learning than conventional teaching (Wen et al., 2024), and blended PAD designs have yielded similar gains in neurosurgery and toxicology courses (Dai et al., 2022; Yu et al., 2023; Liu et al., 2024). The course design also shares key elements with case-based and online case-based learning (Varma et al., 2025; Donkin et al., 2023) and with team-based learning and peer instruction (Roossien et al., 2025; Fakoya et al., 2023), whose effectiveness has been documented in systematic reviews. Finally, the reflection and feedback components of the course are consistent with evidence linking reflective practice to critical thinking in medical students, although their specific contribution was not tested separately in this study (Khoshgoftar & Barkhordari-Sharifabad, 2023).

Teachers likewise gave higher ratings to the experimental teaching on all eight dimensions, which covered lesson preparation, classroom communication, feedback, and case-based guidance. Under this model, the teacher no longer lectures for most of the class period; the main tasks become delivering a condensed presentation, facilitating the case discussion, and summarizing at the end. This change in role places new demands on teachers. Core content has to be compressed without loss of accuracy, cases need to be designed in advance, expectations for discussion must be stated explicitly, and online questions require timely responses (Jiang & Shen, 2022). The format may be particularly suitable for reproductive health teaching, in which many topics are sensitive: written or anonymous questions lower the threshold for students to raise private concerns, and the teacher's closing summary ensures that the answers remain accurate and privacy is respected.

This study has limitations. It was conducted in two classes at a single institution, so generalization should be cautious, although the shared teaching team and identical syllabus and assessment kept the teaching model as the main difference between groups. Satisfaction was self-reported, but its consistent direction across all sixteen dimensions, which raises the limitation that expectancy and social-desirability effects might have influenced responses. Besides, we must acknowledge the possibility that the advantages in process scores and total scores could be partly attributed to the process assessment aligned with PAD activities. Multi-institutional studies with longitudinal follow-up are a natural next step.

5. Conclusion

In this single-institution comparison, a self-directed blended PAD class was associated with higher process-assessment and total course scores and with greater student and teacher satisfaction than conventional blended teaching, although final examination scores did not differ between groups. The model provides a practical way to combine online preparation, focused teaching, deferred case discussion, and timely feedback within the existing class hours of the reproductive system diseases course. Whether these gains persist, and whether they translate into stronger clinical reasoning or better clinical performance, cannot be determined from a one-semester study; higher-level outcomes of this kind are rarely measured in comparable studies and will require direct, longitudinal assessment.

Ethics Statement

This study was exempt from full review by the Institutional Review Board of Chongqing Medical University because it was conducted in a normal educational setting. All participating students were informed, both orally and in writing, about the purpose of the study, the procedures involved, the voluntary nature of participation, and the measures taken to protect their privacy and data confidentiality. Written informed consent was obtained from all participants prior to randomization. Students were explicitly assured that their decision whether or not to participate, or to withdraw at any time, would have no influence on their academic grades, course assessment, or standing in the program. To safeguard this, participation status was kept confidential from the instructors responsible for grading, all study-related data were anonymized and analyzed separately from official course records, and the experimental and control groups followed identical class hours, syllabus, and assessment weights, so that the educational experience and evaluation criteria were equivalent for all students. Students who declined to participate still received the same course content and assessments through the conventional blended teaching.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper. This draft was prepared with AI-assisted English-language editing and formatting.

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