

# INPLASY

## Effects of an AI-Enhanced BOPPPS Teaching Model in Nursing Courses: A Meta-Analysis of Randomized Controlled Trials

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### ADMINISTRATIVE INFORMATION

**Support -** No.

**Review Stage at time of this submission -** Data analysis.

**Conflicts of interest -** None declared.

**INPLASY registration number:** INPLASY202620026

**Amendments -** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 6 February 2026 and was last updated on 6 February 2026.

### INTRODUCTION

**Review question / Objective** To evaluate the effectiveness of an artificial intelligence (AI)-enhanced BOPPPS teaching model in nursing courses, with a focus on academic performance, self-directed learning ability, and teaching satisfaction.

**Condition being studied** Nursing students.

### METHODS

**Participant or population** The participants were nursing students. All included randomized controlled trials (RCTs) enrolled nursing students enrolled in formal nursing education programs (e.g., universities, vocational colleges), regardless of their year of study. These students were involved in various core nursing courses, such as Fundamentals of Nursing, Medical Nursing, and Surgical Nursing. This population represents the

broad student body receiving structured nursing education.

**Intervention** The intervention was the implementation of an artificial intelligence (AI)-enhanced BOPPPS teaching model in nursing courses.

**Comparator** The comparator was traditional teaching methods or the standard BOPPPS model alone.

In the control groups, students received instruction through conventional, teacher-centered approaches (such as lecture-based teaching) or through the standard BOPPPS model that did not incorporate any artificial intelligence (AI) technologies. These methods did not feature the personalized, adaptive, or intelligent interactive components that characterized the AI-enhanced BOPPPS intervention.

**Study designs to be included** Randomized controlled trials (RCTs), specifically parallel-group RCTs, will be included. The review will focus exclusively on RCTs as they provide the highest level of evidence for evaluating intervention effectiveness. Other study designs, such as non-randomized controlled trials, cohort studies, case-control studies, single-arm studies, and qualitative research, will be excluded.

#### **Eligibility criteria** Eligibility Criteria

The eligibility of studies for this systematic review and meta-analysis was determined based on the following Population, Intervention, Comparator, Outcomes, and Study design (PICOS) framework:

##### 1. Population (P)

Included: Nursing students at any educational level (e.g., undergraduate, vocational) enrolled in formal nursing courses.

Excluded: Studies involving licensed nurses, other healthcare professional students (e.g., medical students), patients, or mixed populations where nursing student data could not be separately extracted.

##### 2. Intervention (I)

Included: Any teaching model that is explicitly described as combining the BOPPPS framework (Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary) with artificial intelligence (AI) technologies (e.g., intelligent tutoring systems, adaptive learning platforms, AI-simulated cases).

Excluded: Studies applying only the standard BOPPPS model without AI integration, or studies using AI in teaching models other than BOPPPS.

##### 3. Comparator (C)

Included: Traditional teaching methods (e.g., conventional lectures) or the standard BOPPPS model without AI enhancement.

Excluded: Studies using other innovative teaching models as the sole comparator (unless also including a traditional/BOPPPS control group), or studies with no control group.

##### 4. Outcomes (O)

Primary outcomes: Quantitative measures of academic/learning performance (e.g., final exam scores, skill assessment scores) and self-directed learning ability (measured by validated scales).

Secondary outcomes: Measures of teaching/learning satisfaction and other relevant educational outcomes reported in the included studies.

Excluded: Studies reporting only qualitative outcomes or outcomes not relevant to the educational process.

##### 5. Study Design (S)

Included: Randomized controlled trials (RCTs), specifically parallel-group RCTs, published in full text.

Excluded: Non-randomized studies, quasi-experimental designs, conference abstracts, reviews, protocols, and commentaries.

**Information sources** Electronic databases: PubMed, Web of Science, Embase, Cochrane CENTRAL, ERIC, Scopus, CNKI, WanFang, and VIP.

Additional sources: Reference lists of included studies, ClinicalTrials.gov, the Chinese Clinical Trial Registry (ChiCTR), and relevant grey literature.

**Main outcome(s)** The primary outcomes of this review are quantitative measures of the following educational effects:

Academic/Learning Performance: Standardized assessment scores (e.g., final theoretical examinations, objective skill assessments, or comprehensive course grades).

Self-directed Learning Ability: Scores measured by validated scales or instruments (e.g., the Self-Directed Learning Readiness Scale).

**Quality assessment / Risk of bias analysis** The findings will be presented in both a risk-of-bias summary table and a traffic-light plot (generated by the RoB 2 tool) to provide a clear visual overview. Disagreements between reviewers will be resolved through discussion or by consulting a third reviewer. This assessment will be used to interpret the reliability of the synthesized evidence.

**Strategy of data synthesis** The findings will be presented in both a risk-of-bias summary table and a traffic-light plot (generated by the RoB 2 tool) to provide a clear visual overview. Disagreements between reviewers will be resolved through discussion or by consulting a third reviewer. This assessment will be used to interpret the reliability of the synthesized evidence.

**Subgroup analysis** No.

**Sensitivity analysis** Leave-one-out analysis to identify influential studies.

Exclusion of high-risk-of-bias studies.

Comparison of fixed-effect and random-effects models.

Use of alternative effect measures.

**Country(ies) involved** This review is based on studies conducted in China, as indicated by the affiliations of the included trials' first authors.

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**Keywords** Artificial IntelligenceBOPPPS  
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AnalysisRandomized Controlled TrialTeaching  
MethodsEducational Technology.

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