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# Effectiveness of flipped classroom in surgery education: a meta-analysis

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**ADMINISTRATIVE INFORMATION**

**Support -** cstc2021jcyj-msxmX0462.

**Review Stage at time of this submission -** Preliminary searches.

**Conflicts of interest -** None declared.

**INPLASY registration number:** INPLASY202450144

**Amendments -** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 31 May 2024 and was last updated on 31 May 2024.

## INTRODUCTION

**Review question / Objective** The aim of this study was to investigate the differences in teaching effectiveness between the flipped classroom method and traditional teaching methods in surgical education. The chosen research method was a randomized controlled trial (RCT).

**Condition being studied** This meta-analysis aims to evaluate the effectiveness of the flipped classroom method compared to traditional teaching methods in surgical education. The research is conducted by a team of experienced professionals in the field.

## METHODS

**Participant or population** Medical students.

**Intervention** Flipped classroom.

**Comparator** Traditional teaching methods.

**Study designs to be included** RCT.

**Eligibility criteria** Inclusion Criteria Study Design: Randomized controlled trials (RCTs) that investigate the use of flipped classroom methodology in surgical education.
Participants: Medical students.
Intervention: Studies that utilize the flipped classroom model, defined as a pedagogical approach where instructional content is delivered outside of the classroom (e.g., via online videos or readings) and in-class time is used for interactive, practical activities.
Comparison: Traditional teaching methods.
Outcomes: Studies reporting on educational outcomes such as knowledge retention, skill acquisition, student engagement, satisfaction, and performance in surgical procedures.
Language: Studies published in English or Chinese.

Publication Date: No restrictions on the publication date.
Exclusion Criteria:

Study Design: editorials, commentaries, and review articles without primary data.
Participants: Studies focusing on non-surgical medical education or non-healthcare related training.
Intervention: Studies that do not clearly define or implement a flipped classroom model.
Outcomes: Studies that do not report on relevant educational outcomes.
Language: Studies published in languages other than English or Chinese.

**Information sources** PubMed, Cochrane, web of science, Embase, China National Knowledge Infrastructure (CNKI), VIP Database, Wanfang Data.

**Main outcome(s)** Studies reporting on educational outcomes such as knowledge retention, skill acquisition, student engagement, satisfaction, and performance in surgical procedures.

**Quality assessment / Risk of bias analysis** Cochrane.

**Strategy of data synthesis** Statistical analysis was performed using RevMan 5.3 software provided by the Cochrane Collaboration. For continuous data, the weighted mean difference (WMD) was used, and for categorical data, the odds ratio (OR) was used as the combined statistic. All effect sizes are presented with 95% confidence intervals (CI).
When the heterogeneity test result is $P \geq 0.05$ or $I^2 \leq 50\%$, it indicates low heterogeneity among the studies, and a fixed-effects model is used for analysis. When the heterogeneity test result is P50%, it indicates high heterogeneity among the studies, and a random-effects model is used for analysis. Additionally, reasons for heterogeneity are analyzed, and subgroup analysis or sensitivity analysis is conducted. If a meta-analysis cannot be performed, a descriptive analysis is conducted instead.
A funnel plot is used to assess publication bias. A P-value of $<0.05$ is considered statistically significant.

**Subgroup analysis** Country; Type of Surgery; Student Level.

**Sensitivity analysis** To analyze the sensitivity of the study, we examined the changes in effect size after removing each study one by one.

**Country(ies) involved** China.

**Keywords** Flipped classroom, Meta-analysis, Surgery education, Flipped learning, Learning performance.

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