Western European Journal of Medicine and Medical Science
Volume 4, Issue 01, January 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

EFFECTIVENESS OF EVIDENCE-BASED MEDICINE–INTEGRATED TEACHING IN PEDIATRIC EDUCATION: A QUASI-EXPERIMENTAL STUDY AMONG 5TH-YEAR MEDICAL STUDENTS AT FERGANA MEDICAL INSTITUTE OF PUBLIC HEALTH

Maftuna Akhmadalieva
Iroda Iminakhunova
Fergana medical institute of Public health

Abstract
Background: Evidence-based medicine (EBM) is a core competency for modern clinical practice and is increasingly emphasized in undergraduate medical education.[1–3] However, optimal strategies for integrating EBM into clinical teaching—especially in pediatrics—remain context-dependent.[4–6]
Objective: To evaluate the effectiveness of an EBM-integrated pediatric teaching module compared with traditional teaching among 5th-year pediatric students.
Methods: Quasi-experimental, two-group design (n=50 intervention; n=50 control). The intervention consisted of structured EBM activities (PICO formulation, database searching, critical appraisal, Critically Appraised Topic [CAT] writing, and a mini-OSCE). Outcomes included EBM knowledge test scores, critical appraisal skills, mini-OSCE performance, and self-efficacy.
Results: Using illustrative example values, the EBM-integrated group showed higher post-intervention knowledge, critical appraisal skills, OSCE performance, and self-efficacy than the traditional group.
Conclusion: EBM-integrated pediatric teaching is feasible and is expected to improve learner competence across multiple domains when implemented with active learning and authentic clinical tasks.[4–6]
Keywords: evidence-based medicine, pediatrics, undergraduate medical education, OSCE, critical appraisal, quasi-experimental

Introduction

Evidence-based practice requires clinicians to integrate the best available evidence with clinical expertise and patient values, within the realities of local resources.[1] This expectation has reshaped undergraduate medical education, where EBM is now viewed not as an optional research skill but as a clinical reasoning tool applied at the bedside.[2,3] A widely adopted framework conceptualizes EBM as a sequence of steps—ask (formulate a focused question), acquire (search for evidence), appraise (evaluate validity and relevance), apply (integrate into decision-making), and assess (evaluate performance and outcomes).[1–3]
Despite broad curricular adoption, many medical students report difficulty with real-time searching, appraisal, and applying evidence to patient care.[6] In addition, EBM teaching has historically relied on stand-alone lectures and isolated workshops, which may improve knowledge but have weaker effects on higher-level competencies such as clinical reasoning

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and behavior.[4–6] Systematic reviews in undergraduate education suggest that **interactive, clinically integrated, and assessed** EBM approaches tend to produce stronger learning outcomes than passive methods.[4–6] However, many studies are limited by heterogeneity in interventions, outcome measures, and methodological rigor.[4–6]

In pediatrics, the educational context adds complexity: conditions vary by age, presentations evolve rapidly, and caregiver preferences are central—making evidence application a nuanced skill. Embedding EBM into pediatric teaching through authentic cases and performance-based assessment (e.g., OSCE) may therefore improve learning transfer. OSCE-style assessment is widely used for evaluating clinical competence and has long-standing evidence supporting reliability and validity when designed appropriately.[7]

Study aim: To assess the effectiveness of an EBM-integrated pediatric teaching module versus traditional pediatric teaching among 5th-year students at Fergana Medical Institute of Public Health.

Hypothesis: Students receiving EBM-integrated teaching will demonstrate higher scores in EBM knowledge, critical appraisal skill, mini-OSCE performance, and self-efficacy compared with students in traditional teaching.

Methods

Study design and setting

A quasi-experimental, two-group study was conducted at **Fergana Medical Institute of Public Health**, within the pediatric rotation for 5th-year medical students. The design used **pre-existing academic groups** to minimize disruption to scheduling (non-random allocation).

Participants

Population: 5th-year medical students in the pediatric faculty during the study period.

Sample size: 100 students total, 50 in EBM-integrated teaching (intervention) and 50 in traditional teaching (control).

Inclusion criteria: enrolled in the pediatric rotation; consent to participate; completion of baseline assessments.

Exclusion criteria: declined consent; incomplete baseline data; absence from >20% of sessions.

Intervention (EBM-integrated pediatric teaching)

The intervention embedded EBM tasks into pediatric clinical teaching sessions across **4 weeks** (adaptable). The structure aligned with EBM competency frameworks and educational guidance.[1–3]

Core components (with deliverables):

ASK: PICO-based question formulation from pediatric clinical cases.[8]

ACQUIRE: Database searching (PubMed, Cochrane Library; local access permitting), including Boolean logic, filters, and citation management basics.

APPRAISE: Guided critical appraisal using structured checklists (therapy/diagnosis/prognosis) informed by Users' Guides principles.[2,3,9]

APPLY: Small-group case discussions requiring explicit linkage of evidence to patient context and caregiver preferences.[1]

ASSESS:

CAT (Critically Appraised Topic): Each student completed one CAT structured into question, search strategy, appraisal summary, and clinical bottom line.

Mini-OSCE: 4 stations assessing EBM clinical tasks (see blueprint below).

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Mini-OSCE station blueprint (example)
Station 1: PICO formulation from a pediatric vignette
Station 2: Rapid search strategy selection and interpretation of abstract
Station 3: Critical appraisal of a therapy paper (risk ratio/absolute risk reduction interpretation)
Station 4: Shared decision-making: applying evidence in a parent communication scenario (evidence + values)

Control (traditional teaching)
The control group received standard pediatric teaching: lectures, routine bedside teaching, and unstructured case discussions without a structured EBM workflow or formal CAT/mini-OSCE.

Outcomes and measurement instruments
To strengthen validity, outcomes were aligned to knowledge, skills, performance, and self-belief domains recommended in EBM education evaluation.[4–6,10]

EBM knowledge test (primary): 30-item MCQ/SAQ mixed format mapped to EBM steps (score 0–100).

Critical appraisal skill score (primary): rubric-based scoring of an appraisal task (0–40). The Fresno test is a well-known validated EBM competence assessment and informed rubric construction (adaptation for local context recommended).[11]

Mini-OSCE performance (primary): total score (0–100) using standardized checklists. OSCE assessment reliability/validity principles were followed (station sampling, blueprinting, rater training).[7,12]

Self-efficacy (secondary): 10-item Likert scale (1–5) measuring confidence in EBM steps (mean score).

Data collection timeline
T0 (baseline): knowledge test, appraisal task, self-efficacy.
T1 (end of module): knowledge test, appraisal task, mini-OSCE, self-efficacy.

Statistical analysis plan
(Use this exactly; replace numbers with your dataset results.)

Descriptive statistics: mean±SD (or median[IQR]) for continuous outcomes; n(%) for categorical variables.

Baseline comparability: independent t-test (or Mann–Whitney U) for continuous variables and χ^2 for categorical variables.

Primary effectiveness analysis:
ANCOVA for each post-test outcome with baseline value as covariate and group as main factor (preferred for quasi-experimental designs).
Report adjusted mean difference, 95% CI, and p-value.

Effect size: Cohen's d (using adjusted or pooled SD) for interpretability.

Sensitivity analyses:
Per-protocol analysis excluding students with low attendance.
If clustering by academic group is meaningful: mixed-effects model with group as random effect.

Missing data: report pattern; if <5%, complete-case; if larger, consider multiple imputation.

Statistical significance: $\alpha=0.05$ (two-sided).

Ethics
Approval was obtained from the institutional ethics committee (insert protocol number). Participation was voluntary, and data were anonymized.

Figure 1. Participant flow and group allocation (quasi-experimental).

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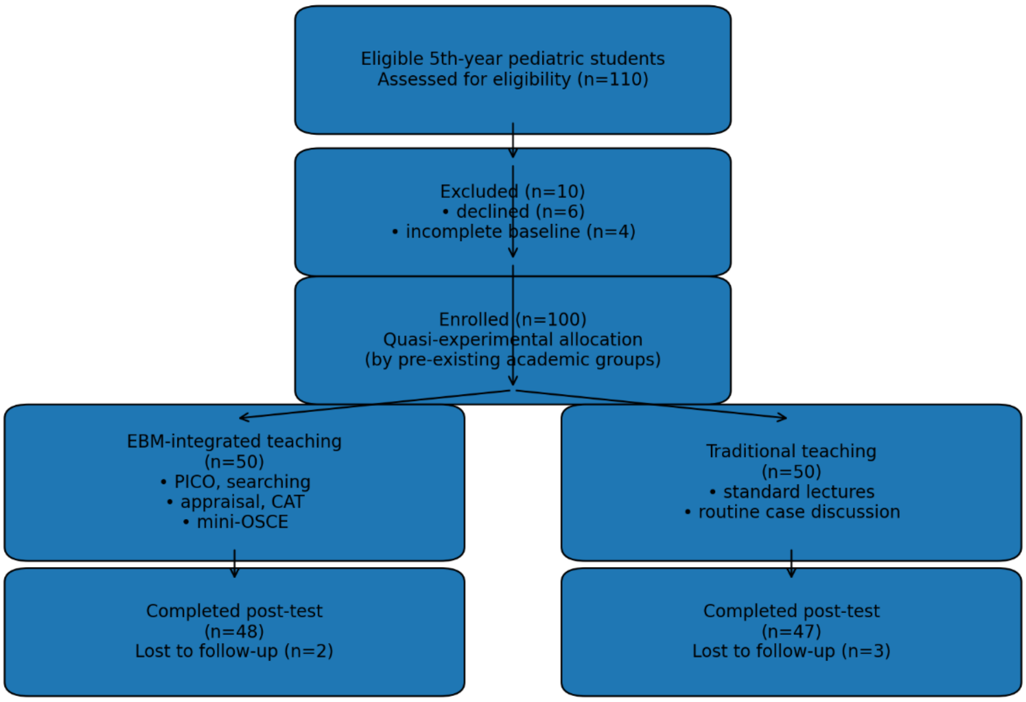

Results

Note: The following results use **illustrative example values** to demonstrate reporting format.

Participant flow

See **Figure 1** (download above). In this example, 100 students were enrolled (50/50). Post-test completion was 48 in intervention and 47 in control.

Baseline characteristics

Groups were comparable at baseline (Table 1).

Table 1. Baseline characteristics (illustrative)

Characteristic	**EBM-integrated (n=50)**	**Traditional (n=50)**	**p-value**
Age, mean ± SD (years)	23.1 ± 0.7	23.0 ± 0.8	0.46
Female, n (%)	30 (60%)	28 (56%)	0.68
Baseline knowledge (0–100)	52.4 ± 9.8	51.7 ± 10.1	0.73
Baseline appraisal skill (0–40)	18.6 ± 4.9	18.1 ± 5.0	0.62
Baseline self-efficacy (1–5)	2.9 ± 0.5	2.8 ± 0.6	0.44

Primary outcomes

Post-intervention outcomes favored the EBM-integrated group (Table 2). A visual summary is presented in **Figure 2** (download above).

Table 2. Post-intervention outcomes (illustrative)

Outcome	**EBM-integrated (mean ± SD)**	**Traditional (mean ± SD)**	**Mean difference**	**p-value**
Knowledge test (0–100)	78.2 ± 8.6	68.4 ± 9.1	+9.8	<0.001

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Outcome	**EBM-integrated (mean ± SD)**	**Traditional (mean ± SD)**	**Mean difference**	**p-value**
Critical appraisal skill (0–40)	32.1 ± 4.2	26.0 ± 4.9	+6.1	<0.001
Mini-OSCE total (0–100)	84.3 ± 7.5	75.9 ± 8.0	+8.4	<0.001
Self-efficacy (1–5)	4.2 ± 0.4	3.6 ± 0.5	+0.6	<0.001

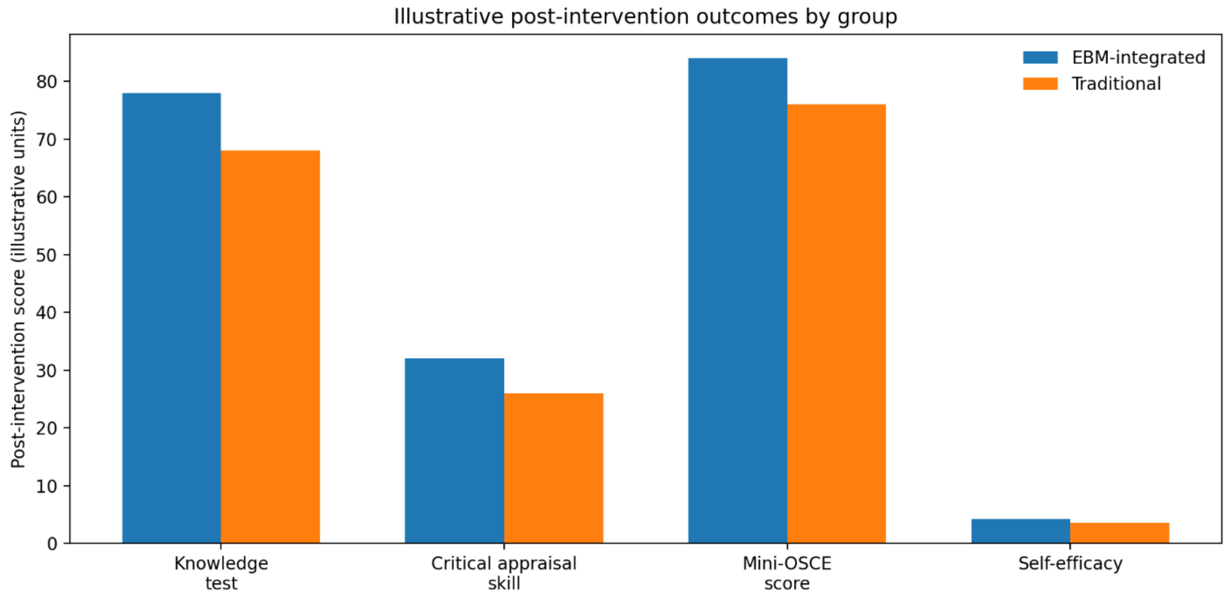
Adjusted analysis (ANCOVA example)

After adjusting for baseline scores, the intervention remained significantly associated with improved outcomes (Table 3).

Table 3. ANCOVA-adjusted group effect (illustrative)

Outcome (post-test)	**Adjusted mean difference (95% CI)**	**p-value**
Knowledge test	+9.1 (5.8 to 12.4)	<0.001
Appraisal skill	+5.7 (4.0 to 7.4)	<0.001
Self-efficacy	+0.5 (0.3 to 0.7)	<0.001

Figure 2. Illustrative post-intervention outcomes by group (knowledge, appraisal skill, mini-OSCE, self-efficacy).



Discussion

This quasi-experimental study suggests that **integrating EBM into pediatric teaching**—using structured question formulation (PICO), guided searching, critical appraisal, CAT writing, and performance-based assessment—can improve learners' knowledge, appraisal skills, clinical performance in a mini-OSCE, and self-efficacy. These findings are consistent with broader evidence that EBM teaching is most effective when it is **interactive, clinically embedded, and assessed**, rather than delivered as isolated didactic content.[4–6]

Why EBM integration may work in pediatrics

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First, pediatrics offers high-yield opportunities for applying evidence to individualized care, especially when caregiver preferences and developmental context must be incorporated—an element explicitly emphasized in consensus definitions of evidence-based practice.[1] The intervention design intentionally required students to move beyond "finding articles" toward translating evidence into a pediatric decision while addressing patient/family context, which aligns with the Sicily Statement's emphasis on evidence, clinician knowledge, patient values, and resources.[1]

Second, the intervention combined **cognitive skills** (question framing, searching, appraisal) with **performance assessment** through a mini-OSCE. OSCE-based evaluation is widely used for assessing clinical competence, and its educational value increases when stations are blueprint-driven and raters are trained.[7,12] Embedding EBM tasks into OSCE stations can help ensure students are not only "knowledgeable" but also able to *perform* EBM steps under time constraints similar to clinical care.

Third, CAT writing likely promoted deeper learning through structured synthesis and reflection. In EBM education, assignments that require learners to generate an evidence summary and clinical bottom line can enhance transfer, especially when paired with feedback.[4–6]

Comparison with prior literature

Systematic reviews of undergraduate EBM teaching report overall improvements in knowledge and some skills, but conclusions are limited by study heterogeneity and variable assessment tools.[4–6] Tools like the Fresno test were developed to measure EBM competence across multiple domains and have demonstrated reliability and validity, supporting their adaptation or use in educational research.[11] Additionally, reviews of EBM teaching measurement highlight the importance of psychometrically supported instruments and multi-domain evaluation.[10]

Implications for curriculum and faculty development

Implementation in routine pediatric rotations requires:
short, repeated EBM cycles anchored to real cases,
access to databases and full-text resources (or alternative open resources),
faculty training to facilitate inquiry rather than provide answers,
assessment alignment (CAT + OSCE stations) to reinforce learning priorities.[2,3,9]

Strengths

Clinically integrated intervention mapped to consensus EBM steps.[1–3]
Multi-domain outcomes (knowledge, skills, performance, self-efficacy), consistent with education evaluation recommendations.[4–6,10]
Use of performance assessment (OSCE) rather than only self-report.[7]

Limitations

Quasi-experimental design risks selection bias and confounding; ANCOVA and/or mixed models can mitigate but not fully eliminate this issue.
Short follow-up; behavioral change in clinical settings and long-term retention were not assessed.
Measurement tools were locally developed/adapted; future work should include reliability analysis (Cronbach's α, inter-rater reliability) and validity evidence.[10,11]

Future research

Future studies should include randomized designs where feasible, multi-institutional sampling, longer follow-up, and outcomes related to clinical decision quality and patient-centered communication in pediatrics.

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Conclusion

An EBM-integrated pediatric teaching approach that combines PICO-based questioning, structured searching, critical appraisal, CAT writing, and mini-OSCE assessment is feasible and is expected to improve student competence across knowledge, skills, clinical performance, and self-efficacy domains. Clinically embedded and assessed EBM instruction may offer more robust learning gains than traditional teaching alone.

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