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The impact of artificial intelligence tools on students' creative performance: A systematic review and meta-analysis of experimental and quasi-experimental studies

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 12 June 2026 and was last updated on 12 June 2026.

INTRODUCTION

Review question / Objective This systematic review and meta-analysis aims to synthesize experimental and quasi-experimental studies to evaluate the overall effect of AI-assisted learning on students' creative performance, and to examine whether the effect varies by type of AI tool (e.g., text-based generative AI vs. multi-agent/multimodal AI systems).

Condition being studied Creativity is a cognitive mechanism evolved for abstracting, integrating, and solving non-routine problems, and is considered a trainable skill that facilitates the transition from knowledge acquisition to knowledge generation (Scheffer, 2014; Reche & Perfectti, 2020). In educational contexts, student creativity encompasses divergent thinking (fluency, flexibility, originality) and convergent thinking (novelty, usefulness, elaboration), which are essential for innovation and adaptation to global uncertainty (UNESCO, 2022). This review focuses on students' creative performance as the outcome condition, measured through standardized creativity tests, expert ratings (e.g., Consensual Assessment Technique), or task-based creative production (e.g., originality, usefulness, flexibility). Unlike conventional health conditions, creativity is an educational and psychological construct that can be enhanced or inhibited by instructional interventions, including artificial intelligence tools.

METHODS

Search strategy Databases: CNKI, ERIC, Google Scholar, Web of Science.

Search period: Up to April 2026.
Search terms (Boolean operators): ("artificial intelligence" OR AI OR "generative AI" OR ChatGPT) AND (student* OR learner*) AND (creativity OR "creative thinking" OR "creative performance").

Participant or population Primary school, secondary school, and university undergraduate students. Excluding preschool, postgraduate, vocational, and adult education learners.

Intervention Use of AI tools (generative AI, chatbots, image generation, multi-agent systems, AI-supported co-regulated learning) for learning, writing, design, problem-solving, or creative tasks.

Comparator Traditional instruction, non-AI conditions, conventional search tools, human feedback, or no AI assistance.

Study designs to be included Randomized controlled trials (RCTs) or quasi-experimental studies with a control group (pretest–posttest or posttest-only). Excluding single-group studies without a comparator.

Eligibility criteria Studies were selected based on the following PICOS criteria:
Population (P)
Included: Primary school, secondary school, and university undergraduate students.
Excluded: Preschool children, postgraduate (master's/doctoral) students, vocational education learners, adult education learners.
Intervention (I)
Included: Use of artificial intelligence (AI) tools (e.g., generative AI, large language models like ChatGPT/DeepSeek, image-generation AI like Stable Diffusion/Midjourney, multi-agent collaborative systems, AI-supported co-regulated learning) for learning, writing, design, problem-solving, or other creative tasks.
Excluded: Studies where AI is not the core instructional tool (e.g., general computer-assisted instruction without AI).
Comparison (C)
Included: Traditional instruction, non-AI conditions (e.g., conventional search engines, textbooks, human feedback), no AI assistance, or routine learning resources.
Excluded: Studies without a concurrent control group (e.g., single-group pre-post design).
Outcome (O)
Included: Creativity, creative thinking, or creative performance, assessed via at least one of the following dimensions: novelty/originality, usefulness, fluency, flexibility, elaboration. Measures may include expert rating (e.g., Consensual Assessment Technique), standardized creativity scales (e.g., Torrance Test), or task-based performance scores.
Excluded: Studies reporting only non-creativity outcomes (e.g., motivation, self-efficacy, academic achievement without creativity measures).
Study Design (S)
Included: Randomized controlled trials (RCTs) and quasi-experimental studies with a control group (pretest-posttest or posttest-only design).
Excluded: Single-group studies, case studies, cross-sectional surveys, correlational studies, qualitative-only studies, or reviews.

Information sources Databases: CNKI, ERIC, Google Scholar, Web of Science.

Main outcome(s) Outcome : Creativity, creative thinking, or creative performance, assessed via at least one of the following dimensions: novelty/originality, usefulness, fluency, flexibility, elaboration. Measures may include expert rating (e.g., Consensual Assessment Technique), standardized creativity scales (e.g., Torrance Test), or task-based performance scores.

Quality assessment / Risk of bias analysis
Funnel plot symmetry will be visually inspected.
Subgroup analyses with ≥10 studies will be supplemented by Egger's test.
Sensitivity analysis will be performed by excluding studies with high risk of bias.

Strategy of data synthesis Two reviewers will independently screen titles, abstracts, and full texts based on the PICOS criteria. Disagreements will be resolved by a third reviewer.
Data extraction will include: first author, year, country, education level, sample size (intervention/control), AI tool type, task description, outcome measures (means, SDs, or pre–post change), study design, intervention duration.
Effect size: Standardized mean difference (SMD) with 95% confidence interval (CI).
Model choice: Fixed-effect model if I^2 0.10; otherwise, random-effects model.
Heterogeneity: Assessed using Cochran's Q test and I^2 statistic.
Subgroup analysis: By AI tool type (ChatGPT/plain text vs. multi-agent/multimodal/image-generative AI).
Sensitivity analysis: Leave-one-out analysis (if sufficient studies).
Publication bias: Funnel plot and Egger's test (if ≥10 studies in a subgroup).
Software: Review Manager 5.4.1 (RevMan).

Subgroup analysis Primary subgroup:
Type of AI tool (text-based generative AI: ChatGPT, DeepSeek; vs. complex AI systems: multi-agent systems, Stable Diffusion, Midjourney, Gemini, AI-integrated PBL).
Secondary subgroups (if data permit):
Educational level (primary, secondary, university).
Intervention duration (single session vs. multiple sessions/weeks).
Creativity dimension (novelty, usefulness, fluency, flexibility, elaboration).

Sensitivity analysis Sensitivity analyses will be performed by: (a) sequentially omitting one study at a time (leave-one-out); (b) excluding studies with high risk of bias based on Cochrane RoB 2.0; (c) comparing fixed-effect vs. random-effects models; (d) removing quasi-experimental studies to retain only RCTs; and (e) varying the choice of creativity outcome dimension. Robustness will be assessed by consistency of the pooled effect direction and significance across these scenarios.

Country(ies) involved China.

Keywords Artificial intelligence; student creativity; Creative performance; Meta-analysis; Systematic review.

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