AI tools in student research practice: A longitudinal study on open digital tools and creativity development in secondary education

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INTRODUCTION

Open digital tools and generative AI — widely adopted in education since the release of ChatGPT in late 2022 — have changed how students conduct research. Current evidence points to a genuine potential for AI to support creativity (Rafner et al., 2023), alongside a parallel need for critical and responsible-use frameworks in education (Garzón et al., 2025). Within this context, AI literacy has emerged as an educational priority (Mills et al., 2024), with direct relevance to open-science practice.

58 / 139
Croatia's rank — Global Creativity Index

30 / 64
Croatia's rank — OECD PISA 2022, creative thinking

Research aim

To examine whether sustained use of openly accessible AI tools (generative language models, open research assistants) is associated with creativity and epistemic autonomy in physics students' research practice.

METHODS

N = 57
students, single cohort

2
measurement points

2023/24–25/26
three academic years spanned

39 / 18
experimental / control, Phase 1

PHASE 1 · 2023/2024

Analytical creativity rubric (AAC&U VALUE framework: originality, synthesis, risk-taking) scored student research papers, plus a survey on motivation and digital-tool use. Quasi-experimental allocation: experimental (n = 39) vs. control (n = 18).

PHASE 2 · 2025/2026

Follow-up survey on attitudes toward AI as a learning support, AI's role in the creative process and in research-paper quality, and understanding of responsible, open-science-aligned AI use.

Same cohort (N = 57) re-surveyed; the intervening year reflects a natural gap in structured research assignments, not a methodological lapse.

Instrument reliability (Cronbach's α, Phase 2)

General creativity (self-assessed)	**α = .757**
AI as learning support	**α = .876**
AI & creative process	**α = .863**
AI & research-paper quality	**α = .919**

4 items per subscale, 5-point Likert; N = 57. All subscales show acceptable-to-excellent internal consistency.

Design notes

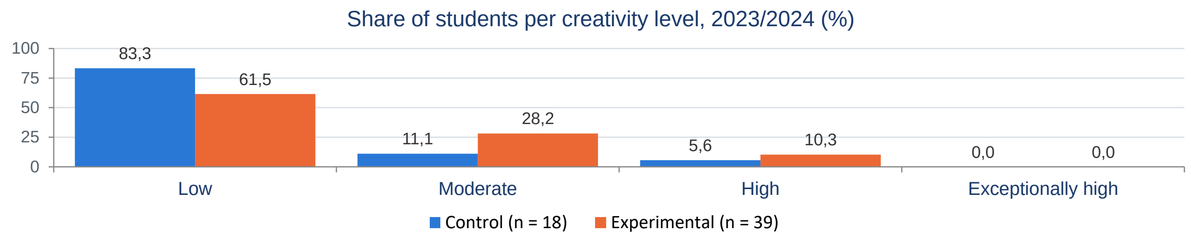
Single-site, quasi-experimental, longitudinal design.

Ethics: anonymous, voluntary participation; data processed under GDPR.

Limitation: single-site sampling constrains external validity but enables tightly controlled implementation in an authentic classroom.

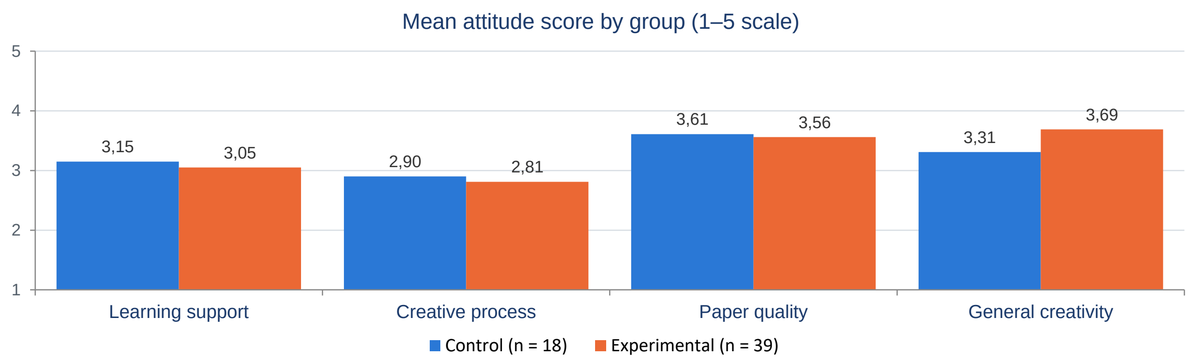
RESULTS

Phase 1 baseline — creativity level by group (analytical rubric)



Most students scored in the low creativity band regardless of group; the group difference in creativity-level distribution was not statistically significant (Mann–Whitney U = 276, p = .117, r = 0.17). Different instrument from the Phase 2 self-report scales below — not directly comparable to the attitude means.

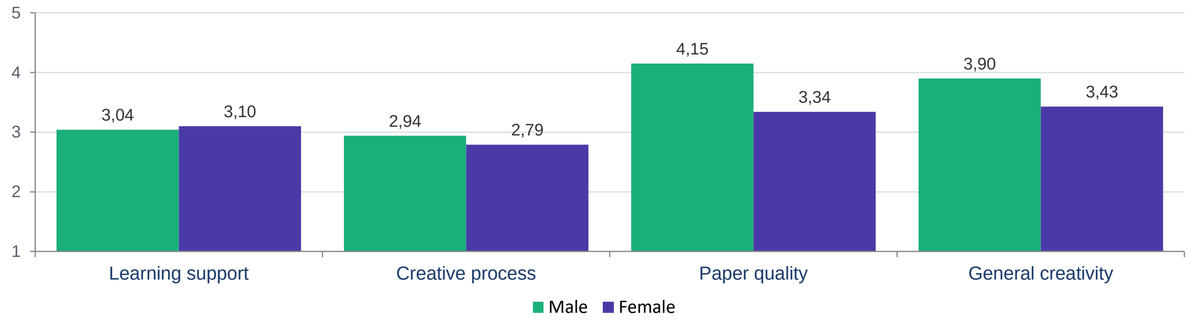
Group comparison — attitudes toward AI (Phase 2)



Learning support	C / E: 3.15 / 3.05	t(55) = 0.33, p = .742, d = 0.09
Creative process	C / E: 2.90 / 2.81	t(55) = 0.31, p = .756, d = 0.09
Paper quality	C / E: 3.61 / 3.56	t(55) = 0.14, p = .887, d = 0.04
General creativity	C / E: 3.31 / 3.69	t(55) = 1.72, p = .091, d = 0.49

None of the four between-group comparisons reached the conventional significance threshold (α = .05). General creativity showed the largest effect (d = 0.49, medium) — a non-significant trend favouring the experimental group.

Gender comparison — attitudes toward AI



Learning support	M / F: 3.04 / 3.10	p = .858
Creative process	M / F: 2.94 / 2.79	p = .635
Paper quality	M / F: 4.15 / 3.34	t(47.48) = 3.08, p = .003, d = 0.74
General creativity	M / F: 3.90 / 3.43	t(55) = 2.06, p = .044, d = 0.60

Two of four dimensions differed significantly by gender (α = .05): general self-assessed creativity (medium effect) and perceived AI contribution to the research paper (large effect); male students scored higher on both.

Association with AI-use frequency (Spearman ρ)

ρ = .403, p = .002 — contribution to research-paper quality

ρ = .358, p = .007 — contribution to the creative process

ρ = .257, p = .055 — AI as learning support (not significant)

Frequency of use, not experimental-group membership, was the stronger correlate of students' attitudes toward AI.

DISCUSSION & CONCLUSION

Experimental-group membership alone did not shift attitudes or self-assessed creativity — consistent with recent work framing AI primarily as a support for idea generation rather than an independent creative source (Habib et al., 2024; Urmeneta & Romero, 2025). Frequency of AI-tool use, not group assignment, was the stronger correlate of perceived creative and research benefit, and gender differences emerged in self-assessed creativity and in perceived AI usefulness in the research-paper process.

These findings support a scaffolding model: AI tools appear to support human creativity rather than substitute for it. Meaningful educational impact depends on pedagogically guided, reflective, and ethically informed integration of AI into student research practice, not on access alone — directly relevant to AI-literacy frameworks (Mills et al., 2024) and to open-science education more broadly.

Limitations: single-site design and modest sample (N = 57) constrain external validity; quasi-experimental grouping precludes causal inference; Phase 1 rubric scoring used a single rater.

KEYWORDS

artificial intelligence in education · creativity development · open digital tools · open science · student research practice

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