



Teaching Mathematical Proof in the Age of Generative AI: Toward AI-Supported Proof Inquiry

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Generative artificial intelligence (Gen AI) can now produce polished mathematical proofs within seconds, and research is examining how students use it to prove mathematical statements (Yoon et al., 2024). This raises an important question: what should proof pedagogy become when students can obtain a complete argument almost instantly? Merely reproducing a standard proof may reveal little about whether students understand why it works. However, AI-generated arguments can become productive objects for inquiry.

Drawing on de Villiers' (1990) account of proof as verification, explanation, discovery and communication, the paper proposes AI-Supported Proof Inquiry (ASPI). Students engage in four interconnected practices: generating candidate proofs; interpreting their assumptions, structure and key steps; comparing alternative arguments; and critiquing their validity and explanatory power. The practices are flexible rather than sequential. Gen AI's distinctive contribution is rapid access to multiple plausible arguments for students to investigate.

For example, students can ask Gen AI to prove that if n^2 is even, then n is even. A superficially convincing response may argue that $n^2 = 2k$, so $n = \sqrt{2k}$, and hence n is even. Students first interpret the proposed reasoning, then identify why its conclusion does not follow. They can repair the argument using the contrapositive and compare the corrected proof with another AI-generated approach. The proof is no longer merely an answer to copy; it becomes an artefact to question, discuss and improve.

ASPI also suggests useful assessment possibilities. Students might submit an AI output together with annotations, a diagnosis of any gaps, and a revised proof, thereby making their mathematical judgement visible. The teacher remains essential in selecting worthwhile claims, pressing for justification and ensuring that students do not treat AI as a mathematical authority. The goal is not less proof, but deeper inquiry into proof.

References

- de Villiers, M. (1990). The role and function of proof in Mathematics. *Pythagoras*, 24, 17-24.
- Yoon, H., Hwang, J., Lee, K., Roh, K. H., & Kwon, O. N. (2024). Students' use of generative AI for proving mathematical statements. *ZDM-Mathematics Education*, 56, 1531-1551. <http://doi.org/10.1007/s11858-024-01629-0>