

Transforming STEM Learning in Higher Education Through Generative AI: A Literature Review



Database

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INTRODUCTION

- This poster presents a literature review on transforming STEM learning in higher education through generative AI
- The proportion of students using Al tools has risen sharply to 92% from 66% within a single year¹
- As generative AI (genAI) continues to transform the learning process, the research specifically focused on learning and teaching for STEM contents remains limited²
- GenAl performs well on basic physics problems but struggles with advanced university-level physics (83.4% on GCSE, 63.8% on A-Level, and 37.4% on university-level questions, with an overall average of 59.9% using the most effective prompting technique)³
- Moreover, ChatGPT-4 can successfully complete most aspects of a UK physics undergraduate degree, except for practical learning or presentation, such as laboratory work and viva assessments⁴

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To synthesise the benefits and drawbacks of using GenAl in STEM education

To identify the transformation of teaching and learning in STEM education

RESULTS

OBJECTIVE(S)



The database contains a total of 17,920 journal and conference proceeding articles. After identifying 7,988 duplicates and excluding 8,432 articles, the review remains ongoing. So far, 15 thoroughly reviewed and finalized articles have been included in this poster.

Table 1. Distribution of STEM Articles by Major/Content and Country-Based Research

DRAWBACKS

OF GEN-AI

Content/Major	Nu.of Articles	Country-based research
Science	3	Australia, Mexico, Brazil
Technology	8	Turkey, Canada, USA
Engineering	3	India, UK, Mexico
Mathematics	1	South Korean

- Misinformation, when the abstraction level and reasoning become more complex, GenAl produces incorrect answer¹²
- The risk of reduced critical thinking, genuine engagement⁵, and increasing dependency on genAl¹⁰
- GenAl uses biased training data and can lead to biased answers^{19,20,} due to the pre-training data model.
- Ethical dilemmas and attitudes towards academic integrity⁸
- Environment impact because AI data centers need tens of terawatt-hours (TWh) of electricity annually^{21,22}

METHODOLOGY



Search strategy

TITLE-ABS (Generative AI OR generative artificial intelligence OR GenAI) AND (learn OR teach OR assess



Inclusion criteria

- Published from 2020 March 2025
- Written in English

Enhancing student

motivation and confidence

by developing GenAl Co-

learner¹⁸ and generating

engaging learning

strategies¹⁴

Prepare students for practical

questioning skill¹³, critical

thinking^{8,13,}, creativity⁶

Promoting students'

transferable skills

problem-solving¹⁰,

- Journal or conference articles
- Evidence-based research or case studies
- Exploring genAl within the context of higher education
- Applying genAl in the classroom for STEM majors/contents



Selecting studies and analysis

- Upload sorted article database to Rayyan.ai to remove and facilitate screening
- Collect information from included article
- Upload sorted article to NVivo to do thematic analysis

Generating ideas GenAl plays a crucial role in

brainstorming and enhancing idea generation in research projects^{5,6,7,8,9}



Improving the output quality

by generating useful suggestion¹⁷ from genAl and Integrating genAl with prompt engineering to improve data analysis task¹³

Personalised
Learning
Providing
instant
responses
appropriate to
the instruction
in real time^{5,10,11}

Time Efficiency

Collecting information quickly^{5,11}, help in automating specific task/ generating simulation¹², and doing more works in less time⁹

OPPORTUNITIES

Students need to evaluate the output of genAl critically by having strong prior knowledge¹³
Energy-efficient designs, renewable energy sourcing, and

enhanced operational transparency²¹
Guided use of GenAl provided by instructor¹⁶

tor¹⁶

CONCLUSION

- GenAl offers personalized learning, enhanced problem-solving, and efficiency in coding and data analysis, yet it also raises concerns regarding accuracy, and ethical considerations.
- GenAl will continue to evolve. The transformation of STEM curricula in higher education is a necessity, from pedagogical catalysts, structured prompts for learners, authentic and continuous assessment

Further Plans

Finalize the literature review research on the transformation of STEM learning, teaching and assessing in the era of genAl

Examine the perceptions of students, staff, and STEM professionals regarding genAl

Design best practices for integrating genAl into STEM higher education to ensure effective and ethical implementation

Authentic and Continuous

Assessment, such as project based assessment to allow students to demonstrate their competencies⁵ and reduce the risk of academic dishonesty⁴

Building Structured Prompt as learning
with genAl to sharpen
students' ability to
evaluate their
concept and refine
problem-solving
strategies¹³

HOW TO REDESIGN STEM EDUCATION?

Pedagogical
Catalyst to help
educators in
preparing diverse
learning scenarios.
GenAl acted to
facilitate the
transformation from
traditional lecture¹⁴

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Have any feedback or questions about this project?
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