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[Work-in-Progress] The Impacts of Students' GenAI Interactions on Their Social and Psychological Dynamics: Preliminary Findings from a Systematic Review in Engineering and Computing Education

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Abstract

This work-in-progress paper presents preliminary findings from a systematic literature review focused on the impacts of Generative Artificial Intelligence (GenAI) on students' social interactions in engineering and computing education. GenAI tools, which refer to AI that goes beyond traditional models by focusing on generating new data rather than solely analyzing or making predictions, such as ChatGPT, have been drastically reshaping education. In engineering and computing education, there has been a surge of research exploring how to integrate GenAI into learning and teaching, and academic integrity. Yet, little is known about how GenAI interaction affects students' interactions with other humans in learning environments, despite recent warnings from scholars in higher education and social psychology about the potential loss of social interactions and related skills resulting from GenAI interaction. Considering the critical role of social interactions in students' learning and in the development of socially constructed psychological constructs that significantly influence integration and retention (e.g., sense of belonging, self-efficacy, identity, and motivation), there is an urgent need to generate evidence-based understanding of the socio-psychological influences of GenAI use in engineering and computing education. To address this need, the study aims to conduct a systematic review that aims to generate synthesized understandings of how students' interactions with GenAI are characterized and how these interactions impact their socio-psychological dynamics in engineering and computing education, while also providing insight into the current research landscape. This work in progress paper presents the backgrounds, related literature, and research design. Preliminary findings from the in-progress data collection will be presented at the poster presentation.

Backgrounds and Related Literature

GenAI as an Operating System for Learning

GenAI tools have been rapidly reshaping education. GenAI tools, such as ChatGPT, refers to AI that goes beyond traditional AI models by generating new data rather than solely analyzing or making predictions. Much of the current literature in engineering education conceptualizes GenAI primarily as a tool to support student learning, often treated as a tool with the capacity to interact, communicate, and generate content on demand [1], [2]. In contrast, an emerging scholarship positions GenAI as an operating system [3], [4], an underlying infrastructure that fundamentally reshapes and reorganizes students' learning processes, similar to how an operating system structures how applications run. Scholars adopting this perspective argue for a critical shift in how we think about and discuss GenAI - not as a single tool, but as an influential participant in the educational ecosystem, with the potential to form a symbiotic relationship between humans and

machines. From this viewpoint, GenAI serves as a foundational layer that shapes how students learn, think, and reason through their interactions with GenAI (GenAI interactions) embedded within everyday learning activities. Consequently, GenAI does more than transform the products of students' work as a tool. It is rewriting the affective, cognitive, and behavioral dimensions of learning through day-to-day GenAI interactions, which differs from human-to-human learning processes and thus necessitates critical investigation [1], [3], [4], [5]. Thus, the proposed adopts the perspective that views GenAI as an operating system that interacts with different components of the learning ecosystem, from system-level infrastructures to micro-level social interactions and individual-level beliefs and perceptions, investigating GenAI interactions with a focus on their social and psychological consequences among engineering undergraduate students.

Benefits and Risks of GenAI in Engineering Education

In engineering education, there has been a rapidly growing body of research investigating GenAI, reflected in the significant increase in publications in recent years [1]. The current literature primarily focuses on how to integrate GenAI tools into teaching and learning [6], [7], AI literacy and pedagogy [8], [9], [10], emerging ethical considerations [11], and students' and faculty's perceptions of GenAI use [12], [13]. Findings highlight advantages of GenAI integration, including encouraging self-directed learning and offering personalized feedback, while also identifying concerns related to knowledge acquisition and application, over-reliance to GenAI, academic integrity, ethical awareness, and critical thinking. Although these insights provide invaluable guidance on what to consider when integrating GenAI in learning and teaching, the prevailing attitude in much of the literature remains limited; conceptualizing GenAI primarily as a tool focused on its cognitive impacts [1], [3]. Consequently, GenAI's impacts within the broader educational ecosystem, beyond cognitive consequences, remain under-investigated, including its social and psychological consequences for students. This gap is problematic given that learning is inherently social, as explained by Vygotsky's sociocultural theory [14], which positions social interaction as a mechanism through which learners co-construct knowledge through dialogic engagement, while also considering the social mechanism of developing psychological constructs that has been consistently linked to learning and retention.

Social and Psychological Consequence of GenAI Interaction

According to a systematic review focused on the consequences of GenAI in computing education, only 8.5 % of the identified literature since 2022 (19 papers) focuses on social aspects of learning [1]. Similarly, in engineering education, our research team's current systematic review identified fewer than ten articles that directly or indirectly focus on the socio-psychological consequences of GenAI [15]. Although there are a few papers on GenAI focused on its impact on social aspect of learning, they provide invaluable insights on social consequence of GenAI integration or interactions. Regardless of the disciplines, there are negative consequences consistently mentioned across the paper, including reduced collaborations or interactions with other human beings significant to their learning, including peers, faculty, and TA. According to Hou et al.'s work in the undergraduate computing education context [5], students expressed that their peer and faculty

interactions within the class being affected by GenAI due to their over-reliance on GenAI to avoid the socioemotional barriers of help-seeking. Guo et al.'s findings from engineering undergraduate students further explains the reasons on students' preference for GenAI, including their immediacy, personalized responses, and streamlined cognitive demands [16]. Arora et al., [17] highlighted another aspect of GenAI interaction that hinders collaborations with teammates in the advanced computing class, i.e., compatibility issues between outputs generated by students and ChatGPT, which complicate integration and slow teamwork. Others reported that students feel pressured to use GenAI to keep up with their peers [18], increasing feelings of isolation while also leading them feeling guilty about their GenAI usage [19]. The findings collectively represent that students' interactions with GenAI, GenAI interaction, has been gradually reshaping peer interactions and collaborations in the process of learning, and potentially friendships, while also reflecting the varied perception toward GenAI, including a tutor, collaborator, to a mere technology.

Research Design

To address this need, the study aims to conduct a systematic review to generate synthesized understandings of how students' interactions with GenAI are characterized and how these interactions impact their socio-psychological dynamics in engineering and computing education, while also providing insight into the current research landscape. The project follows the JBI Manual for Evidence Synthesis [20] developed by The Joanna Briggs Institute, a research group renowned in the field of systematic synthesis research, which is congruent with the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) and PRISMA checklists. The JBI Manual includes six stages: 1) Objectives and research questions, 2) Literature search, 3) Inclusion criteria, 4) Data management and selection, 5) Data extraction and synthesis, and 6) Outcomes. This work in progress presents information on the first four steps, given that the data collection and analysis is in progress.

Research Questions

The study aims to addressing the following research questions:

- **RQ1.** How do students interact with GenAI systems?
- **RQ2.** How do students' interactions with GenAI influence their social interactions and socially constructed psychological beliefs (e.g., sense of belonging, self-efficacy, identity, motivation, etc.)?
- **RQ3.** What is the current landscape of research? What opportunities and risks have been identified?

Literature Search

To conduct an extensive search for relevant literature on the emerging topic in engineering and computing education, we will use a multi-step process, with a set of complementary strategies. The research team consists of a researcher whose research focuses on social interactions and socially constructed psychological constructs, including sense of belonging and self-efficacy, and an engineering and science librarian with expertise in synthesis research.

- **Step 1. Identifying key terms.** This step was conducted to ensure the "sensitivity" of our search terms. We performed a manual search to identify key terms within selected top journals prominent in the research team's pilot review. Journal titles and abstracts were first reviewed to determine relevance to the topic and to identify key terms to add to our initial list for subsequent searches.
- **Step 2. Databases and search string.** We conducted a search using academic databases, leveraging our experience from the first step and previous reviews on related topics in engineering and computing education. ***First***, we searched electronic databases that index engineering, educational, and psychological studies: ERIC, Academic Search Complete, Education Source, Engineering Village, Web of Science, and PsycINFO. ***Second***, key terms identified from the first stage will be used to develop Boolean-based search strings. Search terms included terms related to GenAI–human interactions, research context, and social and psychological dynamics (Table 1). Search strings were refined collaboratively by the two authors in consultation with an engineering and science librarian. We identified literature published within the past five years, corresponding to the emergence of GenAI, and employed Boolean operators refined through our pilot study.

Table 1. Boolean Search Strings

Search String	Terms
GenAI	("generative AI" OR "generative artificial intelligence" OR "Gen AI")
	AND
Research Context	("engineer* educat*" OR "STEM educat*" OR "biology educat*" OR "chemistry educat*" OR "math educat*" OR "physics educat*" OR "geoscience educat*" OR "computer science educat*" OR "engineering student*" OR "STEM student*" OR "biology student*" OR "chemistry student*" OR "math student*" OR "physics student*" OR "geoscience student*" OR "computer science student*" OR "engineering undergraduate stud*" OR "STEM undergraduate stud*" OR "biology undergraduate stud*" OR "chemistry undergraduate stud*" OR "math undergraduate stud *" OR "physics undergraduate stud*" OR "geoscience undergraduate stud*" OR "computer science undergraduate stud*" OR "engineering graduate stud*" OR "STEM graduate stud*" OR "biology graduate stud*" OR "chemistry graduate stud*" OR "math graduate stud*" OR "physics graduate stud*" OR "geoscience graduate stud*" OR "computer science graduate stud*" OR "engineering communit*" OR "STEM communit*" OR "biology communit*" OR "chemistry communit*" OR "math communit*" OR "physics communit*" OR "geoscience communit*" OR "computer science communit*")
	AND
1. Social Dynamics	((human* OR user* OR person* OR people OR individual* OR operator* OR designer* OR creator* OR participant* OR worker* OR collaborator* OR peer* OR faculty OR teacher* OR instructor* OR student* OR classroom OR colleague* OR team* OR group* OR community OR mentor*) AND (interact* OR collaborat* OR communicat* OR co-creat* OR co-design* OR partner* OR assist* OR coordinat* OR cooperat* OR connection* OR affiliat* OR integrat* OR dialog* OR discussion* OR conversation* OR engage* OR engag* OR participat* OR trust* OR empath* OR support* OR bonding OR attachment OR conflict* OR perceive* OR perception* OR attitude* OR accept* OR adoption OR decision* OR behavior* OR relationship* OR dynamic* OR exchange* OR feedback OR teamwork OR team* OR group* OR social*)) OR ("human-computer interaction" OR HCI OR "human-AI interaction" OR HAI OR "human-machine interaction" OR HMI OR "computer-supported cooperative work" OR

	CSCW OR "human-robot interaction" OR HRI OR social OR human OR "human-human" OR interpersonal)
2. Socially Constructed Psychological Constructs	(belonging" OR "identity" OR "self-efficacy" OR "motivation")

- **Step 3. Title, abstract, and full-text reviews.** The titles and abstracts of all search results are currently under-review for relevance. Then, we will perform a full-text review of all potentially eligible articles based on our title and abstract review. The engineering librarian will lead the full-text collection using the library resources.
- **Step 4. Final corpus of literature.** Our final list of included work will be checked and sorted, checking to ensure that all articles that were extracted were reviewed.

Inclusion Criteria

The abstract and full-text review are in progress, and the following inclusion criteria are being applied.

- Studies that involve at least one GenAI system
- Empirical or conceptual studies investigating students' interactions with GenAI or its impact on social interactions and/or psychological dynamics
- Publications in peer-reviewed journals or conference proceedings
- Full-text availability in English

Data Management and Selection

Covidence, an online tool for systematic reviews, will be used throughout all three phases to ensure process integrity by facilitating citation import and screening, duplicate removal, text review for inclusion, quality assessment, data extraction, and result export.

Conclusion and Future Works

The poster presentation will share preliminary synthesized findings, offering insights to support educators and practitioners in balancing technological innovation with human connection in engineering and computing education. By synthesizing how students' interactions with GenAI are characterized and how these interactions shape socio-psychological dynamics, this work helps identify promising and underexplored research directions. By examining both the potential benefits and risks of GenAI interactions for students' social and psychological development, i.e., critical factors to long-term learning and retention, this work provides practitioners with evidence-based guidance for supporting students' GenAI use in engineering and computing learning environments.

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