Navigating generative AI in higher education – six future scenarios

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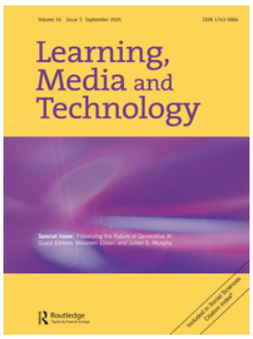

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Navigating generative AI in higher education – six near future scenarios

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ABSTRACT

This study investigates the impact of generative AI (GenAI) on higher engineering education through informed educational fiction. Based on educators' predictions and analyzed through Cultural-Historical Activity Theory (CHAT), the study presents six near-future scenarios. These illustrate both potential strategies and the challenges educators face in managing GenAI, including conflicting learning goals, excessive self-direction among students, unpredictable GenAI development, conflicting regulations, changing educators roles and interactions with students, and the forging and AI-ready campus. The results provide new insights into why GenAI might be challenging to manage in education, while also discussing how potential changes are not historically unprecedented. This study contributes to society and academia by offering empirically grounded future projections that reflect educators' perceptions of managing GenAI. These projections can inform future interventions and support the development of alternative educational futures. In doing so, it advances the discussion on fiction-based research as a method for exploring complex technological transformations.

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Informed fiction; generative AI (GenAI); higher engineering education; Cultural-Historical Activity Theory (CHAT); educational transformations

Introduction

The impact of generative AI (GenAI) on education is uncertain, complex, and 'hard to grasp' (Cox 2021). In recent years, the significant increase in student use of GenAI (Stöhr, Ou, and Malmström 2024) has presented educators with the multifaceted task of managing their use. Given that GenAI is still in 'its infancy,' there is widespread unease about its future direction (Ratten and Jones 2023). Predicting its precise consequences is challenging due to its diverse and 'context-specific' applications in educational settings (Swist et al. 2024; Swist and Gulson 2023). This uncertainty underscores the need to understand how educators respond to and manage the challenges posed by GenAI, as the integration of GenAI in education requires more than just technical know-how (Swist and Gulson 2023).

At the heart of this complexity lies a tension between promise and risk. The role of GenAI in education is shaped not only by its opportunities and challenges, but also by conflicting perspectives, which makes it difficult for educators to navigate (Lindell and Utterberg Modén 2025). For example, some studies warn that excessive reliance on GenAI may hinder students' critical thinking skills (Orduño-Osuna et al. 2023; Tang et al. 2025), while others argue that, when used

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appropriately, it can support deeper analytical thinking (Daniel, Msambwa, and Wen 2025). Beyond pedagogical concerns, ethical issues such as algorithmic bias and fairness also demand attention (Bahroun et al. 2023; Swist et al. 2024). A further complication arises when students use GenAI without disclosing it, making it difficult to distinguish between original and AI-generated content. This raises serious concerns about academic integrity (Ratten and Jones 2023; Williamson, Macgilchrist, and Potter 2023). Moreover, access to GenAI tools varies significantly. While some versions are freely available, others require payment, which risks reinforcing existing educational inequalities. This presents a dilemma for educators, who must balance the potential benefits of GenAI with the risk of deepening disparities in the classroom (Lim et al. 2023). AI-driven education has also been critiqued for advancing market-oriented ideologies and reducing the richness of teaching and learning to simplified processes (Means 2018). Similarly, some voices resist the notion that 'technology-mediated personalization ought to be an instructional goal' (Nichols, Logan, and Garcia 2025). In contrast, a growing body of research highlights GenAI's potential to support personalized learning, boost student engagement, and enhance learning efficiency (Bahroun et al. 2023; Gupta et al. 2024; Shankar et al. 2024). To keep pace with these developments, educators are increasingly encouraged to pursue professional development to integrate GenAI 'effectively' into their practice (Daniel, Msambwa, and Wen 2025). Fassbender (2025) argues that such recommendations, while framed in terms of efficiency, often reflect technology-driven and neoliberal discourses that prioritize productivity over pedagogical values. This raises important questions about whether these initiatives genuinely align with educators' own professional aspirations. Given the central role educators play in shaping how GenAI is used in classrooms, it is essential, as Fassbender emphasizes, to understand how they can take active responsibility in co-creating the future of education. Yet, there remains a significant gap in research on how educators perceive, adapt to, and implement GenAI in their daily practice (Bower et al. 2024). The influence of educational contexts on these processes is frequently overlooked, underscoring the need for more context-sensitive approaches to responsible implementation (Vartiainen et al. 2024). Moreover, educational fiction has been proposed as a promising, though underutilized, method for imagining both dystopian and hopeful futures of education shaped by AI (Hrastinski 2025).

To address these gaps, this paper examines educators' perspectives on the future impacts of GenAI on higher engineering education. Based on educators' predictions, this study aims to explore near-future scenarios for how educators manage GenAI challenges, as well as what they may not be able to handle on their own. Using the Cultural-Historical Activity Theory (CHAT) framework, educators have engaged with students' attitudes toward GenAI. In doing so, the educators have responded to the challenges they themselves perceive. Manageable challenges (tensions) are distinguished from those that may become unmanageable (paralyzing contradictions). These insights inform six near-future scenarios that illustrate potential educational transformations. By foregrounding educators' perspectives, this study contrasts with research that centers on students' views or large-scale, techno-centric narratives. It also strives to promote greater transparency around how educational fiction can be grounded in theoretical and methodological frameworks, which is increasingly acknowledged in current research, although it is still not fully realized (cf. Cox 2021).

The results offer novel insights for decision-makers in universities and among policymakers into the transformations educators envision and the support they need to navigate GenAI on their own terms. The results also provide a strategic foundation for anticipating future challenges and co-constructing a desirable educational future.

Fiction to understand AI uncertainty

When considering the uncertainties of the future, research increasingly turns to methods such as fiction to explore educational futures (Ross 2017). This study applies *informed educational fiction* to fulfill its aim. This type of fiction can be defined by its grounding in empirical data and theory,

offering more realistic yet imaginative visions of how education could potentially look in the 'real' world, in contrast to more speculative forms of fiction (Hrastinski 2025). However, informed educational fiction approaches remain rare and often overlook the perspectives of key stakeholders, who play a crucial role in shaping meaningful educational futures (Veletsianos, Johnson, and Houlden 2024). Macgilchrist et al. (2023) recommend that empirically informed fiction should encompass 'the locally situated values, worldviews, institutions, structures, and practices through which people want to live.'

Unlike most social science disciplines that are characterized by its systematic pursuit of truth and empirical rigor, fiction often diverges in its ability to challenge conventional boundaries (Richardson and St Pierre 2005), often based on researchers' own experiences (e.g., Clough 2002; Gidiotis and Hrastinski 2024; Nieto 1998). The 'fictional turn' has long shown examples of how it offers new ways to explore ideas that address current issues in education (Selbie and Clough 2005). It offers a promising way to explore and discuss the uncertainties surrounding the future, particularly as education continually evolves through technological advancements (Gidiotis and Hrastinski 2024). Fiction allows researchers to explore possibilities unconstrained by the limitations of present norms, creating space for critical reflection on potential futures. It has been proven to enable researchers to present alternative realities that deepen the understanding of AI in education (Cox 2021; Gibbons and Kupferman 2019). For example, Gidiotis and Hrastinski (2024) show how concerns about the ethical, social, and practical implications of AI, such as the extent of implementation, loss of human agency, privacy intrusions, and the risk of bias and discrimination, have been explored through fiction in educational AI. This research also offers examples of how AI is expected to enhance the learning experience, adapt curricula, provide feedback and guidance, and foster collaboration and creativity among students and educators. That said, some argue that fiction research lacks innovation but rather tending to echo societal debates about GenAI (Gidiotis and Hrastinski 2024).

Other challenges that have been raised concern the role of fiction. Even if the intention of fiction is to create a distorted image of the current potential of AI tools, there are risks associated with taking science fiction too literally (Hermann, 2023). Cox (2021) notes that the process of producing fiction is not easy to render transparent. Increasing transparency around the empirical foundations of fiction has traditionally been seen as problematic. Watson (2011) writes that researchers who balance between fiction and social science risk being dismissed and even unread, as they disrupt the expectations that exist between readers and authors within these genres. This challenge may explain the lack of informed educational fiction. Yet, the boundary between what can be categorized as fiction versus fact has long been debated (Zavarzadeh 1975). As Cox et al. (2023) put it, 'since the future is unknown, any statement about the future is at some level a fiction.'

Fiction based on activity theory

To explore future scenarios for how educators might manage challenges related to GenAI, this study employs Cultural-Historical Activity Theory (CHAT). The rationale for using this methodology for informed educational fiction lies in its well-established capacity not only to understand challenges, but also to support transformative action toward future change. As such, the results do not offer a fixed image of what the future might look like but rather serve as tools that can be used to actively shape that future (Engeström 2015).

According to CHAT, we understand an educational environment as an activity. These activities are local phenomena related to a broader societal context. Activities are not confined to specific locations but are rather defined by cultural perceptions. In these activity systems, individuals engage in interactions with *tools*, including technologies such as GenAI. Tools are mediating artifacts that support human actions. They differ from humans in that humans have an agency to act consciously and can use tools for specific purposes. In addition to tools, the activity system includes the following five components: *Subject*: The individuals or groups being studied in the activity, such as students and educators in an academic setting. *Rules*: Everything that governs our actions, including

socially constructed norms and formally established rules such as university plagiarism policies, curricula, or assessment criteria. *Division of Labor*: The distribution of tasks and responsibilities among participants in the activity system. *Object*: The goal that motivates the activity, reflecting the participants' intentions and needs. In this study, the object is defined as the 'learning object,' which represents the educational goals and outcomes that educators aim to achieve through their teaching practices. *Community*: The collective group of individuals engaged in the activity, such as an academic institution or university.

In CHAT, challenges act as catalysts for change. To understand these challenges, particularly those introduced by GenAI tools in education, this study employs the analytical concept of *tensions*. This involves identifying and analyzing how challenges manifest within the contextual activity system. For instance, the integration of new tools like GenAI in academic tasks can prompt educators and students to rethink their methods. This can potentially disrupt previous norms of academic behavior, creating a tension between the rules and tools. However, these tensions are not merely obstacles. They are based on the principle that all challenges act as forces that stimulate the desire for change. Consequently, tensions can serve as catalysts for change when actors within an activity system engage in an informed reformation of challenging activities. We understand this process of addressing tensions and generating new strategies as a form of 'expansive learning,' albeit informed by our own contextualized interpretation of the concept. While these strategies are grounded in specific challenges, they are not predetermined but instead foster new ways of thinking and acting (Engeström 2001). However, some challenges may be so formidable that they lead to what we in this paper refer to as *paralyzing contradictions*. This critical state, characterized by 'a situation of impossibility or unintelligibility' arises when there is uncertainty about how to address a challenge, which can include actors having conflicting motives and expectations. This state is critical because it prevents them from addressing the tensions by the 'subject alone' (Engeström and Sannino 2011). Nevertheless, with structured interventions involving key stakeholders, it is possible to address these contradictions through transformative cycles of expansive learning (Engeström 2001).

Participants

This study involved three groups of educators in different subjects and at different levels of higher engineering education. According to Engeström (2015), involving a diverse range of actors enhances complementary competencies and promotes 'multi-voiced formation.'

One group consisted of two educational specialists responsible for pedagogical development at the faculty level, who also have teaching responsibilities. Another group included postdoctoral teachers at the beginning of their careers, who were undergoing pedagogical training. The final group comprised three experienced teachers with teaching experience at undergraduate, master's, and doctoral levels.

Data collection procedure

To address the research aim, this CHAT-based intervention study collected data on how educators manage GenAI challenges using the following two-phase procedure:

Phase 1: mirror materials

The purpose of collecting Mirror Material was to understand students' attitudes towards GenAI and use these insights as stimuli in phase 2. 'Mirror materials' (MM) is a method for providing stimuli to encourage participants to form new future visions and address challenges (Engeström 2015). It also served to anchor educators' fictional future scenarios to the present situation, as recommended by Peterson, Cumming, and Carpenter (2003). Data collection involved 11 one-to-one interviews and 6 group interviews with 25 engineering students from 13 different programs, following a semi-structured guide with open-ended questions (Gaskell 2000). The questions focused on whether,

how, and why students used GenAI to understand their current usage in relation to the challenges that motivated them. This included their perceptions of its advantages and disadvantages, as well as their reflections on any necessary rules for its use. Students' attitudes towards GenAI were analyzed using activity system analysis to identify why they use GenAI for academic tasks and its impact on the activity system (cf. Engeström 2015). This resulted in five themes illustrating students' perspectives on how they use GenAI and its impact on education, i.e., the activity system. Inspired by Bayne and Gallagher (2021), we compiled the results into five provocative cards, with the following themes (1) Support for self-directed learning (2) job market demands, (3) decreasing student-teacher interactions, (4) new rules, (5) time prioritization. These MM-cards featured provocative headlines describing how students use GenAI. On the reverse side, the reasons why students use GenAI identified in the student data were detailed in text. Additionally, the cards included theoretical descriptions of the changes' impact on the activity system components, marked in red, along with illustrative quotes (see Appendix 1).

Phase 2: scenario planning

Scenario planning was used as a systemic method for educators to predict how education might change in the next two years. The aim was to consider 'a variety of possible futures that include many of the important uncertainties in the system rather than to focus on the accurate prediction of a single outcome,' as advocated by Peterson, Cumming, and Carpenter (2003). Inspired by Bayne and Gallagher (2021), who suggest that scenario planning can help identify a 'possibility space' to pinpoint institutional challenges and envision future directions, we grounded our research design in CHAT's principle that challenges stimulate the motivation to address them, a process central to expansive learning. Participants, working in groups, agreed on and selected three of the six MM-cards they collectively deemed to present key challenges relevant to their experiences. No group chose the fourth MM-card theme. They then collaboratively created fictional future scenarios for each card, envisioning how perceived challenges might be addressed, including ideas about what teaching might look like in two years and the implications for education and teachers. A two-year projection was chosen as a balance between being sufficiently future-oriented and remaining grounded in educators' current experiences (as opposed to purely speculative scenarios). We recorded all workshops for later analysis.

Analysis

To address the aim of this study, we conducted a four-step analysis of educators' data, focusing on their interpretations of students' attitudes toward GenAI. Although student voices were present in the mirror material, they were excluded from the final analysis to foreground how educators respond to these attitudes. The first three steps were based on CHAT's principles for expansive learning, while the fourth step was grounded in the principles of 'informed educational fiction' (See Figure 1 for an overview of the analysis process):

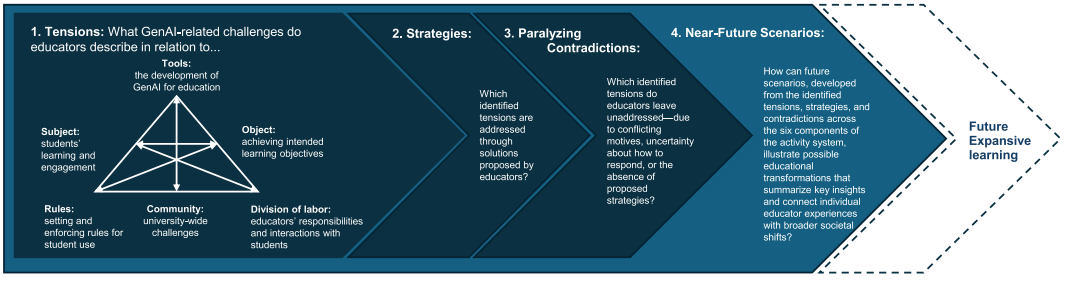

Figure 1. Overview of the analysis process.

(1) **Tensions**: To understand the challenges educators expressed when reviewing the MM-cards, we began by identifying tensions within the activity system. Engeström's activity system components were used as the analytical framework to categorize these tensions (cf. Engeström 2015). Additionally, the MM-card themes served as ad hoc lenses to interpret the specific GenAI challenges that educators fear. For example, when responding to the MM-card on job market demands, educators expressed concerns that '*this change might undermine traditional learning goals.*' These concerns were categorized as potential tensions in the activity system component 'object' because they expressed worries about learning goals, which were due to perceived *job market demands*, further explaining the basis of the tensions.
(2) **Educators' Strategies:** Next, we identified strategies proposed by educators to handle GenAI challenges. Suggestions like '*teaching students to adapt the use of GenAI to traditional goals*' were interpreted as strategies for managing the identified GenAI tensions, reflecting their perceived agency.
(3) **Paralyzing Contradictions**: Finally, we identified potential future paralyzing contradictions that indicate the difficulties encountered in managing GenAI challenges. These included uncertainties about handling GenAI and conflicting perspectives within groups, which could limit their ability to manage GenAI challenges (cf. Engeström and Sannino 2011).
(4) **Future Scenarios:** The fourth analysis is based on the premise that informed educational fiction should be grounded in empirical data and theoretical methodologies (see Hrastinski 2025). This stage aimed to transform the results from the initial analyses into near-future scenarios regarding the potential impacts of GenAI on higher engineering education, based on educators' predictions. By examining the tensions, strategies, and contradictions identified in the first three steps, we developed six future scenarios that illustrate potential educational transformations across each component of the activity system (see Figure 2 for one specific analysis example). These scenarios, intended as provocative narratives of how the future might unfold, synthesize the predictions from all groups and follow Leavy's (2018) recommendation to 'flesh out micro-macro connections,' linking individual experiences with broader societal dynamics. This method allowed us to interpret participants' perceived challenges and future predictions as indicative of larger societal patterns, providing a comprehensive understanding of systemic trends beyond personal expressions, which can be used to inform future expansive learning.

Note: During the analysis process, we noticed that educators often returned to their initially chosen MM-card theme and discussed multiple related GenAI challenges. For example, job market demands were linked to difficulties in keeping up with tool development (tools) and designing relevant learning objectives (object). For transparency, we therefore list the first chosen MM-card themes for each group in Table 1, as these dominated their discussions.

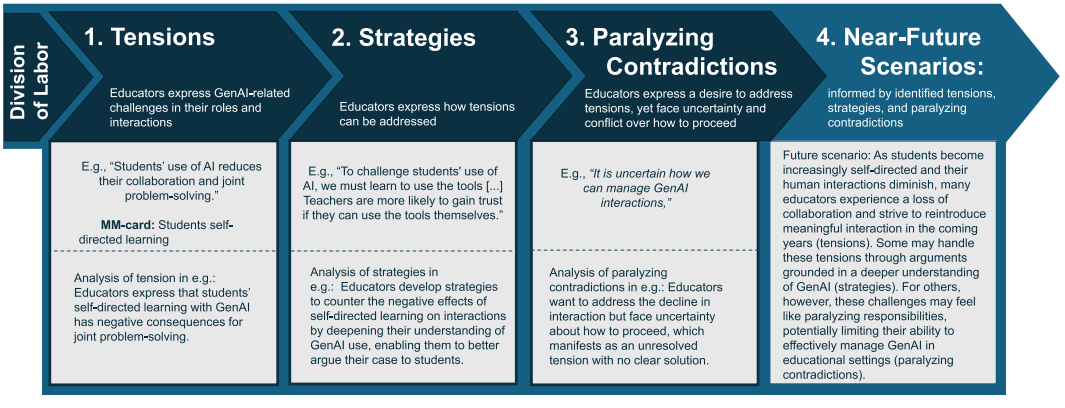

Figure 2. Analysis example.

Table 1. The most discussed Mirror Material-cards for each group.

Educators	MM-card theme
Educational specialists	Decreasing student-teacher interactions
Postdocs	Job market demands
Teachers	Time prioritization

The near future of educators' management of GenAI in higher education

The following section presents six short provocative scenarios illustrating potential changes in higher engineering education over the next two years, focusing on GenAI challenges and how educators might manage them. Each scenario is based on the analyzed tensions in educators' descriptions of GenAI challenges related to the activity system components (i.e., the object, subject, rule, tool, division of labor, and community) including their strategies and paralyzing contradictions. Presented in italics, these scenarios are followed by the empirical data that informed their development.

Future activity system's object

Scenario 1: Conflicting Learning Goals

In the near future, students' GenAI use might challenge traditional learning objectives, creating a divide between students and educators. While educators can counteract this development by arguing their case, their real challenges lie in reaching a consensus on what knowledge and skills are essential in the age of GenAI, and in developing learning goals that incorporate students' GenAI competencies. These challenges create uncertainty, which may lead to paralysis and hinder educators from adapting learning objectives.

Scenario 1 is based on educators' forecasts on addressing GenAI-related challenges for the learning objective, i.e., tensions related to the activity system's object: Educational specialists expressed skepticism about the long-term benefits of students' tailored use of GenAI when discussing how students use GenAI for self-directed learning. They noted, '*Much of what one learns is not tailored in this way. I really don't know – and how it affects if one becomes more rigid in their thinking by being fed something that is tailored.*' This highlights a concern that personalized learning might make students less adaptable to societal and workplace norms. They added, '*It almost changes the social contract. Whether it consists of self-actualized individuals or socialized products that fit into a societal structure.*' They expressed worries that personalized learning could conflict with broader educational and societal goals. To address this tension, they proposed it can be managed with '*good arguments.*' They further suggested that educators must explain to students that their choices are based on '*broader reasons*,' emphasizing that the primary learning objective is '*not just about using GenAI tools,*' but ensuring students develop the necessary competencies, indicating agency in their management of learning objective challenges.

Postdocs expressed different tensions and solutions for adjusting learning objectives to students' GenAI time priorities. One envisioned a future where '*students use AI at all university levels,*' suggesting that '*the only challenge is knowing how to use it at each level.*' The other was more critical, stating, '*But then the question is what they have learned,*' and arguing that in programming, '*at the basic level, they need to learn by themselves*,' indicating a preference for foundational learning without GenAI. This highlights the difficulty in agreeing on learning objectives, indicating paralyzing contradictions among educators' conflicting motives on how to incorporate GenAI into common objectives.

Teachers expressed various tensions that potential job market demands due to GenAI pose for learning objectives. One teacher highlighted the risk of some tasks becoming '*too easy*' with GenAI, suggesting course redesigns to address this. Also, the risk that '*the fundamental understanding*

needed to grasp complex problems' could be lost when students use GenAI for coding was pointed out, advocating for a shift to a '*more holistic understanding*.' Uncertainty about how to prioritize these changes was later acknowledged, noting: '*It would be great to get help, but who can provide it? Adjusting learning objectives is highly subject-specific*.' The teachers then discussed designing courses based on students' use of GenAI but recognized challenges in understanding these. One of them remarked, '*I'd like to know how students use it [GenAI] to adjust the course*,' indicating the difficulty in knowing what students do. Another agreed, elaborating, '*Then, we could also share good practices. Some students might use it smartly, and others could benefit from learning from them. If knowing this helps improve learning, I'm all for it*.' This conversation highlights the teachers' desire to change learning objectives and their willingness to base these changes on students' GenAI use. However, the expressed uncertainty about how to proceed suggests a paralyzing contradiction, partly due to the difficulty in understanding how to develop learning objectives based on students' use of GenAI.

Future activity system's subject

Scenario 2: Excessive Self-Direction among Students

In two years, the rise of overly self-directed students could worry educators about its true benefits and students' ability to prioritize their learning. To tackle this challenge, educators might focus on motivating students, designing innovative courses, and adjusting curricula. Despite these efforts, uncertainty about implementing these initiatives will remain, highlighting potential paralyzing contradictions in educators' ability to provide consistent support.

Scenario 2 is based on educators' predictions about how to address the challenges they expect GenAI will pose for students, i.e., tensions related to the activity system's subject: Educational specialists raised concerns that some students might not identify what is important to learn with GenAI. '*Students might potentially automate tasks they need to learn, which could lead to unmet expectations*,' one of them noted when discussing students' time priorities with GenAI. The other mentioned that it will be crucial for students in the future to '*understand the learning goals*' to develop skills relevant to future employers. They also discussed the '*divergence between students who can and cannot prioritize tasks with GenAI*' as a risk, and suggested it is essential to '*explain why tasks are important, so students feel motivated to work on them*.' as a strategy for addressing this tension.

Both postdocs noted that GenAI could make students more independent while decreasing student-teacher interactions. However, they expressed concern this independence should '*not come at the expense of learning*' stressing a tension, '*This is another unknown aspect – how much independence is good*' The other postdoc noted that students' ability to use GenAI for learning might vary, suggesting that '*master's students might handle it better than undergraduates*.' Both thereafter recommended a curriculum where students' responsibility with GenAI increases with their education level, although they had different ideas on how the curriculum could be shaped. Their conversations propose paralyzing contradictions in how they can balance students' level of independence, as it is unclear what is beneficial for students.

Teachers expressed concerns about students' ability to handle GenAI for academic learning objectives when assessing how students meet job market demands. One teacher emphasized the need for supporting them in learning to use GenAI, stating, '*They need to know how to use it effectively. You can't just leave it to the students themselves*,' and suggested new assignments and curriculum changes as a strategy. Another teacher disagreed, while a third proposed a '*gradual introduction of GenAI in the course content*,' This conflict highlights paralyzing contradictions in developing common strategies, while also showcasing individual strategies to support students.

Future activity system's tools

Scenario 3: Unpredictable development of GenAI

The near-future development and use of GenAI tools are highly unpredictable. While there is a chance that this challenge might become manageable to some extent with careful planning and additional time, there is also a risk that the uncertainty surrounding GenAI development makes it paralyzingly difficult for educators to plan for change, limiting their capacity to manage GenAI in education.

The third scenario is grounded in educators' predictions on how they can address challenges in GenAI development, i.e., tensions related to the activity system's tool: Educational specialists found it challenging to predict how GenAI might evolve, especially when discussing its impact if students start preferring GenAI over teachers. One noted, '*It's difficult to predict two years ahead. We don't know what technological development will bring or what the tools' capabilities will be. The leap could be very large or marginal*,' highlighting concerns about future advancements and their impact on education. However, they also expressed hope by saying, '*I can plan my teaching with these tools in mind. Then there might be a greater chance – rather than just letting it happen,*' suggesting a strategy that a proactive approach could lead to mastering the outcomes.

Among the postdocs, one expresses concern about students' time prioritization and its consequences for future GenAI development:

> What we consider acceptable now and use to solve many problems is not guaranteed for the future. Current advancements are due to programmers who learned without ChatGPT. My concern is that we still need skilled programmers, and I'm not sure how many we will have. AI, especially ChatGPT, makes people somewhat lazy because we don't yet have a reasonable culture for using it.

This indicates the worry that future developers may lack foundational knowledge, impacting GenAI development and their relevance for higher education. In contrast, the other confidently states, '*There will be many tools for both teachers and students. We can have personalized or individual teachers for every student,*' envisioning a future where GenAI tools support personalized learning. These differing perspectives suggest paralyzing contradictions surrounding GenAI development and whether and how these tools can support education.

Teachers worry about the constant changes in GenAI, seeing it as a challenge to support students' use to meet job market demands. They explain how tool development complicates their handling of GenAI, indicating a tension as it is challenging for '*teachers to keep up with the changes*.' Another suggests that with more time, they could manage the challenges better: '*This would have been possible if they had spent even more time*.' Showing a strategy where they see these tensions as manageable with more time.

Future activity system's rules

Scenario 4: Conflicting and Counterproductive Regulations

In two years, educators will likely guide students' use of GenAI through strategies such as, innovative teaching methods, implementation of university policies and curriculum adjustments to mitigate negative impacts. However, these intended rules could be hindered by some educators' counterproductive attitudes, conflicting responsibilities, divergent views on regulations, and gaps in knowledge, making the management of GenAI paralyzingly difficult. This development may lead to students using GenAI in ways that contradict the intended regulations, thereby undermining the effectiveness of these strategies.

This scenario is based on educators' forecasts for addressing GenAI regulatory challenges, i.e., tensions related to the activity system's rules: All groups discussed tensions related to rules when reviewing students' time prioritization with GenAI. Educational specialists emphasized the importance of teachers clearly explaining why learning objectives are crucial for students' futures and that fundamental subject knowledge is necessary for meaningful GenAI use to prevent cheating and

promote transparent use. However, tensions were raised about the potential for educators' teaching methods to inadvertently encourage cheating, indicating paralyzing contradictions about how these desirable norms can be upheld in practice. As one pointed out, '*Teachers might impose high demands with more complex and challenging assignments, which force students to prioritize very hard*.' This could lead students to violate academic integrity rules. Additionally, they worried that teachers' negative attitudes towards GenAI might hinder transparent use, potentially penalizing honest students while those who secretly use GenAI.

Postdocs had differing views on how students' time prioritization challenges established rules. While they agreed on the need for curriculum changes where students' GenAI responsibility increases with their education level, their implementation strategies varied. One postdoc suggested '*a specific course for practicing GenAI use*' and supported unrestricted use, arguing that '*students should be able to use GenAI as much as they want with support from teachers*.' The other doubted whether GenAI enhances learning, warning that '*it risks the loss of fundamental knowledge.'* This postdoc suggested that '*students should not use GenAI without clear regulations*' but was unsure how such regulations could be formed, seeking a general university policy first to adapt to. Their disagreement highlights the paralyzing contradiction about how educators can form common rules for GenAI management.

Teachers expressed uncertainty about how unified and practically implementable rules can be formed, even though all expressed a desire to allow students' use of GenAI. One teacher felt no special regulations were needed and advocated for changing assessment criteria so that '*linguistic skills are not heavily weighted.'* Another teacher emphasized that '*banning AI is impossible and undesirable'* but described it as a '*huge challenge'* to balance students' engagement with GenAI. The third teacher expressed concern that also job market demands could increase pressures on students and lead to a loss of fundamental knowledge if GenAI usage is not regulated in curricula. To address this, a three-step approach was proposed: '*Step 3, in two years, is to support students in the process – teaching them how to use the tools effectively so it becomes a learning objective. The challenge is having the competence to describe how to work.'* These discussions suggest paralyzing contradictions due to differing views on regulations, the ability to balance restrictions with usage, and a lack of professional competence to maintain stepwise deregulation.

Future activity system's division of labor

Scenario 5: Changing educator roles and interactions with students

As students become increasingly self-directed and their interactions with educators diminish, many educators may strive to foster greater collaboration with their students in the coming years. This ambition, however, could lead to conflicts that educators will need to navigate carefully. The evolving role of educators, shaped by the integration of GenAI, will likely necessitate adjustments and introduce uncertainties regarding their professional development. These dynamics suggest potential paralyzing difficulties in their responsibilities, complicating the management of GenAI.

This scenario is based on educators' predictions for addressing challenges posed by GenAI in their responsibilities and interactions with students, i.e., tensions related to the activity system's division of labor: To address the risk of decreasing student-educator interactions due to GenAI, educational specialists expressed a vision of future education characterized by collaborative problem-solving, described as a '*laboratory.'* One specialist referred to this as '*a classic ideal,'* where students and educators work together to solve problems without predetermined answers. However, they worried that '*students might take firm stances*,' causing conflicts due to differing views on learning objectives, especially if they aim to use GenAI to support personalized learning. They expressed a strategy to mitigate this tension by deepening their understanding of GenAI. One noted, '*Educators are more likely to gain trust if they can use the tools themselves*.' This knowledge would not only enable them to present credible arguments but also enhance their responsibility to guide students towards

their learning goals. However, they worried that managing students' GenAI use could increase educators' workload, representing an '*additional cost*,' a tension and paralyzing contradiction requiring university support to handle. They also expressed concern that GenAI use could reduce students' overall knowledge levels, which changes the role of the educator: '*In two years, students might cheat through high school and arrive here knowing very little, which would change our teaching to a high school level. The ever-falling curve. Socrates complained about this too*.' This worry reflects a tension about a future where students' increased use of GenAI force educators to lower teaching standards. It's a paralyzing contradiction driven by these societal changes they cannot influence but must adapt to.

Postdoctoral researchers expressed differing opinions on how students' use of GenAI for self-directed learning challenges the division of labor. One researcher feared this could lead to decreased interactions and advocated for '*increased collaboration'* with students to mitigate this. Another was concerned about the unpredictability of their future responsibilities, stating, '*It is uncertain how we can manage GenAI interactions,'* and called for university policies to support these responsibilities. This uncertainty about how the division of labor is challenged and can be managed indicates tensions and a paralyzing contradiction about forming common strategies for future interactions.

While teachers initially agreed that students' use of GenAI for self-directed learning would not significantly change student-teacher interactions over the next two years, they also expressed concerns that decreased interactions might negatively impact students' learning. They suggested using '*practical classroom exercises and discussions to foster human engagement'* as a strategy to address this tension. Additionally, they feared their responsibilities might evolve. One teacher noted they '*need to learn the tools and prioritize which learning objectives are redundant and need to be replaced,'* a responsibility they are unsure how to manage, indicating a paralyzing contradiction in their roles for which they seek support.

Future activity system's community

Scenario 6: Forging and AI-ready campus

Imagine, in the near future, educators may face significant challenges in managing GenAI due to a lack of support from their institutions. They need guidelines and policies in place to support their roles and ensure fair usage standards. Additionally, educators expect continuous training to adapt to changing responsibilities. Without such support, educators' management of students' GenAI use risks becoming paralyzingly arduous.

This scenario is based on educators' predictions about GenAI challenges at the university level and how they can address them, i.e., tensions related to the activity system's community: Educational specialists expressed concern that students will prefer GenAI over educators, noting that its management would increase their workload. They called for university support, including '*a larger and structurally sustained effort'* with *'resource allocation and training.'* This request indicates a tension at the university level that cannot be managed within their professional roles.

A postdoc emphasized, '*It is important to have a policy in place first so that education can then be adapted to these rules*,' when responding to students' time priorities with GenAI. This statement reflects tension and calls for action at the university level so that educators can manage GenAI accordingly.

Teachers also noted that without common policies, '*demands on students could become unreasonable*,' and clearer guidelines from the university would be beneficial. Additionally, a teacher emphasized the need for professional support when discussing how students meet job market demands with GenAI '*Teachers need to keep up with what is happening, and we need to incorporate elements of how companies work; it can't just be up to educators*.' They further stressed the necessity of support for professional development, noting that '*subject-specific workshops and ongoing support are crucial. Temporary measures won't suffice*.'

These statements from educators illustrate potential paralyzing contradictions about handling challenges with GenAI without university support and their desire for the university community to evolve.

Result conclusion

The results present scenarios that highlight potential transformations for higher engineering education in the near future. These scenarios are informed by analyses of the tensions that educators perceive within various components of the activity system. Collectively, they offer a comprehensive view of the activity system, showing where these tensions emerge, and the extent of agency educators perceive they have to manage them. Additionally, they identify issues that educators find difficult to address, which may lead to paralyzing conditions in their management. In conclusion, Appendix 2 provides a concise overview of this whole picture.

Discussion

Guided by the study's aim of mapping near-future scenarios in which educators can and cannot manage the challenges posed by GenAI, this discussion is structured around the tensions and paralyzing contradictions identified in the empirical material.

Beginning with the tensions that educators actively developed strategies to address, one prominent issue concerns the educational value of personalized learning, particularly when facilitated by GenAI. This tension, which we identified in relation to the learning objective, extends beyond previously noted concerns that GenAI may hinder students' critical thinking skills and negatively impact higher education (Orduño-Osuna et al. 2023; Tang et al. 2025). Instead, it reflects a broader challenge: how to foster competencies that are socially and culturally meaningful. This perspective, expressed by some educators in our study, contrasts with research that highlights GenAI's potential to enhance student engagement and support individualized learning pathways (Bahroun et al. 2023; Gupta et al. 2024; Shankar et al. 2024). The present study contributes to this discourse by examining *why* some educators critique personalized learning with GenAI as an educational aim, a position also noted in prior research (cf. Nichols, Logan, and Garcia 2025).

Furthermore, this research expands the discussion on inequality in access to GenAI. While earlier studies have emphasized that unequal access can exacerbate disparities among students (Lim et al. 2023), our results suggest that excessive self-direction in students' use of GenAI may also contribute to future inequalities. At the same time, the study identifies ways in which these challenges could be addressed by educators. Educators also proposed strategies to address tensions arising from the unpredictable development of GenAI, as well as from shifting educator roles and evolving interactions with students.

Many of the tensions, and strategies identified in this study are not unique to GenAI, nor are they exclusive to this particular context. As several educators themselves point out, concerns about the decline of human knowledge have been debated since the time of Socrates. In a similar vein, the notion that AI will challenge and replace traditional learning objectives due to its ability to support students' individual needs has been discussed for at least 20 years (McArthur, Lewis, and Bishay 2005). It has also been noted that AI can support students' individual goals and reduce the need for educators' presence for more than a decade (Williamson and Eynon 2020), while some research has also long criticized this development (cf. Means 2018; Selwyn 2019). Furthermore, the need for educators to regulate AI's negative impacts through curricula, teaching methods, and policy has been predicted since the early research on AI (McArthur, Lewis, and Bishay 2005). Even before GenAI became common in education, the necessity for public policies to mitigate its negative impacts was discussed (Pedro et al. 2019). These historical foundations suggest that these tensions are not specific to this context, but rather systemic and embedded in broader societal structures. Despite this background and the knowledge that GenAI development can be traced back to the

1950s (Cao et al. 2023), our results indicate that educators still perceive managing GenAI as challenging – across all components of the activity system – even in the near future. This raises a significant question: Why?

By grounding the future scenarios in analyses of paralyzing contradictions, this study suggests new insights into why educators find it difficult to manage GenAI. For instance, similar to Rudolph, Tan, and Tan (2023), this study finds that educators struggle with GenAI due to a lack of understanding of how students use the tool. However, the analysis goes further by showing how this lack of insight creates paralyzing contradictions around how learning goals can be adapted to better integrate students' knowledge of GenAI, rather than focusing solely on ethical concerns such as academic integrity (e.g., Ratten and Jones 2023; Williamson, Macgilchrist, and Potter 2023) as highlighted in earlier research. It also broadens the perspective on cheating, emphasizing that the challenge extends beyond individual student behavior and can be shaped by systemic contradictions in rules.

Additionally, some educators call for the establishment of general policies to manage GenAI in educational settings, aligning with previous research on the need for such frameworks (cf. Bower et al. 2024; Vartiainen et al. 2024). Others express concern that unregulated GenAI use may undermine students' critical thinking, a view also reflected in earlier studies (Orduño-Osuna et al. 2023; Tang et al. 2025). At the same time, several educators highlight GenAI's potential to support and enhance knowledge development (cf. Daniel, Msambwa, and Wen 2025). These differing perspectives point to deeper systemic contradictions in how learning objectives and regulatory practices are negotiated. They indicate that educators have varying, and at times conflicting, needs, as also observed by Lindell and Utterberg Modén (2025).

This study suggests that educators' paralyzing contradictions in managing GenAI are not limited to higher engineering education but are shaped by broader societal implications. This is because GenAI governance is influenced by prior education and, for example, affects students' future workplaces. As such, GenAI emerges as a complex and context-dependent phenomenon, consistent with prior research (Cox 2021; Swist et al. 2024; Swist and Gulson 2023). This complexity may help explain why the near-term future of GenAI remains uncertain and difficult to conceptualize, an issue previously identified as a research gap (Fassbender 2025). However, these contradictions are not merely paralyzing; they may also serve as a generative force for expansive learning by prompting exploration of the future scenarios presented in the results.

Methodological reflections

This study explores fictions grounded in educators' predictions about near-future GenAI challenges, rather than presenting the researcher's own fictional narratives, which is otherwise common in fiction research (e.g., Clough 2002; Nieto 1998). The scenarios are based on theoretical analyses of empirical data and literature, in order to provide informed educational fiction that enhances transparency, a known limitation in fictional approaches (Cox 2021).

The results offer new perspectives on GenAI management and its persistent challenges, possibly due to the 'fictional turn' approach, which enabled educators to speculate about the future (Cox 2021; Gibbons and Kupferman 2019). However, differences from previous studies may also reflect the local context. For instance, the educators' desire to align learning objectives with students' GenAI use may stem from the study's setting at a technical university, where technology is deeply embedded in the institutional culture. Similarly, the emphasis on collaborative problem-solving may reflect norms commonly found in engineering education (cf. Devan et al. 2024). As with all qualitative research, the small-scale nature of the study limits generalizability, and in this case, may have constrained the scope of the scenarios. Yet the results offer a compelling reason to conduct similar studies in other contexts, which could help clarify what is specific to the setting in which this study was carried out. Another limitation is that the MM-cards, which were framed around student perspectives, may have shaped and limited the discussions. This may help explain the absence of concerns such as algorithmic bias (Bahroun et al. 2023; Swist et al. 2024).

The MM-cards, which presented predefined problems, may also have constrained participants' ability to imagine alternative futures. While inspired by the values-based approach of Bayne and Gallagher (2021), our design contrasts with theirs in that it may have reduced the study's speculative dimension. This makes it distinct from the more open-ended fiction approaches often advocated in the field (e.g., Gidiotis and Hrastinski 2024). At the same time, these methodological consequences are consistent with informed educational fiction, in contrast to speculative fiction (Hrastinski 2025). Despite these limitations, educators expressed a range of challenges. Only the card on time prioritization prompted all participants to discuss tensions within the same activity component (rules), reflecting CHAT's principle of expansive learning, which suggests that individuals respond to challenges based on their specific roles and contexts (Engeström 2015). For instance, educational specialists tended to emphasize societal implications, likely influenced by their broader institutional responsibilities.

The study's contribution may lie in anchoring fiction in local contexts, where institutional values and practices are taken into account as proposed by Veletsianos, Johnson, and Houlden (2024) & Macgilchrist et al. (2023). The novel results may also stem from limited research on how educators wish to manage GenAI (compare Ross 2017). However, these empirically based fictions presented can also risk making it difficult for readers to interpret the results, as this research neither belongs to speculative fiction research nor social science, but somewhere in between, as Watson (2011) discussed. Nevertheless, the hope is to expand the boundaries of fiction in educational research (Cox et al. 2023) and inspire further inquiry in this methodological borderland.

Concluding remarks

This study has explored near-future scenarios that illustrate how educators might respond to the challenges posed by GenAI, as well as the limitations of what they can address independently, based on their own anticipations. Based on our methodology, we suggest that even the most paralyzing contradictions educators face can be addressed through systematic and collaborative interventions (cf. Engeström 2001). For such efforts to be meaningful, they must involve key stakeholders, including institutional and societal actors with the authority and capacity to enact change. Each scenario can therefore serve as a catalyst for expansive learning. The example of creating an 'AI-ready campus' clearly demonstrates what the university involved in this study must collectively confront in order to shape alternative futures, rather than passively accept those contradictions that may otherwise unfold. Similarly, these scenarios can serve as stimuli in other contexts. In such settings, key stakeholders such as educators, system developers and policymakers can use them to reflect on how GenAI may transform their conditions and to act accordingly.

In this way, fiction-based research serves not only as a method for exploring possible futures but also as a means of initiating change. It supports discussions about which futures are desirable and how different actors might contribute to realizing them. Rather than offering literal forecasts, which is a known risk with fiction-based approaches (cf. Hermann, 2023), these scenarios have the potential to function as exploratory tools that provide insight into alternative futures. Their relevance, we suggest, extends beyond the scope of this study and may continue to offer value in broader educational and societal contexts.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics approval

The study received approval from the Chalmers Institutional Ethical Advisory Board (IEAB) and the Head of Department of Communication and Learning in Science (CLS) at Chalmers University of Technology. The approval was granted on 1 November 2024, with the reference number CLS 2024-0087.

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