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Use of LLM tools within higher education: Report 1

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[1] Public- fully open (automatically posted online on the Project Results platforms)

Executive Summary

This report is based on a systematic literature review. It examines the impact of Generative Artificial Intelligence (GenAI) and Large Language Models (LLMs) on higher education. The rapid advancement of GenAI tools, such as ChatGPT, has transformed educational practices, bringing both significant opportunities and critical challenges. This report synthesizes findings from a structured rapid literature review encompassing 112 sources, including peer-reviewed articles and grey literature, and addresses three core research questions regarding the implications of LLMs in higher education. It refers to articles published between January 2022 and October 2024, that focus on the opportunities, challenges, and implications for teaching, learning, and diversity, inclusion, and institutional policies. It summarises the latest research in the field and provides insights into how these technologies are reshaping educational practices, while addressing ethical concerns and practical challenges.

Key findings are grouped and listed below:

Opportunities:

- **For Educators**: GenAI tools, such as ChatGPT, offer significant advantages in streamlining a range of tasks related to teaching. LLMs offer substantial benefits for educators, such as automating content creation, developing customized lesson plans, allowing educators to focus more on student engagement and personalised instruction, providing instant feedback, and supporting interactive learning environments, particularly in fields like STEM, healthcare, and computer programming.
- **For Learners**: GenAI enhances learning efficiency by offering personalised learning experiences, instant real-time feedback, and the ability to foster independent learning. The use of AI in STEM and or computer programming education is particularly promising, with applications ranging from coding assistance to virtual clinical simulations in healthcare education.

Challenges:

- **Critical Thinking and Plagiarism:** There are concerns about GenAI's potential to reduce critical thinking, problem-solving and creativity, leading to reduced academic integrity. The risk of plagiarism and the over-reliance on AI-generated content necessitates strong institutional guidelines to ensure responsible use.
- **Ethical Considerations:** Data privacy, algorithmic bias, and the ethical use of AI in education are key concerns. Institutions must address these issues by ensuring transparency and fairness in AI applications.

Diversity, Inclusion, and Accessibility:

- **Equity and Access**: GenAI holds the potential to promote equity by offering resources to underserved students, such as language support for non-native speakers. However, access to premium AI tools could aggravate existing inequalities, particularly for students with limited digital resources.

- **Accessibility**: AI tools can significantly improve accessibility for students with disabilities through features like real-time language translation and cognitive accessibility enhancements, yet such tools tends to align more closely with western corpus only, American cultural norms and values, exhibiting less adaptability to other cultural contexts. Thus, the need for refinement in AI outputs remains to ensure inclusivity for diverse student populations.

Institutional Policies and Guidelines:

- **Global Trends in Policy Development**: Universities are developing comprehensive policies to guide the ethical use of GenAI. These guidelines address plagiarism prevention, the redesign of assessments, and the responsible integration of AI tools into teaching and learning. Regulatory efforts across the UK, EU, and U.S. highlight the global emphasis on balancing AI innovation with ethical oversight.
- **Interdisciplinary Collaboration**: Effective implementation of GenAI in higher education requires collaboration between educators, AI experts, and policymakers. This approach is necessary to develop well-structured frameworks that ensure responsible use while enhancing educational outcomes.

Methodology:

A rapid evidence assessment approach was employed, incorporating both peer-reviewed and grey literature published between January 2022 and October 2024. The review followed PRISMA guidelines for systematic selection, resulting in the inclusion of 112 articles relevant to the research questions.

Conclusions and Recommendations:

The integration of LLMs in higher education offers transformative potential but necessitates a balanced approach to address ethical, accessibility, and educational concerns. While these technologies can enhance teaching, learning, and accessibility, their use must be carefully managed to address ethical concerns, plagiarism, and data privacy; and pedagogical concerns such as critical thinking. Institutional guidelines, interdisciplinary collaboration, and global regulatory frameworks are essential for ensuring that GenAI is used responsibly and equitably in higher education. Institutional policies should prioritize GenAI literacy, critical thinking, and equitable access to AI tools. Future research should focus on refining pedagogical models, enhancing AI literacy, and ensuring inclusive AI practices across diverse disciplines. Collaboration among educators, AI developers, and policymakers is essential for fostering responsible GenAI adoption that aligns with educational values and missions.

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Background

The main objective of this deliverable is to explore the latest *published developments* in research and innovation relating to the use of Large Language Models (LLMs) in higher education. Furthermore, it covers research, innovation and innovative *practices* related to evolving opportunities and challenges of LLMs and their *implications for the design* of teaching and learning in higher education. It also assesses the implications of LLMs for diversity, inclusion, and accessibility within higher education, identifying challenges associated with these tools and highlighting good practices. Finally, it investigates the institutional policies and strategies related to the use of LLMs in higher education, identifying key components for developing educational and ethical frameworks and guidelines for best practice and implementation.

Research Questions

This review examines the three following Research Questions:

1. *What opportunities and challenges do LLMs present for teaching and learning practices in higher education?*
2. *How do LLMs impact diversity, inclusion, and accessibility in higher education?*
3. *What guidelines and institutional policies are being established to ensure the responsible and effective use of LLMs in higher education?*

These research questions aim to explore the multifaceted implications of LLMs in higher education, focusing on innovation, diversity and inclusion, and institutional policies. They provide a comprehensive framework for investigating how LLMs can be effectively and ethically integrated into higher education to enhance teaching and learning practices.

Methodology

A structured rapid literature review approach (Smela et al., 2023) was employed to identify relevant studies, involving a search of peer-reviewed literature databases and an internet search to locate pertinent grey literature, such as newspaper articles and blog posts. The methodology is based on Rapid Evidence Assessment (REA). The initial methodology was based on Rapid Evidence Assessment (REA) to account for the anticipated limited number of peer-reviewed publications due to the rapid adoption of the technology. However, as peer-reviewed publications proliferated beyond initial expectations, a systematic literature review was preferred over the REA approach to comprehensively capture the considerable volume of available articles. Consequently, this review predominantly relies on published articles (n=72), supplemented by twelve grey literature sources, including government reports and news articles discussing the attitudes of institutions, countries, and governments toward Generative AI.

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher et. al, 2009) when selecting relevant articles, see Figure 1. The final search was conducted on 20 September 2024. The literature to answer the above questions has been searched on Google Scholar and The Open University's library by using the following keywords:

(("Large Language Models" OR LLM OR chatgpt OR GenAI) AND ("Higher Education" OR university OR teaching OR learning) AND (diversity OR accessibility OR inclusivity OR awareness OR perceptions OR opportunities OR benefits OR challenges OR risks OR policies OR guidelines OR framework))

Academic articles published between 1 January 2022 and 20 September 2024 (the date of the final search) were reviewed, including advanced online publications and preprints. Non-academic articles, i.e. grey literature, (e.g., articles from mass media) were also included. At the time of writing, this period covered all the articles that had been published about GenAI. To be included in this rapid review, articles had to discuss GenAI in the field of higher education, with no constraints on any specific educational contexts. Literature reviews, if retrieved, were used as background references. In addition, only English-language articles were included in this review. Table 1 summarises the inclusion and exclusion criteria for article selection.

Table 1 Inclusion and exclusion criteria for article selection.

Criteria	**Inclusion**	**Exclusion**
Subject	Discuss GenAI in the field of higher education	Do not discuss GenAI in the field of higher education (i.e. school settings, primary/secondary etc.), workplace etc.
Article type	Academic articles & Grey Literature (e.g. blogposts, news articles, websites)	Social media
Time period	1 January 2022 and 23 September 2024	Articles outside the time period
Language	English	Non-English

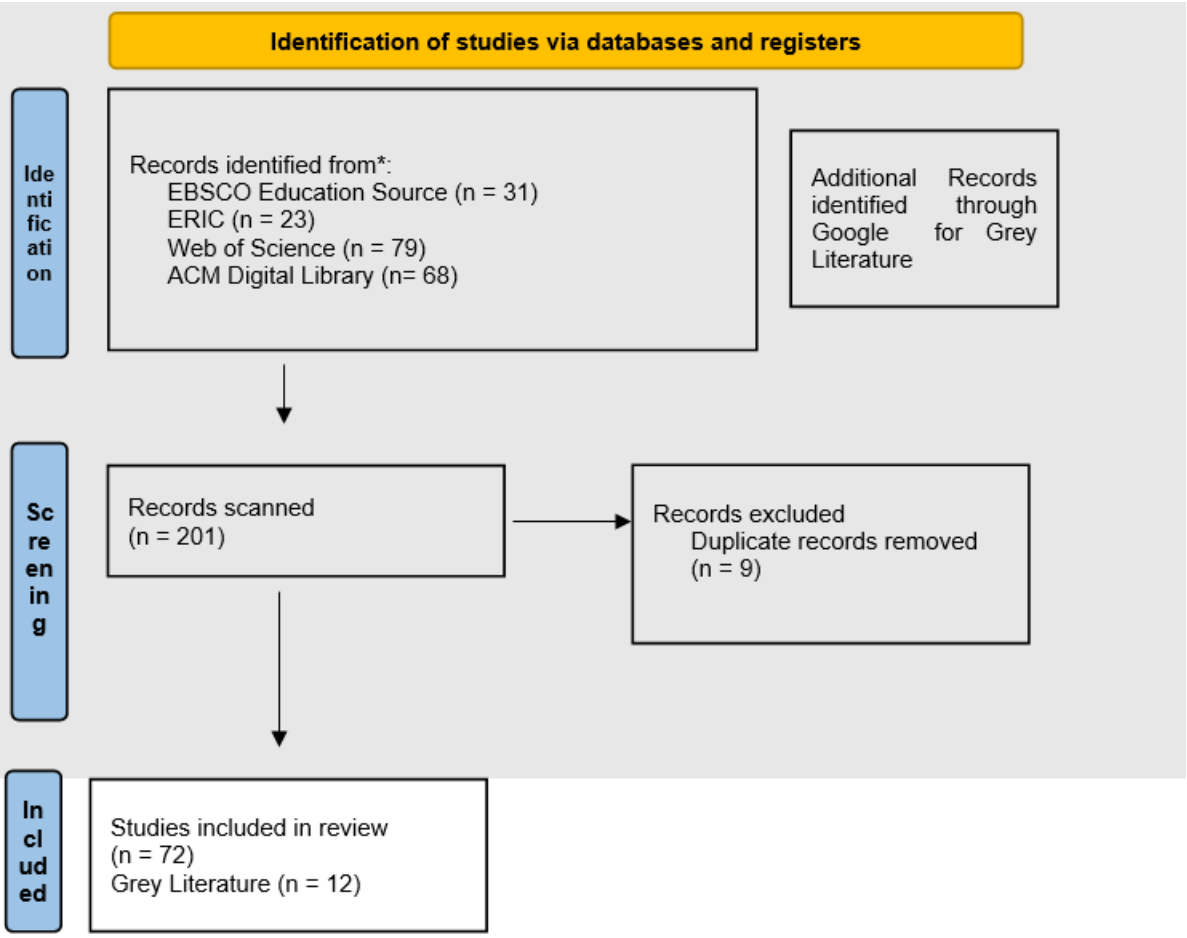

Figure 1-Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram of article selection

Peer-reviewed articles in English, reporting on AI within education primarily at university level, and indexed in these international databases: EBSCO Education Source, ERIC, Web of Science and ACM Digital Library (covering titles, abstracts, and keywords) were included in the review. To capture the grey literature, a search for keywords was conducted using Google. This approach enabled the retrieval of additional relevant articles that were not captured in the literature. Database search has returned 201 articles, grey literature was searched in Google with the first 50 citations screened for relevance. Following the removal of duplicate records (n=9), titles and abstracts were screened for relevance to the research questions in the preliminary review. Each article was skimmed with an inclusion criterion: its relevance to the GenAI, higher education, LLMs, and whether the study reflects on awareness, and perceptions of people on using AI, opportunities and challenges, diversity, equity, and inclusion and if it is related to policies and guidelines. Following the first phase of selection 120 articles are excluded. The most common reason for discarding a paper was that it simply did not address the usage of LLM in education but rather in a different context, and the non-English language. Identified papers which have met the inclusion criteria were tabulated and grouped in a spreadsheet by the type of research, research question, sample size (if available), most important findings, limitations and results, and quality (1-5) summarised for each. In total, 84 articles (of which 12 is grey literature) were carefully reviewed.

Following the initial round of review, all project partners were invited to contribute to the literature selection process. All partners were provided with the list of referenced papers, the search query, and a draft of this report, allowing them to recommend any additional papers they believed should be included. These could include published guidelines from their institutions, country, or papers in a language other than English. All partners contributed between one to five additional papers. In total, 30 additional papers were analyzed, four of which were grey literature and two in a language other than English (noted as footnotes in the report, *e.g.* page 32). One duplicate record was removed, and the remaining 28 papers were incorporated into this report, making it 112 articles in total.

Main Findings and How They Are Presented

GenAI tools like ChatGPT offer substantial advantages for educators by automating tasks such as content creation, assessment generation, and lesson planning. For learners, GenAI tools enhance learning by providing personalized feedback, fostering independent learning, and supporting education in STEM and healthcare with tools like virtual clinical simulations. The opportunities are presented with concrete examples of how AI impacts different fields, particularly highlighting fields such as healthcare, STEM, and computer programming education.

There are concerns about reduced critical thinking, creativity, and increased reliance on AI-generated content, which could lead to academic dishonesty. Institutions are urged to develop guidelines to mitigate these risks. Issues like data privacy and algorithmic bias are significant concerns. The challenges are discussed through examples of potential academic dishonesty, ethical dilemmas, and data privacy issues. The review emphasizes the need for institutional policies to manage these risks.

GenAI holds promise in providing equitable learning opportunities for underserved students, especially non-native speakers, and students with disabilities. However, access to premium AI tools may create inequalities among students. AI tools can support students with disabilities, providing features like language translation and cognitive accessibility. However, there are concerns about biases in AI outputs that align with Western cultural norms. Therefore, for AI tools there is need for refinement to ensure inclusivity.

Universities are developing policies that focus on ethical use, plagiarism prevention, and AI integration into teaching and assessment. Global regulatory efforts (e.g., UK, EU, US) are focused on balancing innovation with ethical oversight. Successful AI integration in higher education requires interdisciplinary collaboration among educators, AI experts, and policymakers to ensure responsible use.

The report examines how universities globally are responding to AI adoption by developing guidelines on academic integrity, assessment design, and AI tool usage. It also highlights the regulatory frameworks adopted by various countries like the UK, US, and EU. Examples of different university policies, the global regulatory landscape, and the development of frameworks to manage the integration of GenAI tools are presented.

The findings in this literature review are presented systematically by exploring each major theme (awareness, opportunities, challenges, diversity, inclusion, policies) in separate sections. Each section includes real-world examples from multiple studies and research, emphasizing both the benefits and the limitations of GenAI in higher education. The report provides practical examples of GenAI applications and discusses the broader implications for educators, students, and institutions, with a strong focus on evidence from recent research.

GenAI Awareness and Perceptions

As with any significant transition we are passing through a phase where there is a wide range of familiarity with and attitude towards GenAI. This phase is likely to persist for some time due to the extended nature of this transition.

In relation to perception towards genAI tool, a recently published UK YouGov Whitepaper (2024) identifies three types of AI user which are shaped around their GenAI awareness: 1. the AI Ignorant; 2. the AI Abstainers, and 3. the AI Optimist. The first type has limited knowledge about AI, does not use AI frequently and is indifferent to it. The second type also has limited knowledge about AI and does not use it often, but it holds a very negative attitude towards AI. The last type actively uses AI with a belief that it can benefit society as a whole. This classification underscores the importance of awareness in shaping AI perceptions. Limited understanding often leads to indifference or negativity, while greater familiarity fosters optimism. However, this typology may not fully capture the diversity of AI user experiences. For instance, a 2024 report by Microsoft and LinkedIn (Varley, 2024) identifies four distinct AI user types: Sceptics, Novices, Explorers, and Power Users, each with unique engagement levels and attitudes toward AI. Recognizing these varied user profiles is crucial for developing targeted strategies to enhance AI awareness and adoption across different segments of the population.

Students generally have positive perceptions towards AI, influenced by prior exposure (Lin, Huang & Yang, 2023; Ali et al., 2023; Eysenbach, 2023) but are hesitant about AI replacing faculty roles (Kumar & Raman 2022; Eysenbach, 2023; Rospigliosi, 2023). Kumar & Raman (2022) surveyed 682 Indian business management students to assess their opinions on AI usage in higher education. Students had positive perceptions of AI, especially in administrative and admission processes. However, they were more hesitant about AI replacing faculty in teaching–learning processes. The study found that students' prior exposure to AI influenced their perceptions. Some students and teachers have reported feeling anxious and less confident when learning with AI. Furthermore in Chiu et. al, 2023 were highlighted the worries of students towards their future, as AI technologies may make their preferred careers redundant.

The literature clearly indicates that there are significant differences in the teaching preferences, learning styles, technology usage, and communication methods among generations. The understanding of generational differences is particularly crucial for the effective adoption of GenAI technologies in higher education. Chan and Lee (2023)'s study employed a mixed method online survey to investigate the current experiences, perceptions, knowledge, and concerns of Gen Z students ("digital-first/technoholic", born between 1995

and 2012), Gen X ("digital immigrants", born between 1960 and 1980) and Gen Y (Millennial, "digital natives", born between 1980 and 1995) teachers regarding the use of GenAI in higher education. Chan and Lee (2023) had 583 participants, among which 399 were students and 184 teachers. The majority of teachers in Chan and Lee's (2023) study generally fall within the birth year ranges of Gen X or Gen Y, and students typically belong to the Gen Z age group. Gen Z participants demonstrated optimism towards the potential benefits of GenAI in higher education, including enhancing productivity, efficiency, and personalized learning. On the other hand, Gen-X and Gen-Y teachers, who have experienced the transition from traditional to technology-based educational settings, demonstrated a more cautious approach to GenAI adoption. They acknowledged the potential benefits of GenAI but showed greater uncertainty and concerns about ethical and pedagogical implications, emphasizing the need for proper guidelines and policies to ensure responsible use of the technology.

Lemke et. al (2023) explored 111 undergraduate computer science-related students' perspectives assessing technology readiness and acceptance for adopting LLMs. They found that the optimism toward the new technology positively influences technology acceptance, while discomfort with the technology negatively influences perceived ease of use. Albayati (2024) found the perceived ease of use and usefulness of ChatGPT significantly shape students' attitudes toward the tool. Privacy concerns and security measures were also highlighted as vital in influencing students' perceptions. Albayati finds when students perceive a positive social influence regarding the use of ChatGPT. They are more likely to adopt a favourable attitude toward the tool. Korseberg et al. (2024) explore how higher education institutions perceive the potential inherent in AI and their initial responses to the proliferation of ChatGPT through a qualitative, interview-based study conducted at three HEIs in Norway. The article examines the type of change pressure ChatGPT was perceived to represent following its launch and the corresponding organizational responses it warranted. The findings indicate that, while ChatGPT and related technologies were expected to potentially threaten — and challenge — key norms and values in the long term, they were primarily perceived in the short term as a regulatory issue that needed to be managed by higher education institutions.

Rudolph et. al, 2023a, conducted a multi-disciplinary test of the current chatbot cohort such as Bard, Bing, ChatGPT and beyond and analysed their performance. The study has shown that the bots are not doing as well as some may have feared or hoped in assignment questions that are not difficult to construct and certainly do not constitute any assessment innovations, which provides valuable contributions to concerns from educators about GenAI and strategies to address these within the assessment development and academic integrity space. The next section, on the use of GenAI across disciplines, also explores how awareness varies depending on the field of study or discipline.

Summary of Results for GenAI Awareness and Perceptions

This section provided a summary of key findings regarding awareness and perceptions of GenAI across different user groups. Studies indicate that awareness and attitudes towards GenAI vary widely:

- **Awareness and User Typologies**: According to a 2024 UK YouGov Whitepaper, AI users can be broadly categorized into three groups: AI Ignorant, AI Abstainers, and AI Optimists. While limited awareness often correlates with indifference or negativity towards AI, greater familiarity tends to foster optimism (YouGov, 2024). Similarly, a 2024 report by Microsoft and LinkedIn expands on this by identifying four user profiles—Sceptics, Novices, Explorers, and Power Users—each reflecting unique engagement levels and attitudes (Varley, 2024).
- **Student Perceptions**: Multiple studies, including Lin, Huang, & Yang (2023) and Ali et al. (2023), reveal that students generally hold positive views on AI, particularly when it enhances administrative and admission processes (Kumar & Raman, 2022). However, hesitancy remains about AI replacing faculty roles, emphasizing a need for balance between AI integration and traditional teaching methods.
- **Generational Differences**: Perceptions and attitudes also differ by generation. Chan and Lee (2023) highlight that Gen Z students are optimistic about GenAI's potential, while Gen X and Y educators express more caution due to ethical and pedagogical concerns. This underscores the importance of tailored guidelines for responsible GenAI adoption.
- **Technology Readiness and Acceptance**: Studies such as Lemke et al. (2023) and Albayati (2024) show that technology readiness influences user acceptance, with perceived ease of use and social influence playing crucial roles in shaping attitudes toward GenAI tools like ChatGPT. Privacy and security concerns, however, remain significant barriers to widespread adoption.

In summary, **15 studies** reviewed indicate that awareness and perceptions of GenAI are complex and influenced by factors such as generational differences, prior exposure, and perceived utility. While **10 studies** (UK YouGov Whitepaper (2024), Microsoft and LinkedIn Report (Varley, 2024), Lin, Huang, & Yang (2023), Ali et al. (2023), Eysenbach (2023), Kumar & Raman (2022), Rospigliosi (2023), Chiu et al. (2023), Chan and Lee (2023), Lemke et al. (2023), Albayati (2024), Korseberg et al. (2024), Rudolph et al. (2023a), McDonald et al. (2024), Kelly et al. (2023)) reflect predominantly *positive attitudes* towards GenAI's potential in education, **5 studies** (Chiu et al. (2023), Korseberg et al. (2024), Rudolph et al. (2023a), Rospigliosi (2023), Chan and Lee (2023) (also noted ethical concerns despite optimism)) highlight significant *reservations and ethical concerns*. These insights emphasize the need for clear institutional policies and targeted strategies to enhance AI awareness and adoption within different educational contexts.

Use of GenAI across disciplines

This section reviews the use of GenAI across various academic disciplines, highlighting global trends in adoption. GenAI tools, such as ChatGPT, demonstrate potential across a wide range of fields, including medicine, health, STEM, accounting, and distance education (Khan et. al, 2024). In their analysis of case studies, Khan et al. (2024) explores the integration of GenAI in multiple domains, mapping its use across key disciplinary categories in 80 countries. Their findings reveal that the healthcare sector is the leading field for GenAI application, followed closely by education, research, computer science, and information technology.

The literature extensively discusses GenAI's potential in education, particularly in specific fields such as medicine, health, STEM, accounting, and distance learning. For instance, in the medical and health sectors, ChatGPT facilitates interactive and collaborative learning by enabling students to apply theoretical knowledge in real-world scenarios, such as practicing diagnostic skills, engaging in clinical communication with virtual patients, and participating in peer and expert discussions (Ali et. al, 2023 and Abd-Alrazaq et. al 2023). Vasconcelos et al. (2023) highlight ChatGPT's transformative impact on STEM education, noting its role in fostering critical thinking, problem-solving, and engagement through inclusive, accessible learning environments that promote creativity and deeper understanding of complex concepts. Collins et al. (2024) developed a platform to facilitate interactive evaluation by observing real mathematicians as they interact with and evaluate LLMs in theorem proving. The aim is to study how individuals solve problems with the assistance of LLMs and to categorize these interactions to enable detailed analyses. This taxonomy can help inform the careful design and deployment of LLM-based mathematics assistants and reasoning engines. Yilmaz and Yilmaz (2023) underscore its potential in programming education, where students can leverage the platform for instant feedback, coding queries, and problem-solving. Similarly, Al Ghatrifi et al. (2023) emphasize ChatGPT's utility in accounting education, where it helps students grasp complex concepts more efficiently than traditional resources. Additionally, Huang and Li (2023) explore ChatGPT's role in foreign language instruction, envisioning it as a "virtual language partner" that guides students through language learning via real-time conversational practice Shaikh et. al (2023) showed promising results, indicating that ChatGPT is a useful and effective tool for formal English learning; findings revealed that participants perceived ChatGPT as a highly effective tool for language learning, with positive feedback across the tasks performed. The results indicate the tool's capacity to assist in formal English learning contexts, contributing to the growing field of AI-based language learning technologies. Most publications centre around English as a Foreign Language (EFL) learners and the most widely studied application of GenAI in language teaching and learning has been its use for writing instruction (Law, 2024).

Von Garrel and Mayer (2023) conducted a nationwide survey in Germany with over 6,300 students, investigating their use of AI-based tools. Their results show that nearly two-thirds of students have used or are currently using such tools, with the highest levels of usage observed in engineering, mathematics, and natural sciences. The authors suggest that the structure of study programs in these fields may actively promote the use of AI tools and that students in these areas may possess a higher affinity for technology. They also note potential

gender-specific differences in technology usage, likely influenced by the higher proportion of male students in these disciplines.

McDonald et. al (2024) also pointed the STEM-related use of AI-based tools. In their study, where they examined GenAI policy documents from 116 U.S. universities. They found out that half of these institutions referenced GenAI in relation to STEM related courses (N=58, 50%) with most mentioning computer science (N=56, 48%), while fewer discussed its use in mathematics or natural sciences. Notably, only seven institutions mentioned engineering. McDonald et. al (2024) point out GenAI's applications in STEM, particularly in coding, are not perceived as a major threat or advantage. For example, Yale University acknowledges GenAI's broad impact on learning across disciplines but emphasizes that STEM problem sets requiring explanations depend on students' ability to generate language to enhance their understanding.

Kelly et al. (2023) conducted a study on university students' awareness, experience, and confidence in using GenAI across various disciplines. The findings revealed significant disciplinary differences in GenAI exposure. Nursing students reported substantially lower awareness of GenAI compared to students in most other disciplines, with the exception of Medical and Health Sciences. In contrast, Science students exhibited greater awareness of GenAI than those in Medical and Health Sciences, Business and Law, and Arts and Humanities. Differences in GenAI usage were also evident across disciplines. Engineering students reported significantly higher usage rates than students in Nursing, Medical and Health Sciences, and Arts, while Science students had higher usage rates than those in Nursing, Medical and Health Sciences, Arts, Business and Law, and Education.

Overall, students from Science and Engineering disciplines reported higher levels of awareness, experience, and confidence in using GenAI tools, whereas students in healthcare-related fields demonstrated the lowest levels in these areas. This trend may be linked to the varying relevance of technology in different fields of study. GenAI's capabilities, such as coding, solving mathematical problems, and designing scientific experiments, may offer more immediate and practical applications for students in technical disciplines, supporting McDonald et al.'s (2024) conclusions. In contrast, students in human-centered disciplines, such as healthcare, may find fewer immediate applications for tools like ChatGPT, as noted by Cascella et al. (2023).

Furthermore, the extent to which GenAI tools are directly discussed within each discipline may also shape student awareness and use. This aligns with the findings of Smith and Storrs (2023), who reported that students in communications and health science programs demonstrated higher levels of digital literacy when using social media, largely due to the integration of these tools into their professional curricula.

Summary of Results for Use of GenAI across disciplines

In reviewing the use of GenAI across disciplines, this section highlights significant trends and variations:

- **Widespread Use Across Fields**: A total of **10 studies** focused on GenAI's application across multiple disciplines, with notable emphasis on STEM fields, healthcare, accounting, and language education (Khan et al., 2024; Ali et al., 2023; Abd-Alrazaq et al., 2023; Vasconcelos et al., 2023; Collins et al., 2024; Yilmaz & Yilmaz, 2023; Al Ghatrifi et al., 2023; Huang & Li, 2023; Shaikh et al., 2023; Law, 2024). STEM fields, including engineering, mathematics, and computer science, exhibit higher adoption rates due to their affinity for technological tools and problem-solving applications.
- **Disciplinary Differences**: Among the studies, **6** focused on higher awareness and utilization of GenAI tools in STEM and technical disciplines (Von Garrel & Mayer, 2023; McDonald et al., 2024; Kelly et al., 2023; Cascella et al., 2023; Smith & Storrs, 2023). Students in these areas benefit from GenAI's capabilities in coding, mathematical problem-solving, and experimental design. Conversely, human-centered disciplines, such as healthcare and arts, show lower adoption and awareness levels, often due to limited immediate applicability.
- **Positive Impacts and Adoption Trends**: Across **8 studies**, GenAI demonstrated the ability to enhance educational experiences, facilitate critical thinking, and offer interactive learning solutions (Vasconcelos et al., 2023; Ali et al., 2023; Huang & Li, 2023; Yilmaz & Yilmaz, 2023). However, its adoption is often shaped by discipline-specific needs, student familiarity, and professional integration, as observed in studies focusing on communication and health sciences (Smith & Storrs, 2023).

In summary, GenAI's integration varies considerably across disciplines, with stronger adoption and utilization in STEM and technical fields, where its capabilities align closely with academic and practical needs. The reviewed studies indicate that while healthcare, humanities, and other fields are exploring GenAI's potential, the extent of usage and perceived benefits differ widely based on the discipline's nature and relevance to AI applications.

Opportunities and Challenges of LLMs

Opportunities

Opportunities for Educators

With the rise of GenAI, the integration of AI in Education has seen significant advancements. GenAI is increasingly being used for a range of purposes: from creating instructional content, and providing immediate automated assessment feedback (Farrokhnia et. al, 2024) to supporting academic services (Pelletier et al., 2022). GenAI is heralded to serve as a curriculum partner for educators, aiding in the creation of educational resources and activities (Kukulska-Hulme et. al, 2024). A course designer could develop highly engaging course content simply by providing a GenAI engine with a few sophisticated text prompts that are aligned with student learning outcomes (Bektik et. al, 2023; Ullman et. al 2024). Recent research applying GenAI to education illustrates how a dialogue between educators and AI can support the development of learning content, such as lesson objectives (Herft, 2023), assessment rubrics (Michel-Villarreal et al., 2023), and interactive activities (Li & Wang, 2023). Dickey and Bejarano (2024), developed the GenAI Content Generation Framework to help educators create unique and engaging course content using chat-based GenAI, reducing workload and promoting diversified educational resources. Preliminary evaluation of model indicates its effectiveness in mitigating the instructional challenges associated with content creation. Educators reported a significant reduction in the time and effort required to develop course materials, without compromising on the breadth or depth of the content.

Some educators have already started testing the efficiency of LLM tools, such as ChatGPT, by integrating it in their educational activities (e.g., research, teaching, assessment) and found that through automation of certain tasks and processes, ChatGPT is *able to save time for other important activities* like spending more time with students (Alshater, 2022; Terwiesch, 2023). Terwiesch (2023) indicated that ChatGPT was able to decrease the time needed to create exams (from 20 hr to 10 hr) and help Teaching Assistants to test the exam and write solutions to it (from 10hr to 5hr). Halving the time needed to create exams and test them shows 100% productivity increase in the “exam writing operation” (Terwiesch, 2023, p. 23).

Another interesting opportunity for educators is to leverage LLMs like ChatGPT to innovate their teaching strategies. They could use flipped learning to ensure that the most critical pieces of work are completed in class and to focus more on multimedia assignments or oral presentations as opposed to class assignments (Rudolph, 2023b).

LLMs, like ChatGPT, can also be valuable tools for educators as it can help in *creating lesson plans for specific courses*, *developing customized resources, and learning activities*, *carrying out assessment and evaluation*, and *supporting the writing process of research* (Rahman, 2023). They might also be used to enrich a reflective teaching practice by *testing existing assessment methods* to validate their *scope*, *design*, and *capabilities* (Michel-Villarreal et. al, 2023).

Teachers can leverage the capabilities of LLMs to *create prompts for open-ended questions* that align with the learning goals and success criteria of the unit of instruction (Herft, 2023). AI-powered tools can assist educators in *creating assessment materials* tailored to their

teaching objectives and student's needs; teachers can get support of such tools in *generating exercises, quizzes, and scenarios for student evaluation* (Li & Wang, 2023). Additionally, they can be used to also *generate quality rubrics* that clearly and concisely explain exactly what students need to accomplish to be successful in the various required levels of proficiency. Again, teachers can use ChatGPT to create "*prompts for formative assessment activities* that provide ongoing feedback to inform teaching and learning" (Herft, 2023, p. 3). Thus, GenAI-powered assessment systems may support the *integration of continuous feedback* into learning processes by utilising distinctive and atypical artefacts.

GenAI is already a big part in educators' agenda so that there exist several online courses dedicated for educators, providing them an understanding about GenAI, how it can impact education and learners and how educators can use it to enhance their teaching, such as

- An introduction to Generative AI in education - Jisc
- Generative AI for Educators - Online Course - CFTE
- Generative AI in Higher Education - Online Course - FutureLearn
- GenAI for Teaching and Learning: How to do it right? – Open Courses
- Saïd Business School, University of Oxford Oxford Artificial Intelligence Programme (getsmarter.com)
- Generative AI Fundamentals | Databricks
- Artificial Intelligence (AI) Education for Teachers Course (Macquarie University & IBM) | Coursera
- AI Course for Educators — AI for Education
- GenAIEdu - Integrating Generative AI in Adult Education: Empowering Teachers, Trainers and Facilitators • ALL DIGITAL (all-digital.org)

Additionally various companies and platforms have developed AI-powered tools since ChatGPT was launched in late 2022 to aid in curriculum generation, enhancing the course creation process for educators. We have reviewed these tools and their functionalities, including examining each tool's features, capabilities, and specific contributions to educational content creation and course design. Table 2 summarises some notable developments in this field. The table encapsulates the functionalities and distinctive aspects of each AI tool or platform, illustrating the diverse ways AI is being integrated into educational technology to support teaching and learning processes.

Table 2 Generative AI applications for content generation

Tool/Platform	Description	Key Features
Blackboard's AI Design Assistant	Simplifies the creation of courses by assisting in structure construction, content creation, and aesthetic design.	Generates learning modules, rubrics, question banks, and assessments. Customisable content and aesthetics. Image insertion from Unsplash. Guidance on course structure.
Moodle Plugins	Enhances Moodle with AI-powered features like ChatGPT, DALL-E, Stable Diffusion integrations, AI chat support, AI-generated images, and AI-generated questions.	AI Connector for API services. AI chat block[4] for 24/7 support. AI Text to Image for Moodle file picker. AI Text to questions generator.
Khan Academy's Khanmigo	An AI-powered guide aiding educators in lesson planning and providing student feedback. Acts as a writing coach and offers real-time progress insights.	Lesson planning assistance. Real-time student feedback. Collaboration and customisation tools for educators.
TeacherMatic	An AI tool suite offering various educational tasks. Developed with input from educators, it streamlines material creation and course improvement.	Generates lesson plans, quizzes, rubrics, and more. Course Improvements Generator for personalised teaching enhancements.
Course AI	A platform designed to simplify the online course creation process, making it accessible to a wide audience, including non-educators.	Intuitive interface with drag-and-drop functionality. Generates course outlines, quizzes, video scripts, and content.
EduWeaver	An open-source tool using AI to create course outlines and learning activities, enhance text content generation, and integrate interactive elements.	Generates course outlines, sections, examples, and quizzes. Utilises ChatGPT for instructional design advice.
Coursera	Prototype AI engine assisting educators in content creation and learning pathway design, integrating Coursera content and user-uploaded materials.	Generates course structure and content. Incorporates public Coursera materials. Easy Author for course review and editing.

Opportunities for Learners

Integrating AI tools like ChatGPT might enhance the efficiency and effectiveness of learning, especially in subjects that are traditionally challenging for students (Talan & Kalinkara, 2023), such as medical education. The predominant view is that GenAI holds significant potential for both students and teachers when used appropriately and responsibly in education (Patrício et al., 2024). As an accessible and easy-to-use software, ChatGPT can reduce the time and effort required for academic tasks, aiding in the development of linguistic and cultural skills (Hung et al., 2023). Students find ChatGPT helpful for enhancing performance due to its instant and automated responses (Lin, Huang & Lu, 2023). Another study showed university students studying tourism and economics, with a focus on their language learning experiences

(B2 and C1 English Level) were fascinated and satisfied with ChatGPT, finding it useful for grammar correction, essay writing, and language practice (Klimova, 2024).

Due to its ability to generate and assess information, ChatGPT can play a range of roles in teaching and learning processes. Together with other forms of AI, ChatGPT could improve the process and experience of learning for students (Sabzalieva & Valentini, 2023).

Timesaving is emphasized by Naidu and Sevnarayan (2023) who note ChatGPT's capability to automate tasks and processes, particularly in assessment correction, allowing for personalised learning experiences tailored to individual student needs. The feature of providing on-demand feedback and support enhances student engagement and participation is a common theme across many studies, even supporting peer-feedback processes (Bauer et. al, 2023). According to Muñoz et al. 2023, incorporating ChatGPT into educational programs can boost students' motivation to study independently and under teacher supervision. Another relevant study by Lim et al., 2023 highlights that students using ChatGPT as a virtual tutor take greater responsibility for their learning, asking questions and making decisions, leading to autonomous, quick, and effective learning. The positive impact of ChatGPT on students' self-study experiences in HE is emphasized by Larsson and Eriksson (2023) as well: ChatGPT has a capacity to guide students through complex topics and clarifying some doubts they may have.

Current GenAI systems can play diverse roles in student learning and education; such as broadening perspectives through collaborative exploration (Possibility Engine), acting as a critical dialogue partner to challenge students' reasoning (Socratic Opponent), and supporting creative tasks by aiding in design, research, and brainstorming (Co-designer). Additionally, it assists in data interpretation and visualization (Exploratorium) and helps students collaboratively create inclusive narratives by generating diverse, stereotype-free content (Storyteller) (Sharples, 2023).

Challenges

The rise of GenAI has brought with it concern and controversy. Since ChatGPT has been open to public use, it has become the centre of ongoing debate regarding the potential negative effects that it can have on teaching and learning. “Generative AI has been identified by many higher education experts as one of the most disruptive technologies of our time” (EDUCAUSE, 2023, p. 21). With the potential to create text, images, and sounds in ways that sometimes convincingly mimic human creation, this technology has the potential to impact instructional materials, assessments, and more. “This is a much bigger disruption than the pandemic,” stated Emad Mostaque, founder and CEO of Stability AI, to an audience at Goldman Sachs 2023 Disruptive Technology Symposium in London, by pointing to the fact that AI LLMs successfully writing software code and OpenAI’s ChatGPT can pass Google’s exam for a high-level software engineer, even though it’s a non-specialized model. Reviewing the literature, the key issues with the use of ChatGPT in education can be summarised mainly around its accuracy, and reliability, and its potential to lead to plagiarism which was also noted by other researchers such as Lim et. Al (2023) and Kasneci (2023). One of the earliest and most prevalent concerns about using ChatGPT has been that it threatens the essay as an assessment method. For a start, some instructors are worried that students will outsource

their written assignments to ChatGPT as it can generate passable prose in seconds without triggering any plagiarism detector (Rudolph, 2023b).

AI potentially may undermine the academic integrity by reducing critical thinking (Farrokhnia et. al, 2024) and creativity, raising questions about the balance between efficiency and originality. Chang et. al, 2024 reveals that current LLMs exhibit certain limitations in numerous tasks, notably reasoning and robustness tasks. Despite the usefulness discussed in previous section, students raised concerns about the possibility of cheating, over-reliance, and a lack of critical thinking (Klimova, 2024). This raises concerns about the reliability of information (Kim et. al, 2023). The training data for LLMs contains bias or outdated information, which can also lead to the propagation of harmful stereotypes or inaccurate information (Kim, J.K. et al., 2023 and Lo, 2023). Concerns are raised about 'hallucinations', presenting false information as accurate, thus complicating students' learning and critical judgment, especially as ChatGPT becomes integrated into various software tools, obscuring its AI nature and complicating the validation of information (Loos, Gröpler, and Goudeau, 2023). LLMs can hallucinate and create false references, even Elsevier have chosen to overcome this by constraining Scopus AI to give its response based on five to ten paper abstracts only (Van Noorden, 2023). Some even claim that GenAI will lead to the end of creative expression and individual thought, and ChatGPT could negatively impact students critical thinking and problem-solving skills (Kasneci, 2023). Educators worry that if students do not learn about the limitations and ethical implications of GenAI (and AI tools more broadly), they may be susceptible to misinformation and inappropriate reliance on GenAI outputs (Liu, 2023).

The use of genAI tools such as ChatGPT-4, Claude 3, and beyond is relatively new; thus evidence-based learning strategies for their optimal use are still lacking (de Fine Licht, 2024). There is insufficient data to identify the most effective methods for teaching students to enhance their learning with these tools (see, e.g., Adiguzel et al., 2023; Malmström et al., 2023). As a result, even well-funded universities face challenges in delivering high-quality instruction on AI tool usage (de Fine Licht, 2024).

AI tools have long been cautioned against due to their potential to lead to superficial engagement with learning materials, prioritizing efficiency over depth of understanding (de Fine Licht, 2024). This is particularly concerning in disciplines that require strong analytical skills and a deep comprehension of underlying principles, which universities strive to teach to their students. Today's GenAI models are often good at summarizing text for specific purposes and performing tasks such as processing and analysing lab data with minimal instruction. While these capabilities are impressive, their extensive use by students' risks promoting shallow engagement with academic content, preventing deeper learning (de Fine Licht, 2024). An example of this trend can be observed in the coding community, where platforms like Stack Overflow have seen a decline in queries from regions where genAI tools are widely available, while activity remains steady in places like Russia and China, where access to these tools is restricted (de Fine Licht, 2024). A similar phenomenon may occur in universities, where students might prefer using AI tools independently rather than collaborating with peers.

Furthermore, there are concerns that students may unknowingly share their data with AI systems without fully understanding the implications of doing so. To give informed consent, individuals must not only be aware they are sharing data but also comprehend the potential consequences of that data sharing (de Fine Licht, 2024). Research shows that many students, as well as the general-public, lack a clear understanding of what private and public entities can do with seemingly trivial pieces of data (Veliz, 2021). With advanced AI systems, even small data fragments can be used to make predictions, influence behaviours, or reveal sensitive information, such as undiscovered health conditions. Therefore, even if students are aware of their data-sharing practices, they are not necessarily doing so with full informed consent. The opaque nature of GenAI systems, often referred to as "black boxes," further complicates the possibility of achieving true informed consent, as there is little transparency into how these systems function.

It is crucial to address ethical considerations related to data privacy, bias in AI algorithms, transparency, accessibility, cultural sensitivity, the potential impact on students' critical thinking and creativity, as well as the risks and concerns of possible misuse (Nikolopoulou, 2024).

Summary of Results for Opportunities and Challenges

This section examined the opportunities and challenges presented by GenAI for educators and learners.

- **Opportunities for Educators (7 Studies)**: GenAI offers significant benefits for educators, including creating instructional content, automated assessment tools, and lesson plans, thereby reducing routine workloads and allowing more time for direct student engagement (Terwiesch, 2023; Farrokhnia et al., 2024; Rahman, 2023; Kukulska-Hulme et al., 2024; Michel-Villarreal et al., 2023; Li & Wang, 2023; Herft, 2023). The potential for AI-generated lesson plans, tailored learning resources, and real-time student assessments has shown to be effective in enhancing teaching practices.
- **Opportunities for Learners (5 Studies)**: For learners, GenAI tools offer personalized learning experiences, real-time feedback, and motivation for self-directed study (Muñoz et al., 2023; Lim et al., 2023; Larsson & Eriksson, 2023; Talan & Kalinkara, 2023; Hung et al., 2023). The ability of GenAI to provide instant support, facilitate independent learning, and offer feedback tailored to individual student needs supports improved learning outcomes, particularly in STEM and complex subject areas.
- **Challenges and Risks (6 Studies)**: Despite the benefits, significant challenges were noted, such as risks to academic integrity through potential plagiarism, reduced critical thinking due to over-reliance on AI-generated content, and concerns regarding data privacy and bias (Kasneci, 2023; Lim et al., 2023; Kim et al., 2023; Farrokhnia et al., 2024; Liu, 2023; de Fine Licht, 2024). These challenges highlight the importance of developing robust institutional guidelines and promoting ethical, informed use of GenAI tools in educational settings.

In summary, while GenAI holds transformative potential for enhancing educational practices for both educators and learners, its integration must be balanced with efforts to mitigate risks, address ethical concerns, and foster critical engagement and responsible use of AI tools in educational environments. This approach ensures that the benefits of GenAI are maximized without compromising academic integrity or educational quality.

Navigating Diversity, Inclusion, and Accessibility in the Era of Large Language Models

Miao et al. (2024) discuss that the United Nations Sustainable Development Goal 4 recognizes education as a fundamental human right and promotes an agenda of "inclusive and equitable quality education". They also highlight the opportunities and challenges that AI presents in the context of education. The authors, including a representative from UNESCO, emphasize the need for policymakers to address the rapid growth of AI in the education sector. They stress that policy decisions should be guided by the core principles of inclusion and equity, particularly in ensuring access to AI technology for all. Next section discusses the implications of LLMs for diversity, inclusion, and accessibility within HE, identifying challenges associated with these tools, and highlighting good practice.

Equitability

Like many internet-based technologies, there is considerable optimism that GenAI can promote equity in education, such as by providing writing support for non-native English speakers or offering learning opportunities to those who might otherwise be unable to afford them (McDonald et al., 2024); or its importance in distance science education, noting its ability to overcome geographical barriers and provide consistent educational experiences (Kilinc, 2023). However, concerns persist that GenAI could make inequalities worse by disproportionately benefiting privileged students, especially those who can afford access to premium versions (Cotton et al., 2023).

Institutional guidance on GenAI and Diversity, Equity, and Inclusion (DEI) frequently highlights concerns about biased outputs and the need to accommodate underprivileged students who face barriers, such as limited internet access or the inability to afford GenAI subscriptions. There is also a need to consider students with disabilities that might hinder their use of such technologies. Additional concerns include the impact of structural bias in AI and labour practices involved in training these systems (McDonald et al., 2024).

A growing issue is the lack of licensed GenAI tools in universities where data privacy is protected (de Fine Licht, 2024). Without institutional licenses, students may resort to using free versions that trade their data for access, as seen with GitHub Copilot, which offers students a premium version in exchange for their student ID and data. This compromises both student privacy and institutional adherence to data protection laws, raising ethical concerns.

Faculty members worldwide are often left to navigate GenAI adoption on their own, purchasing licenses with personal funds and dedicating their own time to learning how to use these tools. While this approach is feasible, it is slow and inefficient, emphasizing the need for institutions to regulate student use and consider more effective strategies for integrating GenAI into educational practices (de Fine Licht, 2024).

Encouraging the widespread use of GenAI, as many institutions do, may not yield the desired learning outcomes. Moving forward, the integration of GenAI could serve as a catalyst for reshaping assessment and evaluation methods in ways that are more ecologically valid and grounded in fairness, justice, and ethics. However, achieving these positive outcomes will

require a more thoughtful and deliberate approach to the role of GenAI in education (McDonald et al., 2024).

Accessibility

Real-time language translation powered by AI can make education more accessible to diverse groups, including international students (Nikolopoulou, 2024). While chatbots like ChatGPT can help address language barriers and cultural differences, they are seen as complementary resources rather than replacements for human instructors (Wang et al., 2023), educators need to stay informed and actively engage with AI tools as catalysts for inspiration rather than replacements for human ingenuity (Wilson et. al, 2024). For example, ChatGPT can aid language learners by offering vocabulary, grammar, pronunciation feedback, and conversation practice (Liang, 2023).

AI also holds promise for promoting inclusivity and equity in education, depending on its design and implementation (Nikolopoulou, 2024). AI-powered platforms offering online courses can benefit students who lack access to traditional educational institutions, while language translation tools can enable accessing materials in students' native languages. Increased accessibility can aid students with different learning needs, making educational content more accessible and inclusive. For example, ChatGPT can assist students with disabilities by providing alternative formats for content such as text-to-speech or speech-to-text capabilities/ functions. Inclusive learning environments can open the way for academic success among students with disabilities, but ethical concerns and challenges (data privacy, algorithmic bias, etc.) should be carefully addressed to fully harness the potential of AI tools (Almufareh et. al, 2024). The integration of LLMs in education technology has renewed concerns over algorithmic bias, which may exacerbate educational inequalities (Lee et. al, 2024). Indicatively, biases in the data AI systems are trained, might disadvantage certain groups, and bring inequalities. Or the digital divide may be widened if students lack access to the AI-powered educational technology tools (Nikolopoulou, 2024), worsening educational inequity by widening the digital divide among students (Chiu et. al, 2023).

The application of LLMs should have broad accessibility to meet the needs of diverse learners (Gan et. al, 2023). This includes support for students with disabilities, such as assistive features for visually and hearing-impaired students. Ensuring that accessibility needs are considered in the design and implementation of LLMs is a significant challenge (Gan et. al, 2023).

LLMs can also be utilised to address existing web accessibility issues. Othman et al. (2024) investigated the potential of ChatGPT as an effective and accurate tool for enhancing web accessibility. Their study highlighted several key benefits of integrating ChatGPT into the accessibility remediation process. Specifically, Othman et al. (2024) found that ChatGPT demonstrated a high degree of accuracy in resolving accessibility errors on the websites of Qatar Airways and British Airways. Of the 39 identified errors across both websites, ChatGPT successfully corrected 37, achieving an impressive accuracy rate of 94%. These results suggest that the LLM used in the study is highly effective in addressing web accessibility issues and has the potential to complement existing accessibility evaluation methods. However, the

authors recommend that ChatGPT be used alongside other evaluation techniques, with manual verification of the results to ensure accuracy.

Urruchio et al. (2024) examined the application LLMs, such as OpenAI's ChatGPT, for simplifying sentences in accordance with easy-to-read (E2R) guidelines. This exploratory study aimed to evaluate the potential of LLMs, specifically ChatGPT, to enhance cognitive accessibility by simplifying sentences (SS) in line with E2R principles. Through two studies, the researchers assessed LLMs' awareness of E2R guidelines and their ability to simplify sentences in the context of an archaeological museum.

The findings showed mixed results. In Experiment 1, ChatGPT-4 demonstrated a generally adequate understanding of E2R guidelines but struggled with specific elements, such as consistently applying positive rather than negative sentence constructions. Experiment 2 compared sentence simplification tasks and revealed that, while ChatGPT can generate texts that somewhat align with E2R guidelines, its outputs in Italian did not consistently match the quality of those produced by human experts or co-design processes that involved people with intellectual disabilities.

Expert evaluations indicated that texts simplified by ChatGPT often retained complex semantic structures, lacked appropriate examples, and contained overly long sentences, all of which reduced their accessibility. However, based on feedback from individuals with intellectual disabilities, the texts generated by ChatGPT-4 achieved a high level of cognitive accessibility.

This suggests that while LLMs like ChatGPT have potential for enhancing accessibility, they still require refinement to fully comply with E2R standards, especially in languages other than English.

Inclusivity and Diversity

The limitations of GenAI systems, such as ChatGPT, stem from inherent biases in the training data, which can lead to the dissemination of misleading or false information, as well as a lack of transparency in how data is selected and processed (Ding et al., 2023). For example, Cao et al. (2023) found that ChatGPT tends to align more closely with American cultural norms and values, exhibiting less adaptability to other cultural contexts. These issues underscore the need for caution in interpreting AI outputs, particularly in global or multicultural settings.

To ensure accessibility and inclusion, computational designs must incorporate tools that ensure accessible functionalities and guarantee a certain control and social fairness in their outcomes (Feltrero and Osuna-Acedo, 2023). However, cognitive impairments present distinct challenges that demand innovative designs to address ethical considerations such as inclusivity, bias, privacy, error, expectation setting, simulated data, and social acceptability Additionally, it is crucial to develop training programs for individuals with disabilities on how to effectively use and maintain AI technologies, select appropriate datasets or algorithms for generating easily comprehensible documents, and utilize these tools in alignment with their rights. Addressing these challenges is essential to ensuring that AI is developed in a just and fair manner that benefits all users (Feltrero and Osuna-Acedo, 2023).

Inclusivity of AI systems is related to their effectiveness for diverse user populations (Feltrero and Osuna-Acedo, 2023). There are many discussions regarding a lack of, age, gender and racial diversity in training data for AI systems, and how these biases can be exacerbated in the case of people with disabilities (Morris, 2020); and many studies on how we should design AI solutions for people with disabilities avoiding biases (Whittaker 2019). Fairness may be a good methodology to do so (Guo et. al, 2020; and White, 2020) since is a main principle to be respected. But maybe it is not enough for cognitive disabilities because of is multiple variations and individual differences (Whittaker, 2019). A more comprehensive approach based on differences instead of equality can be used to design individual interfaces suitable for each case. Only individual users or very limited and specialized groups of users with cognitive disabilities can understand how a set of data or particular outcomes of an AI translation machine. Thus civil participation is needed to work together with engineers to refine the fairness of datasets and outcomes and to provide insights on how to integrate them into the interfaces for interaction with those texts (Feltrero and Osuna-Acedo, 2023).

While LLMs like ChatGPT can serve as useful tools for simplifying text, human oversight is essential to ensure the content meets the diverse needs of various target audiences (Uricchio et al., 2024). It is crucial to integrate LLMs within broader co-design frameworks that involve stakeholders from diverse backgrounds, including individuals with cognitive disabilities. This inclusive approach can enhance the relevance and accessibility of simplified texts by combining the strengths of AI with human expertise.

Sharples (2023) states designing new social AI systems for education requires building GenAI to follow fundamental human rights, respect the expertise of educators and care for the diversity and development of learners. Designing new social AI systems for education requires more than fine tuning existing language models for educational purposes. It requires building GenAI to follow fundamental human rights, respect the expertise of teachers and care for the diversity and development of students. This should involve a collaborative partnership between experts in neural and symbolic AI, along with specialists in pedagogy and the science of learning. Together, they can design models based on the best principles of collaborative and conversational learning, working closely with educators and practitioners to test, evaluate, and implement these models. The outcome could integrate human empathy and experience with advanced machine learning technologies.

The implementation of GenAI in online and distance education must be driven by a dedication to fundamental educational values like equity, diversity, and inclusivity, while acknowledging the complex and evolving nature of the digital educational landscape (Bozkurt and Sharma, 2023). This approach is essential to ensure that GenAI contributes to, rather than detracts from, the key objectives of education in the digital era.

Summary of Results for Diversity, Inclusion and Accesibility

This section highlighted the diverse and complex implications of GenAI on equitability, accessibility, and inclusivity in education:

- **Equitability (6 Studies)**: GenAI has potential to promote equity by offering resources for non-native speakers and underserved students (McDonald et al., 2024; Kilinc, 2023). However, disparities in access to premium AI tools and biases in AI outputs remain key concerns (Cotton et al., 2023; de Fine Licht, 2024). Addressing structural biases and ensuring data privacy are critical to bridging these gaps.
- **Accessibility (7 Studies)**: AI-powered features, such as real-time language translation and assistive technologies, show promise in enhancing accessibility for diverse learners, including students with disabilities (Nikolopoulou, 2024; Liang, 2023; Almufareh et al., 2024; Gan et al., 2023; Othman et al., 2024). However, challenges such as data privacy, bias, and achieving compliance with accessibility standards still require further refinement (Urruchio et al., 2024).
- **Inclusivity and Bias (5 Studies)**: LLMs like ChatGPT highlight issues of inclusivity due to biases in training data that often reflect Western cultural norms (Ding et al., 2023; Cao et al., 2023). Effective designs must integrate diverse perspectives and consider the unique needs of marginalized groups (Feltrero & Osuna-Acedo, 2023). Co-designing with diverse stakeholders can improve relevance and accessibility for underrepresented populations (Uricchio et al., 2024).

Studies and References on Diversity, Inclusion, and Accessibility:

1. **Miao et al. (2024)** - Discusses the implications of AI on education within the context of the United Nations Sustainable Development Goal 4.
2. **McDonald et al. (2024)** - Covers the role of institutional guidance and concerns about equity, bias, and access to GenAI in education.
3. **de Fine Licht (2024)** - Examines the implications of GenAI usage in universities, data privacy concerns, and accessibility of licensed tools.
4. **Kilinc (2023)** - Highlights GenAI's role in distance science education, reducing geographical barriers.
5. **Cotton et al. (2023)** - Raises concerns about GenAI potentially exacerbating educational inequalities.
6. **Nikolopoulou (2024)** - Discusses AI's potential to improve accessibility through real-time language translation and inclusivity.
7. **Wang et al. (2023)** - Notes chatbots' role in bridging language and cultural gaps in education.
8. **Wilson et al. (2024)** - Emphasizes educators' role in engaging with AI as complementary tools.

9. **Almufareh et al. (2024)** - Discusses the accessibility potential of GenAI for students with disabilities.
10. **Lee et al. (2024)** - Addresses concerns about algorithmic bias and its impact on educational equity.
11. **Chiu et al. (2023)** - Examines the potential for AI to widen the digital divide among students.
12. **Gan et al. (2023)** - Focuses on designing accessible LLMs for diverse learners, including assistive features for disabilities.
13. **Othman et al. (2024)** - Investigated ChatGPT's potential in enhancing web accessibility.
14. **Urruchio et al. (2024)** - Evaluated ChatGPT's application for simplifying sentences according to easy-to-read guidelines in an archaeological museum context.
15. **Feltrero and Osuna-Acedo (2023)** - Discusses the role of inclusive designs and civil participation in refining AI tools for diverse user populations.
16. **Cao et al. (2023)** - Highlights the cultural bias of ChatGPT.
17. **Sharples (2023)** - Advocates for designing socially inclusive AI systems for education based on collaborative and conversational learning principles.
18. **Bozkurt and Sharma (2023)** - Emphasize the role of equity, diversity, and inclusivity in the integration of GenAI in online and distance education.

Summary of Studies Count:

- **Studies Highlighting Opportunities for Accessibility and Inclusivity**: Miao et al. (2024), Nikolopoulou (2024), Gan et al. (2023), Almufareh et al. (2024), Othman et al. (2024), Urruchio et al. (2024).
- **Studies Highlighting Challenges and Concerns (Bias, Digital Divide, Equity)**: McDonald et al. (2024), de Fine Licht (2024), Cotton et al. (2023), Lee et al. (2024), Chiu et al. (2023), Cao et al. (2023).

In conclusion, while GenAI offers promising opportunities to enhance equity, accessibility, and inclusivity, its implementation must be approached thoughtfully. This requires addressing inherent biases, ensuring privacy, and promoting designs that are inclusive of diverse learner needs. By doing so, institutions can maximize the benefits of GenAI while mitigating risks and promoting a more inclusive educational landscape.

Large Language Models and Their Effects on Student Learning and Academic Performance

Freire et al. (2023) investigated the use of ChatGPT as a consultation tool for students during a Human-Computer Interaction (HCI) written exam, exploring both the advantages and limitations of using ChatGPT in this context. The authors analysed the types of questions ChatGPT could solve directly without intervention, as well as those where ChatGPT's assistance could be beneficial without undermining the assessment of higher-order learning outcomes that educators aim to evaluate in HCI courses. To categorise and evaluate the questions, the researchers employed Bloom's Taxonomy, identifying the extent to which ChatGPT could address different cognitive levels and abilities.

The findings revealed several limitations in ChatGPT's performance. The tool sometimes provided incorrect cues regarding the relevance of topics, offered incomplete answers, and its responses were influenced by the wording of the students' prompts, leading to potential "prompt bias" and skewed answers. Moreover, users needed to critically assess the terminology used by ChatGPT to ensure its appropriateness for the context, as the tool sometimes produced inaccurate terms ("Incorrect Terminology"). Additionally, ChatGPT struggled to process queries involving images, requiring more time to respond accurately or attempting to generate answers without sufficient information or context. The absence of visual figures in ChatGPT's explanations further hindered students' understanding of complex topics, as visual aids can significantly enhance comprehension.

The thematic analysis of ChatGPT's performance mapped onto various categories of Bloom's Digital Taxonomy. Lower-order thinking skills such as Remembering and Understanding were reflected in themes like "Lack of negative feedback," "Incomplete answers," and "Incorrect terminology." Higher-order thinking skills, such as Applying and Analyzing, were represented by themes like "Incorrect nudges," "Prompt bias," and "Processing images taking time." By identifying the cognitive processes associated with each theme, students can develop a better understanding of the challenges posed by ChatGPT and employ strategies to mitigate these limitations effectively.

In summary, while ChatGPT can assist students with certain lower-order cognitive tasks, its limitations in addressing higher-order skills and providing complete and accurate information suggest that its use in exams should be approached with caution. Institutions need to clarify what the availability of LLMs mean for remote assessment, and provide guidelines for educators as in the example of Fern Uni, EDUDL+. (2023). Educators and students alike must remain critical of the tool's outputs and consider its appropriate role within an educational context.

Lyu et al. (2024) evaluated the effectiveness of large language models (LLMs) in introductory computer science education through a semester-long, between-subjects study involving 50 students. The study focused on how students used an LLM-powered virtual teaching assistant, "CodeTutor," to support their learning in introductory programming courses. The authors examined the impact of CodeTutor on students' academic performance, analyzed their

attitudes towards learning with the tool, and characterized their engagement patterns in these courses.

The field study provided insights into the ways students utilized CodeTutor and its effects on educational outcomes. Students in the experimental group, who had access to CodeTutor, showed significant improvements in their final scores compared to the control group, with first-time users of LLM-powered tools experiencing the greatest gains. While students generally gave positive feedback on CodeTutor's ability to understand queries and assist with syntax learning, concerns were raised about its effectiveness in fostering critical thinking skills.

Key findings from the study include: (1) students who used CodeTutor demonstrated significant score improvements; (2) while CodeTutor was appreciated for its help with comprehension and syntax, students expressed doubts about its ability to enhance critical thinking skills; (3) skepticism regarding CodeTutor as a substitute for human teaching assistants increased over time; (4) CodeTutor was primarily used for tasks such as syntax comprehension, debugging, and clarifying fundamental concepts; and (5) the effectiveness of CodeTutor's responses was notably higher when students provided clearer and more detailed prompts.

Lyu et al.'s (2024) research shows a positive correlation between the use of generative AI tools and improved student learning outcomes. However, 63% of student-generated prompts were found to be suboptimal, indicating that many students lacked the necessary skills to fully leverage GenAI tools. This finding underscores the need to promote GenAI literacy among students, equipping them with the ability to critically engage with and effectively use these technologies.

The study suggests that while CodeTutor can provide practical assistance in coding and syntax understanding, there remains a gap in using such tools to enhance critical thinking skills. The authors recommend that educational programs integrate GenAI literacy as a core component of their curricula, teaching students not only how to use these tools for problem-solving but also how to engage with them critically. This could involve workshops on effective query formulation, sessions on interpreting AI-generated responses, and exercises that encourage students to critically evaluate the information and solutions provided by AI tools. The authors also propose incorporating human-computer interaction (HCI) principles into LLM-enabled platforms, such as by offering prompt construction templates to help users generate clearer, more effective queries.

Over time, a preference for human teaching assistants over CodeTutor emerged, despite CodeTutor's utility in completing programming tasks, understanding syntax, and debugging. The study highlights the importance of prompt quality in maximizing CodeTutor's effectiveness, demonstrating that detailed and clear prompts lead to more accurate responses. These findings underscore the critical need to embed generative AI literacy into educational curricula and promote critical thinking skills among students.

Bernabei et al. (2023) investigate whether engineering students can produce high-quality university essays with the assistance of LLMs, the effectiveness of existing LLM detection

systems in identifying essays generated by LLMs, and students' perceptions of the usefulness and acceptance of LLMs in their learning experience.

The study explores the application of LLMs in engineering education and examines how students perceive and accept these technologies, as well as their impact on the quality of learning. The results show that students produced well-graded essays, indicating that LLM use did not significantly affect their performance. Furthermore, students demonstrated their understanding of the topics during oral presentations, providing additional evidence that LLM assistance did not hinder their preparation. However, as noted earlier in the study, many students did not sufficiently revise or critically engage with the text generated by ChatGPT. While LLMs tend to produce accurate content, the quality is often superficial, and the large volumes of text generated can give a false sense of value. Additionally, LLMs often use repetitive lists and bulleted formats, which, without student reworking, can lead to contradictory paragraphs. The LLMs' knowledge base is also derived from a mix of encyclopedic and web-based sources, which can further affect content quality.

The study also tested various AI detection systems to assess their effectiveness and usability but found that none of the systems were reliable in detecting AI-generated text. Therefore, the researchers recommend that teachers should not rely solely on AI detection tools to identify LLM-produced content. This finding suggests that imposing strict restrictions on students' use of LLMs may be of limited value and should be reconsidered. Instead, the educational sector should focus on developing students' critical thinking, problem-solving skills, and ability to seek effective solutions (Yu, 2023), while incorporating technological advancements.

The research also highlights students' evolving perspectives on the integration of LLMs into their academic experience. Initially, students viewed the tool as reliable, but their continued use led to a deeper understanding of its limitations. Nonetheless, they acknowledged the potential benefits of LLMs for improving task performance, enhancing comprehension, and supporting teaching. Students emphasized the continued importance of teachers, whose emotional intelligence and expertise remain central to education, while AI can complement their role by fostering innovation, engagement, and interaction. Additionally, students underscored the need for clear regulations regarding the use of LLMs during exams, consistent guidelines across courses, and adequate preparation for an AI-driven future.

Wecks et al. (2024) evaluate the impact of students' use of GenAI tools, such as ChatGPT, on academic performance. In analysing how GenAI usage influences exam scores, the study finds that students who use GenAI tools score, on average, 6.71 points lower (out of 100) compared to non-users. While GenAI tools may offer certain learning and engagement benefits, their actual use correlates with decreased academic outcomes. This study contributes to the ongoing debate about the role of GenAI in education by providing evidence on the tangible effects of GenAI use on exam performance, addressing a significant gap in the literature where performance effects have yet to be thoroughly examined/

The findings reveal that using GenAI tools for tasks such as essay writing, and likely other learning purposes, significantly lowers exam scores. Further analysis identifies a mechanism

through which GenAI usage may hinder learning, thereby negatively affecting academic performance. These results have important implications for students, educators, and educational institutions.

The study is limited to a financial accounting course at one German university and does not account for the intensity or patterns of GenAI use. It is possible that different usage intensities could produce varying impacts on exam performance, suggesting a need for further research on this variable.

Nakavachara et al. (2024) conducted an experiment involving 121 economics students who were tasked with performing writing analysis in a non-English language (Thai) and math and data analysis tasks using a less commonly used programming tool, Stata. The results indicated that, on average, participants who used ChatGPT achieved higher scores and completed the tasks more quickly. However, a more detailed analysis revealed that 34% of participants showed no improvement in their writing analysis tasks, and 42% saw no improvement in math and data analysis tasks when using ChatGPT. Further investigation suggested that students with higher ability, as indicated by their econometrics grades, tended to perform worse in writing analysis tasks when using ChatGPT. Additionally, the study found that students with stronger digital skills performed better when utilizing ChatGPT.

Essel et. al (2024) investigated the impact of using ChatGPT on the critical, creative and reflective thinking skills of 125 undergraduate students in Ghana during the second semester of "Quantitative Research Design" course. Essel et. al (2024) found cognitive skills are improved; ChatGPT significantly enhanced students' critical, creative, and reflective thinking skills and notably there was better performance in experimental group that used ChatGPT.

In his systematic review of language learning literature Law (2024) found that studies have demonstrated that GenAI systems can, to various extents, assist learners improve their writing skills by providing real-time feedback on grammar, vocabulary, and sentence structure.

In conclusion, the studies discussed provide valuable insights into the impact of large language models (LLMs) on student academic performance across various disciplines. A common theme emerging from these findings is that while LLMs, such as ChatGPT, can enhance task performance—particularly in areas like coding, data analysis, and essay writing—their impact on learning outcomes is nuanced and context-dependent.

Lyu et al. (2024) showed that LLM-powered tools can lead to improvements in coding tasks, but concerns were raised about their ability to foster critical thinking. Similarly, Bernabei et al. (2023) highlighted that while students using LLMs produced well-graded essays and demonstrated comprehension in presentations, many failed to critically engage with or revise the AI-generated content, raising questions about the depth of learning achieved through these tools. Wecks et al. (2024) further emphasized the potential drawbacks of GenAI in education by demonstrating a decline in exam performance among students using ChatGPT. This suggests that although LLMs offer certain conveniences, their use may inadvertently hinder deeper cognitive processes necessary for academic success. Nakavachara et al. (2024) reinforced this by noting that

while LLMs can improve task efficiency, their benefits are uneven across students, with high-ability students sometimes performing worse when relying on AI tools.

These studies collectively underscore the need for a balanced approach to LLM integration in education. While these tools have the potential to support learning, their limitations—particularly in fostering critical thinking and deep learning—must be addressed. This highlights the importance of teaching students how to use AI tools effectively and critically, integrating GenAI literacy into curricula, and ensuring that human educators continue to play a central role in guiding the learning process. As we move towards an AI-driven future, educational institutions must focus on developing students' critical thinking, problem-solving, and digital literacy skills to fully harness the benefits of LLMs without compromising academic rigor and performance.

Summary of Results on LLM and effect on Student Performance

The studies presented offer a detailed examination of the effects of large language models (LLMs) such as ChatGPT on student learning and academic performance across various disciplines, revealing both their opportunities and limitations:

- **LLM Impact on Academic Performance**: Research shows that LLMs can enhance specific aspects of learning, such as coding, essay writing, and data analysis, with positive outcomes (Freire et al., 2023; Lyu et al., 2024; Nakavachara et al., 2024). Notably, students using LLM-powered tools like CodeTutor demonstrated improved performance in coding and syntax tasks (Lyu et al., 2024), and Bernabei et al. (2023) found that engineering students produced well-graded essays with LLM assistance.
- **Critical Thinking and Engagement**: Despite their benefits, concerns about LLMs' impact on higher-order cognitive skills, such as critical thinking, persist. Lyu et al. (2024) and Bernabei et al. (2023) highlighted a lack of critical engagement with AI-generated content among students, raising questions about the depth of learning. Wecks et al. (2024) found that students using GenAI tools scored lower on exams, suggesting potential drawbacks in relying heavily on AI for learning.
- **Equitable Use and Limitations**: The benefits of LLMs are not uniformly experienced across all learners. Nakavachara et al. (2024) showed that high-ability students sometimes performed worse when using LLMs, and Essel et al. (2024) noted variability in the development of critical thinking skills. Similarly, studies demonstrated that effective LLM use requires skillful engagement, highlighting the need for GenAI literacy and training (Lyu et al., 2024; Nakavachara et al., 2024).

Studies Referenced:

1. **Freire et al. (2023)** - Investigated ChatGPT use in Human-Computer Interaction (HCI) exams.
2. **Lyu et al. (2024)** - Evaluated the effectiveness of the "CodeTutor" LLM-powered virtual teaching assistant in computer science courses.

3. **Bernabei et al. (2023)** - Examined engineering students' use of LLMs for producing university essays.
4. **Wecks et al. (2024)** - Analyzed the impact of GenAI tools on exam performance.
5. **Nakavachara et al. (2024)** - Conducted an experiment with economics students using ChatGPT for writing and data analysis tasks.
6. **Essel et al. (2024)** - Investigated ChatGPT's impact on students' critical, creative, and reflective thinking skills in Ghana.
7. **Law (2024)** - Systematic review on GenAI systems' assistance in improving language learning and writing skills.

Positive Effects (4 Studies): Lyu et al. (2024), Bernabei et al. (2023), Nakavachara et al. (2024), and Essel et al. (2024) showed varying degrees of positive learning outcomes when using LLMs.

Concerns or Limitations (4 Studies): Freire et al. (2023), Wecks et al. (2024), Lyu et al. (2024), and Bernabei et al. (2023) highlighted limitations, such as critical thinking deficiencies and potential for decreased exam performance.

While LLMs hold promise for enhancing certain learning outcomes, their integration in education must be balanced with careful consideration of their limitations. Educators must play a central role in guiding AI use, ensuring that students develop critical thinking, problem-solving, and digital literacy skills alongside their engagement with GenAI tools. Integrating AI literacy into educational curricula and promoting thoughtful, context-aware use of LLMs will be crucial to maximizing their potential benefits without undermining academic rigor and deep learning.

Policies and Strategies for Integrating Generative AI in Higher Education

Generative AI tools such as ChatGPT and Bard, now Gemini, are rapidly transforming higher education, presenting both opportunities and challenges. The launch of such GenAI tools has raised concerns among various organizations. Faculty remain concerned about the accuracy of applications, and the extent to which students and other stakeholders unconditionally trust AI outputs. Some posit that this is cause for banning AI-powered technologies such as Dwivedi et al. (2023) (e.g., the University of Hong Kong and Hong Kong Baptist Universities were among the first Chinese universities to prohibit students from utilizing ChatGPT or any similar AI-powered tools to complete coursework and assignments). Paris' Institute of Political Science also prohibited ChatGPT use to avert academic dishonesty, and academic journals have updated policies to exclude ChatGPT as an author (Gaceta, 2023). But others see this as an opportunity to teach students how to use them prudently (Liu, 2023). For instance, a professor at the University of Iowa taught students how to get better results and create more specific outputs from ChatGPT with a classroom assignment using six tips (Mowreader, A, 2023). Another example from the UK shows how top universities split over how to respond to ChatGPT. Whilst the University of Cambridge, University of Oxford and University of Edinburgh were among those banning the technology over plagiarism fears, others have opted to embrace it (Wood, 2023). Most Russell Group universities in the UK have started creating guiding principles for GenAI that allow students to use AI in a specific way.

New York City schools and Seattle Public Schools have restricted access to ChatGPT, concerned about its potential misuse by students in academic work (Lukpat, 2023). Australian universities, responding to fears of AI-assisted essay writing, now consider its use as cheating (Cassidy, 2023). Italy has become the first Western country to block ChatGPT over privacy concerns, questioning the necessity of collecting private data for algorithm training (McCallum, 2023). The Italian data-protection authority said there were privacy concerns relating to the model, a possible violation of stringent European Union data protection rules (D'Emilio and O'brien, 2013 and McCallum, 2023).

The increasing integration of LLMs in higher education has prompted institutions to develop comprehensive policies and strategies to navigate their use in academic settings. These local policies sit within a developing global landscape of policy and regulation.

Institutional policies and guidelines

Beckingham et al. (2024) recommend that when incorporating generative AI (GenAI) into teaching, learning, and assessment, educators should adhere to institutional guidelines regarding the selection and use of these tools. This ensures that the integration of GenAI aligns with the ethical, sustainable, and secure practices required by both nationally defined legal-regulatory frameworks and institution-specific policies. Additionally, Chan (2023) emphasizes that AI-related policies in education should be developed through interdisciplinary collaboration to create a comprehensive and inclusive policy framework that addresses the multifaceted challenges posed by AI integration in educational contexts.

Several recent studies have examined such university policies, guidelines, and media coverage to better understand the adoption and response to generative AI (GenAI) in higher education. Analyses of leading universities in the U.S. and globally have revealed a cautious yet receptive approach to integrating GenAI into academic settings, with key concerns centred around ethics, accuracy, and privacy (McDonald et al., 2024; Moorhouse et al., 2023; Wang et al., 2023). These studies highlight the balancing act institutions are performing as they explore the potential benefits of GenAI while addressing the challenges it presents. This section discusses the results of such studies.

McDonald et al. (2024) analysed GenAI policy documents from 116 U.S. universities to assess the advice and guidance institutions are offering to their faculty regarding the use of generative AI. Their findings revealed that the majority of universities (N=73, 63%) encourage the use of GenAI, with many providing detailed guidance on its application in the classroom (N=48, 41%). Over half of the institutions included sample syllabi (N=65, 56%), and 50% (N=58) provided sample curricula and activities designed to help educators integrate GenAI into their teaching. A significant portion of the guidance centred on writing-related activities, whereas code and STEM-related applications were mentioned only half as often and were generally described in vague terms, despite their higher relevance in these fields.

Jin et al. (2024) conducted a policy analysis on how top-ranked higher education institutions are responding to the growing presence of generative AI tools in academic assessment practices (Moorhouse et al., 2023). The study focused on the top 50 universities from global rankings and collected publicly available guidelines on generative AI use from their official websites to identify common themes and recommendations. These guidelines addressed three main areas: academic integrity, assessment design, and communication with students.

The guidelines on academic integrity highlighted various forms of plagiarism involving generative AI, such as copying AI-generated text without proper attribution. For instance, the University of California, Berkeley clarified that the use of AI-generated content without appropriate credit is considered plagiarism. Regarding assessment design, the guidelines encouraged educators to rethink tasks to minimize the misuse of generative AI, suggesting the creation of assignments that demand critical thinking and incorporate contextual elements. The University of Texas at Austin, for example, provided detailed strategies for redesigning assessments with AI tools in mind.

Communication with students was also emphasized as a key area, with guidelines recommending that instructors establish clear expectations regarding the use of generative AI, engage in open discussions about its ethical implications, and collaborate with librarians to teach students the responsible and proper use of AI tools. These recommendations aim to guide institutions in navigating the challenges posed by generative AI while maintaining academic integrity and fostering meaningful student engagement.

Ioku et al. (2024) provide insights into how varying university policies are shaping the landscape of GenAI integration. Their study examines the differences in acceptance of GenAI among top-ranked universities by applying latent profile analysis to classify institutions based on four key characteristics: the ratio of international students, citations per faculty, academic

reputation, and faculty-student ratio. The analysis revealed four distinct profiles, each reflecting unique patterns of GenAI acceptance and the associated institutional characteristics. The findings suggest that universities with a high ratio of international students and strong research output tend to adopt stricter policies regarding AI use, emphasizing the importance of academic integrity. In contrast, institutions with lower research output and international presence, but that support responsible and ethical AI use, underscore the positive effects of a supportive environment for GenAI integration. These findings align with prior research on AI acceptance at the student and faculty levels, emphasizing the importance of clear institutional policies and a supportive educational environment.

Further studies have also explored the implications of GenAI in higher education policy. Plata et al. (2023) analyzed academic integrity articles and policies from leading global universities, proposing a model to uphold academic integrity in the GenAI era. Sullivan et al. (2023) investigated the impact of ChatGPT on higher education across Australia, New Zealand, the U.S., and the U.K. through an analysis of news articles. Cheng and Yim (2024) documented policy adaptations and management strategies at eight Hong Kong public universities using local newspaper reports, while Xiao et al. (2023) conducted a quantitative analysis of ChatGPT policies at the top 500 universities worldwide, identifying differences in these policies and the factors influencing them.

Jin et al. (2024) explored GenAI adoption policies in higher education, analyzing data from 40 universities across six global regions using the Diffusion of Innovations Theory (DIT) framework. Their findings highlighted a universal emphasis on GenAI's compatibility with educational values, its potential to foster innovation and critical thinking, and the importance of trialability and observability in the adoption process. Despite the optimism surrounding GenAI's potential, the study also identified significant gaps in comprehensive policy development, communication strategies, and equitable resource distribution for GenAI integration. The need for a structured approach to stakeholder engagement, particularly in defining clear roles and responsibilities, emerged as a critical component, underscoring the importance of a collaborative and inclusive model that aligns GenAI adoption with institutional values and educational missions.While previous research has examined the roles of faculty and students in GenAI adoption (Moorhouse et al., 2023; Wang et al., 2023), Ioku et al. (2024) provide a more comprehensive perspective by including the roles of administrators, offering insights into the responsibilities of various stakeholders in GenAI adoption. The study's findings highlight the importance of collaboration among all members of the educational ecosystem to manage the complexities of GenAI integration effectively. This approach suggests that successful GenAI adoption in higher education depends not only on the technology itself but also on the preparedness and involvement of the academic community. This perspective supports existing literature on the significance of clearly defined roles and responsibilities in the adoption of educational technologies (Kamal et al., 2011; Okai-Ugbaje et al., 2020), emphasizing the need for a structured and community-driven approach to fully leverage the potential of GenAI in higher education.

Global regulatory landscape

Depending on access, development, and infrastructure, the international perspectives regarding GenAI vary to a great extent as outlined in Hsu and Ching (2023). While many countries embrace the powerful technology and its arguably endless uses, they are also cautious about related issues. The absence of national regulations on GenAI in most countries leaves the data privacy of users unprotected and educational institutions largely unprepared to validate the tools. UNESCO's first global guidance in 2023 on GenAI in education aimed to support countries to implement immediate actions, plan long-term policies and develop human capacity to ensure a human-centred vision of these new technologies (UNESCO, 2023a). OpenAI's opacity in its operations has intensified global worries (Brodkin, 2023).

In November 2023, the UK hosted the world's first Artificial Intelligence (AI) Safety Summit, where representatives from 28 countries and the European Union signed the Bletchley Declaration on AI safety. This declaration acknowledges both the benefits and risks associated with AI, presenting a global challenge for governments: how to balance the promotion of AI technology while preventing its malicious use.

At the AI Safety Summit, held at Bletchley Park from 1-2 November 2023, world leaders agreed on the need for coordinated international action. The Bletchley Declaration focuses on two key goals:

- Identifying AI safety risks of shared concern and developing a common, scientific, and evidence-based understanding of these risks.
- Establishing risk-based policies across countries to ensure AI safety, with an emphasis on international collaboration, while acknowledging that national approaches may vary.

It was further agreed that such summits would be held every six months, with the most recent taking place in the Republic of Korea in May 2024, and the next scheduled in France later this year.

The global regulatory landscape for AI remains fragmented, with countries adopting a mix of statutory and non-statutory frameworks (Senedd Research, 2024). National Strategy[2] for Artificial Intelligence: actions for the Utilization and Development of AI in Cyprus published by Cyprus Ministry of Transport, Communications and Works, consists four pillars: maximising investment through partnerships, creating national data spaces, cultivating talent, skills and lifelong learning, and developing ethical and trustworthy AI.

Similarly, in the UK, the government outlined its national approach to AI regulation on 6 February 2024, following a public consultation. The proposed "pro-innovation regulatory framework for AI" is built around five core principles:

[2] https://dec.dmrid.gov.cy/dmrid/dec/ws_dec.nsf/All/21122CD12D52BD70C2258505002E43D1?OpenDocument

- Safety, security, and robustness;
- Appropriate transparency and explainability;
- Fairness;
- Accountability and governance;
- Contestability and redress.

This framework operates on a non-statutory basis, which, according to the UK government, provides “critical adaptability” in responding to the rapidly evolving nature of AI technology. The government has committed to reviewing this approach and consulting with devolved administrations as the framework is developed and implemented. Additionally, the UK announced the establishment of an AI Safety Institute, which will focus on testing cutting-edge AI systems for potential harmful capabilities.

Meanwhile, The European Parliament is moving towards regulations, like the EU AI Act, to limit AI uses in certain contexts, including emotional detection and biometrics (Ryan-Mosley, 2023). The European Union has enacted the Artificial Intelligence Act in 2024, which is described as the "first-ever comprehensive legal framework on AI worldwide."The EU AI Act represents a significant milestone in global AI regulation. It establishes a comprehensive framework for the development and use of AI technologies within the EU, emphasizing risk-based governance. The Act outlines clear requirements and responsibilities for AI developers and users, classifying AI systems based on their risk levels and prohibiting those deemed high risk, such as social scoring systems that rank individuals based on social and economic behaviors. The Act categorizes AI systems into prohibited, high-risk, limited risk, and minimal risk categories, imposing strict requirements on high-risk applications such as educational technologies. This regulatory emphasis is crucial for pedagogy, as it mandates transparency, accountability, and bias mitigation in AI systems used in education. For example, adaptive learning platforms and student assessment tools must ensure data privacy, explainability, and fairness to avoid reinforcing inequalities or unethical practices. The AI Act establishes clear transparency requirements to ensure individuals are informed when needed, promoting trust. For instance, when interacting with AI systems like chatbots, people should be notified that they are engaging with a machine, enabling them to make an informed choice about whether to proceed or disengage. By promoting ethical and responsible AI deployment, the Act has the potential to reshape educational practices, ensuring that technological advancements align with pedagogical integrity and equity, thus fostering inclusive and student-centered learning environments. This regulatory foresight places the EU at the forefront of harmonizing innovation with societal values.

This act and its implementation will naturally become the primary set of rules to impact on higher education in the EU, with the expectation that institutional policy will adapt to align to this. The EU Act therefore will be reviewed by the team further and it’s implications will permeate the overall project.

In contrast, the United States does not yet have federal AI legislation. However, President Biden issued an executive order on the safe, secure, and trustworthy development and use of AI. This order mandates AI companies to share safety test results with the federal government, establishes privacy guidelines, and provides best practices for AI's role in the justice system. The UK and US have also signed a bilateral agreement focused on evaluating the safety of AI tools and systems.

Since its 2017 national AI strategy, China has introduced regulations targeting specific issues, such as the management of recommendation algorithms and deepfakes. In March 2024, Forbes reported that China had published a draft AI law that appears to prioritize AI development.

These developments highlight the varying approaches taken by major global players in regulating AI. While the UK, EU, US, and China adopt different regulatory frameworks, all recognize the need for international cooperation and careful oversight to ensure that AI is developed and deployed safely and responsibly.

In conclusion, the integration of GenAI tools in higher education is reshaping teaching, learning, and assessment practices, bringing both opportunities and challenges. Institutional policies and guidelines are evolving to ensure the ethical, secure, and sustainable use of these technologies, with a focus on maintaining academic integrity and fostering innovation. Studies indicate that while universities are generally receptive to GenAI, they emphasize the importance of clear communication, ethical considerations, and pedagogical adaptation. The findings highlight the need for interdisciplinary collaboration, comprehensive policy development, and continuous oversight to effectively harness the potential of GenAI in higher education while addressing concerns such as plagiarism, critical thinking, and equitable access. While the rate of GenAI adoption and deployment varies by regions, the experiences and paths traversed by earlier adopters can provide valuable insights for those considering the adoption of this powerful technology (Hsu and Ching, 2024). Ultimately, the successful adoption of GenAI depends not only on the technology itself but also on the preparedness of academic institutions and their ability to implement well-structured frameworks that align with their educational values and missions.

Summary of Results for Policies and Strategies for Integrating Generative AI in Higher Education

This section explores the evolving policies and strategies surrounding the integration of GenAI tools in higher education, focusing on institutional approaches, challenges, and global regulatory perspectives.

- **Policies and Strategies in Universities (9 Studies):** Universities worldwide are developing policies to navigate the integration of GenAI tools, with a focus on ethics, academic integrity, and effective use (Dwivedi et al., 2023; McDonald et al., 2024; Moorhouse et al., 2023; Wang et al., 2023; Beckingham et al., 2024; Chan, 2023; Jin et al., 2024; Ioku et al., 2024; Plata et al., 2023). The studies highlight a range of responses, from strict bans to guidelines that support responsible use, reflecting the

balance institutions seek between harnessing AI's potential and addressing its challenges.

- **Global Regulatory Landscape (8 Studies/Regulatory Examples):** International regulatory efforts vary widely, with countries adopting statutory and non-statutory frameworks to ensure AI safety and ethical use. Examples include the Bletchley Declaration (Senedd Research, 2024), UK's pro-innovation regulatory framework (UK Government, 2024), and the EU AI Act (Ryan-Mosley, 2023). Countries like China, Italy, and the US have implemented or proposed specific regulatory measures, reflecting diverse national priorities and approaches (UNESCO, 2023a; Brodkin, 2023; McCallum, 2023).
- **Challenges in Policy Development (5 Studies):** Several studies emphasize the challenges in creating effective GenAI policies, including concerns over data privacy, academic integrity, and equitable access (de Fine Licht, 2024; McDonald et al., 2024; Kamal et al., 2011; Okai-Ugbaje et al., 2020; Sullivan et al., 2023). The complexities of integrating GenAI require interdisciplinary collaboration and well-defined roles for faculty, administrators, and students to ensure responsible use and integration.

In summary, the studies indicate that while institutions are receptive to GenAI integration, the successful implementation of policies requires clear communication, ethical oversight, and alignment with educational values. As global regulatory efforts continue to evolve, the experience of early adopters provides valuable lessons for others considering the adoption of GenAI in education. The key to success lies in developing comprehensive, inclusive, and adaptive frameworks that prioritize ethics, academic integrity, and innovative pedagogical practices.

Conclusion

This systematic literature review explored the evolving awareness, perceptions, and use of GenAI in higher education. It highlights global trends in adoption, the attitudes of different user groups, and the role of GenAI in reshaping teaching, learning, and assessment practices. The review also addressed the challenges and ethical considerations related to the integration of GenAI in education.

This literature review answered the proposed research questions (RQs), as follows:

RQ1: *What opportunities and challenges do LLMs present for teaching and learning practices in higher education*?

There is optimism among Gen-Z students towards GenAI in higher education, while Gen-X and Y teachers expressed ethical concerns and emphasized the need for guidelines Chan and Lee (2023). The ease of use and perceived usefulness of GenAI significantly shape user attitudes, with social influence also playing a crucial role in its adoption (YouGov 2024; and Albayati, 2024).

GenAI's potential spans multiple disciplines, with leading fields including healthcare especially in clinical training for students when GenAI used as virtual patients, and in STEM particularly for programming (Vasconcelos et al., 2023). There is also higher GenAI usage in the field of STEM, driven by technological affinity (Von Garrel & Mayer, 2023); and lower awareness and use; and fewer immediate applications in Human-Centered Disciplines compared to technical fields (Cascella et al., 2023).

GenAI can support educators by generating instructional content, assessments, and lesson plans, reducing time spent on routine mundane tasks (Terwiesch, 2023). This allows educators to focus more on engaging with students and enhancing the teaching experience. For students, GenAI enhances learning efficiency and effectiveness, offering personalized learning experiences, instant feedback, and motivation for self-study (Muñoz et al., 2023; Lim et al., 2023; Farrokhnia et. al, 2024). Studies like Lyu et al. (2024), Nakavachara et al. (2024), Wecks et al. (2024), Yu (2023), Freire et al. (2023), Bernabei et al. (2023) and Essel et. al (2024), have shown LLM and their effects on student learning and academic performance. However, its impact varies across disciplines and students' abilities. Concerns include AI's potential to reduce critical thinking, plagiarism risks, data privacy issues, and biases in AI systems (Kim et al., 2023; Liu, 2023). Thus, institutions must address these risks through policies, guidelines, and educational reforms.

RQ2: *How do LLMs impact diversity, inclusion and accessibility in higher education*?

While GenAI can promote equity by providing resources for non-native speakers or underserved students, there are concerns about exacerbating inequalities for those without access to premium tools (Cotton et al., 2023). Biases in AI training data and access limitations pose significant challenges (McDonald et al., 2024). AI tools, such as ChatGPT, offer opportunities for enhancing web accessibility and cognitive accessibility for students with disabilities, though refinement is needed to meet diverse needs fully (Othman et al., 2024; Urruchio et al., 2024). LLMs, such as ChatGPT, have shown mixed results in fostering academic

success. While they support task efficiency, their overuse may hinder critical thinking and deeper learning, especially in subjects that require strong analytical skills (Lyu et al., 2024; Bernabei et al., 2023). Therefore, educational institutions must teach students how to critically engage with GenAI tools.

RQ3: *What guidelines and institutional policies are being established to ensure the responsible and effective use of LLMs in higher education*?

Universities are already adopting policies to guide the ethical use of GenAI. Guidelines focus on preventing plagiarism, rethinking assessments, and promoting ethical use in classrooms (McDonald et al., 2024; Jin et al., 2024). Collaboration across disciplines is key to developing comprehensive AI policies. Countries are adopting varied regulatory frameworks to ensure AI safety and fairness. The UK's non-statutory AI regulation framework, the EU's AI Act, and the U.S. executive order on AI also illustrate the global emphasis on balancing AI innovation with ethical oversight (Senedd Research, 2024).

We note here that policy is a focus of several parts of the overall project.. This report includes the results from the search terms used and is not intended to provide a balanced view of policy and regulation overall, as this is central to other parts of the project. As project progresses, a broader detailed view will emerge as a result.

Gaps

A significant concern identified across studies is that GenAI may reduce students' critical thinking and creativity. The over-reliance on AI-generated content could lead to superficial learning, with students failing to engage deeply with the material (Kasneci, 2023; Liu, 2023). Moreover, AI's tendency to "hallucinate" or provide inaccurate information is a concern, necessitating further emphasis on teaching students how to critically evaluate AI-generated content.

There is insufficient data on effective strategies for teaching students how to use GenAI tools optimally (Adiguzel et al., 2023; de Fine Licht, 2024). Many students lack the skills needed to critically engage with AI tools, resulting in suboptimal use and learning outcomes. Developing GenAI literacy should be a core component of any course design on the subject. Education should not only incorporate AI technologies but also teach students about AI. This dual approach aims to prepare students for a future where AI plays a significant role (Holmes and Tuomi, 2022). Future higher education should be transformed to prepare students to be future-ready for employment in a society driven by GenAI, emphasizing skills in learning and teaching with GenAI, AI literacy, competence for the future workforce, and self-assessment measures (Chiu, 2024).Chang et al. (2024) emphasise the need for contemporary evaluation systems to adapt and evolve to ensure accurate assessments of the inherent capabilities and limitations of LLMs. Future research should address these aspects, with the aspiration that LLMs can progressively enhance their service to humanity.

Bias in AI training data is a pressing issue. GenAI tools like ChatGPT tend to reflect Western cultural norms, limiting their adaptability to diverse cultural contexts (Cao et al., 2023). More research is needed to explore how these tools can be refined to better align with non-Western cultures and avoid existing inequalities.

Ethical issues such as data privacy, bias, and fairness remain central challenges. There is a need for collaborative rule-making to navigate the complexities of integrating LLM-based chatbots into higher education, ensuring fairness and accessibility while maintaining the quality of learning (Carbonel & Jullien, 2024). Many studies point to the need for clearer guidelines and more transparent AI systems to ensure responsible use in educational settings (Kim et al., 2023; Nikolopoulou, 2024). This includes not only addressing plagiarism and academic integrity but also ensuring that students' data is protected when using AI-powered tools.

While STEM and computer science fields have embraced GenAI, other disciplines, especially human-centered fields like the humanities, have been slower to adopt these technologies (McDonald et al., 2024). More research is needed to explore how LLMs can be tailored to the specific needs of non-technical fields, which may benefit from GenAI in different ways.

Areas for Further Research

1. **Developing Pedagogical Models for GenAI Use**: More evidence-based research is required to identify the most effective pedagogical models for using GenAI in higher education. Studies suggest that AI tools can improve learning efficiency, but optimal strategies for integrating these tools into the curriculum are still lacking (de Fine Licht, 2024). There is a lack of evidence-based learning strategies on teaching students how to critically engage with and effectively use GenAI tools.

2. **Improving AI Literacy and Critical Engagement**: Further studies are needed to understand the extent to which features of GenAI tools might diminish critical thinking, creativity, and deep learning. Courses on GenAI need to focus not only on how to use AI tools but also on fostering critical engagement. LLM-based chatbots are forcing a re-evaluation of what should be taught and how learning could be facilitated. There is a call for critical AI literacy and a better understanding of the redefinition of the division of labour between students, AI and the community (Carbonel & Jullien, 2024), as Bond et. al pointed out there is lack of collaboration. Students, teachers, and institutions need to be involved in discussions to ensure AI benefits all in distance-based higher education (Holmes et. al, 2023). A proper investment in building AI skills in academic teaching plays a valuable role in fostering the students' positive attitude and innovativeness towards this new technology (Lemke et. al, 2023).Teaching students how to question AI-generated outputs, assess their validity, and understand the limitations of these systems is essential to maximize their educational benefit (Lyu et al., 2024).

3. **Balancing AI Innovation with Ethical Considerations**: Future studies should explore how to balance the benefits of AI with the ethical challenges they present. This includes developing institutional frameworks that allow for innovation while ensuring ethical oversight and fair access to technology (Senedd Research, 2024). Disparities in access to premium AI tools among students raise concerns about educational inequalities. There is an urgent need for in-depth research on ethical considerations associated with the use of GenAI. This includes addressing issues related to data privacy, algorithmic bias, equity, and student well-being. By further research into

these ethical dimensions, researchers can contribute to the development of robust guidelines and policies to ensure the responsible and equitable implementation of GenAI in educational settings (Samala et. al, 2024). There is a greater need on ethical, methodological, and contextual considerations within future research, alongside interdisciplinary approaches to AIED application (Bond et. al, 2024). The application of LLMs in providing personalized learning may raise issues of social equity. Future research can explore how to address these issues through the design and implementation of models, ensuring that their applications do not exacerbate educational inequalities but instead promote a fair and inclusive learning environment (Gan et. al, 2023).

4. **Expanding GenAI Beyond STEM**: While STEM and computer science fields have embraced GenAI, there is a need to explore tailored strategies for human-centered disciplines such as humanities, social sciences, and arts. More research is needed to understand how GenAI can benefit students in non-technical fields. Early studies on the potential of using LLMs in non-technical fields, such as Physical Education, have recently started to emerge in the last quarter of 2024 (Albaloul et. al, 2024). Tailoring AI applications to meet the needs of disciplines such as the humanities, and social sciences is crucial for broadening the impact of GenAI in higher education. Research should focus on identifying specific applications, challenges, and benefits of LLMs in these fields.

In conclusion, while GenAI offers promising opportunities for enhancing teaching, learning, and accessibility, there are significant gaps in its integration. Future studies on GenAI must address critical thinking, ethical issues, and inclusivity while promoting interdisciplinary collaboration and GenAI literacy.

Moving Forward with D2.2

The method, search terms, and list of search repositories will be refined in collaboration with partners as part of the next iteration of reporting, leading to the second report, D2.2, in December 2025.

Over the next twelve months, we will focus on developing D2.2 and improving our methodology. First, we acknowledge the growing number of large language models (LLMs) being developed, including both proprietary and open-source options, as well as free and paid-for products. To ensure comprehensive representation in future reports, we will review and update our search terms to include open-source LLMs like Mistral and Gemma.

Second, we recognise potential biases in database coverage and language inclusion. To address this, we will expand the range of databases and repositories used, incorporating recommendations from our partners. This will include platforms such as IEEE Xplore, European research databases like CORDIS, the EU Open Data Portal, and PubMed. Additionally, we will prioritize obtaining papers from six major European conferences, including EADTU and EDEN, where partners typically attend and have access to conference proceedings. This approach will help us capture insights into practical, real-world use cases involving educators and students before these findings appear in journal publications.

To facilitate this process, we will collaborate with partners in January 2025 to create a regularly updated spreadsheet for systematically collating this information.

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