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Generative Artificial Intelligence and education: Research, policy and practice

Don Passey [1], Sammy Taggart [2], Serena Leow [3], Cheng Ean (Catherine) Lee [3]

[1] Department of Educational Research, Lancaster University, Lancaster, United Kingdom

[2] School of Education, Ulster University, Coleraine, United Kingdom

[3] Department of Communication, Sunway University, Bandar Sunway, Malaysia

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1. Is research needed to support educational policy and practice with generative artificial intelligence (GenAI)? (Don Passey)

In this STEL Special Issue, papers are published soon after they are accepted. In this way, this Special Issue will continue to develop at least during this calendar year 2024. To set the scene and context for the topic covered in this Special Issue, the guest editors provide here:

- a broad introduction, reasons why generative artificial intelligence (GenAI) research is important, and some ways that current issues and advantages might be interposed or considered;
- a perspective on benefits and challenges from a compulsory education perspective, considering uses by teachers and pupils across the age range from 3-18 years;
- a perspective on benefits and challenges from a tertiary education perspective, considering uses by students, administrators and academic staff; and
- a perspective on how research might be undertaken to explore issues and advantages, and how research might be conducted to support the wide range of stakeholders.

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Generative artificial intelligence (GenAI) has only recently become a focus of prominent discussion for many educational institutions and educators. Responses and reactions to the idea of access to GenAI and the uses of GenAI in education are varied – for example, there are those who advocate use (those who see its benefits and put use into practice), those who oppose use (those who recognise ethics and bias as major issues and ban use in practice), and those who believe that trialling use is important (those who see both potential benefits and challenges and are willing to trial use to assess the range of outcomes that might arise). This Special Issue is concerned with research that can shed light on the range of benefits and challenges that are highlighted in this emerging field—seeking to offer perspectives to support current and future research, practice and policy.

Potential uses of GenAI are in some respects being recognised as age-independent, and inclusive, in the sense that GenAI is being seen to offer potential benefits and challenges across the age spectrum with increased forms of accessibility. Examples of research evidence from teachers in primary and secondary schools (Kaplan-Rakowski, Grotewold, Hartwick, & Papin, 2023), administrators in universities (Luo, 2024) and adult educators (Cacicio & Riggs, 2023) show educational GenAI uses are being developed across the lifespan. This Special Issue seeks to gather evidence from across this wide age spectrum, offering readers perspectives that can be considered within their own contexts and areas of focus.

1.1 Research and current positions

As the emergence of GenAI in education has only been recently highlighted (Kanbach, et al., 2024), and that initial highlighting was not based on any fundamental educational research through which to view it, then the need for research in this field is clear. This is especially the case when views about GenAI's potential benefits and challenges are so divided across educational populations.

Some would argue that GenAI is not a new field and development; and certainly, it is true that GenAI could not have been developed without earlier developments in the AI field (Hermann, & Puntoni, 2024). Digital technology facilities that respond to human interactions with software are not new. For example, tutoring systems and integrated learning systems have been accessible since the 1970s (Guo, et al., 2021). What is new in current GenAI applications is the range of background data that a GenAI facility can draw upon, the way that responses are matched to key requests that individuals make, and the forms of responses that are possible. But, if these statements are true, then therein lie some of the features that are leading to variations in responses to these technologies. If the range of background data is wide, then key questions arising would be - of what is it composed, and how will the GenAI system use the data that are generated by the individual using the system? If the responses are matched to key requests, then a key question would be - to what extent can the responses from the GenAI system be considered valid or accurate or ethical (Khosrowi, Finn, F., & Clark, 2024)?

1.2 How current benefits and challenges might be interposed or considered educationally

Educational uses of GenAI tools rely upon three fundamental elements: the data that the system accesses from requests made; the way that requests are matched to the individual request; and the ways that the outcomes are viewed and assessed by users. From an educational viewpoint, all of these are important. The data can determine the width, accuracy or non-biased outcome that is generated; the match can determine the sensitivity, focus or individual interpretation that is generated; and the outcome can determine the value, use or acceptability of what is generated. Having understandings of each of these elements can allow a user to be in a position where outcomes can be judged with critical concern rather than accepting them at face value. If users are to be positively critical of outcomes rather than accepting of them superficially, then questions about the three elements should be raised and known. Pedagogically, educational assessment of outcomes from a GenAI application should rely upon a knowledge of all three elements, rather than a knowledge of only the latter of these three. Whether that knowledge is known to the user (a learner), or to a teacher or tutor, or to an administrator or policy maker should be of concern to any educational institution or system. Advocates of GenAI should be aware of all three elements when they are recommending uses of any specific GenAI system.

Over the past two years at least, the range of GenAI systems available for education is undoubtedly increasing. For example, educational GenAI systems are being developed and used to support reading, numeracy, career choices, mental health issues, and social challenges. Widely used software is also continuing to integrate GenAI facilities, providing audio, image and video as well as textual responses on request. Given the differences that each GenAI system has with regard to the three fundamental elements of background data, match and outcome appropriateness, research exploring specific systems should offer support to those in policy and practice who wish to take forward potential benefits and to realise challenges.

In this Special Issue, we are concerned with exploring educational uses of GenAI systems, offering perspectives across a range of different users, whether they be developers, learners, teachers, advisors or policy makers.

2. The promise of GenAI in compulsory education (Sammy Taggart)

Generative Artificial Intelligence (GenAI) is reportedly poised to revolutionise compulsory education, offering a myriad of benefits and challenges for both teachers and learners. GenAI is said to hold the promise of enhancing instructional effectiveness and efficiency, yet it also brings significant ethical concerns and implementation challenges, not least in school environments where learners are under the age of 18 years.

The potential to personalise learning, provide real-time feedback, and support diverse needs, thereby enhancing inclusivity and engagement, is far-reaching (Owan, 2023; Rosalina, 2022). At an individual level, GenAI tools can, for example, support teachers in developing tailored teaching materials based on specific learner needs, promoting inclusivity (Jančařík et al., 2022). Systemically, GenAI has speculative capacity to address global teacher shortages by employing artificially intelligent robots as educators (Chen et al., 2023). The potential is both individually focused and globally expansive in scope. Yet, as with other disruptive technologies, GenAI in education will likely experience phases of hype, hope, and disappointment (Gouseti, 2010); but teachers' attitudes will, no doubt, be pivotal in determining its successful integration and impact in schools.

2.1 Teachers as gatekeepers of GenAI integration

An often-overlooked aspect is the indispensable role classroom teachers play in effectively integrating GenAI in education (Mudawy, 2024). The perspectives of teachers on GenAI are crucial for achieving a balance that maximises its benefits while safeguarding stakeholders' rights (Uygun, 2024). Collaborative efforts among teachers, policymakers, and industry stakeholders are essential to harness the full potential of GenAI in learning, teaching and assessment and to minimise the associated risks (Owan, 2023). As "the keystone species" (Davis, 2018, p.11) in the classroom ecosystem, teachers' understandings and acceptances of GenAI are critical factors that can either facilitate or hinder its adoption. Comprehensive professional learning is essential to equip teachers with the knowledge and skills necessary to use GenAI effectively, considering both its technical integration and ethical implications, including the potential impact on student and teacher privacy and data security.

2.2 GenAI-enriched inclusive education

Inclusive education is not merely about providing access to learning but is also about ensuring that all students can participate fully and benefit from the educational experience. GenAI can play a significant role in this regard by personalising learning experiences and providing additional support where needed. For instance, GenAI can identify learning gaps and suggest targeted interventions, making education more responsive to individual student needs. This is particularly important for students requiring additional support to achieve their full potential. In compulsory education, as with other phases of education, GenAI presents opportunities for personalised learning, efficient administrative processes, enhanced accessibility, and data-driven insights. Personalised learning through GenAI allows for tailored educational experiences based on individual student needs, while administrative tasks can be streamlined, giving teachers more time to focus on learning and teaching. GenAI also enhances accessibility by providing support for students with additional needs and offers valuable data insights to improve teaching strategies and student outcomes (Kamalov et al., 2023).

2.3 Challenges and ethical considerations

It is imperative, however, to acknowledge that GenAI applications risk exacerbating social inequalities and can systematically "(dis)advantage some groups of students and teachers over others" (Facer & Selwyn, 2021, p.13). Not all countries, regions, schools or learners have equal access to advanced technologies and there is potential to widen the existing digital divides locally and globally. As such, the integration of GenAI in schools poses significant challenges where endeavour to provide system-wide, guard-railed provisions may be more equitable, cost-effective and ethically sound. Privacy and data security concerns arise due to the collection and analysis of vast amounts of student data, necessitating robust data protection measures agreed by all stakeholders. Teacher education and in-service adaptation are crucial for effectively integrating GenAI into the classroom, as educators need to continue to acquire new skills and adapt to these rapidly evolving technologies and associated pedagogies. Moreover, there is a concern about dependency and overreliance on GenAI systems, which could diminish the human elements of teaching and learning (Akgün & Greenhow, 2021).

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2.4 Balancing GenAI integration and educational values

To address these challenges, it is essential for educators, policymakers, and stakeholders to strike a balance between harnessing the benefits of GenAI while safeguarding the core values of education. This balance requires thoughtful and ethical considerations to ensure that GenAI can serve as a catalyst for positive change in education. By navigating the complexities of GenAI integration in schools, stakeholders can revolutionise learning experiences and administrative processes while upholding the fundamental principles of education (Kamalov et al., 2023). Teachers, as the frontline enablers of GenAI in the classroom, need robust support and ongoing opportunities for professional learning. Policymakers must urgently collaborate to create frameworks that promote ethical GenAI use while protecting data and privacy to embrace the change needed by an already GenAI-immersed citizenry and workforce. Researchers and developers should work closely with teachers to design GenAI tools and resources that are both pedagogically informed and learner centric. Ultimately, the goal is to create an educational ecosystem where GenAI enhances the capabilities of teachers and learners, fosters inclusivity, and prepares all for the challenges and opportunities of the future.

3. Navigating the benefits and challenges of using GenAI in tertiary education (Serena Leow)

Incorporating technology into teaching and learning practices in tertiary education has become imperative. The current tertiary education landscape has in some instances witnessed an evolutionary method of teaching and learning by using GenAI. Students, administrators, and academic staff have found this technology to be helpful. However, as with any technology, challenges exist with the myriad of benefits that technology brings. Indeed, researchers (Rasmussen & Karlsen, 2023) discovered that students and academic staff have mixed feelings and attitudes towards the use of GenAI. However, GenAI can enable personalised experiences in teaching and learning.

GenAI's ability to tailor learning content according to courses and individual learning approaches represents a significant advancement in tertiary education. From a student's perspective, simplifying complicated information or new knowledge can provide further understanding and can improve their learning experiences. For administrators, GenAI can enable processes to be more efficient by compiling and analysing trends in educational data. For academic staff, GenAI can assist in routine tasks such as grading and administrative work so that academic staff are able to focus more on teaching and research activities.

On the other hand, GenAI has spurred countless discussions concerning its ethical use amongst students, particularly in completing assignments and assisting students to understand course materials (Hopfenbeck et al., 2023; Polemi et al., 2024). From the academic staff perspective, discussions have revolved around the use of GenAI in research and report writing, specifically to generate new knowledge in research (Hsu, 2023). In terms of administration, the question of trustworthiness in using GenAI for administrative tasks remains a concern (Polemi et al., 2024). As tertiary education institutions continue to adapt to the evolving technology of GenAI, stakeholders who are involved in using the technology need to be aware of the benefits as well as challenges that the technology affords.

3.1 The pros and cons of using GenAI

Studies (Fosso Wamba et al., 2023; Hopfenbeck et al., 2023; Kalota, 2024; Kostka & Toncelli, 2023; Mello et al., 2023) have delved into the uses of GenAI throughout the years and have discovered multiple benefits of using the technology in education. The use of GenAI has been shown to bring about significant changes towards students' learning experiences. The ability to customise learning paths in order to understand complex content in courses provides a personalised platform for students to learn efficiently and effectively. However, research in the area of student learning through the use of GenAI is still lacking, considering the capabilities that GenAI affords in multiple facets of learning. Will students be over-reliant on GenAI to the point where critical thinking skills are no longer developed in the learning process? Will students be able to discern the level of privacy when they feed GenAI with information for the purpose of completing assignments? These are questions that could potentially impact future uses of GenAI among students.

Conversely, academic staff are able to use GenAI for assessments, as well as identify students' learning trends in a course. Data that GenAI provide can be used to understand students' performance and behaviour besides increasing student engagement. GenAI has been shown to be useful for academic staff in teaching and student engagement, but do pedagogical methods need to be examined with the existence of GenAI in teaching and learning? GenAI can enable academic staff to also gain deeper insights on students' learning patterns, which could improve academic staff's pedagogical methods. However, what is the level of comfort

amongst academic staff in using GenAI to continuously improve and evolve pedagogical methods in the current generation? Studies have highlighted a significant concern among academic staff, in terms of academic integrity among educators and students in the context of GenAI. This topic remains a critical area for researchers and policymakers to explore, as the ethical standards and credibility of educational institutions are reflected in individuals' academic integrity.

Besides the issue of ethical use in the context of GenAI, the technology affords automation of routine tasks, which frees up time for academic staff to proceed with strategic tasks in teaching and learning (Rasmussen & Karlsen, 2023). Emphasising strategic teaching efforts among academic staff is essential, in which GenAI can play a pivotal role in efficiently simplifying routine tasks. Further studies are needed to understand challenges that prevent academic staff from using GenAI frequently in teaching.

From the perspective of administrators, GenAI can automate administrative tasks such as scheduling and attendance tracking that are repetitive and time-consuming. While GenAI is able to analyse large datasets for administrators and complete mundane tasks, the question of trustworthiness and accuracy of using GenAI in administrative tasks remains to be explored. Furthermore, the cost of integrating GenAI technologies requires resources and investments, which is a concern for educational institutions to address should administrators be encouraged to utilise GenAI in their daily tasks.

The integration of GenAI in education can offer significant benefits as well as challenges, which are addressed in papers in this Special Issue. Future research and policy development are crucial, as students, academic staff and administrators navigate through the challenges as well as harnessing the uses of GenAI and its potential within education.

4. Research approaches on Generative Artificial Intelligence in education: Exploring its benefits and challenges (Cheng Ean (Catherine) Lee)

The use of artificial intelligence (AI) in education is not a new phenomenon. Recently, GenAI has emerged as a stated powerful tool with the potential to revolutionise education by offering personalised learning experiences, enhancing content creation for teaching and learning, and supporting diverse learning needs. However, integrating GenAI into educational settings also presents challenges that must be carefully examined, as research has not solely focused on its benefits. To understand the implications of GenAI tools in education, research in this area will need to highlight both opportunities and challenges for educators seeking to harness the power of GenAI within the digital learning ecosystem.

To navigate the opportunities and challenges presented by GenAI in education, several methodological approaches can be employed to conduct comprehensive and interdisciplinary research. Firstly, qualitative research, such as in-depth interviews and focus groups with students, educators, and administrators, can provide valuable insights into the experiences and perceptions of those directly interacting with GenAI tools. Additionally, ethnographic studies within classrooms can reveal the nuanced ways in which GenAI can impact teaching and learning dynamics. Qualitative approaches can help to capture the human element and contextual factors that influence effectiveness and acceptance of GenAI in educational settings. For instance, a study involving semi-structured interviews with 13 students at a regional Australian university revealed six distinct themes: the educational impact of GenAI tools; equitable learning environments; ethical considerations of GenAI use; technology integration; safe and practical utility; and generational differences. This qualitative exploration sheds light on the potential for both positive contributions and challenges associated with integrating GenAI in nursing education and practice (Summers et al., 2024).

Second, quantitative research using surveys and longitudinal studies can track the impact of GenAI on educational outcomes. Experimental designs can allow researchers to rigorously evaluate the efficacy of GenAI interventions, providing measurable evidence of their impact and facilitating objective analysis and comparison. For example, a survey of 399 undergraduate and postgraduate students from various disciplines across six Hong Kong universities revealed a generally positive attitude towards GenAI in teaching and learning (Chan & Hu, 2023). The results indicated that students recognised the potential of GenAI for personalised learning support, writing and brainstorming assistance, and research and analysis capabilities. However, the survey also highlighted concerns about accuracy, privacy, ethical issues, and the impact of GenAI on personal development, career prospects, and societal values.

Additionally, mixed-methods research, combining qualitative and quantitative approaches, can provide a holistic understanding of GenAI's impact. In one example, a study that integrated quantitative and qualitative findings through surveys and interviews gathered insights from educators

in Saudi institutions. The results offered a comprehensive perspective on the integration of GenAI in education. Quantitative data revealed trends in awareness and adoption, while qualitative insights highlighted individual nuances and concerns. This mixed-methods approach presented promising opportunities for enhancing academic achievement, fostering collaboration, and encouraging professional development among educators (Alammari, 2024).

Based on the challenges and potential that GenAI offers to the education sector, it is crucial to highlight and synthesise the literature to understand the potential uses, impacts, and ethical issues posed by GenAI tools in the context of teaching and learning. A recent paper provides an overview of the current state of research on GenAI for teaching and learning in higher education through a systematic review of relevant studies indexed by Scopus, using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review of 355 research papers demonstrated the current state and future trends in incorporating GenAI into educational curricula for assessments, teaching, and learning delivery. This review strengthens the awareness and understanding of students, tutors, and other stakeholders and will be instrumental in formulating guidelines, frameworks, and policies for the use of GenAI (Ogunleye et al., 2024).

GenAI is stated to hold significant promise for revolutionising education by offering personalised learning experiences and innovative resources. However, its integration presents challenges that must be recognised and addressed through rigorous research and development. By employing diverse research methodologies, both the benefits and challenges of GenAI can be systematically explored. This will enable researchers and educators to harness GenAI's potential to create more equitable, engaging, and effective educational environments. Such research approaches are crucial for maximising the benefits of GenAI while mitigating its risks, ultimately fostering an educational landscape that benefits all learners.

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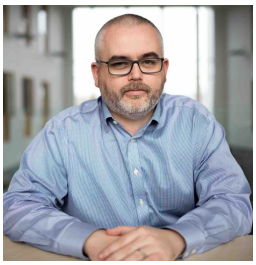
About the authors

Don Passey

Don is Professor of Technology Enhanced Learning and Director of International Strategy in the Department of Educational Research at Lancaster University, UK, and an Honorary Professor of the Institutes of Education and of Information Technology at Amity University, Uttar Pradesh, India. He is a current staff member of the Centre for Technology Enhanced Learning in the Department of Educational Research, and and was the founding director and co-director of the Centre. His research investigates how digital technologies support learning and teaching. Recent studies have explored innovative and inclusive practices, in and outside educational institutions and classrooms, in off-site, home and community settings. His findings have informed policy and practice, for international institutions and groups, government departments and agencies, regional and local authorities, companies and corporations. His publications span theoretical as well as empirical studies, and the methodological approaches he adopts widely range across bespoke mixed methods. He is currently chair of the International Federation for Information Processing (IFIP) Technical Committee on Education, has chaired a number of international conferences in his academic field, and is the recipient of Outstanding Service and Silver Core Awards from IFIP for his international contributions to his field in education.

d.passey@lancaster.ac.uk
0000-0002-9205-502X



Sammy Taggart

Sammy is a teacher educator in Technology and Design Education at Ulster University, Northern Ireland. Having taught in a NI grammar school for 13 years and as Head of Department for a number of years, Sammy joined Ulster University in 2017. His research interests focus on the use of educational technologies to support learning and teaching, particularly within Initial Teacher Education. In 2021 Sammy received the Distinguished Education Excellence Award for his work during lockdown.

s.taggart@ulster.ac.uk
0000-0001-8076-8607
@Sammy__T

Serena Leow

Prior to joining academia, Serena was an industry practitioner with experience working on business consulting projects with the government and multinational companies to provide market research, countries benchmarking, competitor analysis, policymaking and implementation in SME e-commerce, product commercialization, talent management, and halal business industry. She has experience in producing business conferences to address industry practitioners' challenges in topics related to shopper marketing, product management and marketing, internal audit, and total productive maintenance. Serena is interested in quantitative and qualitative research that examines individuals' use of technologies as well as their social and psychological well-being while using technologies in everyday life.

serenaleow@sunway.edu.my
0000-0001-8647-9881

Cheng Ean (Catherine) Lee

Catherine Lee is an Associate Professor and Deputy Dean (Education) at the School of Arts, Sunway University, Malaysia. She has over 22 years of experience in teaching and research in higher education. Dr. Lee has published extensively in both local and international peer- reviewed journals and has presented at various conferences worldwide. She serves as a Panel Assessor for the Malaysian Qualifications Agency (MQA) and is a member of the Malaysian Association of Communication Educators (MACE) and the Centre for Higher Education Research (CHER). Additionally, she is a reviewer for numerous indexed journals. Her research interests include public relations, social media, communication studies, and technology-enhanced learning.

catherinelee@sunway.edu.my 0000-0003-2360-7369

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