

Literature Review on the Impact of AI in Education (AIED)

Jim Fanning

Education Scotland

Senior Education Officer (Emerging Technologies)

February 2024

CONTENTS

Purpose	2
Background	2
Sources	3
Key themes/information	4
Further reading	6
Appendix 1 Existing literature reviews	7
Appendix 2 Texts	9
Appendix 3 Summary of one literature review	12
Appendix 4 Further reading	16
Appendix 5 Websites	17

Purpose

Review existing academic literature for AI in Education (AIED), and identify the key themes around potential impacts to better inform any discourse on the topic.

Background

- In 1955 John McCarthy held a workshop at Dartmouth College (USA) on 'artificial intelligence' which is the first use of the term, and how it came into popular usage
- There are a variety of definitions of the term
- The [Scottish AI Strategy](#) (2021) defines AI in the following way:
 - 'Technologies used to allow computers to perform tasks that would otherwise require human intelligence, such as visual perception, speech recognition, and language translation. AI is a broad discipline. Think of it as a group of complementary technologies, including data-driven techniques, which are evolving constantly'
- AI has been used in a range of applications for decades (with little awareness amongst the general public) including **voice assistants** (SIRI, Alexa), **facial recognition** (as a safety feature on the iPhone), **Google search**, **personalised content recommendations** (Netflix), **transport** (self-drive cars), **banking systems** (fraud detection), **online customer services** (chatbots) and **healthcare** (analysing X-ray images, for example mammograms, to support radiologists in making assessments)
- The availability of large datasets through the internet has enabled the development of large language AI (ChatGPT, Google Gemini, Microsoft Copilot) models that can recognise and generate text, amongst other tasks
- Since the launch of ChatGPT in November 2022, there has been tremendous interest in generative AI (GAI) in relation to both its potential and the risks it poses across all sectors of society
- Coverage in the media tends to focus on the threats or negative aspects of AI and GAI use, although there is general acceptance that 'Artificial intelligence (AI) is arguably the driving technological force of the first half of this century, and will transform virtually every industry, if not human endeavours at large. [Artificial Intelligence In Education Promises and Implications for Teaching and Learning](#) Wayne Holmes, Maya Bialik, Charles Fadel.
- Wendy Hall, professor of computer science at Southampton University and a co-chair of the British government's AI review, has usefully commented: "I **think everyone's got to get a grip, get over the hype and understand that this is a learning curve.** And we're going to see some exciting things coming

out. But while [the AI models] are being trained on imprecise, inaccurate biased data, you should take the results with a pinch of salt.”¹

Sources

[Eric](#), [Google Scholar](#) and [Elicit](#) services were used to surface relevant academic papers.

The following search terms were used: artificial intelligence in education, AIED, generative AI, GAI, systematic review, online learning.

11 AIED related literature reviews were identified (Appendix 1), along with 11 recently published texts (Appendix 2).

The majority of this content was published in the time period 2019-2023.

All content was published in English.

A glossary of key terms related to AI can be found in [Scotland's AI Strategy](#) document (March 2021).

Figure 1 illustrates the growth in interest in AIED over the last decade through the quantity of academic papers that have been published in relation to this topic.

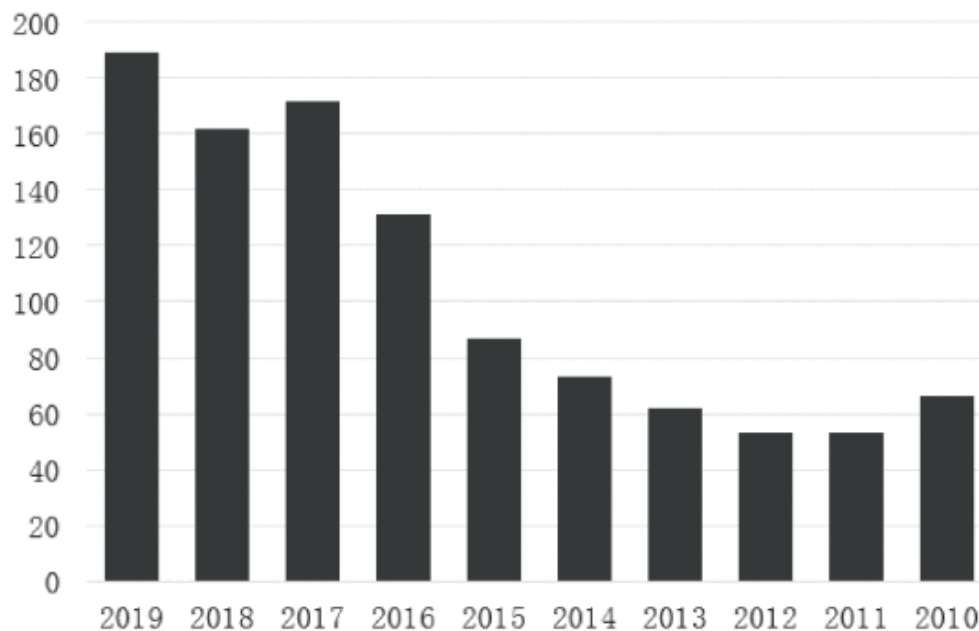


FIGURE 1 Papers in Web of Science and Google Scholar in the last ten years with key words “AI” and “Education”. L. Chen, P. Chen and Z. Lin, "[Artificial Intelligence in Education: A Review](#)," in *IEEE Access*, vol. 8, pp. 75264-75278, 2020, doi: 10.1109/ACCESS.2020.2988510.

Key themes and information

¹ Source: [Google's AI chatbot Bard spits out factual error during launch](#)
[Scientists seize on 'hallucination' by rival to ChatGPT](#)
[The Times](#), 9th February 2023

- most of the content accessed for this paper identified the following common key themes across AIED:
 - **learner assessment and feedback** (to improve engagement, grades, retention and reduce drop-out rates)
 - **personalised learning** (ranging from the development of bespoke learning materials, to systems that support flipped, distance and learner self-directed approaches through the use of intelligent tutoring systems)
 - the use of AI enabled services to **reduce the administrative burden** on educators and thus support more targeted interventions with learners
- the 11 literature reviews take a standard approach to their studies, identifying common keywords – artificial intelligence, AIED, deep learning, machine learning, online learning – to surface relevant material from a range of academic databases (Eric, Google Scholar, Scopus, Web of Science)
- China, India and the United States feature prominently in the development of AI solutions in education
- a small number of countries have published curriculum guidelines and guidance in relation to the use of AI in education
 - in China the Ministry of Education has integrated AI into the compulsory secondary school curriculum
 - in Singapore a programme for AI learning in schools has also been developed where K12 children learn AI interactively ('however the programme is hindered by a lack of professionals with adequate training')
 - in Germany there are also several initiatives to pilot AI related projects and studies including the launch of a national initiative²
 - the National AI in Schools Taskforce in Australia has published an Australian Framework for Generative Artificial Intelligence in Schools
- the reviews reveal the complexity of the field of study, with different services and tools – from generative AI to bots³ and robots - being cited

² Casal-Otero, L., Catala, A., Fernández-Morante, C. *et al.* AI literacy in K-12: a systematic literature review. *IJ STEM Ed* **10**, 29 (2023). <https://doi.org/10.1186/s40594-023-00418-7>

³ It is evident that chat bot technology has a significant impact on overall learning outcomes. Specifically, chat bots have demonstrated significant enhancements in learning achievement, explicit reasoning, and knowledge retention. The integration of chat bots and education offers benefits such as immediate assistance, quick access to information, enhance learning outcomes, and improved educational experiences. However, there have been contradictory findings related to critical thinking, learning engagement to, add motivation. 2023. Labadze, L et al.

- the literature is weighted towards further and higher education, although many of the lessons learned in these contexts are transferable
- most are positive about the future integration of AI into education but also highlight a number of risks and concerns including:
 - bias in the data models that either provide inaccurate information or privilege certain sections of the learner cohort
 - data security (personal information) issues ('Although artificial intelligence technologies use human generated data, there is a lack of regulation on how to use this data and how to apply artificial intelligence ethics.')
 - systems being implemented with little evidence of desired impacts or outcomes ('In China, systems are already being used to monitor student participation and expressions via face recognition in classrooms and display them to the teacher on a dashboard. This is an example of educational surveillance, and it is highly questionable whether such systems provide real added value for a good teacher who should be able to capture the dynamics in a learning group and respond empathically and in a pedagogically meaningful way.')
 - the commercialisation of AI development that leaves educators 'out of the loop' ('The low presence of authors affiliated with education departments identified in our systematic review as evidence of the need for educational perspectives on these technological developments.')
 - studies that focus on the technical nature of the tools and services as opposed to a holistic view of benefits and impacts in education ('The vast majority of papers published are from the computer science or engineering field, focusing on technological implementations of AI.')
 - an AI development that increases the digital divide (both in relation to access to the technology and the skills required to use it)
 - a need for teacher and learner skills development
 - impacts on learner health and wellbeing (e.g. isolation, individualisation)
 - a use of AI that will change the educator/learner relationship

- the teaching of AI concepts in the school curriculum is scarce ('There are few studies of AI enabled learning systems implemented in educational settings.')
- research into AI in education is still very limited ('There's a lack of longitudinal studies in relation to AI use.')
- approaches to AI literacy require an inter-disciplinary approach

Further reading

- **Appendix 3.** A summary of the key information from one detailed literature review.
 - Title: Systematic Literature Review on opportunities, challenges, and future research recommendations of artificial intelligence in education. Thomas K F Chiu et al. Computers and Education: The Journal of Artificial Intelligence, volume 4, 2023.
[Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education – ScienceDirect](#)
- **Appendix 4.** A selection of papers that further explore AI use in compulsory age education in a variety of innovative ways and from different perspectives.
- **Appendix 5.** Selection of relevant websites.

Appendix 1 : Existing literature reviews used in this paper

Ahmad, Kashif & Qadir, Junaid & Al-Fuqaha, Ala & Iqbal, Waleed & Elhassan, Ammar & Benhaddou, D. & Ayyash, Moussa. (2020). Artificial Intelligence in Education: A Panoramic Review. 10.35542/osf.io/zvu2n

Bozkurt, Aras, Abdulkadir Karadeniz, David Baneres, Ana Elena Guerrero-Roldán, and M. Elena Rodríguez. 2021. "Artificial Intelligence and Reflections from Educational Landscape: A Review of AI Studies in Half a Century" *Sustainability* 13, no. 2: 800. <https://doi.org/10.3390/su13020800>

Chiu, Thomas K.F. & Xia, Qi & Zhou, Xinyan & Chai, Ching & Cheng, Miaoting. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. 4. 10.1016/j.caeai.2022.100118

Casal-Otero, L., Catala, A., Fernández-Morante, C. *et al.* AI literacy in K-12: a systematic literature review. *IJ STEM Ed* 10, 29 (2023). <https://doi.org/10.1186/s40594-023-00418-7>

Dogan, Murat Ertan, Tulay Goru Dogan, and Aras Bozkurt. 2023. "The Use of Artificial Intelligence (AI) in Online Learning and Distance Education Processes: A Systematic Review of Empirical Studies" *Applied Sciences* 13, no. 5: 3056. <https://doi.org/10.3390/app13053056>

Labadze, L., Grigolia, M. & Machaidze, L. Role of AI chatbots in education: systematic literature review. *Int J Educ Technol High Educ* 20, 56 (2023). <https://doi.org/10.1186/s41239-023-00426-1>

Limna, Pongsakorn and Jakwatanatham, Somporch and Siripipattanakul, Sutitthep and Kaewpuang, Pichart and Sriboonruang, Patcharavadee, A Review of Artificial Intelligence (AI) in Education during the Digital Era (July 2022). *Advance Knowledge for Executives*, 1(1), No. 3, 1-9, 2022, Available at SSRN: <https://ssrn.com/abstract=4160798>

Mohamed, M. Z. b., Hidayat, R., Suhaizi, N. N. b., Sabri, N. b. M., Mahmud, M. K. H. b., & Baharuddin, S. N. b. (2022). Artificial intelligence in mathematics education: A systematic literature review. *International Electronic Journal of Mathematics Education*, 17(3), em0694. <https://doi.org/10.29333/iejme/12132>

Tahiru, Fati. (2021). AI in Education: A Systematic Literature Review. *Journal of Cases on Information Technology*. 23. 1-20. 10.4018/JCIT.2021010101.

Tumaini Kabudi, Ilias Pappas, Dag Håkon Olsen, AI-enabled adaptive learning systems: A systematic mapping of the literature, *Computers and Education: Artificial Intelligence*, Volume 2, 2021, 100017, ISSN 2666-920X, <https://doi.org/10.1016/j.caeai.2021.100017>

Zawacki-Richter, Olaf & Marín, Victoria & Bond, Melissa & Gouverneur, Franziska. (2019). Systematic review of research on artificial intelligence applications in higher

education -where are the educators?. International Journal of Educational
Technology in Higher Education. 16. 1-27. 10.1186/s41239-019-0171-0

Appendix 2 : Texts consulted for this paper

Coeckelbergh, M. 2022. The political philosophy of AI.

From the philosophy of technology, we know that technologies are not, and cannot be, morally and politically neutral. This is so in general for all technologies and it is also the case with AI and data science. While some people think that.... algorithms could be neutral, if humans would not constantly spoil them with the biases, this view is mistaken. Instead, the relation between humans and machines is far more complex, and this is also true for humans and AI. AI algorithms are never neutral....and the biases that result from the algorithms and the data science process is need to be evaluated.

Crawford, K. 2021. The Atlas of A.I.

In this book I argue that AI is neither artificial nor intelligent.....AI systems are not autonomous, rational, or able to discern anything without extensive, computationally intensive training with large datasets or predefined rules and rewards. In fact, artificial intelligence as we know it depends entirely on a much wider set of political and social structures. And due to the capital required to build AI at scale and the ways of seeing that it optimises AI systems are ultimately designed to serve existing dominant interests. In this sense, artificial intelligence is a registry of power.

Page 19.....artificial intelligence is now a player in the shaping of knowledge, communication, and power.

Page 95. Data has become a driving force of the success of AI and its mythos and how everything that can be readily captured is being acquired.... This has resulted in a profound metamorphoses, where all forms of image, text, sound, and video are just raw data for AI systems and the ends are thought to justify the means. But we should ask, who has benefited most from this transformation, and why have these dominant narratives of data persisted?

Fitzpatrick, D et al. 2023. The AI classroom. The Ultimate Guide to Artificial Intelligence in Education.

We can't push the genie back into the bottle nor can we close Pandora's box once it has been opened. Hence we need to prepare ourselves and the next generation for the new realities.

The world of education is at a crossroads. Rapid advancements in artificial intelligence are changing the way we live, work, and interact with one another. As educators, we have a responsibility to prepare our students for the future we will inhabit yet many of us feel ill equipped to navigate this brave new world of AI in the classroom. This gap in understanding is the problem that we must address.

This book has some useful examples of existing AI related tools and applications that can be used by teachers in the classroom. Useful to note that a lot of these do require a cost some are freemium and some are free.

Houghton, J. 2023. Innovative teaching with AI. Creative approaches to enhancing learning in education.

McCrae, H. 2022. The world in 2050. How to think about the future. London.

Page 155. AI is wonderful at analysing data, far better than we are. But it is useless at much else; It cannot unload a dishwasher. So until we had the deluge of data, it was essentially a toy. It could beat us at chess, but it could not help us find a cure for cancer.

We are in the very early stages of learning what AI can do, but we already have several areas where its ability to pick its way through a forest of information is transforming things. There are thousands of examples already. Mirfield's Eye Hospital in London found that if AI was used to scan patients retinas, it could identify I diseases earlier than even the most experienced doctors. AI is being used in facial recognition, in hiring, in marketing, in supply chain management and so on.

There are inevitably a host of challenges, which are already cropping up. One is privacy. To what extent do we want not just our personal data to be analysed, but all the data we create as we move through life? Another is bias, it has become clear that AI can develop biases just as human intelligence can. Still another is how to use AI's hard skills of analysis and reason alongside human beings soft skills of empathy, creativity and imagination.

Seldon, A et al. 2020. The 4th education revolution reconsidered. Will artificial intelligence enrich or diminish humanity?

Page 128. The potential of AI in education may be viewed as the difference between supervised and unsupervised learning. The former follows known patterns; the latter thinks for itself, and cannot be said to be creative. Generative AI can similarly be said to be creative and challenges those who say imagination is uniquely human.

Page 130 . Andrew Ng, one of the world's most prominent AI experts, has said, worrying about AI turning evil is a little bit like worrying about overpopulation on Mars.

Page 134 . At the heart of computing lies the ideal that humans should be free of tedium and drudgery to pursue more intellectual goals. It is not difficult to see how this ambition leads directly to the creation of AI, which is more than adept at circumventing tedium. This philosophy also underpins the future of education, which is concerned with shaping individuals to live more rewarding lives. Teachers were the key drivers of learning in the third revolutionary age, but were deeply handicapped by the tedium of administration, even more so

in today's data-driven, evidence based performance culture. They need help if they are to fully educate our young people in this new era.

Page 211. Our thinking needs to change, ignorance of AI is not an excuse, teachers must engage with what is happening. Digital crusaders are in part to blame. For too long, they have oversold the benefits digitalization will bring in schools, citing evidence that supports their views and ignoring contrasting views.

Selwyn, N.

- 2021. Education and Technology: Key Issues and Debates
- 2019. Should Robots Replace Teachers

Shah, P. 2023. AI and the future of education. Teaching in the age of artificial intelligence.

Page 2. Significant technological developments have always forced educators and the systems they work in to evolve to meet the educational needs of their students and take advantage of new opportunities. In that way, AI is similar to the challenges that educators have faced in the past. However, what makes these challenges different is the rapid pace at which they're developing, and the pain points and fractures within our educational models that they are exposing. These two factors make it essential that educators think about the implication of these developments on their practise and pedagogy quicker and more thoroughly than ever before.

Page 23. The proliferation of generative AI brings with it a unique set of challenges. One of the primary challenges is the quality control of generated content. While generative AI can create high quality outputs, it can also generate inaccurate or nonsensical results, especially when working outside of the contexts present in the training data. This issue is related to the challenge of AI hallucination, where the AI generates content that deviates significantly from reality, creating an output based more on the AI's interpretation rather than an accurate representation of the data.

Page 24. Effective prompt writing is an important skill for all educators in the use of AI.

Suleiman, M. 2023. The Coming Wave. AI, power and the 21st century's greatest dilemma.

Wilks, Y. 2019. Artificial intelligence. Modern magic or dangerous future?

Appendix 3: A summary of the key points from one major literature review

Title: Systematic Literature Review on opportunities, challenges, and future research recommendations of artificial intelligence in education. Thomas K F Chiu et al. Computers and Education: The Journal of Artificial Intelligence, volume 4, 2023. [Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education – ScienceDirect](#)

Introduction

AI in Education (AIEd) refers to the application of AI technologies, such as intelligent tutoring systems, chatbots, robots, and automated assessment, that support and enhance learning and teaching.

Current position

A number of national initiatives emphasise how important such approaches are: e.g. in 2019 the Chinese government launched a strategic policy to encourage the greater integration of AI into education, including teacher professional learning.

The impact of AI in education remains unclear and more research is required to understand whether and how these emerging technologies benefit education. Current research papers tend to focus on a specific key domain (learning, teaching, assessment, administration) and a more holistic approach to the examination of AI is required.

This paper asks two questions:

RQ1

How do AI technologies support learning, teaching, assessment, and administration in education, and what are the challenges in their research and development?

RQ2

What student and teacher learning outcomes are fostered by AI technologies?

RQ1:

- **Examples of AI in student learning**
 - **Assigning tasks based on individual competence:** AI-based environments have been used to personalise tasks for student learning
 - **Providing human-machine conversations:** Most of the studies in the review implemented AI chatbots and interactive books that allowed students to have conversations with machines about their learning
 - **Analysing student work for feedback:** Another common use of AI has been to give students timely guidance and feedback by analysing their work and learning process
 - **Increasing adaptability and interactivity in digital environments:** AI technologies have been implemented to capture student learning data and facilitate interactions for more adaptive digital environments
- **Examples of AI in Teaching**
 - **Providing adaptive teaching strategies:** Intelligent tutoring systems aim to recommend teaching content and tasks that are appropriate for teaching needs

- **Enhancing teachers' ability to teach:** The combination of computer assisted instruction and AI technologies has been applied to helping teachers manage their classroom teaching
- **Supporting teachers' professional development:** AI technologies have been applied not only to support teaching but also to support the professional development of teachers

- **Examples AI in assessment**

Two main roles have been assigned to AI in assessment: (i) providing automatic marking and (ii) predicting students' performance.

- **Providing automatic marking:** Our analysis showed that the use of AI to enhance and automate assessment resulted in more effective grading
- **Predicting students' performance:** AI technologies appear to have assisted in predicting student performance, particularly in online education

- **Examples of AI in administration**

The three main roles assigned to AI in administration are (i) improving the performance of management platforms, (ii) providing convenient and personalised services, and (iii) supporting educational decision-making with evidence.

- **Improving the performance of management platforms:** Our results indicate that AI has significantly enhanced the performance of management platforms
- **Providing convenient and personalised services:** AI technologies have been used to offer personalised academic and non-academic recommendations, thereby improving the work efficiency and quality of staff
- **Supporting educational decision-making with evidence:** AI technologies have provided educational administrators and management teams with evidence to support their decision-making. With access to big data, AI agents can predict the probability of students discontinuing their courses, identify the factors affecting student academic performance, and assist students with course selection

Student and teacher learning outcomes in AIEd research

From the reviewed AIEd research, four categories of student learning outcomes and three categories of teacher learning outcomes were identified.

The student outcomes can be classified into motivation and engagement, academic performance, [21st century skills](#), and non-cognitive aspects.

The teacher outcomes can be classified into working efficiency, teaching competence, and attitude toward AIEd.

Thirty percent of the studies reported that AI technologies improved teacher working efficiency.

AI technologies have been used to automate and simplify trivial and routine tasks, which eases teachers' workloads.

Specifically, AI has been applied to online classroom management, including course enrolment and student attendance.

- **Two major educational outcomes**
 - **Student learning:** Among students, the effects of AIEd have been tested on the outcomes of (i) motivation and engagement, (ii) academic performance, (iii) [21st century skills](#), and (iv) non-cognitive aspects
 - **Teacher practice and learning:** Among teachers, the effects of AIEd have been tested on the outcomes of (v) working efficiency, (vi) teaching competence, and (vii) attitude toward AIEd
- These roles and outcomes represent the current research focus in the field and can inform practitioners on how to approach the application of AI to teaching and learning as well as inform administrators on when and how they should look to support their work using AI technologies.
- The multiple roles and outcomes associated with AIEd suggest that research should be interdisciplinary and engage scholars from outside of the education field.
- **Challenges of AIEd and future research directions**
 - **Lack of relevant learning resources for personalised/adaptive learning:** Teachers have reported that the teaching methods and learning resources recommended by personalised/adaptive learning platforms are overly homogeneous.
 - **Selecting appropriate data for AI predictive models:** Further research is needed into what types of data should be used in AI models, with careful consideration of ethical issues.
 - **Lack of connection between the AI technologies and their use in teaching:** Emerging AI technologies look to offer instructional assistance (e.g., via chatbots and robots) and to provide teachers with rich information supporting their pedagogical. However, this review indicates that teachers may not have a sufficient understanding of the technologies to apply them effectively.
 - **Lack of interdisciplinary AI technologies for learning:** As learning is complicated, AI technologies developed for a particular discipline may not be effective for all student learning.
 - **Worsening educational inequity by widening the digital divide among students:** Most of the reviewed AIEd studies highlighted that AI technologies could motivate student engagement and foster 21st century skills. However, the benefits often accrued mostly to the most competent and motivated students.
 - **Insufficient knowledge of AI technologies among teachers:** Most teachers lack an understanding of how AI technologies work. As a result they and cannot fully utilise the technologies for learning, teaching, and assessment. The need for teachers to have knowledge of AI and its application to pedagogy should therefore be considered in future research.

- **Negative attitudes toward AI among students and teachers:** Some students and teachers have reported feeling anxious and less confident when learning with AI, generating negative attitudes toward AIEd.
- **Lack of AIEd research on socio-emotional aspects:** Most studies of AIEd have been devoted to cognitive outcomes and adaptive learning, with few having examined socio-emotional outcomes
- **Lack of education perspectives in AIEd research:** Most AIEd researchers have a strong engineering background and therefore tend to focus on technological design and development and to take an engineering approach to AIEd research. This approach fails to capture the perspectives of educational researchers and teachers.
- **Ineffective evaluation methods of AIEd:** The most commonly used evaluation methods may not be effective for AIEd research.

Appendix 4 : Suggested Further Reading

BAÍDOO-ANU, D., & OWUSU ANSAH, L. (2023). Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning. *Journal of AI*, 7(1), 52-62.

<https://doi.org/10.61969/jai.1337500>

- Summary: this paper summarises the benefits and limitations of GAI in education.

Bozkurt, A. et al. (2023). Speculative Futures on ChatGPT and Generative Artificial Intelligence (AI): A Collective Reflection from the Educational Landscape. *Asian Journal of Distance Education*, 18(1). Retrieved from

<https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/709>

- Summary: the potential impact of Generative AI explored through a series of short narratives and stories.

Liu, M. et al. (2023). Future of education in the era of generative artificial intelligence: Consensus among Chinese scholars on applications of ChatGPT in schools. *Future in Educational Research*, 1(1), 72–101. <https://doi.org/10.1002/fer3.10>

- Summary: this article summarises the views of Chinese scholars and experts around the implementation of GAI in education.

Mogas, J. et al. (2022). Smart schools on the way: How school principals from Catalonia approach the future of education within the fourth industrial revolution. *Learning Environ Res* 25, 875–893

Link: <https://doi.org/10.1007/s10984-021-09398-3>

[Smart schools on the way: How school principals from Catalonia approach the future of education within the fourth industrial revolution | Learning Environments Research \(springer.com\)](https://doi.org/10.1007/s10984-021-09398-3)

- Summary: 37 principals from primary and secondary schools in Catalonia discuss the future use of AI and the development of smart schools.

Roschelle, J., Lester, J. & Fusco, J. (Eds.) (2020). AI and the future of learning: Expert panel report [Report]. Digital Promise. <https://circls.org/reports/ai-report>.

- Summary: a panel of 22 experts consider the knowledge required by leaders in education to plan for the effective use of AI, and what research needs to take place to better inform future educational use.

Appendix 5 : Websites

- [Edinburgh AI | The University of Edinburgh](#)
 - AI research, development and use at the University of Edinburgh
- [Scottish AI Alliance - Scottish AI Alliance](#)
- [Exploring Children's Rights and AI - Children's Parliament \(childrensparliament.org.uk\)](#)
- [Teaching and Learning with Artificial Intelligence \(AI\) | Resources | Education Scotland](#)

Education Scotland AI webpage, summarising AI developments for educators
- [SLF Conversations | Education Scotland](#)

The Scottish Learning Festival is an annual exhibitor and educator event hosted by Education Scotland. The 2023 event focused on engagement with and presentations by a key number of global researchers and commentators on education. Their presentations included views on the development and impact of AI in education
- [DigiLearn \(glowscotland.org.uk\)](#)

Education Scotland digital education website, with details of AI webinars for educators
- [University of Glasgow - Research - Research units A-Z - Education Interdisciplinary Research Group - Teaching for Digital Citizenship: Digital ethics in the classroom and beyond](#)
- [Strategic Area 6: Artificial Intelligence \(AI\) and the Digital World - International Council of Education Advisers: third report 2021-2023 - gov.scot \(www.gov.scot\)](#)

The (Scottish Government) International Council of Education Advisers recommendations on the development of AI within a Scottish context
- [The-Institute-for-Ethical-AI-in-Education-The-Ethical-Framework-for-AI-in-Education.pdf \(buckingham.ac.uk\)](#)