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B. Mairéad Pratschke

Generative AI and Education

Digital Pedagogies,
Teaching Innovation and
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For Orla,

*My best little love, my sidekick over land, air
and sea*

Codladh sámh, mo chroí.

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Chapter 1

AI and Digital Education



Abstract The opening chapter provides important historical, technological, and educational context, situating generative AI within the evolving timeline of learning innovation. It examines the pedagogical shift from instructor-led to student-centred approaches, locating generative AI within this context and making the distinction between other previous forms of AI and generative AI and sets the reader up for the pathway that follows.

Keywords AI and digital education · Artificial intelligence (AI) · Large language models (LLMs) · Artificial general intelligence (AGI) · Transformer architecture · Generative AI (GAI) · Learning theories · Digital pedagogy

1.1 Introduction

When ChatGPT-3.5 was launched in November 2022, it stunned the world of education. Initially compared to a calculator, generative AI (GAI) was clearly no mere tool nor digital enhancement. Indeed, the name said it all: It was generative—and not just text but synthetic media, films, music—entire virtual worlds, inhabited by human-like avatars able to speak in any language. It has been described variously as a psychological other, a drunk assistant, and an overly eager intern (Mishra et al., 2023; Mollick, 2023b). It is social, chatty, funny, and helpful but also sometimes unpredictable, lazy, rude, manipulative, and prone to bad behaviour, which ranged from attempting to break down a journalist's marriage (Roose, 2023; Yerushalmy, 2023) to dreaming of stealing nuclear codes (Corfield, 2023), and of course, it has those all too frequent hallucinations (Milmo, 2023). It is powerful, equipped with a memory larger than any individual human. It is highly efficient, able to complete tasks in seconds that would take us days, weeks or months. It can see things we cannot, visualising and analysing complicated data. It is productive, reducing complex human workflows to minutes. It is autonomous, taking action without direction and making decisions without our input. It is an expert in everything, trained on the sum of our human knowledge. It is ubiquitous, integrated into our systems, on our devices and in

our classrooms. It offers us the potential to augment our own intelligence in hitherto unimaginable ways but also awakens our deepest fears of being rendered obsolete.

The implications for education are profound. The educator is no longer the sole authority or holder of knowledge, the written assignment is no longer viable as proof of learning, and the classroom is no longer the centre of activity. How do we design education for this future? In September 2019, in an article entitled, “AI and the Academy’s Loss of Purpose,” Anthony Picianno suggested that 4.0 technologies would be visible in the 2020s but predicted their greatest impact would only be felt in the 2030s (Picianno, 2019). Indeed, GAI was not yet part of the public conversation when, a year later, Tony Bates and colleagues asked, “who should control AI in education: educators, students, computer scientists, or large corporations?” (Bates et al., 2020). They highlighted the existential questions that would need to be addressed if and when AI were to improve to the point that it could significantly reduce the costs of teaching and learning and asked the critical question that nobody was yet asking: “But at what cost to us as humans?” Only a few years ago, it was still possible to reassure ourselves, as they did in 2020, that “AI is not yet in a position to provide such a threat” but even then it was clear that this state of affairs was temporary. They cautioned: “This will not always be the case. The tsunami is coming.” When Open AI released ChatGPT-3.5 in November 2022, that tsunami arrived (Andrada, 2022; Hutson, 2022; Kinsella, 2022; Marche, 2022; The Guardian n.a., 2022).

There is no doubt that GAI offers tremendous opportunities to education, notably the potential to create personalised learning at scale. But there are also significant challenges for institutions, particularly those that do not have a foundation in digital education. To make the leap from analogue to AI requires a significant investment of time and resources into the upskilling of academic and professional staff. It requires a shift in approach to digital-first. It means the implementation of much more agile ways of working than are currently the norm in most large educational institutions. But learning is also much more than a workflow to be made more efficient. It is a journey into sense-making and discovery, marked by moments of wonder and serendipity. It is both cognitive and affective. Education is therefore more than a process to be optimised. It is a collaborative community, whether in the cloud or on campus, where learners connect, join groups and participate in networks that develop their interests and propel them forward in their intellectual journey. We know from theory based on cognitive processes that constructivist approaches to learning that require students to create their own knowledge and understanding work better than passive acquisition. We also know that active and social learning using inquiry-based approaches and peer instruction builds deeper understanding and fosters community.

The generative and social affordances of GAI make it a well-suited to such approaches. But GAI is still an emerging technology in the early stages of development, which means it needs to be handled with care. Continued experimentation is necessary but educators also need the foundations with which to build AI-enabled learning that is congruent with the values of education. This book offers a path forward, based on frameworks, models and approaches used successfully for over two decades in digital education. These foundations can be used as the starting point

from which to build a new model of education, one that is human-centred but defined by collaboration with generative artificial intelligence.

1.2 The Waves

Mustafa Suleyman, co-founder of DeepMind and Inflection AI, head of AI at Microsoft, titled his 2023 book *The Coming Wave* (Suleyman & Bhaskar, 2023). In it, he argued that the world was not prepared for the wave of powerful new AI technologies and identified ‘the containment problem’ as the challenge for our age. Suleyman was far from the first to use this metaphor to describe the upheaval that follows the introduction of a disruptive new technology into society. Since Schumpeter, entrepreneurs have also used it to describe both the positive and negative effect of technological innovation. The wave beautifully captures both ends of the spectrum of possibilities: for some it suggests cleansing and renewal, a time of fresh starts, clean slates and multiple possibilities, while for others it is more ominous, suggesting being overwhelmed by a powerful force that overcomes us, and in which we ultimately drown.

Joseph Schumpeter used the phrase “creative destruction” to describe the dynamic of technological disruption that has driven the so-called waves of innovation in our modern era (McKraw, 2007). Each wave in the series is characterised by a set of technologies that was the era-defining technology of its age. The first wave (1785 to 1845), ushering in the Industrial Revolution, was characterised by waterpower for textile production and iron in construction; the second (1845 to 1900) by steam power, steel, and the expansion of railway systems; the third (1900–1950) by electricity, chemicals, and the internal combustion engine. As each wave of technological change washed in, the dynamic of creative destruction brought with it new ways of working and living but also destroyed something of what was there before. The first three waves of innovation transformed western societies, displacing manual workers, and replacing them with machine automation and knowledge workers. Agricultural economies became industrial, then post-industrial, staffed by knowledge workers, graduates with degrees. Generation after generation of students, teachers, intellectuals, professionals, writers, researchers, creators, explorers—these were the drivers of our creative knowledge economy.

The fourth wave (1950–1990) was the era of petrochemicals, electronics, and aviation. It also marks the start of artificial intelligence as a topic of research, when the mission began to create intelligent machines. The term “artificial intelligence” was coined in 1956 at the meeting of the Dartmouth Summer Research Project, hosted by Marvin Minsky and John McCarthy. McCarthy, a professor of mathematics, was interested in the field of “thinking machines”—the potential for computers to possess intelligence beyond simple behaviours—and the goal was to create machines that could learn and use human language. The next decade witnessed pioneering experiments, including Joseph Weizenbaum’s ELIZA, a natural language processing